AGREEMENT AND SPECIFICATIONS

NORTHEAST DYER/RAILROAD LIFT STATION

BID NUMBER 01-23

VOLUME 1 OF 2

CONTRACT DOCUMENTS

APRIL, 2023

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CIP No. S030016
Eng. / Project ID No. 2649

HUITT ~ ZOLLARS, INC.
ENGINEERING / SURVEYING

NORTHEAST DYER/RAILROAD LIFT STATION
BID NUMBER 01-23

ISSUED FOR BID
APRIL, 2023

STATE OF TEXAS
FLOYD JOHNSON
95506
LICENSED
PROFESSIONAL ENGINEER

11/10/22

HUITT-ZOLLARS
TEXAS REGISTERED
ENGINEERING FIRM F-761

STATE OF TEXAS
JAMES D. BRAUER
66466
REGISTERED
PROFESSIONAL ENGINEER

11/10/22

HUITT-ZOLLARS
TEXAS REGISTERED
ENGINEERING FIRM F-761

STATE OF TEXAS
WENDY L. AMANN
102889
LICENSED
PROFESSIONAL ENGINEER

11/10/22

Exp. 3/31/23

HUITT-ZOLLARS
TEXAS REGISTERED
ENGINEERING FIRM F-761

STATE OF TEXAS
RAYMOND H LEWIS
72071
LICENSED
PROFESSIONAL ENGINEER

11/10/22

HUITT-ZOLLARS
TEXAS REGISTERED
ENGINEERING FIRM F-761

REGISTERED ARCHITECT
HOLGUIN
26935
STATE OF TEXAS

11/10/22

HUITT-ZOLLARS
TEXAS REGISTERED
ENGINEERING FIRM F-761

EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

PSB BID NO. 01-23

INFORMAL NOTICE

Sealed proposals for construction of Northeast Dyer/Railroad Lift Station, will be received by the City of El Paso Water Utilities - Public Service Board at the Board's principal office located at 1154 Hawkins Boulevard or by mail to 1154 Hawkins Boulevard, El Paso, Texas, 79925 until April 5, 2023, 1:30 p.m. local time. **After 1:30 p.m., bids will not be accepted.** Bid Opening will occur at 2:00 p.m. and bids will be publicly opened and read aloud via the "GoToMeeting" format noted in Section 00020.

The work under this contract shall be for furnishing all labor, materials, transportation, and services for the construction and installation of the following work:

The proposed work consists of the construction of a new lift station to be located between NE Dyer St. and Railroad Dr, within El Paso Water property. The lift station will have two process trains: Phase 1 and Phase 2. Phase 1 will be fully equipped under this contract. Portions of the Phase 2 train will not be equipped as part of this project. The work under this contract shall be for furnishing all labor, materials, transportation and services for the work generally described as follows:

- Site improvements include the construction of a 20-ft wide asphalt access road; the construction of an 8-ft tall rock wall; the installation of a 24-ft swing gate; and the construction of sidewalks and curb and gutter; this also includes all earthwork needed to create the desired slopes, elevations, and ponding areas.
- Installation of a proposed 8-ft diameter MH and a proposed 36-in PVC sanitary sewer (98 LF±) to divert flow from existing 24-in sanitary sewer in the existing easement to the proposed on-site splitter MH and ultimately to the Phase 1 and Phase 2 process trains. The project requires 1 – 10-ft diameter MH to split influent, 40 LF± of 24-in PVC pipe that enters the Phase 1 wet well after passing through 1 – 6-ft diameter metering manhole. The Phase 2 train requires 40 LF± of 36-in PVC connecting the splitter MH to 1 - 8-ft diameter MH that directs influent to the Phase 2 wet well through 36 LF± of 36-in PVC pipe. One 6-ft diameter metering manhole (unequipped) is required upstream of the Phase 2 wet well.
- The Phase 1 train will require the installation of 159 LF± of 14", 16", and 18" DI and DR-18 C-905 PVC force main that will connect to an 18-inch off-site force main (not included in this contract) with ultimate discharge to the Fred Hervey Water Reclamation Plant. This includes 1 - 10-ft diameter MH with a 16" magnetic flow meter and 1 – 10-ft diameter MH with an 18" bypass pumping connection inside. In addition, 2 – 16-in plug valves and 1 – 18-in plug valve will be required. Additional pipe, valves, fittings, appurtenances, and other work, as indicated on the plans, is included for the proper and complete installation of the Phase 1 process train.
- The Phase 1 train will require the installation of 3 - 45-hp Flygt NP 3202 MT 3~641 submersible pump controlled by variable frequency drives (VFDs).
- Work included for the Phase 2 train includes the installation of 145 LF± of 18" and 24" DI and C-905 PVC force main that will connect to the off-site 24-inch force main (not included in this project) with ultimate discharge to the Fred Hervey Water Reclamation Plant. Additional Phase 2 train work includes 1 - 10-ft diameter metering MH, excluding the Phase 2 24" magnetic flow meter, and 1 – 10-ft diameter MH with a 24" bypass pumping connection inside. In addition, 3 – 24-in plug valves will be required. Additional pipe, valves, fittings, appurtenances, and other work, as indicated on the plans, is included for the proper and complete installation of the Phase 2 process train.

- The construction of an approximate 37’ x 19’ x 14’ CMU electrical building to house the VFDs and all other flow measuring and control equipment.
- The installation of a 480Y/277 Volt, 3-phase, 4-wire, 650 KVA Diesel Engine Generator Set with sub-base diesel fuel tank and remote annunciator for emergency backup power.
- The installation of lighting and security items are also included in the project.
- Installation of electrical primary and secondary conduit ductbanks, secondary service conductors, metering stand as directed by electric utility company.
- Lightning Protection for the electrical / control building.
- The Phase 1 lift station will have an electric overhead travelling crane for servicing the pumps and any equipment situated in the valve vaults. The Phase 2 crane is not included in this contract.
- A concrete pump washdown pad is provided for Phase 1 at the end of the crane nearest the access drive. Four-inch PVC gravity drain lines will convey washdown water from the concrete pad back to the wet wells. The Phase 2 pump washdown pad is not included in this project.
- The installation of odor control for the splitter manhole and Phase 1 wet well. An I-BOx-42 is proposed for the splitter manhole with a 4-in FRP intake line. The Phase 1 wet well will have an I-Box-7000 unit with a 10-in FRP intake line. Water service to the Phase 1 unit will be by a 3/4” service tap from the proposed 8-inch on-site water system. Liquid waste from the Phase 1 unit will by a 4-inch PVC gravity drain. The Phase 1 unit will drain back to the structure it serves.
- The installation of a proposed 730 LF of 8-in WL to service the site connected to the existing 12-in WL along the off-site easement, 8-in reduced pressure principal backflow preventer in an aluminum enclosure, a 3/4" water service with meter and reduced pressure principle backflow preventer in a fiberglass enclosure for on-site domestic use, 4 – 5-1/4-in fire hydrants with respective 8-in WL, 6 - 8-in gate valves, 4 – 6-in gate valves, 2 – 2-in post hydrants. Small quantities of 6-inch water line and 2” copper line are also included along with various valves, fittings, and appurtenances required to provide the anticipated level of service at the site.

Clarification of work included/excluded for the Phase 2 process train

Items not included in contract:

1. NP 3301.185 LT 3~624 pumps and associated power/sensor cables/ENM-10 level floats
2. Electrical and control components, j-boxes, disconnects, and uni-strut stands for Phase 2 pumps
3. Local electrical disconnects for Phase 2 overhead crane and odor control unit.
4. Phase 2 upstream flow measuring manhole laser flow meter and cable
5. Wet well radar level sensor and cable
6. 18” valves, piping, and appurtenances, and adjustable pipe/valve supports in Phase 2 valve vault
7. Valve vault sump pump and control panel with associated valves, fittings, and appurtenances.
8. Erect-a-Step pipe crossover system
9. 24” mag meter and cable
10. Phase 2 I-Box-7000 odor control unit
11. Phase 2 NOMAD crane system
12. Pump washdown pad

Items included for each Phase 2 pump location:

1. 12” base
2. 3” guiderails
3. Intermediate brackets
4. Upper bracket
5. 12” x 18” SCH 40 316L SS reducer (FL x PE) w/Protecto 401 lining
6. 18" SCH 40 316L SS vertical discharge pipe (PE x PE) w/Protecto 401 lining
7. 18” SCH 40 90° bend (PE x PE) w/Protecto 401 lining
8. 18” SCH 40 316L SS horizontal discharge piping (FL x PE) w/Protecto 401 lining
9. 18” 316L blind flange to close off stainless steel pump discharge piping
10. 18” ductile iron flange to close off 18” DI wall flange and discharge end of valve vault

Additional items included in contract for Phase 2 train:

1. 1-1-ft long 24" PC350 DI flanged spool piece in place of mag meter to provide temporary connection in Phase 2 Meter Manhole
2. All conduit required for Phase 2 electrical/control/sensing equipment including, capped-off conduit through all wet/well/valve vault wall and floor penetration suitable for removal of cap and extension of conduit at a future date.
3. Phase 2 10" PC150 FRP odor control piping. Extend 10" PC150 FRP 6 inches inside Phase 2 wet well and install a blind flange as a temporary seal off to be removed when Phase 2 wet well placed in operation. Extend from wet well to buried 90° bend at Phase 2 odor control unit location. Cap for future connection.
4. 4" SCH 40 DWV piping for Phase 2 pump washdown pad and odor control unit. Cap the discharge into the Phase 2 wet well and future connections at Phase 2 pump washdown pad and odor control unit.
5. Valve vault overhead exhaust fan with electrical connection and on/off switch.
6. Underground conduit from control building out to the first pullboxes serving phase 2 pumps and sensors.

Contract documents may be examined and obtained by accessing the following El Paso Water's website:
www.epwater.org/business_center/purchasing_overview/bids

If you have trouble accessing the Contract Documents, please contact the Purchasing Department of the El Paso Water Utilities, Public Service Board, at (915) 594-5628. Physical (hard) copies of the Contract Documents will **NO** longer be made available.

A pre-bid meeting will be held on March 21, 2022 at 10:00 a.m., local time (see instructions at the end of Section 00020).

Each Bid shall be submitted in accordance with the Instructions to Bidders and be accompanied by a Bid Security in the amount of five percent of the amount bid.

The Successful Bidder states he or she must furnish a 100 percent (100%) Performance Bond and a 100 percent (100%) Payment Bond, in accordance with the Instructions to Bidders and the General Conditions.

Bids shall be submitted at the time and place indicated in the Advertisement or Invitation to Bid and shall be enclosed in an opaque, sealed envelope marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. The Bid proposal package shall include one original, three copies and an electronic version of the bid, containing a copy of the full bid package submitted, saved on a USB drive.

By submission of the bid, Bidder fully understands the requirements of the Contract Documents and agrees to comply with all requirements thereof.

Wages paid on this project shall be not less than the minimum prevailing wage rates listed in the Contract Documents, Section 00840, General Wage Requirements.

The El Paso Water Utilities (EPWU) adheres to the Cone of Silence policy which prohibits any communication regarding the bid between potential bidders (and subcontractors) and EPWU Board Members, Staff, and assigned Consulting Engineers. The provisions do not apply to oral communications with Purchasing Agent or Administrative Analyst, provided the communications is limited strictly to

matters of process or procedure already contained in the solicitation document, oral communications at pre-bid conferences, or communications in writing (email preferred) submitted to the Administrative Analyst in response to inquiries regarding the bid. In addition to any other penalties provided by law, violation of the Cone of Silence by any bidder shall render that bidder's bid voidable. Any person having personal knowledge of a violation of these provisions shall report such violations to the EPWU General Counsel and/or the Purchasing Agent in writing.

EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

NORTHEAST DYER/RAILROAD LIFT STATION

Bid Number 01-23

CITY OF EL PASO, TEXAS

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(See Attached)

SECTION 00020

INVITATION TO BID

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- The installation of lighting and security items are also included in the project.

- Installation of electrical primary and secondary conduit ductbanks, secondary service conductors, metering stand as directed by electric utility company.
- Lightning Protection for the electrical / control building.
- The Phase 1 lift station will have an electric overhead travelling crane for servicing the pumps and any equipment situated in the valve vaults. The Phase 2 crane is not included in this contract.
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Items included for each Phase 2 pump location:

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2. 3" guiderails
3. Intermediate brackets
4. Upper bracket
5. 12" x 18" SCH 40 316L SS reducer (FL x PE) w/Protecto 401 lining
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Additional items included in contract for Phase 2 train:

1. 1-1-ft long 24" PC350 DI flanged spool piece in place of mag meter to provide temporary connection in Phase 2 Meter Manhole
2. All conduit required for Phase 2 electrical/control/sensing equipment including, capped-off conduit through all wet/well/valve vault wall and floor penetration suitable for removal of cap and extension of conduit at a future date.
3. Phase 2 10" PC150 FRP odor control piping. Extend 10" PC150 FRP 6 inches inside Phase 2 wet well and install a blind flange as a temporary seal off to be removed when Phase 2 wet well placed in operation. Extend from wet well to buried 90° bend at Phase 2 odor control unit location. Cap for future connection.
4. 4" SCH 40 DWV piping for Phase 2 pump washdown pad and odor control unit. Cap the discharge into the Phase 2 wet well and future connections at Phase 2 pump washdown pad and odor control unit.
5. Valve vault overhead exhaust fan with electrical connection and on/off switch.
6. Underground conduit from control building out to the first pullboxes serving phase 2 pumps and sensors.

Contract documents may be examined and obtained by accessing the following El Paso Water's website:
www.epwater.org/business_center/purchasing_overview/bids

If you have trouble accessing the Contract Documents, please contact the Purchasing Department of the El Paso Water Utilities, Public Service Board, at (915) 594-5628. Physical (hard) copies of the Contract Documents will **NO** longer be made available.

A pre-bid meeting will be held on March 21, 2022 at 10:00 a.m., local time (see instructions at the end of this Section 00020).

Each Bid shall be submitted in accordance with the Instructions to Bidders and be accompanied by a Bid Security in the amount of five percent of the amount bid.

The Successful Bidder must furnish a 100 percent (100%) Performance Bond and a 100 percent (100%) Payment Bond, in accordance with the Instructions to Bidders and the General Conditions.

Bids shall be submitted at the time and place indicated in the Advertisement or Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted) and name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. The Bid proposal package shall include one original, three copies and an electronic version of the bid, containing a copy of the full bid package submitted, saved on a USB drive.

By submission of the bid, Bidder states he or she fully understands the requirements of the Contract Documents and agrees to comply with all requirements thereof.

Wages paid on this project shall be not less than the minimum prevailing wage rates listed in the Contract Documents.

The El Paso Water Utilities (EPWU) adheres to the Cone of Silence policy which prohibits any communication regarding the bid between potential bidders (and subcontractors) and EPWU Board Members, Staff, and assigned Consulting Engineers. The provisions do not apply to oral communications with Purchasing Agent or Administrative Analyst, provided the communications is limited strictly to

matters of process or procedure already contained in the solicitation document, oral communications at pre-bid conferences, or communications in writing (email preferred) submitted to the Administrative Analyst in response to inquiries regarding the bid. In addition to any other penalties provided by law, violation of the Cone of Silence by any bidder shall render that bidder's bid voidable. Any person having personal knowledge of a violation of these provisions shall report such violations to the EPWU General Counsel and/or the Purchasing Agent in writing.

PRE-BID MEETING INSTRUCTIONS

The Pre-Bid meeting will be held via Microsoft Teams. Please join the meeting from your computer, tablet, or smartphone using the link below:

Click here to join the meeting
Meeting ID: 272 033 420 308
Passcode: Yroywp
Download Teams | Join on the web
Or call in (audio only)
+1 915-255-2297,,642543527# United States, El Paso
Phone Conference ID: 642 543 527#
Find a local number | Reset PIN

BID OPENING INSTRUCTIONS

Bid Openings are now to be broadcast through "GoToMeeting" format. To View Bid Opening Click the Link Below:

01-23 NE Dyer/Railroad Lift Station
Apr 5, 2023, 2:00 – 2:30 PM (America/Denver)

Please join my meeting from your computer, tablet or smartphone.
https://meet.goto.com/301208453

You can also dial in using your phone.
Access Code: 301-208-453
United States (Toll Free): 1 877 309 2073
United States: +1 (646) 749-3129

Get the app now and be ready when your first meeting starts:
https://meet.goto.com/install

SECTION 00100

INSTRUCTION TO BIDDERS

SECTION 00100

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS *(Revised 3/18/96, 9/9/96, 4/21/97, 7/13, 10/16/20)*

Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract (EJCDC C-700, 2018 ed.) have the meanings assigned to them in the General Conditions. The term "Bidder" means the entity (such as a corporation, partnership, or sole proprietor) that submits a Bid directly to Owner, as distinct from a sub-bidder, who submits a Bid to a Bidder. The term "Successful Bidder" means the lowest, responsible, and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award. The term "Bidding Documents" includes the Advertisement or Invitation to Bid, Instructions to Bidders, the Bid Form, the Bid Bond or other Bid Security, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids). Other terms are defined in this Section 00100.

Other terms used in the Bidding Documents and not defined elsewhere have the following meanings which are applicable to both the singular and plural thereof:

Texas Resident Bidder - A bidder whose principal place of business is in this state and includes a Contractor whose ultimate parent company or majority owner has its principal place of business in this state.

Nonresident Bidder - A bidder whose principal place of business is not in this state but excludes a Contractor whose ultimate parent company or majority owner has its principal place of business in this state.

EPCWID #1 - El Paso County Water Improvement District #1 which authorizes dewatering into its facilities under certain terms and conditions and with whom the Owner has negotiated specific basic fees and procedures.

NADB – North American Development Bank

2. COPIES OF BIDDING DOCUMENTS *(Revised 10/16/20)*

2.1 Complete sets of the Bidding Documents stated in the Advertisement or Invitation to Bid may be obtained by accessing the following El Paso Water Utilities – Public Service Board (EPWU-PSB) website:

https://www.epwater.org/business_center/purchasing_overview/bids/construction

If you have trouble accessing the Contract Documents, please contact the Purchasing Department of the EPWU-PSB at (915) 594-5628. Physical (hard) copies of the Contract Documents will no longer be made available.

2.2 Complete sets of Bidding Documents must be used in preparing Bids; neither the Owner nor the Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

2.3 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

3. DETERMINING LOWEST RESPONSIBLE, RESPONSIVE BIDDER *(Revised 9/2/92, 2/25/94, 1/10/95. 5/22/95, 3/18/96, 9/9/96, 4/17/97, 6/17/97, 9/26/97, 12/10/97, 6/3/99, /10/99, 12/17/99, 3/13/00, 8/19/04, 1/18/10, 1/12/11,7/18/11, 11/2/16, 1/11/17, 9/27/17, 11/9/17, 7/23/18, 1/17/19, 10/16/20, 3/4/22)*

To demonstrate that the Bidder is responsible and able to perform the Work, each Bidder must be prepared to submit written evidence, such as financial data, previous experience, present commitments, and other data as may be called for below (or in the Supplementary Instructions). Each Bid must contain evidence of Bidder's qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to Award of the Contract.

In determining the lowest responsible, responsive Bidder, in addition to price, the following elements will be considered:

(a) the quality, availability, and adaptability of the supplies, materials, equipment, or contractual services, to the particular use required;
(b) the number and scope of conditions attached to the bid;
(c) the ability, capacity, and skill of the entity to perform the contract or to provide the service required;
(d) whether the bidder can perform the contract and provide the service promptly, or within the time required, without delay or interference;
(e) the character, responsibility, integrity, reputation, and experience of the bidder;
(f) the quality of performance of previous services, or contracts;
(g) the previous and existing compliance by the bidder with laws relating to the contract or service;
(h) any previous or existing noncompliance by the bidder with specifications, or requirements relating to time of submission of specified data such as samples, models, drawings, certificates, or other information;
(i) the sufficiency of the financial resources and ability of the bidder to perform the contract or to provide the service;
(j) the ability of the bidder to provide maintenance, repair parts, and service for the use of the subject of the contract during the required one-year warranty period.
(k) the ability of the bidder to provide competent personnel for the job, as demonstrated by a listing of the names and the skills of experienced personnel who are currently employed by the bidder and who will be available for performing this work;
(l) the experience of the bidder in performing work similar in type, size and complexity to this project, as demonstrated by a listing of projects, with verifiable references (names, addresses, phone numbers, etc.), successfully completed.

MINIMUM GENERAL REQUIREMENTS - ALL CONSTRUCTION PROJECTS

QUALIFYING PROJECTS

Bidders on Qualifying Projects must provide a Safety Record consisting of: (1) copies of the bidder's OSHA Forms 300, 300A, and 301 for the last three calendar years (January – December); (2) the Establishment Search Results from the Occupational Safety and Health Administration's website (https://www.osha.gov/pls/imis/establishment.html); and (3) a completed and signed Contractor Pre-Qualification Form (Section 00301). A Qualifying Project is a project with a value greater than $100,000 or one that the Chief Technical Officer and Vice President of Operations and Technical Services determine poses a significant hazard.

EPWU will deem a bidder not responsible if the bidder (1) fails to provide a complete Safety Record; (2) received within the last three calendar years (January – December) six or more serious violations, one or more willful violations, or a single repeat of a serious violation; or (3) has experienced a workplace

fatality in the last three calendar years (January – December), unless the bidder can demonstrate that the factors that caused the fatality were outside the bidder's control. A bidder, however, may fail the above criteria but still be deemed responsible if (1) no other appropriate bidder can be found; (2) the bidder is approved by the Chief Technical Officer and the Vice President of Operations and Technical Services; and (3) the bidder agrees to implement the special safety procedures (which might include a requirement to work only with trained EPWU personnel present) that the Vice President of Operations and Technical Services establishes for the project.

PROJECTS WITH VALUE LESS THAN $1,000,000:

The Bidder, or at least two *Key Personnel employed by the Bidder, must demonstrate **Successful Completion of a project similar in nature and scope to this project within the past five years and a similar project with a value of at least one-third the value bid for this project.

PROJECTS WITH VALUE BETWEEN $1,000,000 AND $3,000,000:

The Bidder, **or** at least three *Key Personnel employed by the Bidder, must demonstrate **Successful Completion of one project similar in nature and scope to this project within the past five years and one similar project with a value of at least 50% of the value bid for this project.

PROJECTS WITH VALUE BETWEEN $3,000,000 AND $6,000,000:

The Bidder must demonstrate a minimum of four years of experience in projects similar in nature and scope to this project. At least four *Key Personnel employed by the Bidder must have a minimum of five years of experience in similar construction projects. The Bidder must demonstrate **Successful Completion during the last five years of at least one project comparable in nature and scope to this project and one similar project with a dollar value of at least 60% of the value bid for this project. The Bidder must have an employee, to be dedicated to this project, who is experienced in scheduling, with demonstrated ability in employing scheduling techniques similar to those to be used for this project.

PROJECTS WITH VALUE BETWEEN $6,000,000 AND $15,000,000:

The Bidder must have a minimum of five years of experience in projects similar in nature and scope to this project. At least four of the Bidder's *Key Personnel must have a minimum of five years of experience in similar construction projects. The Bidder must demonstrate **Successful Completion of at least two projects similar in nature and scope to this project and one similar project with a dollar value of at least 75% of the value bid for this project, both within the past five years. The Bidder must demonstrate that it has an experienced employee who will serve as the scheduler; who is dedicated to this project; who has successfully employed scheduling techniques appropriate for this project. At least two *Key Personnel for this project must have completed at least two projects, similar in scope and nature to the project being bid, as an employee of the Company bidding this project.

* KEY PERSONNEL: Defined as individuals who will be directly assigned to this project which includes, but is not limited to, the Bidder's Project Manager, the Project Superintendent, the Scheduler, the Bidder's Construction Engineer, and Supervisory personnel such as the Foremen who will be directly assigned to this project as well as similar Subcontractor Key Persons. Resumes of Key Personnel must be submitted and accepted by the Owner in order for Bidder to receive the Award.

** SUCCESSFUL COMPLETION: Defined as completion of a project on time, which generally means no more than thirty days later than the original contract time allocated. It also means within budget, which generally means within 5% of the original contract price. If there is any project submitted by the Bidder as qualifying, but which does not meet these requirements, in order to be fully responsive, the Bidder is required to submit detailed information on that project demonstrating what caused the increases to cost or

time. The name and telephone numbers of the Design Engineer and the Client are to be provided for evaluation as to whether the project may be considered "successful". For any project where liquidated damages were assessed, the Bidder will not be considered to have been on time.

BIDDER MUST MEET THE FOLLOWING MINIMUM PROJECT SPECIFIC CRITERIA IN ORDER TO QUALIFY FOR AWARD OF THE BID:

1. Project involves a By-Pass Operation to maintain a minimum of 1,500 GPM of uninterrupted (constant) operation of wastewater collection. Bidder and key personnel must demonstrate one (1) project where wastewater by-pass pumping operations (750 GPM minimum) was successfully completed within the last five (5) years. Qualifications of a Subcontractor that demonstrate successful completion of at least two (2) similar projects in the past five (5) years with similar complexity will be accepted.

2. Project involves the installation of sanitary sewer, force main, and water main piping. Bidder and key personnel must demonstrate successful completion of two (2) projects of similar scope and nature within the last five (5) years. Qualifications of a Subcontractor will be acceptable. Provide Subcontractor's and key personnel qualifications meeting this requirement.

3. Project involves the installation of Hot Mix Asphaltic Concrete. Bidder and key personnel must demonstrate successful completion of three (2) projects having similar scope within the last two (5) five. Qualifications of a Subcontractor will be acceptable. Provide Subcontractor's and key personnel qualifications meeting this requirement.

4. Project involves the installation of a 480Y/277 Volt, 3-phase, 4-wire, 650 KVA Diesel Engine Generator Set to include concrete pad, wiring, remote annunciator panel and instrumentation. Bidder and key personnel must demonstrate successful completion of one (1) project of similar complexity in the past five years. Qualifications of a Subcontractor will be acceptable. Provide Subcontractor's and key personnel qualifications meeting this requirement.

5. Project involves providing underground ductbank for utility primary feeder, transformer pad, support structure for utility metering and all other work as directed by local utility company in order to obtain electrical service to the iste.

6. Project involves extensive use of electrical and instrumentation control. Bidder and key personnel must demonstrate successful completion of one (1) project of similar complexity or scope of electrical and instrumentation control in the past five years. This requirement may be satisfied by employing a qualified Subcontractor that must demonstrate two (2) successful projects of the similar complexity and scope in the past five years.

7. *Key Personnel required to be assigned full time to this project include: Project Manager, Project Scheduler, Project Superintendent, Foreman, and an OSHA competent person (may be Superintendent, Foreman, or other qualified person). *Key Personnel must also provide evidence and examples of projects demonstrating their ability to maintain good public relations with customers and respond quickly to customer complaints. *Key Personnel could have obtained the experience while employed by another contractor.

EPWU CIP FUNDED PROJECTS
GOOD FAITH EFFORTS
TO OBTAIN MINORITY PARTICIPATION IN THIS PROJECT

The Utility's policy for its projects is to encourage the participation of Small Locally-Owned Businesses (SLBE), Minority Business Enterprises (MBE), and Women-Owned Business Enterprises (WBE). The utility's minimum goals for this project are:

25% FOR SMALL LOCALLY-OWNED BUSINESSES
10% FOR MINORITY-OWNED BUSINESSES
7% FOR WOMEN-OWNED BUSINESSES

The bidder must meet each of these three goals or demonstrate at the time of making the bid that he or she has made a good faith effort to meet each of the three goals in order to qualify for award of this project. The definition of a "Good Faith Effort" is described below. If the bidder fails to meet the goals, *and also fails to provide evidence that a good faith effort has been made to meet each goal*, the Owner reserves the right to request additional information from the bidder as support to Good Faith Effort documentation. The bidder may meet the requirement in one of three ways:

1. If goals in each category are fully achieved, bidder to provide all details of the actual participation in the Bid Proposal Form, Section 00300, where space has been provided for bidder's use.

2. If goals are partially achieved in each of the categories, bidder to provide the details of the actual participation in the Bid Proposal Form, and to provide evidence of the Good Faith Effort to meet each goal, as part of the bid proposal, at the time the bid is submitted.

3. If goals are not achieved, bidder to provide evidence of a demonstrated Good Faith Effort, as defined below, as part of the bid proposal, at the time the bid is submitted.

Although a single prime contractor, a subcontractor, or a supplier may be a Small Locally-Owned Business and also a Minority Business or a Woman-Owned Business, each firm will be counted in only one category (SLBE, MBE, or WBE) for purposes of meeting these goals.

DEFINITIONS *(Revised 7/28/14, 10/16/20, 3/4/22)*

GOOD FAITH EFFORT: Documentation that minority firms were given a genuine opportunity to participate. Evidence of a Good Faith Effort must include copies of a reasonable number of letters sent to bona fide firms in each of the categories described showing the full details of the work solicited to be performed by the minority firm; copies of certified mail/return receipts, facsimile or e-mail confirmations of receipt, copies of responses to the letters, and copies of correspondence with the Chamber of Commerce, Small Business Administration, Minority Business Development Agency, MBE and WBE associations, and/or newspaper or trade magazine notices. Facsimile and e-mail confirmations of receipt must show sufficient information to identify the company name to which the solicitation was sent. Sample solicitation letters are included in Section 00310. The Owner's Purchasing Department has a listing of qualified firms in each of these categories, which are available on the Owner's website, https://www.epwater.org/business_center/purchasing_overview/become_a_hub_vendor. Additional sources for locating Small Locally-Owned Business Enterprises, Minority-Owned Business Enterprises, and Women-Owned Business Enterprises: Texas Comptroller of Public Accounts http://www.window.state.tx.us/procurement/prog/hub/hub-reporting/, El Paso Hispanic Chamber of Commerce Minority Business Enterprise Center, https://ephcc.org/blog/other-resources/procurement-opportunities/.

SMALL LOCALLY-OWNED BUSINESS ENTERPRISE (SLBE): A business corporation, partnership, joint venture, sole proprietorship, or other legal entity formed for the purpose of making a profit, has been located within the County of El Paso for at least twelve months and is 51% or more owned by residents of El Paso County; furthermore, that business must employ fewer than 100 employees or have annual gross sales of less than $7,000,000 and is not a subsidiary of a business which would not meet these guidelines.

MINORITY-OWNED BUSINESS ENTERPRISE (MBE): A business that is at least 51% owned and controlled by one or more citizens or lawful permanent residents of the United States who are either African American, Hispanic American, Asian American, Native American, or Service Disabled Veteran.

WOMEN-OWNED BUSINESS ENTERPRISE (WBE): A business that is at least 51% owned and controlled by one or more citizens or lawful permanent resident of the United States who are non-minority

females.

The form entitled "Minority Certification and Participation Summary", which is located at the end of Section 00300, Bid Form, should be completed and submitted by the Successful Bidder within ten days of Notice of Award.

It is mandatory that bidder submit <u>with his or her bid</u> a fully executed bid proposal (including the tabulation of proposed subcontractors and suppliers), an original bid bond, the certificate of insurance availability, and minority participation categories reflecting bidder has met minority participation goals OR evidence of bidder's good faith effort to do so. Failure to submit these items with the bid will result in a finding that the bid is non-responsive and the bid will be disqualified.

Evidence of bidder's good faith effort *or* evidence of *full* participation in each category is also required at the time of bid. Owner reserves the right to request additional information from the bidder as support to good faith effort documentation.

Bidders shall furnish a financial statement or other evidence of the Bidder's financial sufficiency to perform the contract, a sworn statement of his or her experience record, and a listing of the equipment available to him or any other statement or documentation required by the Owner or Owner's consultant as to his or her capability to complete the Work. The Post-Bid/Pre-Award Checklist and the Qualifications Statement may require submittal of additional documentation. PLEASE REVIEW THE CHECKLISTS PROVIDED AT THE END OF THIS SECTION 00100.

To assist the Owner in evaluating the Bidder's responsibility, the lowest responsive Bidder is required to complete and submit the "Qualification and Financial Disclosure Statement" found at the end of Section 00100 within five calendar days of the consulting Engineer's request. The Engineer will submit this document and any additional information received as requested by the consulting Engineer, to the Owner as an attachment to his or her Recommendation of Award.

The Checklists found at the back of this Section are provided to assist the Bidder in fulfilling these requirements.

The Purchasing Department will evaluate the responsiveness of the Bidder's submittal. Purchasing Agent will forward the bids and results of the Purchasing Department's evaluation to the consulting Engineer for further evaluation of responsiveness, qualifications of the Bidder and other related conditions of this Bid. Engineer will forward the results of the evaluation to the Owner in writing. Owner will review Engineer's evaluation and present its recommendation to the Public Service Board for award.

Bidder is required to submit information regarding his or her status as a "RESIDENT" or "NONRESIDENT" as shown on the spaces provided in the proposal form.

A "Nonresident Bidder" will not be awarded the Contract if the state of his or her principal place of business assesses a penalty against out-of-state bidders <u>unless</u> his or her bid is lower than the lowest bid submitted by a responsible Texas resident bidder by the same amount that a Texas resident bidder would be required to underbid the nonresident bidder to obtain a comparable contract in the state in which the nonresident's principal place of business is located.

The terms "Texas Resident Bidder" and "Nonresident Bidder" shall the meanings set forth for those terms in Chapter 2252 of the Texas Government Code.

4. <u>EXAMINATION OF CONTRACT DOCUMENTS AND SITE</u> *(Revised 3/18/96, 4/21/97, 1/18/10, 1/12/11, 4/13, 10/16/20)*

4.1 It is the responsibility of each Bidder, before submitting a Bid, to (a) examine the Contract

Documents thoroughly, (b) visit the site to become familiar with local conditions that may affect cost, progress, performance or furnishing of the Work, and to determine the character of equipment and facilities needed preliminary to and during the prosecution of the Work, (c) consider federal, state and local laws and regulations that may affect cost progress, performance or furnishing of the Work, (d) study and carefully correlate Bidder's observations with the Contract Documents, and (e) notify Engineer of all conflicts, errors, or discrepancies in the Contract Documents.

When information as to soil conditions, test borings, and existing underground and overhead utility locations is shown on the Plans, Specifications, Drawings, or in preliminary reports prepared by the Engineer or under the Engineer's direction, such information was obtained for the Owner. The correctness of such information is not guaranteed by the Owner or by the Engineer and in no event shall be considered as a part of the contract, an inducement to bidding, or a factor for computation of bids. If such information is used by the Bidder in preparing a proposal, the Bidder must assume all risks that conditions encountered in performing the Work may be different from the approximation shown. Owner hereby grants reasonable access to Bidder and/or his employees or contractors to examine the work site over which Owner has ownership or control.

4.2 Reference is made to the Supplementary General Conditions for identification of:

4.2.1 Those reports of explorations and tests of subsurface conditions at the site which have been utilized by Engineer in preparation of the Contract Documents.

4.2.2 Those drawings of physical conditions in or relating to existing surface and subsurface conditions (except Underground Facilities) which are at or contiguous to the site which have been utilized by Engineer in preparation of the Contract Documents.

Copies of such reports and drawings will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents. Technical data has been identified and established in the Supplementary General Conditions.

4.2.3 See SC 18.13. Those certain dewatering issues, procedures, payment terms, submittal requirements, and close out terms which are the responsibility of the Bidder and which may impact Bidder's pricing of this Bid.

4.3 Information and data reflected in the Contract Documents with respect to Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities or others, and Owner does not assume responsibility for the accuracy or completeness thereof.

4.4 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Facilities and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Paragraphs 5.03 and 5.04 of the General Conditions, and as may be amended in the Supplementary General Conditions.

4.5 Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work and which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

4.6 Each Bidder will be required to get permission from property owners to obtain access to the site to

conduct such explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall fill all holes, clean up and restore the site to its former condition and to the satisfaction of the Engineer, upon completion of such explorations. Owner hereby grants reasonable access to Bidder and/or his employees or contractors to examine the work site over which Owner has ownership or control.

4.7 The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by Contractor. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by Owner unless otherwise provided in the Contract Documents.

4.8 The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents and such means, methods, techniques, sequences or procedures of construction as may be indicated in or required by the Contract Documents, and that the Contract Documents are sufficient in scope and detail to indicate and convey to Bidder the understanding of all terms and conditions for performance and furnishing of the Work.

5. INTERPRETATIONS AND ADDENDA *(Revised 10/16/20, 3/4/22)*

5.1 Pursuant to the Cone of Silence policy, all questions about the meaning or intent of the Contract Documents are to be directed to the Purchasing/Contracts Department *(see Purchasing Contacts on EPWU website: https://www.epwater.org/business_center/purchasing_overview/bids/construction)*. Interpretations or clarifications considered necessary by EPWU staff, Engineer, or Consultant in response to such questions will be issued by Addenda and will be posted on the EPWU website. Bidder will be responsible to check the website regularly for any addenda or additional information for the project. Questions received less than ten (10) days prior to the date for opening of Bids will not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications, either by EPWU staff, Engineer, or Consultant will be without legal effect.

5.2 Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer, with Owner's approval.

6. BID SECURITY *(Revised 10/12/92, 2/25/93, 1/10/95, 5/22/95, 1/18/10, 7/13, 1/17/19, 10/16/20, 3/4/22)*

6.1 Each Bid must be accompanied by an original and notarized Bid security made payable to Owner in an amount of five percent of the Bidder's maximum Bid price and in the form of a certified or cashier's check or a Bid Bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions and Paragraph 6.01 of the Supplementary General Conditions.

6.2 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Agreement and furnished the required contract security and insurance, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security, insurance, and other required contract documents within ten days after the Notice of Award, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the Effective Date of the Agreement or the ninety-first day after the Bid opening, whereupon Bid security furnished by such Bidders will be returned. Bid security with Bids which

are not competitive will be returned within seven days after the Bid opening.

The Bidder agrees by signing this Bid that he fully understands the requirements of the bid documents.

An incentive payment is available in the amount of $100 per day, up to a maximum of $300, for the Bidder's successful efforts in expediting delivery of fully compliant documents in a time period shorter than the 10-day maximum called out in the Notice of Award.

Should the Bidder fail to return the Agreements, acceptable Bonds, Insurance Certificates and insurance policies within ten days of receipt of the documents, the Utility may charge excess costs generated by such delay at the rate of $100 for each day of delay. In the event more than two reviews of insurance submittals are required by the Utility's Risk Manager, the Successful Bidder will additionally reimburse the Utility for those costs at the rate of $150 per hour which will apply to each fifteen-minute fraction thereof charged by the Risk Manager. These reimbursed costs will be deducted from the Bidders first Application for Payment or, in the event a Bid Bond is forfeited, such expenses may be reimbursed from the proceeds of the Bid Bond as part of the excess costs or re-procurement.

7. CONTRACT TIME

The number of Calendar Days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the Contract Time) are set forth in the Agreement. Completion within this time is of the essence in the performance of this contract.

8. LIQUIDATED DAMAGES *(Revised 3/18/96, 10/16/20)*

Provisions for liquidated damages, if any, are set forth in the Agreement and in the Supplementary General Conditions SC-11.11.

9. SUBSTITUTE OR "OR EQUAL" ITEMS

The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items. Whenever it is indicated in the Drawings or specified in the Specifications that a substitute or "or equal" item of material or equipment may be furnished or used by Contractor is acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the date of the Notice to Proceed. The procedure for submission of any such application by Contractor and consideration by Engineer is set forth in Paragraphs 7.05 and 7.06 of the General Conditions and may be supplemented in the General Requirements.

10. SUBCONTRACTORS, SUPPLIERS AND OTHERS *(Revised 10/12/92, 9/9/96, 12/10/97, 12/17/99, 7/13, 10/16/20)*

10.1 The Bidder is required to identify all Subcontractors and Suppliers; to provide the value of each proposed subcontract or purchase order; and to report their own and their subcontractor's business classification (Small Locally-Owned Business Enterprise, Minority Business Enterprise, Woman-Owned Business Enterprise, or Other). The Bidder shall submit with his or her Bid a list of all proposed Subcontractors and Suppliers. Space for this submittal is provided within the Bid Proposal, Section 00300. Use additional sheets as necessary. The Bidder is required to submit the MWBE Certification and Participation Summary Form with his or her Bid. If requested by Engineer or by Owner, Bidder shall provide an experience statement with pertinent information regarding similar projects and other evidence of qualifications for each such Subcontractor, Supplier, person, or organization. If Owner or Engineer, after due investigation, has reasonable

objection to any proposed Subcontractor, Supplier, other person or organization, either Owner or Engineer may, before the Notice of Award is given, request the apparent Successful Bidder to submit an acceptable substitute, in which case the apparent Successful Bidder shall submit an acceptable substitute, that Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution and Owner may consider such price adjustment in evaluating Bids and making the Contract Award.

10.2 No Contractor shall be required to employ any Subcontractor, Supplier, other person or organization against whom Contractor has reasonable objection.

10.3 The Bidder shall submit a Final Report of total payments made to each subcontractor and supplier, as part of the required close out documents.

This submittal shall be made as a condition precedent to Final Payment.

11. BID FORM *(Revised 10/16/20)*

11.1 The Bid Form is included with the Bidding Documents.

11.2 All blanks on the Bid Form must be completed in ink. Bids which do not have all blanks filled in or completed may be rejected at the Owner's option by Owner or Purchasing Agent.

11.3 Bids by corporations must be executed in the corporate name by the president or a vice president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal if any must be affixed and officer's signature must be attested by the secretary or an assistant secretary. The corporate address, state of incorporation, and state of principal place of business must be shown below the signature.

11.4 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title and authority to sign must appear under the signature and the official address of the partnership must be shown below the signature.

11.5 All names must be printed below the signature.

11.6 The Bid shall contain an acknowledgment of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).

11.7 The address and telephone number for communications with Bidder regarding the Bid must be shown.

12. SUBMISSION OF BIDS *(Revised 10/16/20, 3/4/22)*

Bids shall be submitted at the time and place indicated in the Advertisement or Invitation to Bid and shall be enclosed in an opaque, sealed envelope, marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), name and address of the Bidder and accompanied by the Bid security and other required documents. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it. The Bid proposal packet shall include one original, three copies and an electronic version of the bid, containing a full copy of the full bid package submitted, saved on a USB drive.

Any questions or clarifications pertaining to the bid documents, requirements, specifications, or terms and conditions of the bid or contract documents should be addressed via the Addendum process described above in Section 5. Any extraneous documentation, letters, explanations, limitations, commentary, conditions, or

the like submitted with a Bid will ***NOT*** be considered or incorporated as the basis of any award. Bidder agrees to be held solely to the terms and conditions of these Bid documents; General and Supplementary Conditions (as may be amended from time to time); and any other documents identified by EPWU.

13. MODIFICATION AND WITHDRAWAL OF BIDS

13.1 Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

13.2 If, within twenty-four hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid; that the mistake is clerical; that the mistake is so serious that enforcement of the Bid would be unconscionable; and that the mistake has occurred despite the exercise of ordinary care; that Bidder may withdraw its Bid and the Bid security will be returned. Thereafter, that Bidder will be disqualified from further bidding on the Work to be provided under the Contract Documents.

14. OPENING OF BIDS

Bids will be opened and (unless obviously nonresponsive) read aloud publicly. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Bidders after the opening of Bids.

15. BIDS TO REMAIN SUBJECT TO ACCEPTANCE *(Revised 12/10/97, 1/18/10, 7/13, 10/16/20)*

All Bids will remain subject to acceptance for a minimum of 90 days after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date. In the case of State, Federal, or NADBank-funded projects, all Bids will remain subject to acceptance for 90 days or such reasonable time as the funding agency may require.

16. AWARD OF CONTRACT *(Revised 3/18/96, 12/10/97, 10/9/98, 1/18/10, 10/16/20)*

16.1 Owner reserves the right to reject any and all Bids, to waive any and all informalities not involving price, time or changes in the Work and the right to disregard all immaterial, nonconforming, nonresponsive, unbalanced, or conditional Bids. Also, Owner reserves the right to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to the Bidder, whether because the Bid is not responsive, or the Bidder is not responsible because the Bidder is deemed to be unqualified or of doubtful financial ability or fails to meet any other pertinent criteria established by Owner under Paragraph 3 hereof. Discrepancies in the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Any bids submitted in which there is a material failure to comply with the Bid requirements or specifications will be rejected and the contract will be awarded to the lowest responsible Bidder conforming to the specifications unless the Owner decides to reject all Bids.

16.2 In evaluating Bids, Owner will consider the responsiveness of the Bid, responsibility of the Bidders, whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

16.3 Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in

the Supplementary General Conditions or other sections of this bid document. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award or as a substitute.

16.4 Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.

16.5 If the contract is to be awarded, it will be awarded to the lowest Bidder whose responsibility has been evaluated in accordance with these Instructions to Bidders.

16.6 If the contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within 90 days after the day of the Bid opening. In the case of State or Federally-funded projects, Owner will give the Successful Bidder a Notice of Award within 90 days after the day of the Bid opening, or such reasonable time as the funding agency may require.

17. CONTRACT SECURITY *(Revised 9/17/93; 3/18/96, 7/13, 10/16/20, 3/4/22)*

Paragraph 6.01 of the General Conditions and the Supplementary General Conditions set forth Owner's requirements as to performance and payment Bonds. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by the required Performance and Payment Bonds and the Certificate of Insurance and insurance policies. A Payment Bond must be provided for contracts more than $50,000 in value. If the contract requires an expenditure of less than $100,000, the Owner reserves the right to waive the requirement for a Performance Bond, provided that payment is not due to the Contractor until the Work is completed and accepted by the Owner. Any provision in any bond furnished in attempted compliance with House Bill No. 31 that expands or restricts the rights or liabilities provided under this Act shall be disregarded and the provisions of this Act shall be read into that Bond.

18. SIGNING OF AGREEMENT

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within ten days after, Contractor shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner with the required Bonds and a copy of the Certificate of Insurance along with a copy or copies of the actual Insurance policy or policies. Owner shall deliver fully signed final contract to Contractor when all pre-construction contract requirements have been met.

19. PRE-BID CONFERENCE *(Revised 10/16/20)*

A pre-bid conference will be held at 10:00 a.m., local time, on the 21st day of March, 2023 virtually using Microsoft Teams Software. The link for the meeting will be posted on the EPWater website. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Owner will publish on the EPWater website such Addenda as Engineer considers necessary in response to questions arising at the conference.

20. SALES AND USE TAXES *(Revised 3/18/96, 4/13)*

Owner is exempt from Municipal and State Sales and Use Taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Contract Price. Refer to Supplementary General Conditions SC-7.10.B for additional information.

QUALIFICATION AND FINANCIAL DISCLOSURE STATEMENT

BIDDER: _____

PROJECT NAME:

Northeast Dyer/Railroad Lift Station

1. ORGANIZATION

1.1 How many years has your organization been in business as a Contractor?

1.2 How many years has your organization been in business under its present business name?

1.2.1 Under what other or former names has your organization operated?

1.3 If your organization is a corporation, answer the following:

1.3.1 Date of incorporation: _____

1.3.2 State of incorporation: _____

1.3.3 President's name: _____

1.3.4 Vice-president's name(s): _____

_____

1.3.5 Secretary's name: _____

1.3.6 Treasurer's name: _____

1.4 If your organization is a partnership, answer the following:

1.4.1 Date of organization: _____

1.4.2 Type of partnership (if applicable): _____

1.4.3 Name(s) of general partner(s): _____

1.5 If your organization is an individually owned sole proprietorship, answer the following:

1.5.1 Date of organization: _____

1.5.2 Name of owner: _____

1.6 If the form of your organization is other than those listed above, describe it and name the principals:

2. LICENSING

2.1 List jurisdictions and trade categories in which your organization is legally qualified to do business, and indicate registration or license numbers, if applicable. Indicate name, license number and expiration date for Master Electrician or other trade required under the Instructions to Bidders section of this Bid.

2.2 List jurisdictions in which your organization's partnership or trade name is filed.

3. EXPERIENCE *(Revised 3/18/96, 9/9/96, 12/10/97, 10/9/98, 7/13)*

3.1 List the categories of work that your organization normally performs with its own forces.

3.2 Claims and Suits. (If the answer to any of the questions below is yes, please attach details.)

3.2.1 Has your organization ever failed to complete any work awarded to it?

3.2.2 Are there any judgments, claims, arbitration proceedings, or suits pending or outstanding against your organization or its officers?

3.2.3 Has your organization filed any lawsuits or requested arbitration with regard to construction contracts within the last five years?

3.3 Within the last five years, has any officer or principal of your organization been an officer or principal of another organization when it failed to complete a construction contract? (If the answer is yes, please attach details.)

3.4 On a separate sheet, list major construction projects your organization has in progress, giving the name of project, owner, architect, contract amount, percent complete and scheduled completion date.

3.4.1 State total worth of work in progress and under contract:

3.5 On a separate sheet, list the major projects your organization has completed in the past five years, giving the name of project, owner, architect, contract amount, date of completion and percentage of the cost of the work performed with your own forces.

3.5.1 State annual amount of construction work performed each year during the past five years:

3.6 On a separate sheet, list the construction experience and present commitments of the key individuals of your organization. Submit resumes of Key Personnel (as defined in Section 00100, Instructions to Bidders). By execution of this bid, the Bidder certifies that its Resident Superintendent has the authority to act on behalf of the Contractor at all times. No substitution shall be made without the written approval of the Owner and the Engineer based upon acceptance of the qualifications of the proposed substitute.

3.7 On a separate sheet, provide evidence that the Bidder meets the minimum criteria called out in Section 00100, Instructions to Bidders. Provide similar evidence for Subcontractors, if required by Bid or by Engineer.

3.8 Provide the MWBE CERTIFICATION SUMMARY FORM found at the end of Section 00300.

4. REFERENCES

4.1 Trade References:

4.2 Bank References:

4.3 Surety:

Name and telephone number of Bonding Company: _____

Name, telephone, and address of Agent: _____

_____

_____

5. FINANCING

5.1 Financial Statement

5.1.1 Attach a financial statement, preferably audited, including your organization's latest balance sheet and income statement showing the following items:

a. Cash Flow Statement

b. Notes to Financial Statement

c. Auditor Statement

d. Comparison Statements, if available

5.1.2 Name and address of firm preparing attached financial statement, and date thereof.

5.1.3 Is the attached financial statement for the identical organization named on page one?

5.1.4 If not, explain the relationship and financial responsibility of the organization whose financial statement is provided (e.g., parent-subsidiary).

5.2 Will the organization whose financial statement is attached act as guarantor of the contract for construction?

6. SIGNATURE

6.1 To be executed by a Principal of the firm authorized to certify the foregoing information:

_____, being duly sworn, deposes and says that the information provided herein is true and sufficiently complete so as not to be misleading.

6.2 Dated at _____ this _____ day of_____, 20____.

Name of Organization: _____

By: _____

_____
(Printed Name)

Title: _____

BID PROPOSAL CHECKLIST (packet should be submitted unbound and unstapled)		
Section 00100/00300	1.	MANDATORY: Signed Bid Form with all blanks filled in, including acknowledgement of any issued addenda and names of all Subcontractors and Suppliers.
Section 00100/00300	2.	MANDATORY: Original and Notarized Bid Security or Bond
Section 00100/00300	3.	MANDATORY: Certificate of Insurance Availability
Section 00100/00300	4.	MANDATORY: Names and categories (SMLB, MBE OR WBE) of all Subcontractors and Suppliers with SMLB, MBE OR WBE certifications
Section 00100/00310	5.	MANDATORY: Evidence of Good Faith Efforts if Minority Participation Goals are not met
Section 00100/00302	6.	MANDATORY: Texas Ethics Commission requirement, "Certificate of Interested Parties", Form 1295 – Contractor must have registered/completed on-line application
Section 00100/00301	7.	MANDATORY: Safety Record (Qualifying Projects only)
Section 00100/00303	8.	MANDATORY: Statement of Residency
Section 00100/00304	9.	MANDATORY: Statement of Non-Divestment from Israel
Section 00100/00300	10.	MANDATORY: Electronic version of the bid, containing a copy of the full bid package submitted on a USB Drive.
Section 00100/00300	11.	MANDATORY: Provide one original and three hard copies of the bid proposal submitted.
	12.	

POST-BID/PRE-AWARD CHECKLIST		
Section 00100/00800 00810/00850	1.	MANDATORY: Evidence of Worker's Compensation Insurance Coverage: a Certificate of Insurance or Form DWC-81, DWC-82, DWC-83, DWC-84, DWC-85 or if self-insured, a coverage agreement filed with the Texas Worker's Compensation Commission's Division of Self Insurance Regulation.
Section 00100/00800 /00810	2.	MANDATORY: If employees provided by leasing company, evidence of Texas State License and copy of their Worker's Compensation policy. If no leased employees will be used, provide a letter on Contractor's letterhead stating so.
Section 00100	3.	MANDATORY: Financial Statements
Section 00100	5.	MANDATORY: Qualification Statement and Qualifications of Key Personnel (included in Section 00100)
Section 00100/00300	6.	MANDATORY: Updated Minority Certification and Participation Summary

SECTION 00300

BID FORM

SECTION 00300

BID FORM

PROJECT IDENTIFICATION: El Paso Water Utilities

Northeast Dyer/Railroad Lift Station

BID NO.: 01-23

Name and Address of OWNER:
El Paso Water Utilities
Public Service Board
1154 Hawkins Boulevard
P. O. Box 511
El Paso, Texas 79961

Name and Address of BIDDER:
_____
_____
_____
_____
_____

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Contract Price and within the Contract Time indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. BIDDER accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for ninety days after the day of Bid opening. In the case of State, Federal, or NADBank-funded projects, all Bids will remain subject to acceptance for 90 days or such reasonable time as the funding agency may require. BIDDER will sign and submit the Agreement with the Bonds and other documents required by the Bidding Requirements within ten days after the date of OWNER's Notice of Award.

3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:

   A. BIDDER has examined copies of all the Bidding Documents and of the following Addenda **(receipt of all which is hereby acknowledged)**:

Date	Number

B. BIDDER has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance, or furnishing of the Work.

C. BIDDER has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 5.03 of the General Conditions, and accepts the determination set forth in Paragraph SC-5.03 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings.

D. BIDDER has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests and studies (in addition to or to supplement those referred to in "C." above) which pertain to the subsurface or physical conditions at the site or otherwise may affect the cost, progress, performance or furnishing of the Work as BIDDER considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of Paragraph 5.03 of the General Conditions.

E. BIDDER has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities.

F. BIDDER has correlated the results of all such observations, examinations, investigations, explorations, tests, reports, and studies with the terms and conditions of the Contract Documents.

G. BIDDER has given ENGINEER written notice of all conflicts, errors, or discrepancies that it has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER.

H. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

I. All prices quotes by the bidder shall be entirely in United States Currency (U.S. Dollars).

4. Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

********** HIGH IMPORTANCE **********

TEXAS ETHICS COMMISSION
REQUIREMENT

*****IN THE EVENT YOU RECEIVE AN AWARD OF THIS CONTRACT*****

Reference: FORM 1295 (revised 12/22/17) "Certificate of Interested Parties"

A business entity must file Form 1295 electronically with the Texas Ethics Commission using the Commission's online filing application, which can be found at:
https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

SEE INSTRUCTIONS: Form 1295 and Sample Form 1295 (Section 00302)

Item No.	Estimated Quantity	UOM	Brief Description of Item	Unit Bid Price	Extended Amount (Qty. x Unit Price)
1	1	LS	Insurance, Bonds, and Move-In Related Expenses, not to Exceed 5% of Bid Item Nos. 2 – 24. If Item No. 1 exceeds 5%, bid may be deemed non-responsive.	$_____	$_____
2	4500	CY	Earthwork - Excavation of Existing Soil and regrading (site grading)	$_____	$_____
3	1200	CY	Earthwork - Excavation of retention basin	$_____	$_____
4	1000	CY	Earthwork - Placement of fill and compaction (proposed building and structures)	$_____	$_____
5	3855	SY	Asphalt Paving	$_____	$_____
6	780	LF	Std. 6-in Concrete Curb	$_____	$_____
7	2430	LF	Concrete Header curb	$_____	$_____
8	100	SY	Concrete Sidewalk	$_____	$_____
9	1000	LF	8-ft Rock Wall, Complete and In Place	$_____	$_____
10	1	EA	Iron Swing Gate, Complete and In Place	$_____	$_____

11	1	LS	On-Site Water System Lines - Includes all labor, materials, testing, equipment, required fees, and any other incidental items to install 730 LF of 8-inch DR-18 PVC Water Line, including connection to existing off-site 12-inch water main, 5-8-inch gate valves, 1-8-inch BFP and cover, 4-Fire Hydrant Assemblies, and 2-2-inch post hydrants, as called for in the plans and specifications. This shall also include all 3/4-inch and 2-inch service connections required for the operation of equipment. Refer to plans and specifications for other components required for the completion and operation of this item.	$_____	$_____
12	1	LS	Electrical Building (697 SF) per plans and specifications, complete in place.	$_____	$_____
13	1	LS	Installation of 650 KVA, 277/480 Volt, 3 Phase Diesel Generator Set, and other incidentals, as called for in the plans and specifications (Division 26). Refer to plans sheets and specifications for other components related and required for the completion and operation of this item.	$_____	$_____
14	1	LS	Installation of Electrical Power Distribution Equipment	$_____	$_____
15	1	LS	Installation of Light Fixtures and Poles	$_____	$_____
16	1	LS	Installation of Branch Circuits and Feeders	$_____	$_____
17	1	LS	Installation of Equipment and Material for Obtaining Electrical Utility Service	$_____	$_____
18	1	LS	Installation of Control and Monitoring Equipment	$_____	$_____

19	1	LS	Lift Station Phase 1, to include all labor, material, equipment, required fees, testing, and any other incidental items related to the installation of Lift Station Phase 1 components as called for in the plans and specifications (Divisions 9 – 23). Refer to plans and specifications for other components required for the proper completion and operation of this item.	$_____	$_____
20	1	LS	Gravity Sewer Lines, to include all labor, materials, equipment, testing, required fees, and any other incidental items to install Gravity Sewer Main lines as called for in the plans and specifications. This shall also include but not limited to any additional excavation, the installation of 6-ft manholes, 8-ft manholes, 10-ft manholes, 36-inch and 24-inch F679 PVC sewer pipe, all metering equipment, and equipment required for the operation of the sewer line and its components. Refer to plans and specifications for other components required for the proper completion and operation of this item.	$_____	$_____
21	1	LS	Force Main Sewer Lines – to include all labor, materials, equipment, testing, required fees, and any other incidental items to install Force Main lines as called for in the plans and specifications. This shall also include but not limited to any additional excavation, the installation of 10-ft manholes, 14, 16, 18, and 24-inch DI and DR-18 C-905 FM pipe, all metering equipment, and equipment required for the operation of the force main and its components. Refer to plans and specifications for other components required for the proper completion and operation of this item.	$_____	$_____
22	1	LS	Phase 1 Odor Control, Washdown System, and Overhead Crane as per plans and specifications, complete and in place. Refer to related sections in plans and specifications for other components required for the proper operation and installation of this item.	$_____	$_____

23	1	LS	Structural, to Include all incidental items to construct concrete footings, walls, slabs on grade, and all other structural items required as called for in the Structural plans and specifications (Division 3 – 5). Refer to related sections in plans and specification for other components required in this item.	$_____	$_____
24	1	LS	Trench Safety System: Trench Box Method or Shoring, Sheeting, and Bracing Method/	$_____	$_____

TOTAL BID PRICE (ITEMS 1 THROUGH 24) $ _____

Quantities are not guaranteed.

If multiple awards are contemplated under a single bid document, an additional breakdown of bid amounts, subcontractors, and suppliers is required. It will also be necessary to adjust the MWBE Certification and Participation Summary Form accordingly.

In accordance with Section 151.311 of the Texas Tax Code (V.A.T.C.S.), regarding taxes on materials and services, and requiring a separated contract, the following is the breakdown of cost for materials and cost for labor for this bid:

MATERIALS TO BE INCORPORATED IN PROJECT NOT SUBJECT TO SALES TAX: $_____

LABOR TO BE INCORPORATED IN PROJECT NOT SUBJECT TO SALES TAX: $_____

RENTAL EQUIPMENT AND OTHER TAXABLE ITEMS: $_____

OTHER (I.E. BONDS, INSURANCE, CAPITAL EQUIPMENT, ETC.) $_____

***TOTAL CONTRACT: $_____**
***(TOTAL MUST EQUAL TOTAL BID PRICE)**

5. BIDDER agrees that the Work will be Substantially completed within 510 Calendar Days from the date when the Contract Time commences to run as provided in Paragraph 2.03 of the General Conditions, and as revised in Supplementary Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions, and as revised in the Supplementary Conditions, within 540 calendar days. Final completion includes CONTRACTOR'S resolution of all punch list items and CONTRACTOR'S submission of required

close-out documentation. Any failure of the CONTRACTOR to complete the project within the contract time will be considered a material breach of this contract.

BIDDER accepts the provisions of the Supplementary Conditions and the Agreement as to liquidated damages in the event of failure to complete the Work on time.

6. BIDDER MUST ANSWER THE FOLLOWING QUESTIONS: (Refer to INSTRUCTIONS TO BIDDERS for definitions.)

   A. Is the bidder that is making and submitting this bid a "RESIDENT BIDDER" or a "NONRESIDENT BIDDER"?

      Answer: _____

   B. If the bidder is a "NONRESIDENT BIDDER", does the state in which the Nonresident Bidder's principal place of business is located have a law requiring a Nonresident Bidder of that state to bid a certain amount of percentage under the bid or a Resident Bidder of that state in order for the nonresident bidder of that state to be awarded a contract on his or her bid in such state?

      Answer: _____

   C. If the answer to the question in Paragraph 6B above is "yes", then what amount or percentage must a Texas Resident Bidder bid under the bid of a Resident Bidder of that state in order to be awarded a contract on such bid in said state?

      Answer: _____

7. The following documents are attached to and made a condition of this Bid:

   A. Required Bid Security in the form of _____

      _____

   B. A tabulation of all Subcontractors who will provide labor at the site of the work or render services to the CONTRACTOR in or about the construction of the work and Suppliers and other persons and organizations is required to be identified in this Bid. Complete the following table, designating each as Small Locally-Owned Business Enterprise (SLBE), Minority Business Enterprise (MBE), Women-Owned Business Enterprise (WBE), Small Business Enterprise (SBE), Small Business in Rural Areas (SBRA), or Other (not either SLBE, WBE MBE, SBE or SBRA) is required. Only one category may be checked. Include the work item and value of work to be provided by the Prime Contractor, as well as its category.

Tabulation of Subcontractors and Suppliers

SUBCONTRACTOR/SUPPLIER	WORK ITEM	SUBCONTRACT OR PURCHASE ORDER VALUE (If value is unknown, please list *Pending*)	SLBE	MBE	WBE	SBE	SBRA	OTHER
			Please check one box					
Prime Contractor:								

C. Will the Contractor meet the Small Locally Owned Business Enterprise, Minority Business Enterprise and Women-Owned Business Enterprise goals as required by these contract documents and the funding agencies?

YES _____ NO _____

If "YES", include above each of the firms to be used, their business status as a SLBE, MBE, or WBE, the proposed dollar value and type of work to be performed.

If "NO", documentation supporting good faith effort is required.

8. Communications concerning this Bid shall be addressed to the following named individual, address, telephone number, facsimile number, and e-mail address:

Name: _____

Address: _____

_____

Phone: _____ Fax: _____ E-mail: _____

9. The terms used in this Bid which are defined in the General Conditions of the Construction Contract included as part of the Contract Documents have the meanings assigned to them in the General Conditions.

SUBMITTED on _____, 20__.

If BIDDER is:

An Individual

By _____(SEAL)
(Name of Bidder)

_____
(Title) (Signature)

doing business as _____

Business Address: _____

_____

Phone No.: _____

A Partnership

By _____(SEAL)
(Firm Name)

_____
(Signature - general partner)

Business Address: _____

Phone No.: _____

A Corporation *(Revised 10/12/92, 1/7/93, 4/13, 3/1/22)*

By _____
(Corporation Name)

_____
(State of Incorporation and State of Principal Place of Business)

By _____
(Name of Person Authorized to Sign)

_____
(Title) (Signature)

(Corporate Seal)

Attest_____
(Secretary)

Business Address: _____

_____

Phone No.: _____

Federal Tax Identification Number: _____

When proposing as a Corporation, Bidder swears and affirms by signing this Bid that the proposing Corporation is currently in existence, is currently authorized to do business in the State of Texas (or State of incorporation) and that no franchise tax reports or payments are delinquent as of the date of this Bid Proposal. The Bidder will provide a Certificate of Account Status with the signed Contract Documents. See Section 00510, for the sample form which is to be obtained by the successful Contractor from the Texas (or other state) Comptroller of Public Accounts and submitted as part of the final, executed Contract Documents.

CERTIFICATION OF INSURANCE AVAILABILITY

Date _____

I, _____(Name of Insurance Agent), certify that I have reviewed the insurance requirements listed in Article 5 of the Supplementary Conditions of the specifications for the Northeast Dyer/Railroad Lift Station (Name of Project), Bid No. 01-23, and further certify that _____(Name of Bidder) has or can obtain the insurance coverage required by this Project so that a certificate of insurance and a copy(s) for the actual insurance policies can be submitted to the Owner within ten (10) days of the Notice of Award.

Signed _____

Title _____

Insurance Agency _____

Address _____

Telephone _____

MINORITY CERTIFICATION
AND
PARTICIPATION SUMMARY

(EPWU CIP FUNDED PROJECTS)

BID NUMBER: _____

BID TITLE: _____

I certify that the Small Locally-Owned Businesses (SLBE), Minority (MBE) and Women's Business Enterprises (WBE) participating in this project are qualified in accordance with the Minority requirements included in the above listed Bid Documents and that we will ensure all consultants, contractors, suppliers, and subcontractors will comply with the Minority guidelines. Definitions of each category are found in the 00100, Instructions to Bidders Section. Attached are:

Solicitation Documents: _____ Proposed Subcontracts for the below listed firms: _____

SLBE, MBE, or WBE FIRM NAME	ADDRESS	PHONE	CONTRACT AMOUNT	SLBE	MBE	WBE

The attached documents outline the Good Faith Effort taken in complying with the Minority Guidelines.

_____ _____

CONTRACTOR SIGNATURE OF AUTHORIZED REPRESENTATIVE

_____ _____

DATE PRINTED NAME OF AUTHORIZED REPRESENTATIVE

MINORITY CERTIFICATION
AND
PARTICIPATION SUMMARY

(TWDB FUNDED PROJECTS)

BID NUMBER: _____

BID TITLE: _____

I certify that the Minority (MBE) and Women's Business Enterprises (WBE), Small Business Enterprises (SBE), and Small Business in Rural Area (SBRA) participating in this project are qualified in accordance with the Minority requirements included in the above listed Bid Documents and that we will ensure all consultants, contractors, suppliers, and subcontractors will comply with the Minority guidelines. Definitions of each category are found in the 00100, Instructions to Bidders Section. Attached are:

Solicitation Documents: _____ Proposed Subcontracts for the below listed firms: _____

MBE, WBE, SBE or SBRA FIRM NAME	ADDRESS	PHONE	CONTRACT AMOUNT	MBE	WBE	SBE	SBRA

The attached documents outline the Good Faith effort taken in complying with the Minority Guidelines.

_____ _____

CONTRACTOR SIGNATURE OF AUTHORIZED REPRESENTATIVE

_____ _____

DATE PRINTED NAME OF AUTHORIZED REPRESENTATIVE

SECTION 00301

CONTRACTOR PRE-QUALIFICATION FORM

CONTRACTOR PRE-QUALIFICATION FORM

EPWater requires any contractor who will work on EPWater Qualifying Projects, as well as subcontractors performing 20% of the work on a Qualifying Project, to demonstrate their ability to work safely. A Qualifying Project is a project with a value greater than $100,000 or one that the Chief Technical Officer and Vice President of Operations and Technical Services determine poses a significant hazard. This procedure allows EPWater to identify contractors that can perform site activities without compromising the safety or health of EPWater personnel.

Any contractor wishing to perform work on any Qualifying Project must complete this form and return with the bid package.

The information contained on this form will be evaluated and considered as a part of the overall selection process. Contractors who do not complete and submit this form will be considered non-responsive for any work they propose.

As part of this process, Contractors must certify that its employees have, or will have, appropriate training on the following subjects:

- Basic health and safety issues,
- the Contractor's health and safety programs, and
- the methods and techniques the Contractor will use on the project,
- Procedures for Contractor entrance into and exit from the area of work, and
- Informing EPWater about any unique hazards presented by the Contractor's work or found as a result of the Contractor's work.

Although EPWater will not ask for training documentation on each employee, EPWater requires that this documentation be available within twenty-four hours of request.

CONTRACTOR PRE-QUALIFICATION FORM

1.0 Company Name: _____

Address of Principal Place of Business: _____

Street: _____

City, State, Zip: _____

Telephone Number: _____

E-Mail: _____

2.0 Other Company Names Used: _____

3.0 Name(s) and Relationships of Parent Company, Affiliates, Subsidiaries, Partners:

Company: _____

Address: _____

City, State, Zip: _____

Relationship: _____

Company: _____

Address: _____

City, State, Zip: _____

Relationship: _____

4.0 Has the ownership in your company changed within the last three years? If so, please indicate who the previous owner was in the space below.

YES _____ NO _____

_____

_____

_____

_____

5.0 Please attach certificates showing the extent of coverage, exclusions, and deductibles for the following:

- General Business Liability Insurance Coverage
- Contractors Pollution Liability Insurance Coverage
- Professional Liability Insurance (limits and exclusions)
- Workers' Compensation Insurance Coverage

5.1 How long have you been covered by your current provider of Worker Compensation Insurance?

_____

CONTRACTOR PRE-QUALIFICATION FORM

6.0 Please transfer the numbers and rates of injuries and illnesses from your firm's OSHA No. 300 Logs to the table below:

Injuries & Illnesses in Year:	2020		2021		2022	
Type of Injury Statistic	#	Rate	#	Rate	#	Rate
Lost Workday Cases						
Restricted Workday Cases						
Medical Treatment (not First Aid) Cases						
Total Illness Cases						
Total Recordable Cases						
Employee Hours Worked in Year:						

6.1 List any fatalities your company has had in the last three calendar years (January-December). Include location, cause, and corrective action.

_____
_____
_____
_____
_____

7.0 Do you require that documented safety meetings be held for:

a. Field Supervisor? Yes_____No_____Frequency _____

b. Employees? Yes_____No_____Frequency _____

c. New Hires? Yes_____No_____Frequency _____

d. Subcontractors? Yes_____No_____Frequency _____

8.0 Will a corporate representative audit safety practices on this job?

YES_____ NO_____

8.1 Name _____ Title_____

8.2 How frequently will the representative visit the project?_____

8.3 Does the representative have the authority to take corrective action? Yes_____ No_____

8.4 To whom does the representative report?

Name _____ Title_____

CONTRACTOR PRE-QUALIFICATION FORM

9.0 Does the company have a health and safety plan? If yes, please give details.

_____

_____

_____

10.0 Describe the type and extent of training Contractor employees will have.

_____

_____

_____

10.1 What percentage of those employees will have this training? _____

11.0 Please give the name of the company's health and safety officer, if any.

_____

12.0 Attach a list of any State or Federal Health and Safety citations received in the past three years.

13.0 Signature of Company Officer: _____

Title: _____

Date: _____

SECTION 00302

CERTIFICATE OF INTERESTED PARTIES SAMPLE

INSTRUCTIONS – FORM 1295

*******IN THE EVENT YOU RECEIVE AN AWARD OF THIS CONTRACT*******

Effective January 1, 2016, a governmental entity may not enter into a contract requiring Board approval, unless the business entity submits a Disclosure of Interested Parties (Form 1295) prior to the convening Board awarding the contract.

The following definitions apply:

1. "Interested Party" means a person:
    a. Who has a controlling interest in a business entity with whom a governmental entity contracts, or;
    b. Who actively participates in facilitating the contract or negotiating the terms of the contract, including a broker, intermediary, adviser, attorney, or representative of, or agent for, the business entity.

2. "Intermediary" means a person who actively participates in the facilitation of the contract or negotiating the contract, including a broker, adviser, attorney, or representative of, or agent for, the business who:
    a. Receives compensation from the business entity for the person's participation;
    b. Communicates directly with the governmental entity or state agency on behalf of the business entity regarding the contact, and;
    c. Is not an employee of the business entity.

3. "Business Entity" means any entity, recognized by law, through which business is conducted, including a sole proprietorship, partnership, or corporation. "Business entity includes a for-profit or non-profit entity. The term does not include a governmental entity or state agency.

4. "Contract" includes an amended, extended, or renewed contract.

5. "Controlling Interest" means:
    a. An ownership interest or participating interest in a business entity by virtue of units, percentage, shares, stock, or otherwise, that exceeds ten (10) percent;
    b. Membership on the board of directors or other governing body of a bustiness entity of which the board or other governing body is composed of not more than ten (10) members, or;
    c. Service as an officer of a business entity that has four (4) or fewer officers, or serve as one of the four (4) officers most highly compensated by a business entity that has more than four (4) officers.

A business entity must file Form 1295 electronically with the Texas Ethics Commission using the Commission's online filing application, which can be found at:

https://www.ethics.state.tx.us/whatsnew/elf_info_form1295.htm

The business entity must print a copy of the completed form, which will include a certification of filing containing a unique certification number. "Section 6 - Unsworn Declaration" of Form 1295 must be signed by an authorized agent of the business entity. The business entity must then submit the completed, signed Form 1295 to El Paso Water.

CERTIFICATE OF INTERESTED PARTIES

FORM 1295

Complete Nos. 1 - 4 and 6 if there are interested parties.
Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.

OFFICE USE ONLY

1 Name of business entity filing form, and the city, state and country of the business entity's place of business.

2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.

3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.

4

Name of Interested Party	City, State, Country (place of business)	Nature of Interest (check applicable)	
		Controlling	Intermediary

5 Check only if there is NO Interested Party. ☐

6 UNSWORN DECLARATION

My name is _____, and my date of birth is _____.

My address: _____, _____, _____, _____, _____.
(street) (city) (state) (zip code) (country)

I declare under penalty of perjury that the foregoing is true and correct.

Executed in _____ County, State of _____, on the _____ day of _____, 20_____.
(month) (year)

_____
Signature of authorized agent of contracting business entity
(Declarant)

ADD ADDITIONAL PAGES AS NECESSARY

Must file online at www.ethics.state.tx.us/File

SECTION 00303

STATEMENT OF RESIDENCY

STATEMENT OF RESIDENCY

The following information is required by El Paso Water Utilities – Public Service Board ("EPWU") in order to comply with the provisions of Texas Government Code §§ 2252.001 *et. seq.* Failure to provide the required information may constitute a basis for rejection of your bid. Bidders' cooperation in this regard will avoid costly time delays in the award of bids by EPWU. Failure to provide all required information may result in the apparent low bidder being considered non-responsive and non-responsible, and the second low bidder being considered for award.

Definitions

Resident Bidder: a person whose principal place of business is in the State of Texas, including a contractor whose ultimate parent company or majority owner has its principal place of business in the State of Texas.

Nonresident Bidder: a person who is not a resident.

Principal Place of Business in Texas: a permanent business office located in Texas from which a bid is submitted and from which business activities are primarily conducted for the organization other than submitting bids to governmental agencies, where at least one employee works for the business entity.

Bidder's Complete Company Name: _____

State the address of your principal place of business in the space provided below:

_____

_____

_____

State the nature of the business conducted at your principal place of business in the space provided below:

_____

_____

_____

State the number of employees you have at your principal place of business: _____

I swear and attest that the information provided above is true and correct as of the date _____ ("Bidder") submitted its bid on Bid No.01-23. I further attest that I am an authorized representative of Bidder or have been duly authorized to represent Bidder in this matter. I understand that the information provided is being relied on by EPWU in order for it to comply with state purchasing laws and will materially affect its decisions in this regard. Should the information provided be false or materially misleading, any contract entered into between EPWU and Bidder will be void and EPWU may pursue any legal claims it may have against Bidder.

[SIGNATURE ON NEXT PAGE]

By: _____

Name: _____

Title: _____

Company: _____

ACKNOWLEDGMENT

STATE OF _____ §
§
COUNTY OF _____ §

This instrument was acknowledged before me on the ____ day of _____, 20___, by _____, as _____ of_____, a _____.

_____

Notary Public, State of _____

My Commission Expires:

_____

SECTION 00304

STATEMENT OF NON-DIVESTMENT FROM ISRAEL

STATEMENT OF NONDIVESTMENT FROM ISRAEL

The following information is required by El Paso Water Utilities – Public Service Board ("EPWater") in order to comply with the provisions of Texas Government Code §§ 2270.002.

I swear and attest that the following is true and correct as of the date _____ ("Bidder") submitted its bid on Bid No. 01-23 . Bidder does not boycott Israel and will not boycott Israel during the term of the contract should it be awarded to Bidder. I further attest that I am an authorized representative of Bidder or have been duly authorized to represent Bidder in this matter. I understand that the information provided is being relied on by EPWater in order for it to comply with State purchasing laws and will materially affect its decisions in this regard. Should it be discovered that the statement by Bidder contained herein is false, any contract entered into between EPWater and Bidder will be void and EPWater may pursue any legal claims it may have against Bidder.

By: _____
Name: _____
Title: _____
Company: _____

ACKNOWLEDGMENT

STATE OF _____ §
§
COUNTY OF _____ §

This instrument was acknowledged before me on the ___ day of _____, 20___, by _____, as _____ of _____, a _____.

_____

Notary Public, State of _____

My Commission Expires:

_____

SECTION 00310

MWBE SAMPLE SOLICITATION DOCUMENTS

ACME CONSTRUCTION

10518 Burr Oak Drive
San Antonio, Texas 78609

512-557-7089
Fax 512-557-2097

January 5, 2008

CERTIFIED MAIL / RETURN RECEIPT REQUESTED

Amazing Results Landscape and Supply Company
111 Red Rock Terrace
Lignite, Texas 72533

Gentlemen:

We are actively seeking MWBE Contractors and suppliers for work to be done under Project Number 123456, Sewer System Improvements, City of Anywhere, Texas. The work will consist of utility worm, concrete, paving, fencing, landscaping, masonry, excavation and trucking, barricades, back-hoe work and supplies and materials.

Plans and specifications may be viewed or obtained at the project engineer's general offices, Bing, Campbell and Associates, 19510 Jackson Blvd., Muleshoe, Texas 76698.

All bids must be submitted to the above mentioned address by Noon, Friday, February 16, 2008.

Sincerely,

John Q. Doe, Project Director
Acme Construction

EXAMPLE

Amazing Results
Landscaping

January 12, 2008

Mr. John Q. Doe, Project Director
Acme Construction
10518 Burr Oak Drive
San Antonio, Texas 78609

RE: PROJECT NO. 123456, ANYWHERE TEXAS SEWER SYSTEM IMPROVEMENTS PROJECT

Dear Mr. Doe:

We wish to submit the following bid for the above mentioned project:

St. Augustine sod – 900 square yards at $1.75 per square yard $1,575.00
(Includes installation, rolling, fertilizing, and days of watering)

Hydro-Mulch – 15 acres at $1,175 per acre $17,625.00
(5-acre minimum pre trip; No water; No maintenance; areas that do not germinate will be reseeded) Proper watering is the responsibility of customer.

Hay Bales – We will furnish and install at a rate of $15.00 per bale

We look forward to hearing from you concerning our bid. Thank you.

Sincerely,

Theodore T. "Red" Robbins
Manager

*** * * * A Certified MBE FIRM * * * ***

1111 Red Rock Terrace
Lignite, Texas 72533
(512) 489-5678 (800) 549-0000
(512) 489-5679 fax
www.amazingresults.com

EXAMPLE

10518 Burr Oak Drive
San Antonio, Texas 78609

512-557-7089
Fax 512-557-2097

January 5, 2008

CERTIFIED MAIL / RETURN RECEIPT REQUESTED

Rider Excavation Services
7856 Dry Gulch
Little Indian Mound, Texas 74561

Gentlemen:

We are actively seeking MWBE Contractors and suppliers for work to be done under Project Number 123456, Sewer System Improvements, City of Anywhere, Texas. The work will consist of utility worm, concrete, paving, fencing, landscaping, masonry, excavation and trucking, barricades, back-hoe work and supplies and materials.

Plans and specifications may be viewed or obtained at the project engineer's general offices, Bing, Campbell and Associates, 19510 Jackson Blvd., Muleshoe, Texas 76698.

All bids must be submitted to the above mentioned address by Noon, Friday, February 16, 2008.

Sincerely,

John Q. Doe, Project Director
Acme Construction

EXAMPLE

Rider Excavation Services

January 8, 2008

Mr. John Q. Doe, Project director
Acme Construction
10518 Burr Oak Drive
San Antonio, Texas 78609

RE: PROJECT NO. 123456
ANYWHERE TEXAS SEWER SYSTEM IMPROVEMENTS PROJECT

Dear Mr. Doe:

Thank you for your letter of January 5, 2008 requesting bids for the Anywhere, Texas Sewer System Improvements Project. We will not be submitting a bid because we are scheduled to begin work on another project that is projected to start on approximately the same date as ours.

We appreciate the opportunity to participate in your project. Please contact us again for any future projects.

Sincerely,

Easy Rider President
Rider Excavation Services

EXAMPLE

7856 Dry Gulch
Little Indian Mound, Texas 74561
512-767-9818 ph 512-767-9800 fax

10518 Burr Oak Drive
San Antonio, Texas 78609

512-557-7089
Fax 512-557-2097

January 5, 2008

CERTIFIED MAIL / RETURN RECEIPT REQUESTED

Shadow Paving
P. O. Box 903
Pharr, Texas 72579

Gentlemen:

We are actively seeking MWBE Contractors and suppliers for work to be done under Project Number 123456, Sewer System Improvements, City of Anywhere, Texas. The work will consist of utility worm, concrete, paving, fencing, landscaping, masonry, excavation and trucking, barricades, back-hoe work and supplies and materials.

Plans and specifications may be viewed or obtained at the project engineer's general offices, Bing, Campbell and Associates, 19510 Jackson Blvd., Muleshoe, Texas 76698.

All bids must be submitted to the above mentioned address by Noon, Friday, February 16, 2008.

Sincerely,

John Q. Doe, Project Director
Acme Construction

EXAMPLE

SHADOW PAVING

January 8, 2008

Acme Construction
John Q. Doe, Project Director
10518 Burr Oak Dr.
San Antonio, TX 78609

Dear Mr.Doe:

Thank you for your letter of January 5, 2008 requesting a bid for the paving portion of the Anywhere, Texas Sewer System Improvements Project. Because of the distance of the project from our offices, we will not be interested in submitting a bid.

We appreciate your interest in our services. Please keep us in mind for future projects that may require expertise and services.

Sincerely,

Elmer A. Paver

Office Manager, Shadow Paving

EXAMPLE

ACME CONSTRUCTION

10518 Burr Oak Drive
San Antonio, Texas 78609

512-557-7089
Fax 512-557-2097

January 5, 2008

CERTIFIED MAIL / RETURN RECEIPT REQUESTED

Construction Trades Newsletter
100 Someplace Dr.
P. O. Box 500
Anywhere, Texas 08654

Attn: Ms. Glory Everett, Editor

Dear Ms. Everett:

Please publish the following in the "Public Notices" section of your weekly newsletter on the following dates: 1/11/08; 1/18/08; 1/25/08; and 2/1/08.

"Acme Construction is soliciting subcontract and material bids in connection with the Improvements to the Sewer System for the City of Anywhere, Texas. Qualified MBE and WBE firms are encouraged to submit bids in response to this invitation. The work will consist of utility work, concrete, paving, fencing, landscaping, masonry, excavation and trucking, barricades, back-hoe work and supplies and materials. Plans and specifications may be viewed or obtained at the project engineer's general offices, Bing, Campbell and Associates, 19510 Jackson Blvd., Muleshoe, Texas 76698. Telephone No. 512-557-2091, Fax 512-557-2090. All bids must be submitted to the above mentioned address by Noon, Friday, February 16, 2008".

Please bill Acme Construction, 10518 Burr Oak Drive, San Antonio, Texas 78609. The person authorizing the placement of this ad is B. J. Tenfold. If you have any questions, you may contact Mr. Tenfold at 512-557-7000.

Sincerely,

B. J. Tenfold
Manager of Accounts

EXAMPLE

ACME CONSTRUCTION

10518 Burr Oak Drive
San Antonio, Texas 78609

512-557-7089
Fax 512-557-2097

January 5, 2008

CERTIFIED MAIL / RETURN RECEIPT REQUESTED

Anywhere Weekly Courier
1111 Main Street
P. O. Box 1
Anywhere, Texas 08654

Attn: Mr. Bucky Beaver, Circulation Manager

Dear Mr. Beaver:

Please publish the following in the "Public Notices" section of your weekly newspaper editions on the following dates: 1/11/08; 1/18/08; 1/25/08; and 2/1/08.

"Acme Construction is soliciting subcontract and material bids in connection with the Improvements to the Sewer System for the City of Anywhere, Texas. Qualified MBE and WBE firms are encouraged to submit bids in response to this invitation. The work will consist of utility work, concrete, paving, fencing, landscaping, masonry, excavation and trucking, barricades, back-hoe work and supplies and materials. Plans and specifications may be viewed or obtained at the project engineer's general offices, Bing, Campbell and Associates, 19510 Jackson Blvd., Muleshoe, Texas 76698. Telephone No. 512-557-2091, Fax 512-557-2090. All bids must be submitted to the above mentioned address by Noon, Friday, February 16, 2008".

Please bill Acme Construction, 10518 Burr Oak Drive, San Antonio, Texas 78609. The person authorizing the placement of this ad is B. J. Tenfold. If you have any questions, you may contact Mr. Tenfold at 512-557-7000.

Sincerely,

B. J. Tenfold
Manager of Accounts

EXAMPLE

THE STATE OF TEXAS }
COUNTY OF GHI }

Before me Homer Shortcut, a Notary Public in and for GHI County, Texas on this day personally appeared Bucky Beaver, Circulation Manager for Small Town Newspapers Group, Inc., publishers of the Anywhere Weekly Courier, who being by me duly sworn did depose and say that said newspaper has been published continuously for more than fifty-two weeks prior to the first insertion of this Legal Notice Number 879 at GHI County, Texas and the attached printed copy of the legal notice is a true copy of the original and was printed weekly on the following date(s): 1/11/08; 1/18/08; 1/25/08; 2/1/08.

_____
Circulation Manager
Anywhere Weekly Courier
Small Town Newspaper Group, Inc.

Appeared and sworn to before me on this
21st day of January, 2008

_____
NOTARY PUBLIC in and for the State of Texas
My Commission expires 12/28/2010

Legal Notice as Published

Acme Construction is soliciting subcontract and material bids in connection with the Improvements to the Sewer System for the City of Anywhere, Texas. Qualified MBE and WBE firms are encouraged to submit bids in response to this invitation. The work will consist of utility work, concrete, paving, fencing, landscaping, masonry, excavation and trucking, barricades, back-hoe work and supplies and materials. Plans and specifications may be viewed or obtained at the project engineer's general offices, Bing, Campbell and Associates, 19510 Jackson Blvd., Muleshoe, Texas 76698. Telephone No. 512-557-2091, Fax 512-557-2090. All bids must be submitted to the above mentioned address by Noon, Friday, February 16, 2008.

EXAMPLE

SECTION 00500

STANDARD FORM OF AGREEMENT

BETWEEN OWNER AND CONTRACTOR

SECTION 00500

STANDARD FORM OF AGREEMENT BETWEEN OWNER AND CONTRACTOR ON THE BASIS OF A STIPULATED PRICE

THIS AGREEMENT is dated as of the _____ day of _____ in the year 20___ by and between El Paso Water Utilities-Public Service Board, a component unit of the City of El Paso, a Texas municipal corporation (hereinafter called OWNER), and _____ (hereinafter called CONTRACTOR). OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents. The work is generally described as follows:

Northeast Dyer/Railroad Lift Station

The work under this contract shall be for furnishing all labor, materials, transportation and services for the construction and installation of the following work:

The proposed work consists of the construction of a new lift station to be located between NE Dyer St. and Railroad Dr, within El Paso Water property. The lift station will have two process trains: Phase 1 and Phase 2. Phase 1 will be fully equipped under this contract. Portions of the Phase 2 train will not be equipped as part of this project. The work under this contract shall be for furnishing all labor, materials, transportation and services for the work generally described as follows:

- Site improvements include the construction of a 20-ft wide asphalt access road; the construction of an 8-ft tall rock wall; the installation of a 24-ft swing gate; and the construction of sidewalks and curb and gutter; this also includes all earthwork needed to create the desired slopes, elevations, and ponding areas.
- Installation of a proposed 8-ft diameter MH and a proposed 36-in PVC sanitary sewer (98 LF±) to divert flow from existing 24-in sanitary sewer in the existing easement to the proposed on-site splitter MH and ultimately to the Phase 1 and Phase 2 process trains. The project requires 1 – 10-ft diameter MH to split influent, 40 LF± of 24-in PVC pipe that enters the Phase 1 wet well after passing through 1 – 6-ft diameter metering manhole. The Phase 2 train requires 40 LF± of 36-in PVC connecting the splitter MH to 1 - 8-ft diameter MH that directs influent to the Phase 2 wet well through 36 LF± of 36-in PVC pipe. One 6-ft diameter metering manhole (unequipped) is required upstream of the Phase 2 wet well.
- The Phase 1 train will require the installation of 159 LF± of 14”, 16”, and 18” DI and DR-18 C-905 PVC force main that will connect to an 18-inch off-site force main (not included in this contract) with ultimate discharge to the Fred Hervey Water Reclamation Plant. This includes 1 - 10-ft diameter MH with a 16” magnetic flow meter and 1 – 10-ft diameter MH with an 18” bypass pumping connection inside. In addition, 2 – 16-in plug valves and 1 – 18-in plug valve will be required. Additional pipe, valves, fittings, appurtenances, and other work, as indicated on the plans, is included for the proper and complete installation of the Phase 1 process train.

- The Phase 1 train will require the installation of 3 - 45-hp Flygt NP 3202 MT 3~641 submersible pump controlled by variable frequency drives (VFDs).
- Work included for the Phase 2 train includes the installation of 145 LF± of a 24" DI and C-905 PVC force main that will connect to the off-site 24-inch force main (not included in this project) with ultimate discharge to the Fred Hervey Water Reclamation Plant. Additional Phase 2 train work includes 1 - 10-ft diameter metering MH, excluding the Phase 2 24" magnetic flow meter, and 1 – 10-ft diameter MH with a 24" bypass pumping connection inside. In addition, 3 – 24-in plug valves will be required. Additional pipe, valves, fittings, appurtenances, and other work, as indicated on the plans, is included for the proper and complete installation of the Phase 2 process train.
- The construction of an approximate 37' x 19' x 14' CMU electrical building to house the VFDs and all other flow measuring and control equipment.
- The installation of a 480Y/277 Volt, 3-phase, 4-wire, 650 KVA Diesel Engine Generator Set for emergency backup power.
- The installation of lighting and security items are also included in the project.
- The Phase 1 lift station will have an electric overhead travelling crane for servicing the pumps and any equipment situated in the valve vaults. The Phase 2 crane is not included in this contract.
- A concrete pump washdown pad is provided for Phase 1 at the end of the crane nearest the access drive. Four-inch PVC gravity drain lines will convey washdown water from the concrete pad back to the wet wells. The Phase 2 pump washdown pad is not included in this project.
- The installation of odor control for the splitter manhole and Phase 1 wet well. An I-BOx-42 is proposed for the splitter manhole with a 4-in FRP intake line. The Phase 1 wet well will have an I-Box-7000 unit with a 10-in FRP intake line. Water service to the Phase 1 unit will be by a 3/4" service tap from the proposed 8-inch on-site water system. Liquid waste from the Phase 1 unit will by a 4-inch PVC gravity drain. The Phase 1 unit will drain back to the structure it serves.
- The installation of a proposed 730 LF of 8-in WL to service the site connected to the existing 12-in WL along the off-site easement, 8-in reduced pressure principal backflow preventer in an aluminum enclosure, a 3/4" water service with meter and reduced pressure principle backflow preventer in a fiberglass enclosure for on-site domestic use, 4 – 5-1/4-in fire hydrants with respective 8-in WL, 6 - 8-in gate valves, 4 – 6-in gate valves, 2 – 2-in post hydrants. Small quantities of 6-inch water line and 2" copper line are also included along with various valves, fittings, and appurtenances required to provide the anticipated level of service at the site.

Clarification of work included/excluded for the Phase 2 process train

Items not included in contract:

1. NP 3301.185 LT 3~624 pumps and associated power/sensor cables/ENM-10 level floats
2. Electrical and control components, j-boxes, disconnects, and uni-strut stands for Phase 2 pumps
3. Local electrical disconnects for Phase 2 overhead crane and odor control unit.
4. Phase 2 upstream flow measuring manhole laser flow meter and cable
5. Wet well radar level sensor and cable
6. 18" valves, piping, and appurtenances, and adjustable pipe/valve supports in Phase 2 valve vault
7. Valve vault sump pump and control panel with associated valves, fittings, and appurtenances.
8. Erect-a-Step pipe crossover system
9. 24" mag meter and cable
10. Phase 2 I-Box-7000 odor control unit
11. Phase 2 NOMAD crane system
12. Pump washdown pad

Items included for each Phase 2 pump location:

1. 12" base
2. 3" guiderails
3. Intermediate brackets
4. Upper bracket
5. 12" x 18" SCH 40 316L SS reducer (FL x PE) w/Protecto 401 lining
6. 18" SCH 40 316L SS vertical discharge pipe (PE x PE) w/Protecto 401 lining
7. 18" SCH 40 90° bend (PE x PE) w/Protecto 401 lining

8. 18” SCH 40 316L SS horizontal discharge piping (FL x PE) w/Protecto 401 lining
9. 18” 316L blind flange to close off stainless steel pump discharge piping
10. 18” ductile iron flange to close off 18” DI wall flange and discharge end of valve vault

Additional items included in contract for Phase 2 train:

1. 1-1-ft long 24” PC350 DI flanged spool piece in place of mag meter to provide temporary connection in Phase 2 Meter Manhole
2. All conduit required for Phase 2 electrical/control/sensing equipment including, capped-off conduit through all wet/well/valve vault wall and floor penetration suitable for removal of cap and extension of conduit at a future date.
3. Phase 2 10” PC150 FRP odor control piping. Extend 10” PC150 FRP 6 inches inside Phase 2 wet well and install a blind flange as a temporary seal off to be removed when Phase 2 wet well placed in operation. Extend from wet well to buried 90° bend at Phase 2 odor control unit location. Cap for future connection.
4. 4” SCH 40 DWV piping for Phase 2 pump washdown pad and odor control unit. Cap the discharge into the Phase 2 wet well and future connections at Phase 2 pump washdown pad and odor control unit.

Valve vault overhead exhaust fan with electrical connection and on/off switch.

ARTICLE 2. ENGINEER

The Project has been designed by Huitt-Zollars Inc. who is hereinafter called ENGINEER and who is to act as OWNER's representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE 3. CONTRACT TIME *(Revised 9/2/92, 10/9/98, 6/3/99, 4/13, 10/16/20)*

3.1 The Work will be Substantially completed within 510 Calendar Days from the date when the Contract Time commences to run as provided in Paragraph 4.01 of the General Conditions, and as revised in Supplementary Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions, and as revised in the Supplementary Conditions, within 540 calendar days. Final completion includes CONTRACTOR’S resolution of all punch list items and CONTRACTOR’S submission of required close-out documentation. Any failure of the CONTRACTOR to complete the project within the contract time will be considered a material breach of this contract.

3.2 Liquidated Damages. OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss and public inconvenience if the Work is not completed and the submittals are not submitted within the times specified in Paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving in a legal proceeding the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER the sum of one thousand one hundred sixty dollars ($1,160.00) for each Calendar Day that expires after the time specified in the Agreement for Substantial Completion until the Work is substantially complete. After Substantial Completion, if CONTRACTOR shall neglect, refuse or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER five hundred sixty ($560.00) for each Calendar Day that expires after the time specified in the Agreement for completion and readiness for final payment.

ARTICLE 4. CONTRACT PRICE *(Revised 10/12/92, 6/7/93; 2/13/97)*

4.1 OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract

Documents in current funds, per the attached CONTRACTOR's Bid in accordance with the below listed separate charges:

MATERIALS TO BE INCORPORATED IN PROJECT NOT SUBJECT TO SALES TAX: $_____

LABOR TO BE INCORPORATED IN PROJECT NOT SUBJECT TO SALES TAX: $_____

RENTAL EQUIPMENT AND OTHER TAXABLE ITEMS: $_____

OTHER (I.E. BONDS, INSURANCE, CAPITAL EQUIPMENT, ETC.) $_____

***TOTAL CONTRACT:** $_____
*** (TOTAL MUST EQUAL TOTAL BID PRICE)**

ARTICLE 5. PAYMENT PROCEDURES *(Revised 5/14/96, 7/13, 10/16/20, 3/4/22)*

CONTRACTOR shall submit Applications for Payment in accordance with Article 15 of the General Conditions and Article 15 of the Supplementary Conditions. Applications for Payment will be processed by ENGINEER as provided in the General Conditions.

5.1 Progress Payments. OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER for Work which is completed in accordance with the terms and conditions of the Contract Documents. All progress payments will be on the basis of the progress of the Work measured by the schedule of values established in Paragraph 2.03 and referenced in Paragraph 2.05 of the General Conditions (and in the case of Unit Price Work based on the number of units completed and accepted) or, in the event there is no schedule of values, as provided in the General Requirements. Each invoice, regardless of contract type, shall contain a summary indicating the budget, the current invoiced amount, less a withholding of a 5% retainage amount, and the billed to date figure.

Prior to Substantial Completion, progress payments will be made in an amount equal to the percentages indicated below, but, in each case, less the aggregate of payments previously made and less such amounts as ENGINEER shall recommend, or OWNER may withhold, in accordance with Paragraph 15.06 of the General Conditions.

Ninety-five percent of Work completed (ninety percent for contracts under $400,000.00), including 95 percent of materials and equipment not incorporated in the Work (but delivered, suitably stored and accompanied by documentation satisfactory to OWNER as provided in Paragraph 15.01 of the General Conditions).

5.2 Final Payment. Upon final completion and acceptance of the Work in accordance with Article 15 of the General and Supplementary Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in said Article.

ARTICLE 6. CONTRACTOR'S REPRESENTATIONS *(Revised 10/12/92, 7/13, 11/9/17, 10/16/20, 3/4/22)*

In order to induce OWNER to enter into this Agreement, CONTRACTOR makes the following representations:

6.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.

6.2 CONTRACTOR has studied carefully all reports of explorations and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary Conditions as provided in Paragraph 5.03 of the General Conditions, and accepts the determination set forth in Paragraph SC-5.03 of the Supplementary Conditions of the extent of the technical data contained in such reports and drawings.

6.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in Paragraph 6.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise which may affect the cost, progress, performance or furnishing of the Work necessary for the performance or furnishing of the Work at the Contract Price, specifically within the provisions of Paragraph 5.03 of the General Conditions. CONTRACTOR understands that the correctness of such information is not guaranteed by the OWNER or the ENGINEER and CONTRACTOR understand(s) that the conditions encountered in performing the work may be different from the approximations shown.

6.4 CONTRACTOR has reviewed all information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site and assumes responsibility for the location of said Underground Facilities as determined by his or her own field investigations. CONTRACTOR understands that the correctness of such information is not guaranteed by the OWNER or the ENGINEER and CONTRACTOR understand that the conditions encountered in performing the work may be different from the approximations shown.

6.5 CONTRACTOR has correlated the results of all such observations, examinations, investigations, explorations, tests, reports and studies with the terms and conditions of the Contract Documents.

6.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors, or discrepancies that he has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

6.7 CONTRACTOR affirms it is not a foreign-owned company that is owned or controlled by citizens of or directly controlled by the government of China, Iran, North Korea, Russia or a designated country pursuant to Chapter 2274 of the Texas Government Code. Additionally, CONTRACTOR affirms it is not a company that is headquartered in China, Iran, North Korea, Russia, or a designated country pursuant to Chapter 2274 of the Texas Government Code.

6.8 CONTRACTOR affirms it does not boycott Israel and will not boycott Israel during the term of the Agreement.

6.9 In accordance with Chapter 2274 of the Texas Government Code, CONTRACTOR affirms that it does not boycott energy companies and will not boycott energy companies during the term of the Agreement.

6.10 In accordance with Section 2274.002 of the Texas Government Code, CONTRACTOR affirms that it does not have a practice, policy, guidance or directive that discriminates against a firearm entity or firearm trade association and will not discriminate during the term of the Agreement against a firearm entity or firearm trade association.

ARTICLE 7. CONTRACT DOCUMENTS *(Revised 11/16/94, 1/12/11, 7/13, 11/2/16, 10/16/20, 3/4/22)*

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work consist of the following:

7.1 CONTRACTOR's Bid (Section 00300)

7.2 Agreement (Section 00500)

7.3 Performance and Payment Bonds, and Certificate of Insurance, and insurance policies identified as Sections 00610, 00630 and 00650.

7.4 Notice of Award.

7.5 General Conditions (Section 00700)

7.6 Supplementary Conditions (Section 00800)

7.7 Supplement for Special-Funded Project (Section 00805) – IF APPLICABLE

7.8 General Wage Rates (Section 00840)

7.9 Specifications bearing the title Project Manual for the Construction of Northeast Dyer/Railroad Lift station consisting of division numbers 1 through 32,

7.10 Drawings consisting of a cover sheet and sheets listed in the Index to Drawings, each sheet bearing the following general title:

CITY OF EL PASO, TEXAS
EL PASO WATER UTILITIES - PUBLIC SERVICE BOARD

Northeast Dyer/Railroad Lift Station

(Drawings not attached to this Agreement.)

7.11 Addenda numbers _____ to _____, inclusive (not attached to this Agreement.)

7.12 Documentation submitted by CONTRACTOR prior to Notice of Award (Pages_____ to _____, inclusive).

7.13 Contractor Health and Safety Plan

7.14 The Instructions to Bidders, Information Available to Bidders, Bid Form and Bid Security, as well as any supplements to the Bid Form.

7.15 The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying, or supplementing the Contract Documents pursuant to Paragraphs 11.01 of the General Conditions.

7.16 The documents listed in Paragraphs 7.2 et. seq. above are attached to this Agreement (except as expressly noted otherwise above).

There are no Contract Documents other than those listed above in this Article 7. The Contract Documents may only be amended, modified or supplemented as provided in Paragraphs 11.01 of the General Conditions.

ARTICLE 8. MISCELLANEOUS

8.1 Terms used in this Agreement which are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.

8.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically, but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

8.3 OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

ARTICLE 9. OTHER PROVISIONS *(Revised 3/4/22)*

9.1 It is agreed that should any dispute arise under this Contract which culminates in litigation, venue of that suit shall be in a court of competent jurisdiction sitting in El Paso County, Texas. The court shall apply the laws of the State of Texas in construing and interpreting the terms of this Contract and the Contract Documents.

9.2 In case any one or more of the provisions contained in this Agreement shall, for any reason, be held to be invalid, illegal, or unenforceable in any respect, that invalidity, illegality, unenforceability shall not affect any other provisions and this Agreement shall be construed as if such invalid, illegal, or unenforceable provisions had never been included, and the Agreement provisions shall be read and interpreted so as to harmonize with the Agreement itself.

9.3 The captions or headings of paragraphs in this Contract are for convenience only and shall not be considered in constraining the provisions hereof if any question of intent should arise.

9.4 For NADBank-funded projects, Contractor agrees to indemnify and hold harmless North American Development Bank (NADB) and each of its directors, officers, employees, agents and representatives (collectively, "NADB's Associated Persons") against all claims for death, personal injury, damages, or other relief against NADB or NADB's Associated Persons, including costs, expenses and attorney's fees, resulting from negligence or willful acts or failure to act by the Contractor.

9.5 In accordance with Sections 552.371 and 552.372 of the Texas Government Code, the following language is included, and applicable in contracts that require or result in the expenditure of public funds of at least $1,000,000:

CONTRACTING INFORMATION. CONTRACTOR must preserve all contracting information related to this Agreement as provided by the records retention schedule requirements applicable to the OWNER for the duration of this Agreement. CONTRACTOR will promptly provide the OWNER any contracting information related to this Agreement that is in the custody or possession of the CONTRACTOR on request of the OWNER. On completion of this Agreement, CONTRACTOR will either provide at no cost to the OWNER all contracting information related to this Agreement that is in the custody or possession of the CONTRACTOR or preserve the contracting information related to this Agreement as provided by the records retention requirements applicable to the OWNER.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have signed this Agreement in triplicate. One counterpart each has been delivered to OWNER, CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

This Agreement will be effective on _____, 20___.

OWNER: El Paso Water Utilities
Public Service Board of
the City of El Paso, Texas

By _____
Purchasing Agent

CONTRACTOR: _____

_____

_____

By _____

Name: _____

Title: _____

Address for giving notices:

1154 Hawkins Boulevard
El Paso, Texas 79925

Date Signed _____

Address for giving notices:

_____

_____

Date Signed _____

Federal Tax I.D. No. _____

Agent for service or process:

_____

INSTRUCTIONS FOR EXECUTING CONTRACT

If the CONTRACTOR be a corporation, the following certificate should be executed:

I,_____, certify that I am the_____of

the corporation named as CONTRACTOR hereinabove; that, _____ who

signed the foregoing Contract on behalf of the CONTRACTOR was then,_____ of

said Corporation; that said Contract was duly signed for and in behalf of said Corporation by authority of

its governing body and is within the scope of its corporate powers.

_____

Corporate Seal

If the Contract is signed by the secretary of the corporation, the above certificate should be executed by some other officer of the corporation under the corporate seal. In lieu of the foregoing certificate, there may be attached to the Contract copies of so much of the records of the corporation as will show the official character and authority of the officers signing, duly certified by the Secretary or Assistant Secretary under the corporate seal to be true copies.

The full name and business address of the CONTRACTOR should be inserted and the Contract shall be signed with his or her official signature. Please have the name of the signing party or parties typewritten or printed under all signatures to the Contract.

If the CONTRACTOR should be operating as a partnership, each partner should sign the Contract. If the Contract is not signed by each partner, there should be attached to the Contract a duly authenticated Power of Attorney, or other appropriate resolution or document evidencing the signer's (signers') authority to sign such Contract for and in behalf of the partnership.

If the CONTRACTOR is an individual, the trade name (if the CONTRACTOR is operating under an assumed or trade name) should be indicated in the Contract and the Contract should be signed by such individual. If signed by one other than the CONTRACTOR, there should be attached to the Contract a duly authenticated Power of Attorney evidencing the signer's authority to execute such Contract for and in behalf of the CONTRACTOR.

CONTRACT SUBMITTAL CHECKLIST (The following items must be submitted within **10** calendar days of the Notice of Award unless stated otherwise in the General or Supplemental Conditions)	
	1. Executed Agreement
	2. Payment and Performance Bonds
	3. Insurance Certificate and Policies. Policies should be sent in electronic format to rguevara@epwater.org, with copy to becky.ramirez@hubinternational.com (Owner's Risk Manager) and to Purchasing.Info@epwater.org.
	4. If employees provided by leasing company, evidence of Texas State License and copy of their Worker's Compensation policy. If no leased employees will be used, provide a letter on Contractor's letterhead stating so.
	5. Certificate of Account Status (paid franchise taxes)
	6. Final/Updated (if applicable) Minority Certification and Participation Summary
	7. Preliminary Schedule of Values
	8. Preliminary Construction Schedule
	9. Schedule of Shop Drawings
	10. Trench Safety System (sealed by a Professional Engineer)
	11. Trench Safety Plan
	12. Stormwater Pollution Prevention Plan
	13. Traffic Control Plan
	14. Health and Safety Plan
	15.
	16.
	17.

- **Deliver all items to the OWNER's Purchasing Department**
- **Deliver electronic copies of items 7-14 to EPWater Project Manager**

SECTION 00510

CERTIFICATE OF ACCOUNT STATUS SAMPLE

TEXAS COMPTROLLER OF PUBLIC ACCOUNTS

SUSAN COMBS • COMPTROLLER • AUSTIN, TEXAS 78774

July 30, 2007

CERTIFICATE OF ACCOUNT STATUS

EXAMPLE

THE STATE OF TEXAS
COUNTY OF TRAVIS

I, Susan Combs, Comptroller of Public Accounts of the State of Texas, DO HEREBY CERTIFY that according to the records of this office

is, as of this date, in good standing with this office having no franchise tax reports or payments due at this time. This certificate is valid through the date that the next franchise tax report will be due November 15, 2007.

This certificate does not make a representation as to the status of the corporation's Certificate of Authority, if any, with the Texas Secretary of State.

This certificate is valid for the purpose of conversion when the converted entity is subject to franchise tax as required by law. This certificate is not valid for the purpose of dissolution, merger, or withdrawal.

GIVEN UNDER MY HAND AND
SEAL OF OFFICE in the City of
Austin, this 30th day of
July 2007 A.D.

Susan Combs
Texas Comptroller

Taxpayer number:
File number:

Form 05-304 (Rev. 02-03/14)

SECTION 00610

PERFORMANCE BOND

TEXAS STATUTORY PERFORMANCE BOND

(Penalty of this Bond must be 100% of Contract Amount)
Public Work – State of Texas

STATE OF TEXAS }
COUNTY OF_____ } BOND NUMBER_____

KNOW ALL MEN BY THESE PRESENTS:

That _____ (hereinafter called the Principal), as Principal and _____, a corporation organized and existing under the laws of the State of _____, and whose principal office is located in the City of _____, and duly authorized to do business in the State of Texas (hereinafter called the Surety).

As Surety, are held firmly bound unto El Paso Water Utilities / Public Service Board, hereinafter called the Owner), in the penal sum of _____ Dollars ($_____) for the payment of which sum well and truly to be made, we bind ourselves, our heirs, administrators, executors, successors and assigns, jointly and severally, by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Owner, dated the _____ day of _____, 20___, a copy of which is hereto attached and made a part hereof, for _____.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if the said Principal shall faithfully perform the work in accordance with the plans, specifications and contract documents, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this Bond shall be determined in accordance with the provisions thereof to the same extent as if it were copied at length herein.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this _____ day of _____, 20___.

_____

BY: _____
Principal

WITNESS:

_____BY: _____
Surety

SECTION 00630

PAYMENT BOND

PAYMENT BOND

Public Work – State of Texas

STATE OF TEXAS }
COUNTY OF_____ } BOND NUMBER_____

KNOW ALL MEN BY THESE PRESENTS:

That _____ of the City of _____, County of _____ and State of _____ (hereinafter called the Principal), and _____ authorized under the laws of the State of Texas to act as Surety on bonds for Principals (hereinafter called the Surety) are held firmly bound unto El Paso Water Utilities / Public Service Board, hereinafter called the Owner), in the penal sum of _____ Dollars ($_____) for the payment whereof, the said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents.

WHEREAS, the Principal has entered into a certain written Contract with the Owner, dated the _____ day of _____, 20___, for _____ _____ to which Contract is hereby referred to and made part hereof as fully and to the same extent as if copied at length herein.

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH that if the said Principal shall pay all claimants supplying labor and material to him or a subcontractor in the prosecution of the work provided for in said Contract, then this obligation shall be void; otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this Bond is executed pursuant to the provisions of Chapter 2253 of the Texas Government Code and all liabilities on this Bond shall be determined in accordance with the provisions of said Chapter to the same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract, or to the work performed thereunder, or the plans, specifications or drawings accompanying the same, shall in anywise affect its obligation on this Bond and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract, or to the work to be performed thereunder.

IN WITNESS WHEREOF, the said Principal and Surety have signed and sealed this instrument this ___ _____ day of _____, 20___.

_____

BY: _____
Principal

WITNESS:

_____BY: _____
Surety

SECTION 00650

CERTIFICATE OF LIABILITY INSURANCE

ACORD™ CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C, No, Ext): -	FAX (A/C, No):
	E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE	NAIC #
	INSURER A :	
INSURED Specimen/Sample Certificate Form	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY						EACH OCCURRENCE	$
	COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence)	$
	CLAIMS-MADE / OCCUR						MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG	$
	POLICY / PRO-JECT / LOC							$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$
	ANY AUTO						BODILY INJURY (Per person)	$
	ALL OWNED AUTOS / SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	HIRED AUTOS / NON-OWNED AUTOS						PROPERTY DAMAGE (Per accident)	$
								$
	UMBRELLA LIAB / OCCUR						EACH OCCURRENCE	$
	EXCESS LIAB / CLAIMS-MADE						AGGREGATE	$
	DED / RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						WC STATU-TORY LIMITS / OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? Y / N	N / A					E.L. EACH ACCIDENT	$
	(Mandatory in NH)						E.L. DISEASE - EA EMPLOYEE	$
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - POLICY LIMIT	$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER	CANCELLATION
	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

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SECTION 00660

ENGINEER'S CERTIFICATE OF SUBSTANTIAL COMPLETION

EL PASO WATER UTILITIES - PUBLIC SERVICE BOARD

ENGINEER'S CERTIFICATE OF SUBSTANTIAL COMPLETION

NORTHEAST DYER/RAILROAD LIFT STATION, BID NO. 01-23

(TO BE FILLED OUT AND SUBMITTED BY ENGINEER)

The above-referenced project is substantially complete as of _____, 20____.
Exceptions and/or items requiring additional work are indicated as follows:

The following documents are required contract submittals. Certificate of Final Completion and Final Payment will *not* be issued until all submittals listed below are received and correct (pursuant to contract requirements).	
1. Contractor's Waiver of Claim/Lien (GC 15.06.A.3)	
2. *Original* Consent of Surety to Final Payment (GC 15-06.A.2.a)	
3. Copy of Release to Contractor from EPWID#1 for Dewatering Fees, if applicable (SC 18.13.E)	
4. Completed Operations Insurance Letter (coverage for at least 2 years after final payment (GC 6.03.B.3 and SC-6.03.C.6)	
5. Delivery to the Engineer of all Operating & Maintenance Manuals, Guarantees, Certificates of Inspection, and Marked-up As-Builts or Record Drawings, if applicable (GC 10.07.D and GC 15.06.A.1)	
6. Final Report of Total Payments to subcontractors and suppliers	
7. Evidence of Payment of Final Water Bill and Return of Water Meter	
8. Ensure that *Certified* Payrolls for entire contract period for contractor and all subcontractors, including "Final" (SC 7.11.D.5) payroll from each, are entered in the Utility Automated Payroll Software program and ensure that all outstanding corrections and/or evidence of restitution have been submitted	
9. Warranty/Guarantee, if applicable	
10. NPDES Requirements (NOT), if applicable	

_____ _____

EPWU Engineering Division Manager Project Engineer of Record

_____ _____

Date Date

SECTION 00680

CONTRACTOR’S CLOSE-OUT CHECKLIST

CONTRACTOR'S PROJECT CLOSE-OUT SUBMITTALS CHECKLIST

The following documents are required contract submittals for the Close-Out of this project. Contractor is contractually required to submit the following in one packet to the Engineer for review. Certificate of Final Completion and Final Payment will not be issued until all submittals listed below are received and correct.

REQUIRED ITEM	INCLUDED
1. Final Change Order (if applicable)	
2. Contractor's Waiver of Lien (GC 15.06.A.3)	
3. *Original* Consent of Surety to Final Payment (GC 15.06.A.2.b)	
4. Copy of Release to Contractor from EPWID#1 for Dewatering Fees, if applicable (SC 18.13.E)	
5. Completed Operations Insurance Letter (coverage for at least 2 years after final payment (GC 6.03.B.3 and SC 6.03.C.6)	
6. Transmittal Letter of Delivery to Engineer of all Operating & Maintenance Manuals, Guarantees, Certificates of Inspection, and Marked-up As-Builts or Record Drawings, if applicable (GC 10.07.D and GC 15.06.A.1)	
7. Final Report of Total Payments to Subcontractors and Suppliers	
8. Final Certified Payrolls (list 'Final' atop the payrolls) (SC 7.11.D.5). Submit any and all outstanding corrections and/or evidence of paid restitution.	
9. Warranty/Guarantee, if applicable	
10. NPDES Requirements (NOT), if applicable	
11. Paid Final Water Bill, Completed Meter and Removal Forms for Fire Hydrant Meter	

* All items must be submitted and received as a complete packet. An incomplete packet will be returned.

When all items have been received and approved by EPWater, the assigned Project Compliance Specialist will notify Project Engineer, Consultant Engineer, and Contractor. At that time, Contractor may submit the Final Pay Application to Consultant Engineer. Consultant Engineer will provide the Certificate of Final Completion and the approvable Final Pay Application to the Project Compliance Specialist for processing and closing of project.

SECTION 00700

GENERAL CONDITIONS (EJCDC C-700, 2018 ED)

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By

EJCDC®
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

ACEC
AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

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National Society of Professional Engineers

1420 King Street, Alexandria, VA 22314-2794

(703) 684-2882

www.nspe.org

American Council of Engineering Companies

1015 15th Street N.W., Washington, DC 20005

(202) 347-7474

www.acec.org

American Society of Civil Engineers

1801 Alexander Bell Drive, Reston, VA 20191-4400

(800) 548-2723

www.asce.org

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

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requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. Constituent of Concern—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

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recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

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33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

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43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. *Unit Price Work*—Work to be paid for on the basis of unit prices.

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

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1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

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F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

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into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

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ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

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inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

   a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

   b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

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B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

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established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

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D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

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B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

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and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

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5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

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Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

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3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

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or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

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of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

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Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

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Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

   1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

   2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

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L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

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4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

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Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.

2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

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6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

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2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

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3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

   a. will certify that the proposed substitute item will:

      1) perform adequately the functions and achieve the results called for by the general design;

      2) be similar in substance to the item specified; and

      3) be suited to the same use as the item specified.

   b. will state:

      1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

      2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

      3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

   c. will identify:

      1) all variations of the proposed substitute item from the item specified; and

      2) available engineering, sales, maintenance, repair, and replacement services.

   d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

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7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

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7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

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I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

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3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

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document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

   a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

   b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

   c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

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d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

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9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

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D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;
2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

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E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

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B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

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9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

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ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

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E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

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ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

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B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

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1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);
2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or
3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or
2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

   a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;

   b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;

   c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

   d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

   e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

   f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

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11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

   a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

   b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

   The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

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Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

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and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

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2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

   a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

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consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

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g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

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Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

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thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

   a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

   b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

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D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
3. by manufacturers of equipment furnished under the Contract Documents;
4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

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losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

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or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

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establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

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4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
    a. to supervise, direct, or control the Work;
    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or
    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
    a. the Work is defective, requiring correction or replacement;
    b. the Contract Price has been reduced by Change Orders;
    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

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b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

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submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

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significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

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d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

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appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

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attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

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provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and
2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;
2. agree with the other party to submit the dispute to another dispute resolution process; or
3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

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18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract.

18.09 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SECTION 00800

SUPPLEMENTARY GENERAL CONDITIONS

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SUPPLEMENTARY CONDITIONS
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INTRODUCTORY STATEMENT

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700, 2018 Edition). All provisions which are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, “Paragraph SC-4.05.”

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

SC-1.01.A.4 Add the following sentence to Paragraph 1.01.A.4:

The term “Offer” has the same meaning as the term “Bid”.

SC-1.01.A.5 Add the following sentence to Paragraph 1.01.A.5

The term “Offeror” has the same meaning as the term “Bidder”.

SC-1.01.A.10.e Add the following sentence to Paragraph 1.01.A.10.e

When submitted, a Claim must be signed by the Designated Authorized Representative.

SC-1.01.A.51 Add the following paragraph as reference 1.01.A.51:

Designated Authorized Representative — the representative authorized by the party filing the Claim to execute legally-binding agreements on behalf of that party. For Owner, the Designated Authorized Representative shall be the Chief Technical Officer, a Vice President, or President and Chief Executive Officer. For Contractor, the owner or its designee authorized pursuant to a power of attorney.

SC-1.01.A.52 Add the following paragraph as reference 1.01.A.52:

Health and Safety Plan — The part of the Contract Documents prepared by Contractor that describes safety procedures for the Work, identifies the Contractor’s safety representative required by Paragraph 6.14.A, and certifies that the Contractor’s employees have received or will receive training prior to the commencement of the Work on (1) basic health and safety issues; (2) the Health and Safety Plan; (3) the methods and techniques the Contractor will use on the Project; (4) procedures for Contractor entrance into and exit from the Site(s); and (5) informing Owner about any unique hazards presented by the Work or found as a result of the Work.

ARTICLE 2 - PRELIMINARY MATTERS

2.02 *Copies of Documents*

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following in its place:

A. Owner shall provide to Contractor an electronic version of a fully executed copy of the contract documents.

2.03 *Before Starting Construction*

SC-2.03.B Add the following new paragraph immediately after Paragraph 2.03.A.3

B. *Health and Safety Plan*. Contractor shall submit a copy of Health and Safety Plan fifteen (15) days before mobilization. No Work shall proceed until the Owner has accepted the Health and Safety Plan.

2.04 *Pre-Construction Conference; Designation of Authorized Representatives*

SC-2.04.B Amend the first sentence of Paragraph 2.04.B to read as follows:

At or prior to this conference Owner and Contractor each shall designate, in writing by Owner and in writing by Contractor as a submittal, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract.

2.05 *Acceptance of Schedules*

SC-2.05.A Amend the first sentence of Paragraph 2.05.A to read as follows:

At the preconstruction conference indicated in Paragraph 2.04 or other time acceptable to the parties and Engineer, Engineer and Contractor will review the acceptability to Engineer, as provided below, of the schedules submitted in accordance with Paragraph 2.03.A.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

SC-3.01.C Delete Paragraph 3.01.C in its entirety.

SC-3.03.B.1 Add the following to new paragraph immediately after Paragraph 3.03.B:

SC-3.03.B.1 In resolving such conflicts, errors, and discrepancies, the Contract Documents will be given precedence in the following order: Change Orders, Field Orders, Addenda, Agreement, Performance Bond and Payment Bond, Supplementary Conditions, General Conditions, Specifications and Drawings. Numerical dimensions shown on the Drawings shall govern over scaled dimensions on the Drawings. This Paragraph SC-3.03.B.1 is not, however, a definitive enumeration of what comprises the "Contract Documents", which definitive enumeration is indicated in the Agreement.

ARTICLE 4 - COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

SC-4.01.A Amend the third sentence of paragraph 4.01.A by changing the word "60th" to read as "90th".

4.03 *Reference Points*

SC-4.03.A Amend the third sentence of Paragraph 4.03.A to read as follows:

Contractor shall report to Engineer when a reference point, including property boundary stakes or monuments, or an elevation benchmark, is disturbed, lost, or destroyed, or requires relocation because of necessary changes in grades or locations. Contractor shall be responsible for accurately replacing or relocating such reference points by a professional land surveyor licensed by and registered in the State of Texas.

4.05 *Delays in Contractor's Progress*

SC-4.05.C Amend Paragraph 4.05.C by adding the following subparagraphs:

5. Weather-Related Delays

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Time, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.

b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:

1) Every workday on which one or more of the following conditions exist will be considered a "bad weather day":

i) Total precipitation (as rain equivalent) occurring between 7:00 p.m. on the preceding day (regardless of whether such preceding day is a workday) through 7:00 p.m. on the workday in question equals or exceeds 1-inch over a 24-hour period of precipitation (as rain equivalent, based on the snow/rain conversion indicated in the table entitled Foreseeable Bad Weather Days; such table is hereby incorporated in this SC-4.05.C by reference).

ii) Ambient outdoor air temperature at 11:00 a.m. is equal to or less than the following low temperature threshold: wind chill factor equal or less than 25-degrees Fahrenheit; or, at 3:00 p.m. the ambient outdoor temperature is equal to or greater than the following high temperature threshold: equal or greater than 110-degrees Fahrenheit.

iii) Suspension (greater than 4 hours) or postponement of construction due to high wind advisory/warning that has been issued and does not allow construction activities to continue.

2) Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by the El Paso International Airport weather monitoring station located at 6701 Convair Road in El Paso, Texas.

3) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in the Foreseeable Bad Weather Days table, Exhibit A included in SC-4.05.5.b.4.

4) Foreseeable Bad Weather Days:

i) Foreseeable Bad Weather Days (Standard Baseline) is defined as the normal number of calendar days for each month during which construction activity exposed to weather conditions is expected to be prevented and suspended by cause of adverse weather. Suspension of construction activity for the number of days each month as listed in the Standard Baseline is included in the Work and is not eligible for extension of Contract Time.

ii) The Foreseeable Bad Weather Days are as follows:

Exhibit A

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4	3	3	2	3	4	8	8	6	5	3	4

5) In each month, every bad weather day exceeding the number of foreseeable bad weather days established in the Standard Baseline table in Exhibit A - Foreseeable Bad Weather Days will be considered as "abnormal weather conditions." The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.

ARTICLE 5 - SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

SC 5.01.D Add the following new paragraph immediately after paragraph 5.01.C:

SC-5.01.D All work associated with special provisions of easements shall be performed in accordance with the Contract Documents, unless the Contract Documents indicate that easement

provisions govern. Should the actions of Contractor or Subcontractors or Suppliers cause the Work to be delayed to the point that the ending date of an easement is exceeded, Contractor shall reimburse Owner for additional costs required to extend the period of rights to the easement to complete the Work. Such delay shall be considered to be within the control of Contractor, in accordance with paragraph 4.05.

5.02 *Use of Site and Other Areas*

SC-5.02.E Add the following new paragraph immediately after Paragraph 5.02.D:

SC-5.02.E *Dust Control*

1. Contractor shall not cause or allow dust-generating operations, earthmoving operation, use of property, or other operation that results in fugitive dust emissions that exceed the limits prescribed by the authority having jurisdiction, in accordance with Texas Administrative Code Title 30, Part 1, Chapter 111, Subchapter A, Division 4, Rule 111.145. Contact City of El Paso Environmental Management Division at (915) 212-6000 for additional information regarding nuisance fugitive dust emissions from the Site.
2. Provide necessary equipment and materials to apply sufficient dust suppressants, properly clean all vehicle "track-out" areas on and adjacent to the Site, and provide adequate physical stabilizations of soils to comply with requirements of earthmoving permits and approved dust control plan or activities, if any.
3. Contractor shall pay fines and civil penalties imposed by authorities having jurisdiction and incurred by Owner because of Contractor's violation of earthmoving permits and dust control plans or activities.
4. Implement measures to control fugitive dust emissions from the Site in compliance with earthmoving permit and Laws and Regulations.

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
Northeast Dyer-Railroad Lift Station El Paso, El Paso County, Texas LOI File No. LOI21-255	May 13, 2022	Geotechnical Engineering Study

F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely.

Drawings Title	Date of Drawings	Technical Data
N/A		

G. Contractor may examine copies of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents at the El Paso Water Utilities' website:

www.epwater.org/business_center/purchasing_overview/bids

SC-5.03.A Delete Paragraphs 5.03.A and 5.03.C in their entirety and insert the following in their place:

SC-5.03.A No reports of explorations or tests of subsurface conditions at or contiguous to the Site, or drawings of physical conditions relating to existing surface or subsurface structures at the Site, are known to Owner.

SC-5.03.C Not Used.

5.06 *Hazardous Environmental Conditions at Site*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
N/A		

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
N/A		

SC-5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following in its place:

SC-5.06.A No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

SC-5-06.B Not Used.

ARTICLE 6 - BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01.A Delete Paragraph 6.01.A and 6.01.B in their entirety and insert the following in place of:

SC-6.01.A Except as provided in this Paragraph SC-6.01.A, Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds and certificates of insurance as are required by the Contract Documents. Certificates of insurance shall be in the form prescribed by the Contract Documents. Conditions under which a payment bond and/or performance bond are required are as follows:

1. Payment bond is required when the contract award is in excess of $50,000, and;
2. Performance Bond is required when the contract award is in excess of $100,000.

   (Note: Contract value is excess of $100,000, both bonds are required.)

SC-6.01.B Delete Paragraph 6.01.C in its entirety and insert the following in its place:

SC-6.01.B. All bonds shall be in the form prescribed by the Contract Documents, except as provided otherwise by Laws and Regulations including, but not limited to, Chapter 2253 of the Texas Government Code and Article 7.19-1 of the Texas Insurance Code. The bonds shall be executed by surety which shall be authorized and admitted to do business in the State of Texas, licensed by the State of Texas to issue surety bonds, and carry an A.M. Best Key rating of not less than A VIII. If the amount of the bond is in excess of ten percent of surety's capital and surplus, surety shall furnish to Owner a written certification that surety has insured that portion of surety's risk that exceeds ten percent of surety's capital and surplus with one or more reinsurers who are duly authorized, accredited or trusteed to do business in the State of Texas. If any portion of surety's obligation is reinsured, the amount reinsured shall not exceed ten percent of the reinsurer's capital and surplus. Surety and the reinsurer(s) shall furnish additional information and documentation, if any, required by Owner for Owner to determine whether surety or its reinsurer(s) comply with the requirements of this Paragraph SC-6.01.B. All bonds signed by an agent or attorney-in-fact shall be accompanied by a certified copy of that individual's

authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

6.02 *Insurance - General Provisions*

SC-6.02.G Delete Paragraph 6.02.G in its entirety and insert the following in its place:

SC-6.02.G Not Used.

6.03 *Contractor's Insurance*

SC-6.03.C Add the following immediately after Paragraph 6.03.C.1:

a. In addition to the individuals or entities specified above, include as additional insured, or loss payees as their interest may appear, the following:

1) Huitt-Zollars.

SC-6.03.C Add the following immediately after Paragraph 6.03.C.5:

SC-6.03.C.5 If, at any time, the required insurance policies are canceled, terminated, or modified so that the insurance is not in full force and effect as required under the Contract Documents, Owner may terminate for cause in accordance with Paragraph 16.02 of the General Conditions or, where possible, obtain insurance coverage equal to that required by the Contract Documents, the full cost of which will be charged to Contractor and deducted from any payments due Contractor.

a. Each Contractor shall require his subcontractors, at all tiers, to carry insurance coverages satisfactory to the Contractor and to provide evidence of such insurance as specified herein.

For purposes of this Bid, a Payment Bond will be required in an amount equal to the Bid Price and a Performance Bond (will) or (will not) be required in a like amount.

SC-6.03.C.6 Add the following immediately after Paragraph 6.03.C.5:

SC-6.03.C.6 Contractor shall furnish to Owner and each other additional insured identified in the Contract Documents, to whom evidence of insurance has been issued, evidence satisfactory to Owner and other such additional insured of continuation of such insurance at final payment and for a duration thereafter equal to the correction period required under Paragraph 15.08.

SC-6.03.D Add the following new Paragraph 6.03.D:

D. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation and Employer's Liability Insurance:

a. State: Statutory

b. Employer's Liability: In accordance with Table 00800-1 of these Supplementary Conditions.

c. *Terminology*: The following terms are not defined but when used in this Paragraph SC-6.03.D for workers' compensation insurance, and have the meanings indicated below:

1) Certificate of coverage: A copy of a certificate of insurance, a certificate of authority to self-insure, issued by the Texas Workers Compensation Commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on the Project, for the duration of the Project. Contractor shall not execute TWCC Forms 83 or 85 or other form that precludes coverage under Contractor's policy if Contractor hires a Subcontractor or service provider without worker's compensation insurance.

2) Duration of the Project: Is the time from the Contractor's beginning work on the Project until the time Contractor's and Subcontractor's obligations under the Contract Documents are fully complete.

3) Contractor and Subcontractors (as indicated in Texas Labor Code §406.5096) includes all persons or entities performing all or part of the Work, regardless of whether that person or entity contracted directly with Contractor and regardless of whether that person or entity has employees. This includes, without limitation, independent contractors, Subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the Project. "Services" include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other services related to the Project. "Services" does not include activities unrelated to the Project, such as food or beverage vendors, office supply deliveries, and delivery of portable toilets or portable sanitary facilities.

d. Comply with the following relative to Worker's Compensation and Employer's Liability insurance:

1) *Waiver of Subrogation Relative to Workers' Compensation Insurance*: The policy shall be endorsed to provide that insurer waives any right of subrogation that insurer may acquire against Owner, Engineer, Engineer's consultants, and others named in the Contract Documents as additional insured relative to Contractor's liability insurance, by reason of any payment made on account of injury, including death resulting therefrom, sustained by an employee of the insured.

2) If workers employed on the Work will be employed through a leasing company, furnish evidence of leasing company's State of Texas license and a copy of leasing company's Worker's Compensation policy insuring its employees (including sole proprietors, partners, supervisors, and executive officers) who perform work in the State of Texas.

3) Contractor shall furnish coverage, based on proper reporting of classification codes and payroll amounts and filing of coverage agreements, which meets the statutory requirements of Texas Labor Code §401.011(44) for all employees of Contractor performing the Work or services on the Project, for the duration of the Project.

4) Contractor shall furnish to Owner a certificate of coverage prior to being awarded the Contract.

5) If the coverage period shown on the Contractor's current certificate of coverage ends during the Contract Times, Contractor shall, prior to the end of the coverage period, furnish to Owner a new certificate of coverage indicating that coverage has been extended; furnish updated certificate of coverage throughout the duration of the Project.

6) *Subcontractors and Workers' Compensation and Employee Liability Insurance*:

    a) Contractor shall contractually require each Subcontractor to comply with the workers' compensation and employer's liability insurance requirements of the Contract Documents, to same extent such requirements are binding on Contractor.

    b) Obtain from each Subcontractor and furnish to Owner a certificate of coverage, prior to that Subcontractor beginning work on the Project. Not later than seven days after receipt by Contractor, furnish updated, valid certificate of coverage for each Subcontractor throughout the duration of the Project.

7) Retain Contractor's and Subcontractors' required certificates of coverage for the duration of the Project.

8) Contractor shall notify Owner in writing, in accordance with Paragraph 18.01, within 10 days after Contractor knew or should have known, of a change that materially affects the provision of coverage of any entity performing work or services on the Contract.

9) Post at the Site a notice, in the text, form, and manner prescribed by the Texas Workers' Compensation Commission, informing persons performing work or services on the Contract that they are required to be covered, and stating how a person may verify coverage and report lack of coverage. Such posted notice does not satisfy other posting requirements imposed by the Act or other commission rules in the State of Texas. Such notice shall be printed with a title in text that is not less than 30-point bold type, with and other text in not less than 19-point non-bold type, and shall be in English, Spanish, and other languages, if any, common to the workers at the Site. Text for the notices shall be as indicated by the Commission on the sample notice without changes.

10) By executing the Agreement or furnishing or causing to be furnished a certificate of coverage, Contractor represents to Owner that employees of Contractor and Subcontractors who will perform work or services on the Contract will be covered by workers' compensation coverage for the duration of the Project; that such coverage will be based on proper reporting of classification codes and payroll amounts; and that coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Furnishing false or misleading information may subject Contractor to administrative penalties of authorities having jurisdiction, criminal penalties, civil penalties of authorities having jurisdiction, and other civil actions.

11) Contractor's failure to comply with one or more workers' compensation insurance provisions is a breach of the Contract by Contractor, entitling Owner to terminate for cause in accordance with Paragraph 16.03, unless otherwise provided by Laws and Regulations.

12) If any provision of the Workers' Compensation and Employee Liability insurance requirements of the Contract Documents, or its application to any person or circumstance, is held invalid, the invalidity does not affect other provisions or applications of this rule that can be given effect without the invalid provision or application, and to this end the provisions of this rule are declared to be severable.

2. Contractor's General Liability under Paragraphs 6.03 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the

care, custody, and control of Contractor. General Liability coverage shall be for not less than the limits indicated in Table 00800-1 of these Supplementary Conditions.

3. Automobile Liability under Paragraph 6.03 of the General Conditions: Shall be for not less than the limits indicated in Table 00800-1 of these Supplementary Conditions.

4. Umbrella Liability:

   a. Contractor shall purchase and maintain, until final payment by Owner, Umbrella Liability Insurance. Such insurance shall insure against all claims in excess of the limits provided under workers' compensation and employer's liability, general liability insurance, and automobile liability policies. The limits of umbrella liability shall be in accordance with Table 00800-1 of these Supplementary Conditions.

5. *Table of Minimum Liability Insurance Coverage Limits*: The limits of liability insurance shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations. The limits of coverage under Paragraph 6.03 vary with the Contract Price as indicated in Table 00800-1:

TABLE 00800-1				
LIMITS OF COVERAGE FOR ALL CONSTRUCTION PROJECTS	AUTOMOBILE (6.03) {Combined Single Limit} Per Accident	COMMERCIAL GENERAL LIABILITY (6.03) {Combined Single Limit} Per Project	WORKERS' COMPENSATION (6.03) {Employers' Liability} Per Accident Per Employee Per Disease	UMBRELLA (SC-6.03) {Combined Single Limit}
CONTRACT PRICE LESS THAN $100,000: Occurrence *General Aggregate Products/Completed Operations Aggregate	$300,000	$ 500,000 $ 500,000 $1,000,000	$ 500,000 $ 500,000 $ 500,000	Not applicable
CONTRACT PRICE EQUAL TO $100,000 OR GREATER AND LESS THAN $500,000: Occurrence *General Aggregate Products/Completed Operations Aggregate	$500,000	$ 500,000 $1,000,000 $1,000,000	$ 500,000 $ 500,000 $ 500,000	Not applicable
CONTRACT PRICE EQUAL TO OR GREATER THAN $500,000 AND UP TO AND INCLUDING $10,000,000: Occurrence *General Aggregate Products/Completed Operations Aggregate	$1,000,000	$1,000,000 $2,000,000 $2,000,000	$1,000,000 $1,000,000 $1,000,000	$1,000,000 $1,000,000
CONTRACT PRICE GREATER THAN $10,000,000: Occurrence *General Aggregate Products/Completed Operations Aggregate	$1,000,000	$1,000,000 $2,000,000 $2,000,000	$1,000,000 $1,000,000 $1,000.000	$5,000,000 $5,000,000

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Delete Paragraph 6.04 in its entirety and insert the following in its place:

SC-6.04 *Property Insurance*

A. Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of $500,000.00. This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, Engineer, and other individuals or entities identified herein, and the officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured, additional insured, or loss payee as their interest may appear;

   a. In addition to the individuals or entities specified above, include as additional insured, or loss payees as their interest may appear, the following:

      1) Huitt-Zollars.

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: extended coverage, collapse, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood).

3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and start-up; and

7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

B. Contractor shall purchase and maintain equipment breakdown insurance which will include the interests of Owner, Contractor, Subcontractors, Engineer, and other individuals or entities identified as additional insured or loss payees in this Paragraph SC-6.04, and the officers, directors, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as an insured, additional insured, or loss payee.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with Paragraph SC-6.04 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured or loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph SC-6.05.

D. The risk of loss within any deductible amount applicable to the policies of insurance purchased in accordance with this Paragraph SC-6.04 will be borne by Contractor, Subcontractors, or others suffering such loss.

E. Contractor shall purchase and maintain flood insurance upon the Work in the amount of the full replacement cost of the Work.

6.05 *Property Losses; Subrogation*

SC-6.05 Delete Paragraph 6.05 in its entirety and insert the following in its place:

SC-6.05 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph SC-6.04 will protect Owner, Contractor, Subcontractors, Engineer, and all other individuals or entities identified in Paragraph SC-6.04 to be listed as insureds or additional insured or loss payees (and the officers, directors, members, partners, employees, agents, and other consultants and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of loss or damage the insurers will have no rights of recovery against any of the insureds or additional insured or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable

to the Work; and, in addition, waive all such rights against Subcontractors, Engineer, and all other individuals or entities identified in Paragraph SC-6.04 to be listed as insureds or additional insureds or loss payees (and the officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, Engineer, and the officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire and other perils whether or not insured by Owner, and;

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03 or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage, or consequential loss referred to in Paragraph SC-6.05.B shall contain provisions to the effect that in the event of payment of any such loss, damage or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, Engineer, and the officers, directors, members, partners, employees, agents and other consultants and subcontractors of each and any of them.

ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7:00 a.m. to 5:00 p.m.

2. Owner's legal holidays are New Year's Day (January 1), Martin Luther King Jr. Day (3rd Monday in January), Presidents' Day (3rd Monday in February), Memorial Day (last Monday in May), Juneteenth (June 19), Independence Day (July 4), Labor Day (1st Monday in September), Veterans Day (November 11), Thanksgiving Day (4th Thursday in November), Christmas Day (December 25).

SC-7.03 Amend the first and second sentences of Paragraph 7.03.C to state "…all Work at the Site must be performed during regular working hours, **Monday** through **Friday**. Contractor will not perform Work on a **Saturday**, **Sunday**, or any legal holiday."

SC-7.03 Delete Paragraph 7.03.C in its entirety, and insert the following:

C. In the absence of any Laws or Regulations to the contrary, Contractor may perform the Work on holidays, during any or all hours of the day, and on any or all days of the week, at Contractor's sole discretion.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

D. **Contractor** shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

SC-7.03 Add the following new subparagraph immediately after Paragraph SC-7.03.D:

1. For purposes of administering the foregoing requirement, additional overtime costs are defined as **RPR hours incurred to cover work performed on weekends and holidays.**

SC-7.03.E Add the following new paragraph immediately after paragraph 7.03.D:

SC-7.03.E for work financed in whole or in part by loans or grants from, or loans insured or guaranteed by, the United States or any agency or instrumentality thereof under any statute of the United States providing wage standards for such work, the provisions of the Contract Documents are subject to the applicable provisions of the Contract Work Hours and Safety Standards Act, 40 U.S.C.A. §327 et seq. Contractor and Subcontractor shall not require or allow any laborer or mechanic to be employed on the Work in excess of forty hours in any work week unless such laborer or mechanic receives compensation at a rate not less than one-and-one-half times his or her basis rate of pay for hours worked in excess of forty hours in such work week. Except as may be otherwise required by law, all claims pertaining to the classification of labor employed on the project shall be decided by Owner's governing body or other duly designated official.

7.07 *Concerning Subcontractors and Suppliers*

SC 7.07.N Add the following new paragraphs immediately after Paragraph 7.07.M:

SC-7.07.N Contractor shall perform, with his organization and with the assistance of workers under Contractor's immediate superintendence, not less than 40 percent of the Contract Price, exclusive of Work not commonly found in contracts for similar construction which require specialized knowledge, craftsmanship, or equipment not ordinarily available in the organizations of contractors performing construction similar in nature to the Work. The value of the Work, exclusive of said items, will be interpreted as the value of labor, equipment, superintendence, and

only those portions of materials and equipment incorporated into the Work that are related to the Contract's direct labor requirements.

7.09 *Permits*

SC-7.09.B Add the following new paragraph immediately after Paragraph 7.09.A:

SC-7.09.B TPDES Permit and Related Permits and Requirements

1. The Work is subject to the Texas Pollution Discharge Elimination System (TPDES) permitting requirements for the installation and maintenance of temporary and permanent erosion and sediment controls and stormwater pollution prevention measures throughout the construction period.

2. Owner has prepared a Storm Water Pollution Prevention Plan (SWPPP). SWPPP requirements are in the Specifications.

3. Owner will file Owner's "Notice of Intent" to the Texas Commission on Environmental Quality (TCEQ). Owner will pay the TPDES stormwater application fee.

4. Contractor's responsibilities are as follows:

   a. Prepare a Storm Water Pollution Prevention Plan (SWPPP) in compliance with Laws and Regulations.

   b. Obtain a signed certification statement from all Subcontractors responsible for implementing erosion and sedimentation controls and other best management practices for the Site that are part of the SWPPP. Such statement shall indicate that the Subcontractor understands the permit requirements. The certified statement forms shall be attached to and become part of the SWPPP.

   c. Fill out the TCEQ's "Construction Site Notice" form, which is Attachment 2 to the TPDES General Permit TXR150000 (form available from Owner or on the Internet at http://www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr152d2.pdf ,and post it near the main entrance of the Site, or at multiple postings if the Work is linear. Submit a copy of the completed Construction Site Notice form to Owner and Engineer.

   d. Maintain erosion/sedimentation controls and other protective measures identified in the SWPPP in effective operating condition.

   e. Perform inspections every 14 days and after every half-inch of rainfall, noting the following observations on an inspection form provided by Owner:

1) Locations of discharges of sediment or other pollutants from the Site.

2) Locations of stormwater, erosion, sedimentation controls that are in need of maintenance or repair.

3) Locations of stormwater, erosion, sedimentation controls that are not performing, failing to operate, or are inadequate.

4) Locations where additional stormwater, erosion, sedimentation controls are needed.

f. Continuously maintain at the Site a copy of the SWPPP (with updates, as described below) and inspection reports.

g. Update the SWPPP as necessary to comply with TPDES permitting requirements, which includes noting changes in erosion, and sedimentation controls and other best management practices that are part of the SWPPP and which may be necessary due to the results of inspection reports.

h. Upon Substantial Completion or establishment of permanent cover over disturbed soil areas (if such cover is established after Substantial Completion), submit TPDES records to Owner.

SC-7.09.B *TPDES Permit and Related Permits and Requirements*

1. This Work is subject to the Texas Pollution Discharge Elimination System (TPDES) permitting requirements for the installation and maintenance of temporary and permanent erosion and sediment controls and stormwater pollution prevention measures throughout the construction period.

2. Owner has prepared a Storm Water Pollution Prevention Plan (SWPPP). Requirements are in the Specifications.

3. Owner will file Owner's "Notice of Intent" and "Notice of Termination" to the Texas Commission on Environmental Quality (TCEQ). Owner will pay the TPDES stormwater application fee.

4. Contractor's responsibilities are as follows:

a. Prepare a Storm Water Pollution Prevention Plan (SWPPP) prior to filing the "Notice of Intent" form.

b. File a "Notice of Intent" form with the TCEQ not less than two days prior to starting construction activity at the Site and pay for the permit. Form is available from Owner or on the Internet at http://www.tceq.state.tx.us/assets/public/permitting/waterquality/

forms/20022.pdf. The form shall be mailed or submitted online to the TCEQ. For online submittal, the web address is https://www.tceq.state.tx.us/steers/. If Contractor has not already registered to use the TCEQ online application submittal service, it typically takes approximately ten working days to receive a username and password from TCEQ. No extension of the Contract Times will be granted for this activity. The mailing address is:

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC-228
P.O. Box 13087
Austin, TX 78711-3087

c. Submit to Owner a copy of the completed "Notice of Intent" form as submitted to TCEQ.

d. Obtain a signed certification statement from Subcontractors responsible for implementing erosion and sediment controls. Such statements shall indicate that Subcontractor understands the permit requirements. Such certified statement forms shall be attached to and become part of the SWPPP.

e. Post a notice near the main entrance of the Site with the following information.

1) TPDES permit number for the Work or a copy of the Notice of Intent if a permit number has not yet been assigned,

2) Name and telephone number of Contractor's local contact person,

3) Brief description of the Work, and

4) Location of the SWPPP if the Site is inactive or does not have an on-site location to store the SWPPP.

f. When posting this information near a main entrance is infeasible due to safety concerns, the notice shall be posted in a local public building. If the Work is linear (pipeline, highway, or other linear construction), the notice shall be placed in a publicly accessible location near where construction is actively underway and moved as necessary. For linear Work, multiple postings of the information may be required by Owner.

g. Maintain erosion and sediment controls and other protective measures identified in the SWPPP in effective operating condition.

h. Perform inspections every 14 days and after every half-inch of rainfall, noting the following observations on an inspection form furnished by Owner:

1) Locations of discharges of sediment or other pollutants from the Site.

2) Locations of storm water, erosion, sedimentation controls that require maintenance.

3) Locations of storm water, erosion, sedimentation controls that are not performing, failing to operate, or are inadequate.

4) Locations where additional storm water, erosion, sedimentation controls are needed.

i. Continuously maintain at the site a copy of the SWPPP (with all updates, as described below) and inspection reports.

Update the SWPPP as necessary to comply with TPDES permitting requirements, which includes noting changes in erosion and sedimentation controls and other best management practices that are part of the SWPPP and which may be necessary due to the results of inspection reports.

File a "Notice of Termination" with TCEQ within 30 days of final stabilization of all areas of disturbed soil and disturbed soil cover. Form is available from Owner or on the Internet at http://www.tceq.state.tx.us/assets/public/permitting/waterquality/forms/20023.pdf.

j. "Notice of Termination" shall be mailed to:

Texas Commission on Environmental Quality
Storm Water & General Permits Team; MC-228
P.O. Box 13087
Austin, TX 78711-3087
(512) 239-4671

k. Upon completion of the Work, submit to Owner TPDES records.

7.10 *Taxes*

SC-7.10.B Add the following new paragraph immediately after Paragraph 7.10.A:

SC-7.10.B Exemption from State of Texas sales tax may be obtained on materials and equipment incorporated into the Work and supplies required to perform the Work. Owner is an organization which qualifies for such exemption pursuant to provisions of Article 20.04(F) of the Texas Limited Sales, Excise and Use Tax Act. In accordance with Texas

House Bill 11, Contractor may purchase, materials, equipment, and supplies consumed in the performance of the Work by issuing to Suppliers an exemption certificate in lieu of the tax, said exemption certificate complying with State of Texas Comptroller's Ruling No. 95-0.07. Such exemption certificate(s) issued by Contractor in lieu of the sales will be subject to the provisions of the State of Texas Comptroller's Ruling No. 95-0.09 as amended to be effective October 2, 1968. Exemption certificate may be obtained from Owner's Purchasing Agent.

7.11 *Laws and Regulations*

SC-7.11.C Remove last sentence on Paragraph 7.11.C. "If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim in its entirety."

SC-7.11.D Add the following new paragraph immediately after Paragraph 7.11.C:

SC-7.11.D *Minimum Prevailing Wage Rates*

1. Wage rates paid to workers employed in performing the Work at the Site, including Contractor and Subcontractor employees, shall not be less than the following:

   a. Minimum prevailing wage rates of the City of El Paso, Texas. The prevailing minimum wage rate determination, comprised of _____ pages, applicable to the Project is part of the Contract Documents.

   b. Federal Davis-Bacon minimum prevailing wage rates, comprised of ____ pages, which is part of the Contract Documents. Comply with 40 USC 31 and 29 CFR Parts 1, 3, and 5.

   When a labor classification is included in both the City of El Paso and federal minimum prevailing wage rate determinations, Contractor shall pay the higher of the two minimum prevailing wage rates for that labor classification. Contractor shall be aware of changes in the minimum prevailing wage rates applicable to the Work and shall pay the minimum prevailing wages at no additional cost to Owner. Contractor shall post the schedule of classifications and wage rates at conspicuous locations at the Site. Such schedule shall also show deductions, if any, required by law to be made from wages earned by laborers and mechanics engaged on the Work.

2. Contractor shall give preference to hiring qualified local residents for work as laborers and mechanics on the Project. Employees shall be bona-fide residents of the United States of America.

3. Contractor and Subcontractors shall pay each of their employees, engaged in the Work in full, not less often than once per week, and without

deductions or subsequent rebates on any account, except for deductions mandated by law.

4. Contractor, and Subcontractors shall keep a complete payroll record indicating the name, address, and Social Security number of each employee engaged in the Work, together with the classification of work in which the employee is engaged, the hourly wage rate paid, number of deductions made from such wages and total amount paid to the employee. Submit to Owner one copy of each such payroll record, for the period for which payment is requested, with each Application for Payment. Each payroll record shall bear the affidavit of the employer certifying, under oath, that such payroll is a true, complete, and accurate report of the wages earned and paid to each employee engaged in the Work, that no deductions from any wages due each employee, except as set out on the payroll, have been directly or indirectly made, and that no rebates, either direct or indirect, have been nor will be required of an employee.

5. Certified payroll reports shall indicate for each worker whether the labor performed was performed under the Building, Heavy, Highway, or Water and Sewer Line Prevailing Wage Rate scale. Certified payroll reports shall be submitted for the complete Contract period and, for weeks where no Work was performed, negative reports shall be submitted, marked "No Work Performed". Clearly mark "FIRST PAYROLL" on the first payroll submitted, and clearly mark "FINAL PAYROLL" on the last payroll submitted for the Contract.

6. Apprentices will be work only under a bona fide apprenticeship program registered with the U.S. Department of Labor. A copy of such program shall be submitted to Owner, together with current certification or evidence of registration with the U.S. Department of Labor, Bureau of Apprenticeship and Training, for each apprentice engaged in the Work.

7. Contractor shall, when requested by Owner, submit additional certification and documentation (such as copy of cancelled check or an Employee Restitution Receipt Form) indicating that employee has received back compensation due.

8. Contractor and Subcontractors in violation of this provision are subject to a penalty of $60 per day for each worker that is paid less than the rate specified in the Project's applicable prevailing wage rates.

SC-7.11.E Add the following new paragraph immediately after Paragraph 7.11.D:

SC-7.11.E *Mandatory for Building Projects with Contract Price Over $100,000 – Apprentices*

1. In accordance with resolution adopted on November 9, 1999 by the El Paso City Council regarding apprenticeship programs on City projects, Contractor and Subcontractors shall:

a. Sponsor or participate in a U.S. Department of Labor (DOL) certified apprenticeship program for all job classifications utilized on the Project which are apprenticeable occupations as defined by DOL regulations and which appear on the "schedule of categories of apprentices" kept on file in the office of the City of El Paso's Capital Improvement Department;

b. Pay wage rates and benefits in accordance with the applicable apprenticeship program;

c. Comply with the DOL requirements for ratio of apprentices to journeymen;

d. Hire registered apprentices enrolled in a DOL-certified apprenticeship program in all job classifications utilized on the Project which are apprenticeable occupations as defined by DOL regulations and which are designated for City projects on the "schedule of categories of apprentices" kept on file in the office of the City of El Paso Director of Capital Improvement Department. Helpers, unregistered apprentices, and other substitutes shall not perform apprentice-level work in place of registered apprentices.

2. Contractor shall post the applicable prevailing wage rate schedules at the Site in a prominent location readily accessible to the workers throughout the Project. Contractor shall post a notice to be provided by the City of El Paso Director of Capital Improvement Department regarding prevailing wage rates and the City of El Paso's apprenticeship program, in English and in Spanish, which shall be posted at the Site with the prevailing wage rates.

3. Contractor shall submit to Owner the names of all apprentices employed on the Work; verification of their status as registered apprentices; documentation regarding apprentice's proper wage rates; and documentation regarding journeyman-to-apprentice ratios for each trade as determined by the apprenticeship program.

4. No worker shall be discharged by Contractor or Subcontractor, or in any other manner be discriminated against, because such worker has filed an inquiry or complaint, instituted legal or equitable proceeding, or has testified or is about to testify in such proceeding under, or relating to, the apprenticeship program.

5. Contractor and Subcontractors shall allow immediate entry into all areas of the Site by Owner or Owner's agents and representatives displaying or presenting proper identification to Contractor's Site superintendent or their representative. Owner or their representative may visit the Site to determine adherence to these requirements, Contractor and Subcontractors shall allow access to personnel and apprenticeship program books and records and access to employees to be interviewed at random, at any time and for any reasonable duration to determine compliance with these provisions, including the apprenticeship programs.

6. Owner reserves the right to terminate for cause in accordance with Paragraph 16.02 if Contractor or Subcontractor breaches any of provisions of the Contract Documents regarding apprenticeship programs.

7. Apprentices shall be allowed to work at less than the predetermined rate for the work they performed when apprentice(s) are employed pursuant to, and individually-registered in, a bona-fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration Bureau; or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program but who has been certified by the Bureau of Apprenticeship & Training, or a state apprenticeship agency where appropriate, to be eligible for probationary employment as an apprentice.

8. The allowable ratio of apprentices to journeymen on the Work in any craft classification shall not be greater than the ratio permitted to the Contractor or Subcontractor as to the entire work force under the registered program. Any apprentice performing the Work in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the City Wage Scale for the work actually performed.

9. Contractor shall submit to Owner's Contract Administrator with sufficient information, which demonstrates that apprentices are employed pursuant to, and individually registered in, a bona-fide apprenticeship program. A copy of such program shall be submitted to Owner as well as the current certification for each individual assigned to the Work and appearing on the payrolls for that Contract. Every apprentice must be paid at not less than the rates specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman's hourly rate specified in the City wage determination. Workers not registered in a bona-fide apprenticeship program shall be paid not less than the applicable wage rate in the City Wage Scale for the classification of work actually performed. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the program does not specify fringe benefits, they must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Bureau of Apprenticeship & Training determines that a different practice prevails for the applicable apprentice classification, fringe benefits shall be paid in accordance with that determination.

10. If the Bureau of Apprenticeship & Training or a state apprenticeship agency recognized by the Bureau, withdraws approval of a program, Contractor shall not employ apprentices at less than the applicable City rate for the work performed until an acceptable program is approved and evidence provided.

7.13 *Safety and Protection*

SC-7.13.B.1 Add following new subparagraph immediately after Paragraph 7.13.B:

SC-7.13.B.1 Contractor's safety representative shall be identified in submittal to Owner and Engineer for acceptance prior to commencement of Work at the Site. Name and qualifications of proposed substitute, if any, shall be submitted to Owner for acceptance.

SC-7.13.G Replace the word "safety program" with "Health and Safety Plan."

SC-7-13.H Replace the word "safety program" with "Health and Safety Plan."

SC-7.13.K Add the following new subparagraphs immediately after Paragraph 6.13.J:

SC-7.13.K Within twenty-four hours of receiving a request from Owner, Contractor shall furnish to Owner documentation substantiating representations made in the Health and Safety Plan including, but not limited to, that each of the Contractor's employees has received training on the Health and Safety Plan as well as any other training necessary to competently effectuate the Health and Safety Plan. Select Contractor project management staff shall complete the El Paso Water Online Contractor Orientation, (Course 19ELPWC) available at www.hasc.com, before start of construction.

SC-7.13.L Owner maintains a drug and alcohol-free workplace in accordance with the Drug-free Workplace Act of 1988. Contractor shall publicize a statement notifying employees on the Work that the unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited in the workplace, including at the Site.

SC-7.13.M Owner maintains specific rules regarding smoking on Owner's properties. Contractor shall adhere to such rules at the Site.

SC-7.13.N Owner maintains specific rules regarding firearms and Contractor shall adhere to such rules at the Site.

SC-7.13.O Owner maintains specific rules regarding traffic safety on Owner's properties. Contractor shall adhere to such rules at the Site.

7.16 *Submittals*

SC-7.16.G Add the following new paragraphs immediately after Paragraph 7.16.F:

SC-7.16.G For each Contractor submittal required under the Contract Documents, Engineer will review one initial submittal and one resubmittal at no cost to Contractor. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, Samples, or other

submittals requiring approval or acceptance, and Contractor shall reimburse Owner for Engineer's charges for labor and expenses for such time.

SC-7.16.H In the event that Contractor requests a change of a previously approved or previously accepted submittal, Contractor shall reimburse Owner for Engineer's charges for Engineer's review time unless the need for such change is beyond Contractor's control.

ARTICLE 9 - OWNER'S RESPONSIBILITIES

9.11 *Evidence of Financial Arrangements*

SC-9.11 Delete Paragraph 9.11 in its entirety and insert the following in its place:

SC-9.11 Not used

9.13 *Owner's Site Representative*

SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

9.13 *Owner's Site Representative*

A. Owner will furnish an "Owner's Site Representative" to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Site Representative is not Engineer's consultant, agent, or employee. Owner's Site Representative will be **[here identify individual or entity]**. The authority and responsibilities of Owner's Site Representative follow: [**Here describe the duties and activities of the Owner's Site Representative.]**

ARTICLE 10 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Add a new paragraph immediately after Paragraph 10.03.B that is to read as follows:

SC-10.03.C Resident Project Representative (RPR) will be Owner's and/or Engineer's employee or agent at the Site, will act as directed by and under the supervision of Owner and/or Engineer, and will confer with Owner and/or Engineer regarding RPR's actions. RPR's dealings in matters pertaining to the Work in general shall be with Owner and/or Engineer and Contractor keeping Owner advised as necessary. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner with the knowledge of and under the direction of Engineer.

1. Duties and Responsibilities to RPR:

a. Schedules: Review the Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

b. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.

c. *Safety Compliance*: Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.

d. Liaison:

1) Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent, and assist in providing understanding of the intent of the Contract Documents.

2) Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

3) Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

e. Shop Drawings and Samples:

1) Record date of receipt of Shop Drawings and Samples that are received at the Site.

2) Receive Samples that are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.

3) Advise Engineer and Contractor of the commencement of any Work requiring a Shop Drawing or Sample if the submittal has not been approved by Engineer.

f. Review of Work, Rejection of Defective Work, Inspections, and Tests:

1) Conduct observations of the Work in progress on the Site to assist Engineer in determining if the Work is, in general, proceeding in accordance with the Contract Documents.

2) Report to Engineer when RPR believes that any Work is unsatisfactory, faulty, or defective or does not conform generally to the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test, or approval required to be made; and advise Engineer of Work that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection, or approval.

3) Verify that tests, equipment, and systems startups, and operating and maintenance training are conducted in the presence of appropriate

Owner's personnel and that Contractor maintains adequate records thereof; and observe, record, and report to Engineer appropriate details relative to the test procedures and startups.

4) Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

5) Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to Engineer.

g. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

h. Modifications: Consider and evaluate Contractor's suggestions for modifications to Drawings or Specifications and report with RPR's recommendations to Engineer. Transmit to Contractor decisions issued by Engineer.

i. Records:

1) Maintain at the Site orderly files for correspondence, reports of job conferences, Shop Drawings and Samples, and reproductions of original Contract Documents including all Addenda, Change Orders, Field Orders, work change directives, additional Drawings issued subsequent to the execution of the Agreement, Engineer's clarifications and interpretations of the Contract Documents, progress reports, and other Project-related documents.

2) Keep a record recording Contractor's hours on the Site, weather conditions, data relative to questions on Change Orders or changed conditions, list of visitors to the Site, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.

3) Record names, addresses, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.

4) The RPR shall prepare a daily report or keep a daily diary that records weather conditions, the contractor's daily work activities, and specific observations. The RPR shall regularly photograph the work. The RPR shall maintain orderly files of correspondence, reports of job conferences, change orders, field orders, work change directives, daily reports and/or diaries, photographs and other similar documents. These documents shall be filed in Consultant's project record file. They shall be made available to Owner upon receipt of request from Owner and, if available, uploaded to cloud-based construction management software applications (or any other construction management software applications made available).

j. Reports:

1) Furnish Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and Schedule of Submittals.

2) Consult with Engineer in advance of scheduled major tests, inspections, or start of important phases of the Work.

3) Prepare draft of proposed Change Orders, obtaining backup documents from Contractor, and provide recommendations to Engineer regarding Change Orders and Field Orders.

4) Report immediately to Engineer and Owner upon the occurrence of any Site accident, any Hazardous Environmental Condition, emergencies, or acts of God endangering the Work, or property damage by fire or other cause.

k. Payment Requests: Review Applications for Payment with Contractor for compliance with the established procedure for their submission, and submit recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

l. Certificates, Maintenance and Operation Manuals: During the course of the Work, verify that certificates, maintenance and operation manuals, and other data required by the Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to Engineer for review and forwarding to Owner prior to final payment for the Work.

m. Completion:

1) Before Engineer issues a certificate of Substantial Completion, submit to Contractor a list of observed items requiring completion or correction.

2) Observe whether Contractor has arranged for inspections required by Laws and Regulations, including but not limited to those to be performed by public authorities having jurisdiction over the Work.

3) Conduct final inspection in the company of Engineer, Owner, and Contractor, and prepare a final list of items to be completed or corrected.

4) Observe that all items on final list have been completed or corrected and make recommendations to Engineer concerning acceptance of the Work.

2. The RPR shall not:

a. Authorize any deviation from the Contract Documents or substitution of materials or equipment, including "or equal" items.

b. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

c. Undertake any of the responsibilities of Contractor, Subcontractors, or Contractor's superintendent.

d. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences, or procedures of construction, unless such advice or directions are specifically required by the Contract Documents.

e. Advise on, issue directions regarding, or assume control over safety precautions and programs in connection with the Work.

f. Accept Shop Drawing or Sample submittals from anyone other than Contractor.

g. Authorize Owner to occupy the Project in whole or in part.

h. Authorize the use of any Unmanned Aircraft System (UAS or drone) without prior consent and authorization from Owner.

i. Participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

ARTICLE 11 - CHANGES TO THE CONTRACT

11.02 *Change Orders*

SC-11.02.C Add the following new paragraph immediately after Paragraph 11.02.B:

SC-11.02.C Change Order requests shall be accompanied by Contractor's time impact analysis for the Change Order request to be reviewed.

11.03 *Work Change Directives*

SC-11.03.A.1 Add the following new subparagraphs immediately after Paragraph 11.03.A:

SC-11.03.A.1 Without invalidating the Contract, OWNER may, by written Work Change Directive, using the Cost of the Work method, order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, the Contract Amount and Contract Time being adjusted as necessary. "Cost of the Work" means a basis of payment for the direct performance of Work with payment based on the actual cost of the labor, equipment and materials furnished and consideration for overhead and profit as set forth in Section 13.01, below. A Work Change Directive shall be used in the absence of complete and prompt agreement on the terms of a Change Order. Where practicable, any items of Work that may be agreed upon, prior to the performance of Work under this Section, will be included in a separate Change Order.

SC-11.03.A.2 If the Work Change Directive provides for an adjustment to the Contract Amount, the adjustment shall be based on the method provided in paragraph 13.01. The estimated value of the work issued under each individual Work Change Directive shall not exceed five (5) percent of the original contract price.

SC-11.03.A.3 A Work Change Directive shall be effective immediately and shall be recorded later by preparation and execution of an appropriate Change Order.

SC-11.03.A.4 Upon receipt of a Work Change Directive, CONTRACTOR shall promptly proceed with the change in the Work involved, provided, prior to the commencement of any Work under this section, the CONTRACTOR must submit its proposed Work plan, anticipated schedule, and a list of its work force and equipment proposed to be used in the Work for OWNER'S approval. Upon such approval, CONTRACTOR must promptly commence and make continuous progress in the Work. The OWNER reserves the right to withhold payment for low production or lack of progress.

11.07 *Change of Contract Price*

SC-11.07.C.2.c Delete 27 percent and replace with 25 percent.

SC-11.11 Add the following new paragraph immediately after Paragraph 11.10:

SC-11.11 Liquidated Damages:

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

B. Liquidated Damages Relative to Substantial Completion and Readiness for Final Payment: Owner and Contractor recognize that time is of the essence as stated in Paragraph SC-11.11.A above and that Owner will suffer financial loss if the Work is not completed within the Contract Times for Substantial Completion, completion and readiness for final payment, and Milestones (if any) specified in the Contract Documents, plus any changes thereof allowed in accordance with Article 11 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration preceding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner $1,160.00 for each day that expires after the time specified in the Contract Documents for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner $560.00 for each day that expires after the time specified in the Contract Documents for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 12 - CLAIMS

SC-12.01.B Add the following immediately after Paragraph 12.01.B:

SC-12.01.B.1 In the event a delay Claim arises due to Standby Equipment Costs, Contractor must notify, through an RFI, Engineer and Owner no later than 72-hours in advance of such claim at which time Contractor, Engineer and Owner will evaluate the progress of the Work and determine if no other Work can be performed. Once that determination has been made, official response from Engineer and Owner acknowledging the delay at which point the Standby time will commence.

ARTICLE 13 - COST OF WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

SC-13.01 In Paragraph SC-13.01.A, delete the last sentence and replace with:

The provisions of this Paragraph 13.01 are used for **three** distinct purposes:

SC-13.01 Add the following new paragraph immediately after Paragraph 13.01.A.2:

SC-13.01.A.3 If neither of the methods defined in paragraphs 13.01.A.1 nor 13.01.A.2 can be agreed upon before a change in the Work is commenced which will result in an adjustment in the Contract Amount, then the change in the Work will be performed by Work Change Directive, using the Cost of the Work method, and payment will be made as described below:

SC-13.01 Supplement Paragraph 13.01.B.5.c.(2) by adding the following sentence:

The equipment rental rate book that governs the included costs for the rental of machinery and equipment owned by Contractor (or a related entity) under the Cost of the Work provisions of this Contract is the most current edition of **Rental Rate Blue Book**. Equipment or machinery with a value of less than $1,000 will be considered small tools.

SC-13.01 Add the following new subparagraphs immediately after Paragraph 13.01.B.5.i:

SC-13.01.B.5.j Standby Equipment Costs: Standby equipment time will not exceed more than eight (8) hours per twenty-four (24) hour day, forty (40) hours per week, and one hundred seventy-six (176) hours per month Payment for standby equipment will be made in accordance with 13.01.B.5.c except that:

SC-13.01.B.5.j.(1) Contractor-Owned Equipment. For Contractor-owned machinery, trucks, power tools, or other equipment, Standby will be paid at 50% (to account for the removal of operating costs) of the rate established under 13.01.B.5.c.(2). Standby costs will not be allowed during periods when the equipment would have otherwise been idle.

SC-13.01.B.5.j.(2) Equipment Not Owned by the Contractor. For equipment rented from a third party not owned by the Contractor, Standby will be paid at the invoice daily rental rate, excluding operating cost, which includes fuel, lubricants, repairs, and servicing. The Owner reserves the right to limit the daily standby rate to comparable rates established

under 13.01.B.5.c.(2). Standby will be paid for equipment operators when included on the invoice and equipment operators are actually on standby. Standby costs will not be allowed during periods when the equipment would have otherwise been idle.

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

a. For purposes of this paragraph, "small tools and hand tools" means any tool or equipment whose current price if it were purchased new at retail would be less than $1,000.

13.03 *Unit Price Work*

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

   a. the extended price of a particular item of Unit Price Work amounts to 10 percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than **25** percent from the estimated quantity of such item indicated in the Agreement; and

   b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCCEPTANCE OF DEFECTIVE WORK

SC-14.02 Add the following new subparagraphs to Paragraph 14.02.B:

1. Re-Inspection Fees

   a. Pay fees to the Owner to compensate the Owner's Representative as identified in Article 10 of the General Conditions for reinspection of the Work required by the failure of the Work to comply with the claims of status of completion made by the Contractor.

   b. Owner may withhold the amount of these fees from the Contractor's final payment as stipulated in Article 15 of the General Conditions.

c. Cost for additional inspections will be billed to the Owner by the Owner's Representative for the actual hours required for the reinspection and preparation of related reports in accordance with the rates provided in the Supplemental Conditions **Exhibit A-1.**

2. Fees for Inspections Outside Normal Working Hours

a. If some or all of the Work has been determined to be required to be performed outside the normal working hours and or beyond the standard 40-hour work week as defined by Article 7 of the General Conditions, the Contractor is required to:

1) Notify the Owner in advance of their intent to work outside regular working hours or working days;

2) Determine if the work to be performed will require observation by the Owner's Representative or other agencies prior to covering the Work;

b. Pay fees to the Owner to compensate the Owner's Representative as identified in Article 10 of the General Conditions for inspection of the Work performed outside normal working hours;

c. Owner may withhold the amount of these fees from the Contractor's final payment as stipulated in Article 15 of the General Conditions.

d. Cost for inspections will be billed to the Owner by the Owner's Representative for the actual hours required for the inspection and or observation of the work and preparation of related reports in accordance with the rates provided in the Supplemental Conditions **Exhibit A-1.**

ARTICLE 15 - PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.01 *Progress Payments*

SC-15.01.D.1 Delete Paragraph 15.01.D.1 in its entirety and insert the following in its place:

SC-15.01.D.1 Thirty days after presentation of the Application for Payment to Owner by Contractor with Engineer's recommendation, the amount recommended will (subject to the provisions of Paragraph 15.01.E) become due, and when due will be paid by Owner to Contractor.

SC-15.01.D.1.(a) The thirty days' time will commence immediately after Owner acknowledges receipt of the Application for Payment from Contractor.

SC-15.01.D.1.(b) If upon review of the Application for Payment the Owner encounters any error (including, but not limited to, clerical, grammatical, informational, etc…) or lacks documentation as required by the Contract Documents, the Application for Payment will be deemed incomplete and the Owner will reject the Application for Payment. The Owner will immediately notify the Contractor and Engineer the reason for the rejection of the Application for Payment. The thirty days' time allotted will reset and

recommence once a corrected Application for Payment is received by Owner from Contractor.

SC-15.01.F Add the following new Paragraph 15.01.F:

SC-15.01.F For contracts in which the Contract Price is based on the Cost of Work, if Owner determines that progress payments made to date substantially exceed the actual progress of the Work (as measured by reference to the Schedule of Values), or present a potential conflict with the Guaranteed Maximum Price, then Owner may require that Contractor prepare and submit a plan for the remaining anticipated Applications for Payment that will bring payments and progress into closer alignment and take into account the Guaranteed Maximum Price (if any), through reductions in billings, increases in retainage, or other equitable measures. Owner will review the plan, discuss any necessary modifications, and implement the plan as modified for all remaining Applications for Payment.

15.03 *Substantial Completion*

SC-15.03 Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

15.06 *Final Payment*

SC-15.06.B Delete the first sentence and replace with the following:

If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing **to Owner** Engineer's recommendation of final payment and **inform Contractor Final Payment Application is ready to be submitted to Owner for payment**.

SC-15.06.E Delete Paragraph 15.06.E in its entirety and replace with the following:

E. Final Payment Becomes Due: Upon receipt from **Contractor of an approvable Application for Final Payment** and accompanying documentation, Owner shall set-off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including, but not limited to, set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within

30 days of Owner's receipt of the final Application for Payment from Contractor. An approvable application for final payment shall include Contractor and Subcontractor payrolls for the period covered in the final Application for Payment; an update of progress against the accepted Progress Schedule; and such other items as the Engineer may reasonably require.

15.08 *Correction Period*

SC-15.08 Add the following new Paragraph 15.08.G:

G. The correction period specified as one year after the date of Substantial Completion in Paragraph 15.08.A of the General Conditions is hereby revised to be the number of years set forth in SC-6.01. B.1; or if no such revision has been made in SC-6.01. B, then the correction period is hereby specified to be **one** year after Substantial Completion.

ARTICLE 16 - SUSPENSION OF WORK AND TERMINATION

16.02 *Owner May Terminate for Cause*

SC-16.02.A.5 Add the following new paragraphs immediately after Paragraph 16.02.A.4:

SC-16.02.A.5 If the Contract or any part thereof is sublet or assigned to another party by Contractor, without the written consent of Owner and surety that issued the performance bond and payment bond.

ARTICLE 17 - FINAL RESOLUTIONS OF DISPUTES

SC-17.02 Add the following new paragraphs immediately after Paragraph 17.01:

17.02 *Arbitration*

A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of $100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable

proceedings based on such matter in question would be barred by the applicable statute of limitations.

C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.

D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.

E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.

F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.

G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;

3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and

4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.

H. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

I. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is

allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

17.03 *Attorneys' Fees*

SC-17.03 Add the following new paragraph immediately after Paragraph 17.02:

17.03 *Attorneys' Fees*

A. For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18 - MISCELLANEOUS

SC-18.11 Add the following new paragraph immediately after Paragraph 18.10:

SC-18.11 *Use of Unmanned Aerial/Aircraft Systems (UAS)*

A. The use of an UAS on all Owner property is strictly prohibited unless the following are met:

1. The proposed flight is solely for purposes of Utility operations
2. Authorization has been received from Owner to operate on or above Owner property
3. All of the necessary federal, state, and local approvals have been acquired
4. Compliance with federal, state, and local laws are met
5. The Contractor has filed a flight plan with AirMap or any other Owner-approved Unmanned Aircraft System Traffic Management (UTM) ecosystem for uncontrolled operations that is separate from, but complementary to, the FAA's Air Traffic Management (ATM) system prior to flight operations
6. The proposed flight does not photograph, video, or monitor in any way areas where members of the general public would have a reasonable expectation of privacy

B. Any person or vendor, including but not limited to third parties seeking to operate a UAS on or above Owner property or at an Owner-sponsored event must submit a completed UAS (Drone) Use Approval Form to the Owner at least 10 business days in advance.

C. The applicable Owner Representative (PM) who is an employee of the Owner will process the request for UAS use. After review and assessment

of the request, the requestor will be notified of a decision or receive a request of additional information within five (5) business days.

1. If approved, the PM will email a copy of the approved form to the Owner's Utility Security and Emergency Response (USER) Coordinator.

D. The USER Coordinator will advise El Paso Police Department (EPPD) and Airport Operations (if the UAS will be near or entering restricted flight space) of UAS activity for situational awareness.

1. If approved, a copy of the UAS Approval Form must be in possession by the pilot in command at all times during flight activity and must be presented to any EPWater official or representative with control or jurisdiction over the activity, upon request.

E. The USER Coordinator will maintain a copy of the UAS (Drone) Use Approval Forms.

F. Exceptions and Deviations

1. Contractors will be limited to the collection, use, retention, or dissemination of images and videos of Owner's critical infrastructure acquired by UAS.

2. The Owner's Utility Chief Operations Officer may waive the 10-business day notification requirement as deemed necessary.

3. UAS operators must only conduct approved flights under favorable conditions. If unforeseen circumstances develop (e.g. adverse weather) under which operations cannot be conducted in a safe manner, the operation must postpone the flight and request an extension from the Project Manager within 3 business days of the original date. If the extension is not requested within three (3) business days, a new UAS Approval Form must then be completed and submitted.

4. The use of UAS for hobby or recreational use on all EPWater property is always strictly prohibited. Using a UAS to take photographs or videos for personal use is considered recreational use and is prohibited.

SC-18.12 Add the following new paragraph immediately after Paragraph 18.10:

SC-18.12 *Working Near Utilities*

A. *Construction Adjacent to High Voltage Electric Lines:*

1. Contractor shall comply with Laws and Regulations, including U.S. Occupational Safety and Health Administration (OSHA) safety

standards regarding construction adjacent to high-voltage electric lines and facilities, including trenching, crane operations, final grading, and other associated work which may result in impaired clearance to an existing electrical line or facility.

2. It is a violation of OSHA regulations to operate equipment in a manner that results in persons or equipment coming within ten feet of an energized electric line. Such Laws and Regulations are enforced by OSHA, and violators are subject to penalties imposed under federal Law.

3. Texas Law prohibits function or activity where it is possible for the person performing such activity to come within six feet of an overhead power line.

4. Contractor shall notify the El Paso Electric Company in writing of Contractor's anticipated dates and times when such work is scheduled. Written notification of El Paso Electric Company shall be at least six working days prior to each scheduled activity near El Paso Electric Company power lines and facilities, so that El Paso Electric Company personnel can coordinate with Contractor to provide proper clearance of energized electric lines. No other type of notice will be acceptable and work shall not be initiated until proper clearance and arrangements are confirmed by Contractor with the El Paso Electric Company.

5. Submit written notification to:

   Raul Guel, Distribution Engineering Design
   El Paso Electric Company
   P. O. Box 982
   El Paso, Texas 79960
   (915) 543-4015

6. Simultaneously submit one copy of the notification letter to Owner's Contracts Development Manager and retain copy in Contractor's file.

7. Below are selected El Paso Electric Company phone numbers:

Claims Director	(915) 543-4158
Trouble & Emergencies	(915) 543-5720
Field Services/Power Consultants	(915) 543-2255
Cable Locator	(915) 543-4051

B. Construction Adjacent to Gas Lines: Contractor shall comply with the One-Call Notification and System Protection Program developed by Southern Union Gas Company, and with State Damage Prevention Law, HB 2295:

☐ Contact Texas Gas Co. not less than two working days before commencing excavation activities

☐ Determine exact location of all underground utilities by safe and acceptable means

☐ Employ the two-foot safety rule

☐ Utilize "Professional Excavator's Manual" as revised

SC-18.13 Add the following new paragraph immediately after Paragraph 18.12:

SC-18.13 *EPCWID #1 Dewatering Permit Requirements*

A. A license agreement for "Discharge of Foreign Waters into District Drain Ditches" is required between Owner and the El Paso County Water Improvement District (EPCWID) #1 before Contractor may begin dewatering operations. Contractor shall be a co-licensee with Owner. Terms and conditions of the license agreement are applicable to Contractor, who will function, relative to the license EPCWID #1 agreement only, as an agent of Owner, by preparing an approvable plan and carrying out the terms of the plan and the EPCWID #1 license agreement. Contractor shall, to the extent permitted by law, defend and hold harmless Owner, its employees, insurers and agents; and the Engineer and Engineer's consultants, and their employees, officers, insurers, and agents from claims arising out of damages caused by actions, or inactions, of Contractor or as a result of EPCWID's exercise of any or all options given it under the license agreement.

B. Contractor shall prepare and submit to Engineer a "Dewatering Plan", a "Final Schedule for Dewatering", and an estimate of fees due EPCWID #1. Submit "Dewatering Plan" within 15 days of the date that the Contract Times commence running. "Dewatering Plan" shall include the estimated quantities of dewatering for each month of the Contract, the design capacity and number of pumps to be used by Contractor, and the point(s) of dewatering pump discharge. Engineer will review for acceptability the "Dewatering Plan" and, when the submittal is acceptable to Engineer, Engineer will forward it, through Owner, to EPCWID #1. Prepare and submit the submittal and schedule the Work so that Owner receives the "Dewatering Plan" submittal not less than 14 days before the start of dewatering operations at the Site. Owner will pay the fees as estimated in the "Dewatering Plan".

C. Estimate the dewatering fees on the following basis:

1. Drain maintenance fee of $1,000 for each six months a discharge occurs. Fee for maintenance is non-refundable. Subsequent semi-annual fee payments are payable to Owner by Contractor in advance of each respective six-month period.

2. Dewatering fee at the rate of $150 per acre-foot of water discharged. For a month in which the discharge exceeds the amount estimated under the "Dewatering Plan", Contractor shall advise Owner and Engineer in writing, that such excess fees may be due so that the Owner may consider its liability for, and take action to make payment of, such excess fees to EPCWID #1. Owner will pay such excess fees only to the extent that such fees are incurred through no fault of Contractor.

D. Samples of the discharge water shall be tested by a qualified testing laboratory hired by Contractor. Submit to Engineer results of total dissolved solids (TDS) tests, which Engineer will transmit to EPCWID #1. Submit to Engineer and Owner monthly reports of discharge quantities and quality (TDS and sulfates), which specific requirements may be more particularly indicated in the Specifications and in the associated discharge permit; Engineer will transmit monthly reports to EPCWID #1.

E. Contractor will not be eligible for final payment by Owner until final dewatering fees based upon actual quantities and damages (if any) due EPCWID # 1 have been paid and payment due from Contractor has been made. A "Final Release" from EPCWID # 1 shall be received by Owner as a condition precedent to Contractor applies for final payment.

SC-18.14 Add the following new paragraph(s) immediately after Paragraph 18.12:

SC-18.14 *Railroads*

A. *Union Pacific Railroad Company Contractor's Right of Entry*: Contractor shall acquire and pay all associated expenses (including railroad company inspection fees), Contractor's right-of-entry from, the Union Pacific Railroad Company. Refer to Union Pacific Railroad's "Contractor's Right of Entry" form and its exhibits, included in the Project Manual following these Supplementary Conditions. Right-of-entry requirements are interrelated with the railroad liability insurance requirements and both are Contractor's cost responsibility. Contractor shall acquire railroad company's authorization prior to commencing work in the railroad right-of-way. Submit to Owner and Engineer executed copies of Contractor's "Right of Entry" form prior to commencing work on railroad property.

B. *Railroad Liability Insurance*: Contractor shall obtain Railroad Liability Insurance in the form and amount required by the Union Pacific Railroad Company. Such insurance shall be in effect and cover all necessary work and operations required of Contractor within the railroad right-of-way. Refer to the railroad's "Contractor's Right of Entry" form and its exhibits. Insurance requirements of this paragraph are interrelated with the right-of-entry requirements in Paragraph SC-18.14.A and is Contractor's responsibility.

C. For clarification of the requirements and costs of railroad permits and insurance, contact:

Manager Utilities Work
Union Pacific Railroad Company
Contracts and Real Estate Department
1400 Douglas Street STOP 1690
Omaha, Nebraska 68179-1690
Phone: (402) 544-8620
Fax: (402) 501-1519

SC-18.15 Add the following new paragraph immediately after Paragraph 18.14:

SC-18.15 Texas Water Development Board (TWDB) contracts require that all Contractors and subcontractors maintain project costs in a manner consistent with generally accepted accounting principles. All records are to be maintained for a minimum period of three years and beyond that minimum period if litigation, a claim, or an audit is in process, or if audit findings are not resolved. The three-year period will begin upon completion of final payment.

***** END OF SUPPLEMENTARY CONDITIONS *****

REQUIRED WORKERS' COMPENSATION COVERAGE

(Title must be 30 point font & bold lettering)

(19 point font from here on)

The law requires that each person working on this site or providing services related to this construction project must be covered by workers' compensation insurance. This includes persons providing, hauling, or delivering equipment or materials, or providing labor or transportation or other service related to the project, regardless of the identity of their employer or status as an employee."

"Call the Texas Workers' Compensation Commission at 512-440-3789 to receive information on the legal requirements for coverage, to verify whether your employer has provided the required coverage, or to report an employer's failure to provide coverage."

* The above sign to be provided in both English and Spanish without any additional words or changes and shall be posted at the Project Site. Refer to Paragraph SC-6.03.D.1 of the Supplementary Conditions (Document 00800 in the Contract Documents).

SECTION 00810

EP WATER CONTRACTOR INSURANCE COVERAGE CHECKLIST

Contractor Insurance Check List

Project				
Bid Number				
Job Description				
Contract Cost				
Final Completion				
Contractor				
Engineer				
Insurance Agent				
Performance & Payment Bonds	**Bond Limit :**			
	Surety:			
	Certified copy of Authority to Act		☐ Yes	☐ No
	Countersigned by Agent		☐ Yes	☐ No
Workers' Compensation	**Insurance Company / A.M. Best Rating**			
	Policy Period	From:	To:	
	Employers Liability Limits required			
	Employers Liability Limits provided			
	Waiver of Subrogation		☐ Yes	☐ No
	30 Days Notice of Cancellation		☐ Yes	☐ No
	If Employees Leased:			
	– Employee Leasing Company		☐ Yes	☐ No
	– Texas State License		☐ Yes	☐ No
	– Copy of Workers' Compensation Policy		☐ Yes	☐ No
Commercial General Liability	**Insurance Company / A.M. Best Rating**			
	Policy Period	From:	To:	
	Limits required			
	Limits provided			
	Products/Completed Operations – 2 Years after completion		☐ Yes	☐ No
	Personal Injury – Employment Exclusion deleted		☐ Yes	☐ No
	Contractual		☐ Yes	☐ No
	Broad Form Property Damage		☐ Yes	☐ No
	XCU		☐ Yes	☐ No
	Additional Insured		☐ Yes	☐ No
	30 Days Notice of Cancellation		☐ Yes	☐ No
Business Auto	**Insurance Company / A.M. Best Rating**			
	Policy Period	From:	To:	
	Limits required			
	Limits provided			
	Symbol 1		☐ Yes	☐ No
	Additional Insured		☐ Yes	☐ No
	30 Days Notice of Cancellation		☐ Yes	☐ No
Umbrella	**Insurance Company / A.M. Best Rating**			
	Policy Period	From:	To:	
	Limits required			
	Limits provided			
	Follow Form – Additional Insureds and Waivers of Subrogation		☐ Yes	☐ No
	30 Days Notice of Cancellation		☐ Yes	☐ No

Contractor Insurance Check List

Builder's Risk/Installation Floater	**Insurance Company / A.M. Best Rating**			
	Policy Period	From:	To:	
	Limits required			
	Limits provided			
	Deductible			
	– All Risk		☐ Yes	☐ No
	– Flood		☐ Yes	☐ No
	– Earthquake		☐ Yes	☐ No
	– Testing		☐ Yes	☐ No
	– Offsite Storage		☐ Yes	☐ No
	– Transit		☐ Yes	☐ No
	– Additional Interests		☐ Yes	☐ No
	– Waiver of Subrogation		☐ Yes	☐ No
Boiler & Machinery	– **If required**			
Certificates of Insurance	– **All coverages**			
Certified Copies of Policies	– **All policies**			
Requirements	**Additional Insureds – Owner, Engineer and Engineer's Consultants on:**			
	– CGL		☐ Yes	☐ No
	– Auto		☐ Yes	☐ No
	– Umbrella		☐ Yes	☐ No
	Waiver of Subrogation (Workers' Compensation) – Owner, Engineer and Engineer's Consultants		☐ Yes	☐ No
	30 Days Notice of Cancellation to Owner & Engineer by Certified Mail on:			
	– WC		☐ Yes	☐ No
	– CGL		☐ Yes	☐ No
	– Auto		☐ Yes	☐ No
	– Umbrella		☐ Yes	☐ No
	– Builder's Risk		☐ Yes	☐ No
	– B&M (If required)		☐ Yes	☐ No
	Builder's Risk/Installation Floater – Include Additional Insured interests & Waiver of Subrogation in favor of :			
	– Owner		☐ Yes	☐ No
	– Contactor		☐ Yes	☐ No
	– Subcontractor		☐ Yes	☐ No
	– Engineer		☐ Yes	☐ No
	– Engineer's Consultants		☐ Yes	☐ No
Other				

Notice: This checklist is provided as a guide only and is not a substitute for the insurance requirements included in the EPWU contract. EPWU strongly advises contractors provide a copy of the contract insurance requirements to their insurance agents, consultants and providers to ensure their insurance coverages meet the contract insurance requirements.

SECTION 00820

EP WATER STANDARD APPLICATION FOR PAYMENT

APPLICATION FOR PAYMENT NO. ___

Check One: PARTIAL ____ FINAL ____

OWNER: El Paso Water Utilities
Public Service Board
1154 Hawkins Blvd.
El Paso, Texas 79925

PROJECT: _____
_____

BID NO.: _____

PURCHASE ORDER: _____

ORIGINAL CONTRACT AMOUNT: $_____

NET CHANGE BY CHANGE ORDERS: $_____

CONTRACT SUM TO DATE: $_____

THROUGH CHANGE ORDER NO. _____

NOTICE TO PROCEED: _____

CONTRACT TIME: _____ Calendar Days

REVISED: _____ Calendar Days

ELAPSED TIME: _____ Calendar Days

CONTRACT COMPLETION DATE: _____

REVISED COMPLETION DATE: _____

SUBSTANTIAL COMPLETION DATE:_____

FINAL COMPLETION DATE: _____

WORK COMPLETED: $ _____ *See Attached Pay Item Schedule*

MATERIALS STORED: $ _____ *Attach Invoices, Documentation*

TOTAL EARNED: $_____

LESS RETAINED: ____ % - $ _____

LESS PREVIOUS PAYMENTS: - $ _____

NET DUE THIS ESTIMATE: $ _____ *Attach Certified Payroll LCP Tracker Report this Period*

CONTRACTOR'S CERTIFICATION:

The undersigned CONTRACTOR certifies that (1) all previous progress payments received from OWNER on account of work done under the contract referred to above have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with work covered by prior applications for payment; and (2) title to all materials and equipment incorporated in said work or otherwise listed in or covered by this application for payment will pass to Owner at time of payment free and clear of all liens, claims, security interests and encumbrances (except such as covered by bond acceptable to OWNER).

CONTRACTOR: _____

By:_____

Title:_____

Date: _____

RECOMMENDED:

CONSTRUCTION MANAGER: _____

By: _____

Date: _____

APPROVED:

By: _____

Title: _____

Date: _____

SECTION 00825

EP WATER STANDARD APPLICATION FOR PAYMENT

(CONTINUATION PAGE)

CONTINUATION SHEET *AIA DOCUMENT G703* (Instructions on reverse side) PAGE OF PAGES

AIA Document G702, APPLICATION AND CERTIFICATE FOR PAYMENT, containing
Contractor's signed Certification is attached.
In tabulations below, amounts are stated to the nearest dollar.
Use Column I on Contracts where variable retainage for line items may apply.

APPLICATION NUMBER:
APPLICATION DATE:
PERIOD TO:
ARCHITECT'S PROJECT NO:

A	B	C	D	E	F	G		H	I
ITEM NO.	DESCRIPTION OF WORK	SCHEDULED VALUE	WORK COMPLETED		MATERIALS PRESENTLY STORED (NOT IN D OR E)	TOTAL COMPLETED AND STORED TO DATE (D+E+F)	% (G÷C)	BALANCE TO FINISH (C-G)	RETAINAGE
			FROM PREVIOUS APPLICATION (D+E)	THIS PERIOD					

SECTION 00830

PAY APPLICATION CHECKLIST

PAY APPLICATION CHECK LIST

REQUIRED ITEM/PROCESS	INCLUDED
1. Three original Pay Applications are included/submitted and are on the standard EPWU form (CM 11343A in the bid document).	
2. Substantial and Final Completion due dates listed match the bid document.	
3. Project adjustments (e.g., price, quantity, time, etc.) reflected in Work Directives or unexecuted Change Orders are NOT included in the Pay Application.	
4. If charges for paid materials are included in the Pay Application, include paid invoices for the stored material.	
5. Updated Construction Schedule is included	
6. Payrolls to be entered in the Utility Automated Payroll Software program, which include the following:	
a. For 'Negative Payrolls' during week(s) of no work performed, state, "No Work Performed" on those payrolls.	
b. If apprentices are used, submit DOL certification, apprenticeship programs and training periods for each apprentice. (Note: The DOL certificates expire every 90 days and must be renewed and current. If a current DOL certificate is not submitted for each apprentice, the employee must be paid the Journeyman's rate).	

If all requirements are not met or included in the Pay Application package, the Pay Application will be returned for revisions, and payment will not be made until EPW's receipt of 'approvable' Pay Application.

SECTION 00840

GENERAL WAGE REQUIREMENTS

EL PASO WATER
2020 Buil ing Construction Tra es age Rates

CLASSIFICATION	BASE WAGE	BENEFITS	HOURLY PREVAILING WAGE RATE	(8 HOURS) PER DIEM WAGE RATE
Asbestos/Lead Abatement/Mold Remediation	31.51	12.06	43.57	348.56
Automatic Fire Sprinkler Fitter, Certified	30.64	21.68	52.32	418.56
Block, Brick, and Stone Mason	17.97	0.00	17.97	143.76
Carpenters – Acoustical Ceiling Installation	17.36	0.00	17.36	138.88
Carpenter – Rough	17.64	0.00	17.64	141.12
Carpenter – All Other Work	17.40	0.00	17.40	139.20
Caulker / Sealers	11.29	0.00	11.29	90.32
Cement and Concrete Finishers	16.30	0.00	16.30	130.40
Commercial Truck Driver	14.75	0.00	14.75	118.00
Communication/Security Technician	16.50	2.12	18.62	148.96
Crane and Heavy Equipment Operator	31.05	0.00	31.05	248.40
Door & Hardware Specialist	12.00	1.35	13.35	106.80
Drywall and Ceiling Tile Installers	14.40	0.00	14.40	115.20
Drywall Finishers & Tapers	15.55	0.00	15.55	124.40
Electrician	22.70	7.32	30.02	240.16
Elevator Installers and Repairers	31.35	15.10	46.45	371.60
Fence Erectors – Include with Skilled Labor	10.00	0.00	10.00	80.00
Floor Layers- Carpet and Resilient	12.87	0.00	12.87	102.96
Floor Layers- Specialty	13.00	0.00	13.00	104.00
Floor Layers - Wood	11.50	0.00	11.50	92.00
Glaziers	15.86	1.00	16.86	134.88
Hazardous Materials Removal Workers	10.00	0.00	10.00	80.00
Heating, Air Conditioning and Refrigeration Service Technician	31.14	12.43	43.57	348.56
Insulation Workers – Mechanical	31.26	11.96	43.22	345.76
Irrigator – Landscape, Certified	15.28	0.00	15.28	122.24
Laborer	13.13	0.58	13.71	109.68
Locksmith	12.00	1.35	13.35	106.80
Mechanic	17.00	0.00	17.00	136.00
Painters - Building	13.86	0.00	13.86	110.88
Paper Hanger	14.00	0.00	14.00	112.00
Pipe Layer (Utility)	18.00	0.00	18.00	144.00
Pipe Fitters and Steamfitters	23.53	9.02	32.55	260.40
Plaster, Stucco, Lather and EIFS Applicator	16.82	0.00	16.82	134.56
Plumber/ Medical Gas Installer	31.39	10.77	42.16	337.28
Reinforcing Iron and Rebar Workers	22.69	0.00	22.69	181.52
Roofers	16.00	0.00	16.00	128.00
Scaffolding Erector	13.69	0.00	13.69	109.52
Sheet Metal Workers	27.16	0.00	27.16	217.28
Structural Iron and Steel Workers / Metal Building Erector	25.57	13.24	38.81	310.48
Tile Setters	13.86	0.00	13.86	110.88

2020 BUILDING DEFINITIONS

1	**Asbestos/Lead Abatement/Mold Remediation**	Assembles work platform and seals off work area, using plastic sheeting and duct tape. Positions mobile decontamination unit or portable showers at entrance of work area. Positions portable air evacuation and filtration system inside work area. Cuts and scrapes asbestos, mold or paint from surfaces, using knife and scraper. Assists in demolition and deconstruction activities of buildings. Shovels asbestos, mold or paint into plastic disposal bags and seals bags, using duct tape. Cleans work area of loose asbestos, mold or paint, using vacuum, broom, and dust pan. Places asbestos, mold or paint in disposal bags and seals bags, using duct tape, loads bags into truck. Cleans and maintains tools, sampling equipment and lab equipment. Responsible for keeping site and grounds clean and neat. Performs daily equipment checks. Picks up necessary supplies and tools from warehouse as directed. Loads and unloads scrap materials into trucks and roll off boxes. Performs work safely in accordance with departmental safety procedures and operates equipment safely. Reports any unsafe work condition or practice to supervisor. Performs other related and non-related duties as assigned.
2	**Automatic Fire Sprinkler Fitter, Certified**	Sprinkler Fitters specialize in piping associated with fire sprinkler systems. These types of systems are required to be installed and maintained in accordance with strict guidelines, usually National Fire Protection Association (NFPA) standards, in order to maintain compliance with building and fire codes. Sprinkler Fitters work with a variety of pipe and materials including: plastic, copper, steel, cast iron, and ductile iron. The fire suppression piping may contain: water, air, antifreeze, fire retardant foam, gas, or chemicals for hood systems. Sprinkler systems installed by Sprinkler Fitters can include but not limited: to underground supply, standpipes, fire pumps as well as overhead piping systems.
3	**Block, Brick, and Stone Mason**	Lay and bind building materials, such as: brick, structural tile, concrete block, cinder block, glass block, and terra-cotta block, with mortar and other substances to construct, or repair walls, partitions, arches, sewers, and other structures. Classify installers of mortarless segmental concrete masonry wall units. Constructs partitions, fences, walks, fireplaces, chimneys, smokestacks, et cetera using stone, marble, granite, slate. Cutting, grouting, and pointing of materials listed above which is necessary shall be part of this classification.
4	**Carpenters – Acoustical Ceiling Installation**	Construct, erect, install or repair acoustical ceiling grid, ceiling tile, and other items laid in acoustical grid.
5	**Carpenter – Rough**	Construct, erect, install, or repair structures and fixtures made of wood, such as concrete forms; building frameworks, including partitions, joists, studding, and rafters; wood stairways, window and door frames. May also install cabinets, and siding. Include brattice builders who build doors or brattices (ventilation walls or partitions) in underground passageways to control the proper circulation of air through the passageways.

6	**Carpenter – All Other Work**	Construct, erect, install or repair cabinets and other fixtures or structures requiring a high level of workmanship. Includes Cabinetmakers and Bench Carpenters – cut, shape, and assemble wooden articles or set up and operate a variety of woodworking machines, such as power saws, jointers, and mortisers to surface, cut or shape lumber or to fabricate parts for wood products. Perform related duties such as trim work.
7	**Caulker/Sealers**	Applies water proofing agents or caulk to a variety of structures and materials.
8	**Cement and Concrete Finishers**	Smooth and finish surfaces of poured concrete, such as floors, walks, sidewalks, roads, or curbs using a variety of hand and power tools. Align forms for sidewalks, curbs, or gutters; patch voids; use saws to cut expansion joints. Classify installers of mortarless segmental concrete wall units.
9	**Commercial Truck Driver**	Drive a truck, van or tractor-trailer combination to transport and deliver goods, or materials in liquid, loose, or packaged form. May be required to unload truck.
10	**Communication/Security Technician**	Set-up, re-arrange, or remove switching and dialing equipment used in central offices. Service or repair telephones and other communication equipment on customers' property. May install equipment in new locations or install wiring and telephone jacks in buildings under construction. Install, program, maintain, and repair security and fire alarm wiring and equipment. Ensure that work is in accordance with relevant codes. Exclude "Electricians" who do a broad range of electrical wiring.
11	**Crane and Heavy Equipment Operator**	A worker who operates a crane or other types of heavy equipment to hoist and move materials, raise and lower heavy weights and perform other related operations. May be crawler type or rubber-tired. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.
12	**Door and Hardware Specialist**	Installs or repairs doors, hardware and accessories. Are responsible for the installation of contract commercial hardware and custom architectural grade wood doors, steel doors and frames for all Prevailing Wage jobs. Shall be trained by their employer's, employer's apprenticeship, or in factory training classes in the proper methods and techniques and requirements for the installation of Architectural Grade commercial wood and metal doors, frames and hardware in conformance with all local, state, and federal code.
13	**Drywall and Ceiling Tile Installers**	Apply plasterboard, or other wallboard to ceilings, or interior walls of buildings. Apply or mount acoustical tiles or blocks, strips, or sheets of sound-absorbing materials to ceilings and walls of buildings to reduce or reflect sound. Materials may be of decorative quality. Includes metal stud framing. Exclude "Carpet Installers", "Carpenters – Acoustical Ceiling Installation", and "Tile and Marble Setters".
14	**Drywall Finishers and Tapers**	Seal joints between plasterboard or other wallboard, including bedding and texturing, to prepare wall surface for painting or papering.

15	**Electrician**	Plan and execute the layout and installation of electrical conduit, switch panels, buss bars, outlet boxes, electrical wires and cables, lighting standards, lighting fixtures, receptacles, switches, and other electrical devices and apparatus necessary for the complete electrical installation. To include the installation of cabling, wire, conduits and end devices for Temperature Control, Building Automation, and Energy Management Systems, et cetera. Includes installation of photovoltaic solar panels.
16	**Elevator Installers and Repairers**	Assemble, install, repair, or maintain electric or hydraulic freight or passenger conveyances including but not limited to elevators, escalators, dumbwaiters, moving walks and wheelchair lifts.
17	**Fence Erectors - Include with Skilled Labor**	Erect and repair metal and wooden fences and fence gates around highways, industrial establishments, residences, or farms, using hand and power tools. Excludes rock and stone fences.
18	**Floor Layers – Carpet and Resilient**	Apply blocks, strips, or sheets of shock-absorbing, sound-deadening, or decorative coverings to floors. Lay and install carpet from rolls, tiles or blocks on floors. Install padding and trim flooring materials. Installs variety of soft floor materials including vinyl and VCT. Exclude wood floors and specialty floors.
19	**Floor Layers - Specialty**	Prepares surface, installs and finishes specialty floor material such as manufactured or engineered and laminated wood.
20	**Floor Layers - Wood**	Install, scrape and sand wooden floors to smooth surfaces using floor scraper and floor sanding machine, and apply coats of finish to include gymnasium and bowling alleys.
21	**Glaziers**	Installs glass in windows skylights, store fronts and display cases, or on surfaces such as: building fronts, interior walls, ceilings and table tops. The installation, setting, cutting, preparing, fabricating, distributing, handling or removal of the following: glass and glass substitutes used in place of glass, pre-glazed windows, retrofit window systems, mirrors, curtain wall systems, window wall systems, cable net systems, canopy systems, structural glazing systems, unitized systems, interior glazing systems, photovoltaic panels and systems, suspended glazing systems, louvers, skylights, entranceway systems including doors and hardware, revolving and automatic door systems, patio doors, store front systems including the installation of all metals, column covers, panels and panel systems, glass hand rail systems, decorative metals as part of the glazing system, and the sealing of all architectural metal and glass systems for weatherproofing and structural reasons, vinyl, molding, rubber, lead, sealants, silicone and all types of mastics in wood, iron, aluminum, sheet metal or vinyl sash, doors, frames, stone wall cases, show cases, book cases, sideboards, partitions and fixtures. Performs other related duties.

22	**Hazardous Materials Removal Workers**	Identify, remove, pack, transport, or dispose of hazardous materials, including asbestos, lead-based paint, waste oil, fuel, transmission fluid, radioactive materials, contaminated soil, mold, et cetera. Specialized training and certification in hazardous materials handling or a confined entry permit are generally required. May operate earth-moving equipment or trucks.
23	**Heating, Air Conditioning and Refrigeration Service Technician**	Repair and service heating, central air conditioning, or refrigeration systems, including oil burners, hot-air furnaces, heating stoves, and air handlers. (Installation of systems is performed by sheet metal worker). Includes HVAC mechanic.
24	**Insulation Workers – Mechanical**	This work includes the preparation, alteration, application, removal, hauling, erection, assembling, molding, spraying, pouring, mixing, hanging, adjusting, repairing, dismantling, reconditioning, maintenance, finishing, and/or weatherproofing of cold or hot thermal insulations with such materials as may be specified when those materials are to be installed for thermal purposes in voids, or to create voids, or on either piping, fittings, valves, boilers, ducts, flues, tanks, vats and equipment, or on any hot or cold surfaces for the purpose of thermal control or to be installed for sound control purposes mechanical devices, equipment, piping, surfaces related in an integral way to the insulation of such mechanical devices, equipment and piping. This work also includes all labor connected with insulation for; temperature control, personnel protection, safety and/or prevention of condensation. This work also includes all labor connected with hauling, distribution and cleanup of materials on the job premises. All thermal tape, pads, metered fittings (insulation, metal or plastic), batts and lags.
25	**Irrigator- Landscape, Certified**	Certified by TCEQ to install watering systems in various sizes and grades of lawn in order to maintain sufficient pressure and to insure even dispersal of water.
26	**Laborer**	Performs manual duties in all phases of construction. Demolition (interior and exterior), Flagging and Traffic Control, General Clean-Up, Air and Power Tool Operators (Including chipping guns, jackhammers and tampers), all material handling and clean-up, except refractory, chute/hose operator, raking, shoveling and vibrating, raking, shoveling, luting, ironing, dumping and spreading, trenching, material handling, back filling (*Equipment Operators Incidental to Laborers' scope of work). Landscape or maintain grounds of property using equipment as needed. Workers typically perform a variety of tasks, which may include any combination of the following: sod laying, mowing, trimming, planting, watering, fertilizing, digging, raking, sprinkler repair, and installation of mortarless segmental concrete masonry wall units. Does not ordinarily perform work permitting exercise of independent judgment or without close direction by other workers.
27	**Locksmith**	Self-explanatory.

28	**Mechanic**	Maintains and repairs construction tools and equipment.
29	**Painters - Building**	Paint walls, equipment, buildings, bridges, and other structural surfaces, using brushes, rollers, and spray guns. May remove old paint to prepare surface prior to painting. May mix colors or oils to obtain desired color or consistency. Exclude "Paperhangers."
30	**Paper Hanger**	Measures, cuts, and hangs wallpaper and Fiber Reinforced Paneling.
31	**Pipe Layer (Utility)**	Installs concrete, clay, steel, ductile iron, plastic, corrugated pipe and any other type of pipe for storm drainage, water lines, gas lines and sanitary sewer lines. Lays underground communication and electrical ducts. May install and set electrical ground boxes, hand holes, manholes, inlets and other structures. Caulks joints, makes threaded and flanged connections. Installs valves and other accessories. Performs other related duties.
32	**Pipe Fitters and Steamfitters**	Assemble, install, alter, and repair pipelines or pipe systems that carry water, steam, air, or other liquids or gases. May install heating and cooling equipment and mechanical control systems. Includes pressurized lines and flow lines for gas, air, and oil found in industrial settings.
33	**Plaster, Stucco, Lather, and EIFS Applicator**	Apply interior or exterior plaster, stucco, or similar materials. May also set ornamental plaster**.** Applies acoustical plaster, interior and exterior plastering of stone imitation or any patented materials when cast. Molds and sets ornamental plaster and trim and runs ornamental plaster cornice and molding.
34	**Plumbers/ Medical Gas Installer**	Assemble, install, alter, and repair pipelines or pipe systems that carry water, steam, air, or other liquids or gases. May install heating and cooling equipment and mechanical control systems. Assemble, install, alter, and repair pipelines or pipe systems that carry medical gases or liquids. Specialized training and certification required.
35	**Reinforcing Iron and Rebar Workers**	Position and secure steel bars or mesh in concrete forms in order to reinforce concrete. Includes post-tensioning. Use a variety of fasteners, rod-bending machines, blowtorches, and hand tools.
36	**Roofers**	Cover roofs of structures with shingles, tile, slate, asphalt, aluminum, wood, metal and related materials. May spray roofs, sidings, and walls with material to bind or seal sections of structures. Includes metal and membrane roofs.

37	**Sheet Metal Workers**	Fabricate, assemble, install, and repair sheet metal products and equipment, such as ducts, seal the system, pressure test and test and balance , control boxes, drainpipes, architectural sheet metal, hangers, brackets, used in the installation of sheet metal, and installs grills, registers, and furnace casings. Work may involve any of the following: setting-up and operating fabricating machines to cut, bend, and straighten sheet metal, operating soldering equipment to join sheet metal parts; inspecting, assembling, and smoothing seams and joints of burred surfaces, including metal flashings, gutters, canopies, soffit's, louvers, skylights and custom metal roofs. Installs warm air furnaces except where necessary piping for gas, or oil is performed under the plumbing and pipefitting classification. Include sheet metal duct installers who install prefabricated sheet metal ducts used for heating, air conditioning, or other purposes. Fire life safety, damper inspection, stairwell pressurization. May install other heating and cooling devices which are in connection with duct systems.
38	**Structural Iron and Steel Workers/Metal Building Erector**	Rigging, raise, place, and unite iron or steel, prefabricated metal buildings precast concrete, precast "tilt-up" panels, concrete and steel bridge members, concrete decking, ornamental iron, hand rails, stairs, curtain wall/glass framework, girders, columns, beams, and other structural members to form completed structures or structural frameworks using hand tools, power tools, and hoisting equipment. Erects frame of building, using hoist. Bolts steel frame members together. Attaches wire and insulating materials to framework. Attaches sheet metal panels to framework including standing seam sheets. Installs and trims sheet metal on prefabricated metal buildings, using cutting torch, power saw, and tin snips. Rigging of heavy equipment, assembly and disassembly of cranes. May erect metal storage tanks. Exclude "Reinforcing Iron and Rebar Workers".
39	**Tile Setters**	Apply hard tile, terrazzo tile and veneer to walls, floors, and ceilings. Includes surface preparation as necessary.
40	**Scaffolding Erector**	Erection of a temporary elevated platform (both supported and suspended) and its supporting structure (including points of anchorage) to be used for supporting employees or material or both.

- **Welder -** Receives rate prescribed for craft performing operation to which welding is incidental.
- **Fork Lift and Man Lift (boom and scissor) -** Receives rate prescribed for craft performing operation to which operation of this equipment is incidental.

CITY OF EL PASO, TEXAS

2016 Paving and Street Construction, Dirt Work, Heavy Construction, Pipeline Work, Highway Wage Rates

CLASSIFICATION	BASE WAGE PER HOUR	TOTAL FRINGES PER HOUR	HOURLY PREVAILING WAGE RATE	(8 HOURS) PER DIEM WAGE RATE
Asphalt Distributor Operator	14.64	0.00	14.64	117.12
Asphalt Paving Machine Operator / Spreader Box Operator	14.20	0.00	14.20	113.60
Asphalt Raker	12.99	0.00	12.99	103.92
Backhoe Operator	15.95	0.00	15.95	127.60
Concrete Finishers (Paving and Structures)	13.88	0.00	13.88	111.04
Crane Operator, Lattice Boom	17.50	0.00	17.50	140.00
Crane Operator, Hydraulic	17.50	0.00	17.50	140.00
Electrician	23.09	0.00	23.09	184.72
Excavator Operator	16.10	0.00	16.10	128.80
Form Builder/Setter	15.02	0.00	15.02	120.16
Form Setter (Paving and Curb)	12.86	0.00	12.86	102.88
Front End Loader	14.82	0.00	14.82	118.56
Laborer	11.89	0.00	11.89	95.12
Laborer (Skilled)(Utility)	13.65	0.00	13.65	109.20
Mechanic	17.50	0.00	17.50	140.00
Motor Grader Operator (Fine)	17.54	0.00	17.54	140.32
Pipe Layer	12.94	0.00	12.94	103.52
Reinforcing Steel Setter (Structure and Paving)/ Structural Steel Worker	17.00	0.00	17.00	136.00
Rock Mason	12.00	0.00	12.00	96.00
Roller Operator	13.70	0.00	13.70	109.60
Servicer	14.33	0.00	14.33	114.64
Truck Driver, Single Axle	13.19	0.00	13.19	105.52
Truck Driver, Tandem Axle	15.32	0.02	15.34	122.72
Utility Operator Grade 1	12.00	0.00	12.00	96.00
Utility Operator Grade 2	13.95	0.00	13.95	111.60
Welder, Certified/ Structural Steel Welder	13.83	0.00	13.83	110.64

All persons required to be licensed or certified must meet those qualifications to be paid the associated rate.

February 28, 2017

2016 HEAVY / HIGHWAY DEFINITIONS

1	**Asphalt Distributor Operator**	Drives distributor truck, sets spray bars and operates valves and levers to control distribution of bituminous material for highway surfacing. May oil, grease or otherwise service and make adjustments to equipment as needed. Performs other related duties.
2	**Asphalt Paving Machine Operator/Spreader Box Operator**	Operates paving machine that spreads and levels asphaltic concrete on highway. Controls movement of machine, raises and lowers screed, regulates width of screed. Operates spreader box by adjusting hopper and strike-off blade so that gravel, stone or other material may be spread to a specific depth on road surface during seal coat and surface treatment operations. May oil, grease, service and make adjustments to equipment as needed. Performs other related duties.
3	**Asphalt Raker**	Distributes asphaltic materials evenly over road surface by hand-raking and brushing material to correct thickness; may control screed to regulate width and depth of materials; directs Laborers (skilled and unskilled) when to add or take away material to fill low spots or to reduce high spots.
4	**Backhoe Operator**	Operates a rubber-tired machine mounted with a backhoe bucket on one end and a loader bucket on the other end. Used for excavating ditches and structures, laying pipe and precast concrete structures, carrying material in the loader bucket, and general excavation and backfill. May also be equipped with hydraulic attachments. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.
5	**Concrete Finisher (Paving and Structures)**	Finishes the exposed surfaces of fresh concrete paving, median barrier and every element of concrete structures. Operates bridge deck finishing machine. Forms and finishes edges and joints. Finishes concrete curbs and gutters. Finishes exposed surface of concrete after forms have been removed by patching imperfections with fresh concrete, rubbing surface with abrasive stone, and directing others in removing excess or defective concrete with power tools. Performs other related duties.
6	**Crane Operator, Lattice Boom**	A worker who operates a lattice boom type crane to hoist and move materials, raise and lower heavy weights and perform other related operations. May be crawler type or rubber tired. May include placement of rock riprap, clamshell, dragline, pipe and pile driving operations. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.
7	**Crane Operator, Hydraulic**	A worker who operates a hydraulic telescoping boom type crane to hoist and move materials, raise and lower heavy weights and perform other related operations. May be crawler type or rubber-tired. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

8	**Electrician**	Plan and execute the layout and installation of electrical conduit, switch panels, buss bars, outlet boxes, electrical wires and cables, lighting standards, lighting fixtures, receptacles, switches, and other electrical devices and apparatus necessary for the complete installation of wiring systems, works on overhead distribution systems and underground distribution systems. Includes installation of photovoltaic solar panels.
9	**Excavator Operator**	Operates a crawler or rubber-tired machine mounted with an excavator bucket. Used for excavating ditches and structures, laying pipe and precast concrete structures, loading trucks and placing rock riprap. May also be equipped with various hydraulic attachments. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.
10	**Form Builder/Setter**	Works from plans to build, assemble, fit together, align, plumb, and set in place forms for molding concrete structures. Forms may be wood, steel, aluminum, fiberglass or any other type of material. Checks forms while concrete is being placed. May install miscellaneous materials integral to concrete structures. May set precast concrete elements. Prepares for slipforming traffic rail and median barrier. May install permanent metal deck forms. May work with power tools. Performs other related duties. Includes guardrail installation.
11	**Form Setter (Paving and Curb)**	Fits together, aligns and sets to grade metal and wooden forms for placement for concrete paving and curbs. Works with survey crew to set stringline for paving, curb and gutter and curb. Performs other related duties.
12	**Front End Loader**	Operates a rubber-tired, skid steer or crawler type tractor with an attached scoop type bucket on front end. Machine is used to load materials from stockpiles, excavation, charging batch plants, loading and unloading trucks. May be used with attachments in lieu of the bucket. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.
13	**Laborer**	A general term used on construction work covering many unskilled classifications requiring work of a physical nature. Performs a variety of work ranging from pick and shovel work to cleaning up lumber with hammer, shoveling and placing concrete, uses air tools, under the supervision of qualified personnel. Cleans concrete joints and fills joints with sealing compound from bucket or with hose and nozzle from a central source, applies coating of oil to inside face of forms and strip forms, unloads and transports reinforcing steel, cures newly poured concrete, assists pipelayers, works with dirt crew keeping construction layout stakes out of the way of dirt-moving equipment. May fine grade excavation and ditches, shovels hot asphalt material. May use power tools and other necessary equipment in demolition work under the supervision of qualified personnel. Does not ordinarily perform work permitting exercise of independent judgment or without close direction by other workers. Installs and maintains erosion control. Performs other related duties.

14	**Laborer (Skilled) (Utility)**	Performs a variety of manual duties, usually working in a utility capacity by working on multiple projects and tasks where demands require workmen with varied experience and ability to work without close direction. Unloads and transports reinforcing steel. Directs laborers in pouring concrete. Erects trench shoring and bracing. Installs, operates, and maintains watering systems. May assist equipment operators in positioning machines, verifying grades and signaling operators to dumping positions to maintain grades as directed. Uses power tools and air tools. May work as lead man in a labor crew. Is more or less a general utility construction worker. May be a second step in learning a skill. Includes Concrete/Granite Pump Operator, Concrete Saw Operator, Fence Erector, Flagger, and Sign Erector. Performs other related duties.
15	**Mechanic**	Assembles, assist set up, adjusts and maintains and repairs all types of construction equipment and trucks. May perform the duties of a welder in repair of equipment. Performs other related duties.
16	**Motor Grader Operator (Fine)**	Operates motor grader. Performs many of the same duties of Motor Grader, Rough, but in addition performs finish grade work to bluetops or other close specification control. This work is subject to strict inspection and must conform closely to specifications. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.
17	**Pipe Layer**	Installs concrete, clay, steel, ductile iron, plastic, corrugated pipe and any other type of pipe for storm drainage, water lines, gas lines and sanitary sewer lines. Lays underground communication and electrical ducts. May install and set electrical ground boxes, hand holes, manholes, inlets and other structures. Caulks joints, makes threaded and flanged connections. Installs valves and other accessories. Performs other related duties.
18	**Reinforcing Steel Setter (Structure and Paving)/ Structural Steel Worker**	Works from plans to lay out and install reinforcing steel within forms or in mats of concrete paving. Erects and places reinforcing steel and fabricated structural steel members, such as girders, plates, diaphragms, lateral bracing, and unites them permanently to form a completed structural steel unit, including reinforcing members. Fastens steel members together by welding or bolting. May include dismantling and erecting large units of equipment. Gives direction to reinforcing steel worker apprentice or utility laborers. Performs other related duties.
19	**Rock Mason**	Constructs partitions, fences, walls, using rock. Cutting, grouting and pointing of materials listed above which is necessary shall be part of this classification. May also build or repair rock retaining walls, cutting or placing of rock in mortar or other similar material.
20	**Roller Operator**	Operates a self-propelled machine with either steel wheels or pneumatic tires which is used to compact and smooth bituminous and flexible base materials and compact earth fills, subgrade, and all other types of materials. May oil, grease or otherwise service and make necessary adjustments to equipment as needed. Performs other related duties.

21	**Servicer**	Drives a truck which carries various fuels, oils, greases and filters. Must have knowledge of and is responsible for the correct oiling and greasing and changing of filters on equipment according to manufacturers' specifications. Uses compressed air grease guns, wrenches and other tools. May make adjustments to clutches, brakes and other mechanical items. Keeps record of service for preventive maintenance records. . May require a Commercial Driver's License if driving truck on public highways. Performs other related duties.
22	**Truck Driver, Single Axle**	Drives a light capacity truck for transporting loads of construction material. The truck is of single rear axle type, may have various kinds of beds attached such as dump, flat bed, tank, etc. May require CDL license for driving on highway. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.
23	**Truck Driver, Tandem Axle**	Drives a tandem axle powered vehicle. Hauls dirt, rock, aggregates or other material. May require CDL license for driving on highway. May service and make necessary adjustments for proper operation of equipment. Performs other related duties.
24	**Utility Operator Grade 1**	Clam, ditching machine, side booms (except those in Grade 2), operator on dredges, cleaning machine, coating machine, , blending machine, water-kote machine, equipment welder, track tractor, derrick, dragline, shovel, motor grader rough grade, Crawler tractor, foundation drill operator, crawler and truck mounted, and piledriver.
25	**Utility Operator Grade 2**	Pipe, gin truck or winch truck with poles when used for hoisting, side boom (cradling rock drill), tow tractor, farm tractor road boring machine, fork lift **(industrial type)**, pot fireman (power agitated), straightening machine, boring machine, bombardier (track or tow rig), , hydrostatic testing operator, scraper, stalking machine, plant mix pavement roller operator, plant mix pavement, pneumatic motor operator. Concrete paving curing, float, texturing machine, subgrade trimmer, slip-form machine, milling machine, self-propelled sweeping machine, trenching machine, directional drill, , trenching, screening plant, and joint sealer. Off Road Hauler, Pavement Marking Machine Operator Reclaimer/Pulverizer Operator, Slurry Seal or Micro-Surfacing Machine Operator.
26	**Welder, Certified/ Structural Steel Welder**	Certified by the American Welding Society to perform structural steel welding. Operates welding equipment. Welds structural steel girders and diaphragms. May weld permanent metal deck forms. Cuts, lays-out, fits and welds metals or alloyed metal parts to fabricate or repair equipment. Welds the joints between lengths of pipe for oil, gas or other types of pipelines. May assist in welding of permanent metal deck forms. Performs other related duties.

SECTION 00840

GENERAL WAGE REQUIREMENTS

The following Wage Decision(s) will be utilized for this project. **A Wage Rate for one or both Wage Decisions for a construction type(s) included in the Contract Document, the Contractor is required to indicate on his Certified Payroll Reports, the Wage Decision description/construction type under which the works being reported. The wage decisions are attached to this form.**

CONSTRUCTION TYPE / WAGE DECISION	PORTION OF PROJECT FOR WHICH THE WAGE DECISION IS APPLICABLE
El Paso Water Utilities – Public Service Board 2020 Building Construction Trades Wage Rates Adopted by Public Service Board January 12, 2022	Electrical building and wet wells
City of El Paso 2016 Paving and Street Construction, Dirt Work, Heavy Construction, Pipeline Work, Highway Wage Rates Adopted by El Paso City Council February 28, 2017	Where there are similar job classifications in both the Public Service Board 2020 Building Construction Trades Wage Rates and the City of El Paso Prevailing Hourly Wage Rates, the higher wage of the two within the relevant construction types shall be paid.

SECTION 00850

TEXAS WORKERS' COMP FORMS DWC81-DWC85

TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION
7551 Metro Center Drive, Suite 100
Austin, Texas 78744

If you are not certain whether all parties meet the requirements for entering into this agreement, you may wish to consult an attorney.

AGREEMENT BETWEEN GENERAL CONTRACTOR AND SUBCONTRACTOR
TO PROVIDE WORKERS' COMPENSATION INSURANCE

Notice of Agreement

The undersigned General Contractor and the undersigned Subcontractor hereby agree that the General Contractor ☐ will withhold ☐ will not withhold the cost of workers' compensation insurance coverage from the Subcontractor's contract price and that, for the purpose of providing workers' compensation insurance coverage, the General Contractor will be the employer of the Subcontractor and the Subcontractor's employees. This agreement makes the General Contractor the employer of the Subcontractor and the Subcontractor's employees only for the purposes of workers' compensation laws of Texas and for no other purpose.

TERM (DATES) OF AGREEMENT: FROM: _____

TO: _____

LOCATION OF EACH AFFECTED JOB SITE (OR STATE WHETHER THIS IS A BLANKET AGREEMENT):

_____

_____

_____

ESTIMATED NUMBER OF EMPLOYEES AFFECTED: _____

THIS AGREEMENT SHALL TAKE EFFECT NO SOONER THAN THE DATE IT IS SIGNED.
Texas Labor Code, Texas Workers' Compensation Act, Section 406.123

General Contractor's Affirmation

_____
Federal Tax I.D. Number

If the General Contractor's workers' compensation carrier changes during the effective period of coverage, it is advisable for the General Contractor to file this form with the new insurance carrier.

Signature of General Contractor _____ Date _____ Address (Street) _____

Printed Name of General Contractor _____ Address (City, State, Zip) _____

Subcontractor's Affirmation

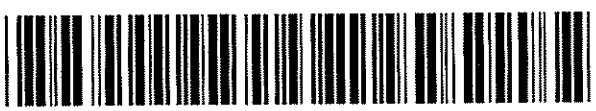
_____
Federal Tax I.D. Number

Signature of Subcontractor _____ Date _____ Address (Street) _____

Printed Name of Subcontractor _____ Address (City, State, Zip) _____

The General Contractor should retain the original. Legible copies of this agreement should be filed with the general contractor's workers' compensation insurance carrier and the Division within 10 days of the date of execution. If the General Contractor is certified self-insured, a copy should be filed with the Division's Self-Insurance Regulation service area. An agreement is not considered filed if it is illegible or incomplete. Filing may be accomplished by mail or facsimile transmission. The Subcontractor must also retain a copy of the agreement.

Division Date Stamp Here



TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION
7551 Metro Center Drive, Suite 100
Austin, Texas 78744

If you are not certain whether all parties meet the requirements for entering into this agreement, you may wish to consult an attorney.

CHECK ☐ BOX OF STATEMENT THAT APPLIES

☐ AGREEMENT BETWEEN MOTOR CARRIER AND OWNER OPERATOR TO PROVIDE WORKERS' COMPENSATION INSURANCE COVERAGE

Notice of Declaration

The undersigned Motor Carrier and the undersigned Owner Operator agree that the Motor Carrier will provide workers' compensation insurance coverage to the Owner Operator and the Owner Operator's employees. The Motor Carrier ☐ will deduct ☐ will not deduct the actual premiums, based on payroll, that are paid or incurred by the Motor Carrier for coverage from the contract price or any other amount owed to the Owner Operator by the Motor Carrier.

TERM (DATES) OF AGREEMENT: FROM: _____

TO: _____

ESTIMATED NUMBER OF WORKERS AFFECTED: _____
Texas Labor Code, Texas Workers' Compensation Act, Section 406.123.

☐ AGREEMENT TO REQUIRE OWNER OPERATOR TO ACT AS EMPLOYER

Notice of Agreement

The undersigned Motor Carrier and the undersigned Owner Operator agree that the Owner Operator assumes the responsibilities of an employer for the performance of work.

TERM (DATES) OF AGREEMENT: FROM: _____

TO: _____

ESTIMATED NUMBER OF WORKERS AFFECTED: _____
Texas Labor Code, Texas Workers' Compensation Act, Section 406.122.

THIS AGREEMENT SHALL TAKE EFFECT NO SOONER THAN THE DATE IT IS SIGNED.

MOTOR CARRIER'S AFFIRMATION

If the Motor Carrier's workers' compensation carrier changes during the effective period of coverage, it is advisable for the Motor Carrier to file this form with the new insurance carrier.

_____
Federal Tax I.D. Number

_____ Signature of Motor Carrier
_____ Date
_____ Address (Street)

_____ Printed Name of Motor Carrier
_____ Address (City, State, Zip)

OWNER OPERATOR'S AFFIRMATION

_____
Federal Tax I.D. Number

_____ Signature of Motor Owner Operator
_____ Date
_____ Address (Street)

_____ Printed Name of Owner Operator
_____ Address (City, State, Zip)

The Motor Carrier should retain the original. Legible copies of this agreement must be filed with the Motor Carrier's workers' compensation insurance carrier and the Division within 10 days of the date of execution. An agreement is not considered filed if it is illegible or incomplete. Filing may be accomplished by mail or facsimile transmission. The Owner Operator must also retain a copy of the agreement.

Division Date Stamp Here

TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION
7551 Metro Center Drive, Suite 100
Austin, Texas 78744

If you are not certain whether all parties meet the requirements for entering into this agreement, you may wish to consult an attorney.

Texas Workers' Compensation Act, Texas Labor Code, Section 406.141(2) defines "independent contractor" as follows: (2) "Independent contractor" means a person who contracts to perform work or provide a service for the benefit of another and who: (A) is paid by the job, not by the hour or some other time-measured basis; (B) is free to hire as many helpers as he desires and to determine what each helper will be paid; and (C) is free to work for other contractors, or to send helpers to work for other contractors, while under contract to the hiring employer.

CHECK ☐ BOX OF STATEMENT THAT APPLIES

☐ JOINT AGREEMENT TO AFFIRM INDEPENDENT RELATIONSHIP FOR CERTAIN BUILDING AND CONSTRUCTION WORKERS

Notice of Declaration

The undersigned Hiring Contractor and the undersigned Independent Contractor hereby declare that the Independent Contractor meets the qualifications of an Independent Contractor under Texas Workers' Compensation Act, Texas Labor Code, Section 406.141, that the Independent Contractor is not an employee of the Hiring Contractor, and that:

(A) the Independent Contractor and the Independent Contractor's employees shall not be entitled to workers' compensation coverage from the Hiring Contractor; and
(B) the Hiring Contractor's workers' compensation insurance carrier shall not require premiums to be paid by the Hiring Contractor for coverage of the Independent Contractor or the Independent Contractor's employees, helpers, or subcontractors.

THIS DECLARATION TAKES EFFECT UPON RECEIPT BY THE TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION. THIS DECLARATION APPLIES TO ALL HIRING AGREEMENTS EXECUTED BY THE HIRING CONTRACTOR AND THE INDEPENDENT CONTRACTOR DURING THE YEAR AFTER THIS DECLARATION IS FILED UNLESS A SUBSEQUENT HIRING AGREEMENT IS MADE TO WHICH THE DECLARATION DOES NOT APPLY. IN THE EVENT THAT A HIRING AGREEMENT TO WHICH THIS DECLARATION DOES NOT APPLY IS MADE, THE HIRING CONTRACTOR AND INDEPENDENT CONTRACTOR SHALL SO NOTIFY THE TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION AND THE HIRING CONTRACTOR'S WORKERS' COMPENSATION INSURANCE CARRIER (IF ANY) IN WRITING WITHIN 10 DAYS AFTER THE NON-APPLYING AGREEMENT IS MADE. ONCE THIS AGREEMENT IS SIGNED, THE SUBCONTRACTOR AND THE SUBCONTRACTOR'S EMPLOYEES SHALL NOT BE ENTITLED TO WORKERS' COMPENSATION COVERAGE FROM THE HIRING CONTRACTOR UNLESS A SUBSEQUENT WRITTEN AGREEMENT IS EXECUTED, AND FILED ACCORDING TO WORKERS' COMPENSATION RULES, EXPRESSLY STATING THAT THIS AGREEMENT DOES NOT APPLY.
Texas Labor Code, Texas Workers' Compensation Act, Section 406.145.

☐ AGREEMENT TO ESTABLISH EMPLOYER-EMPLOYEE RELATIONSHIP FOR CERTAIN BUILDING AND CONSTRUCTION WORKERS

Notice of Agreement

The undersigned Hiring Contractor and the undersigned Independent Contractor hereby agree that the Hiring Contractor ☐ will withhold ☐ will not withhold the cost of workers' compensation insurance coverage from the Independent Contractor's contract price and that the Hiring Contractor will purchase workers' compensation insurance coverage for the Independent Contractor and the Independent Contractor's employees. Once this agreement is signed, for the purpose of providing workers' compensation insurance coverage, the Hiring Contractor will be the employer of the Independent Contractor and the Independent Contractor's employees. This agreement makes the Hiring Contractor the employer of the Independent Contractor and the Independent Contractor's employees only for the purposes of workers' compensation laws of Texas and for no other purpose.

TERM (DATES) OF AGREEMENT: FROM: _____

TO: _____

LOCATION OF EACH AFFECTED JOB SITE (OR STATE WHETHER THIS IS A BLANKET AGREEMENT):

_____

_____

_____

ESTIMATED NUMBER OF EMPLOYEES AFFECTED: _____

THIS AGREEMENT SHALL TAKE EFFECT NO SOONER THAN THE DATE IT IS SIGNED.

Texas Labor Code, Texas Workers' Compensation Act, Section 406.144.

Hiring Contractor's Affirmation

If the Hiring Contractor's workers' compensation carrier change during the effective period of coverage, it is advisable for the Hiring Contractor to file this form with the new insurance carrier.

Federal Tax I.D. Number

Signature of Hiring Contractor | Date | Address (Street)

Printed Name of the Hiring Contractor | Address (City, State, Zip)

Independent Contractor's Affirmation

Federal Tax I.D. Number

Signature of Independent Contractor | Date | Address (Street)

Printed Name of the Independent Contractor | Address (City, State, Zip)

The Hiring Contractor should retain the original. Legible copies of this agreement should be filed with the hiring contractor's workers' compensation insurance carrier and the Division within 10 days of the date of execution. An agreement is not considered filed if it is illegible or incomplete. Filing may be accomplished by mail or facsimile transmission. The Independent Contractor should also retain a copy of the agreement.

Division Date Stamp Here

TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION
7551 Metro Center Drive, Suite 100
Austin, Texas 78744

EXCEPTION TO APPLICATION OF JOINT AGREEMENT TO AFFIRM INDEPENDENT RELATIONSHIP FOR CERTAIN BUILDING AND CONSTRUCTION WORKERS

NOTICE OF DECLARATION

The undersigned Hiring Contractor and the undersigned Independent Contractor declare that the Joint Agreement to Affirm Independent Relationship for Certain Building and Construction Workers (as recorded on DWC FORM-83) does not apply to the subsequent hiring agreement between the Hiring Contractor and Independent Contractor. Nothing in this declaration otherwise nullifies the Joint Agreement to Affirm Independent Relationship for Certain Building and Construction Workers as it applies to other hiring agreements made during the term of the joint agreement.

DATE OF JOINT AGREEMENT TO AFFIRM INDEPENDENT RELATIONSHIP FOR CERTAIN BUILDING AND CONSTRUCTION WORKERS

DATE OF SUBSEQUENT HIRING AGREEMENT TO WHICH THIS FORM APPLIES

LOCATION OF SPECIFIC JOB SITES NOT AFFECTED BY JOINT AGREEMENT: _____

NAME OF HIRING CONTRACTOR

NAME OF INDEPENDENT CONTRACTOR

Texas Labor Code, Texas Workers' Compensation Act, Section 406.145.

Hiring Contractor's Affirmation

If the Hiring Contractor's workers' compensation carrier changes during the effective period of coverage, it is advisable for the Hiring Contractor to file this form with the new insurance carrier.

Federal Tax I.D. Number

Signature of Hiring Contractor

Date

Address (Street)

Printed Name of Hiring Contractor

Address (City, State, Zip)

Independent Contractor's Affirmation

Federal Tax I.D. Number

Signature of Independent Contractor

Date

Address (Street)

Printed Name of Independent Contractor

Address (City, State, Zip)

The Hiring Contractor should retain the original. Legible copies of this agreement should be filed with the hiring contractor's workers' compensation insurance carrier and the Division within 10 days of the date of execution. An agreement is not considered filed if it is illegible or incomplete. Filing may be accomplished by mail or facsimile transmission. The Independent Contractor should also retain a copy of the agreement.

Division Date Stamp Here

TEXAS DEPARTMENT OF INSURANCE, DIVISION OF WORKERS' COMPENSATION
7551 Metro Center Drive, Suite 100
Austin, Texas 78744

If you are not certain whether all parties meet the requirements for entering into this agreement, you may wish to consult an attorney.

Texas Workers' Compensation Act, Texas Labor Code, Section 406.121(2) defines "independent contractor" as follows: (1) "Independent contractor" means a person who contracts to perform work or provide a service for the benefit of another and who ordinarily: (A) acts as the employer of any employee of the contractor by paying wages, directing activities, and performing other similar functions characteristic of an employer-employee relationship; (B) is free to determine the manner in which the work or service is performed, including the hours of labor of or method of payment to any employee; (C) is required to furnish or have his employees, if any, furnish necessary tools, supplies, or materials to perform the work or service; and (D) possesses the skills required for the specific work or service.

AGREEMENT BETWEEN GENERAL CONTRACTOR AND SUBCONTRACTOR TO ESTABLISH INDEPENDENT RELATIONSHIP

Notice of Agreement

The undersigned General Contractor and the undersigned Subcontractor hereby declare that:

(A) the Subcontractor meets the qualifications of an Independent Contractor under Texas Workers' Compensation Act, Texas Labor Code, Section 406.121;
(B) the Subcontractor is operating as an independent contractor as that term is defined under Section 406.121 of the Act;
(C) the Subcontractor assumes the responsibilities of an employer for the performance of work; and
(D) the Subcontractor and the Subcontractor's employees are not employees of the General Contractor for purposes of the Act.

TERM (DATES) OF AGREEMENT: FROM: _____

TO: _____

_____
Name of General Contractor

_____
Name of Subcontractor

LOCATION OF EACH AFFECTED JOB SITE (OR STATE WHETHER THIS IS A BLANKET AGREEMENT):

_____

_____

_____

Estimated number of employees affected: _____

THIS AGREEMENT SHALL TAKE EFFECT NO SOONER THAN THE DATE IT IS SIGNED.

Texas Labor Code, Texas Workers' Compensation Act, Section 406.122 .

General Contractor's Affirmation

If the General Contractor's workers' compensation carrier changes during the effective period of coverage, it is advisable for the General Contractor to file this form with the new insurance carrier.

_____
Federal Tax I. D. Number

_____ _____
Signature of General Contractor Date

_____
Address (Street)

_____
Printed Name of General Contractor

_____
Address (City, State, Zip)

Subcontractor's Affirmation

_____
Federal Tax I. D. Number

_____ _____
Signature of Subcontractor Date

_____
Address (Street)

_____
Printed Name of Subcontractor

_____
Address (City, State, Zip)

The General Contractor should retain the original. The Subcontractor should also retain a copy of the agreement. This form is not required to be filed with the Division, and may be provided to the insurance carrier.

Division Data Stamp Here

EL PASO WATER
PUBLIC SERVICE BOARD

NORTHEAST DYER/RAILROAD LIFT STATION
Bid Number 01-23

City of El Paso, Texas

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Huitt-Zollars, Inc. 5822 Cromo Dr., Ste. 210 ~ El Paso, Texas 79912 (915) 587-4339

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DIVISION 1

GENERAL

SECTION 01000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 01000 – GENERAL

The Contractor shall furnish all labor, superintendence, materials, machinery, equipment, tools, and transportation necessary to complete the work required for the Northeast Dyer/Railroad Lift Station as summarized below.

The proposed work consists of the construction of a new lift station to be located between NE Dyer St. and Railroad Dr, within El Paso Water property. The lift station will have two process trains: Phase 1 and Phase 2. Phase 1 will be fully equipped under this contract. Portions of the Phase 2 train will not be equipped as part of this project. The work under this contract shall be for furnishing all labor, materials, transportation and services for the work generally described as follows:

- Site improvements include the construction of a 20-ft wide asphalt access road; the construction of an 8-ft tall rock wall; the installation of a 24-ft swing gate; and the construction of sidewalks and curb and gutter; this also includes all earthwork needed to create the desired slopes, elevations, and ponding areas.
- Installation of a proposed 8-ft diameter MH and a proposed 36-in PVC sanitary sewer (98 LF±) to divert flow from existing 24-in sanitary sewer in the existing easement to the proposed on-site splitter MH and ultimately to the Phase 1 and Phase 2 process trains. The project requires 1 – 10-ft diameter MH to split influent, 40 LF± of 24-in PVC pipe that enters the Phase 1 wet well after passing through 1 – 6-ft diameter metering manhole. The Phase 2 train requires 40 LF± of 36-in PVC connecting the splitter MH to 1 - 8-ft diameter MH that directs influent to the Phase 2 wet well through 36 LF± of 36-in PVC pipe. One 6-ft diameter metering manhole (unequipped) is required upstream of the Phase 2 wet well.
- The Phase 1 train will require the installation of 159 LF± of 14", 16", and 18" DI and DR-18 C-905 PVC force main that will connect to an 18-inch off-site force main (not included in this contract) with ultimate discharge to the Fred Hervey Water Reclamation Plant. This includes 1 - 10-ft diameter MH with a 16" magnetic flow meter and 1 – 10-ft diameter MH with an 18" bypass pumping connection inside. In addition, 2 – 16-in plug valves and 1 – 18-in plug valve will be required. Additional pipe, valves, fittings, appurtenances, and other work, as indicated on the plans, is included for the proper and complete installation of the Phase 1 process train.
- The Phase 1 train will require the installation of 3 - 45-hp Flygt NP 3202 MT 3~641 submersible pump controlled by variable frequency drives (VFDs).
- Work included for the Phase 2 train includes the installation of 145 LF± of 18" and 24" DI and C-905 PVC force main that will connect to the off-site 24-inch force main (not included in this project) with ultimate discharge to the Fred Hervey Water Reclamation Plant. Additional Phase 2 train work includes 1 - 10-ft diameter metering MH, excluding the Phase 2 24" magnetic flow meter, and 1 – 10-ft diameter MH with a 24" bypass pumping connection inside. In addition, 3 – 24-in plug valves will be required. Additional pipe, valves, fittings, appurtenances, and other work, as indicated on the plans, is included for the proper and complete installation of the Phase 2 process train.
- The construction of an approximate 37' x 19' x 14' CMU electrical building to house the VFDs and all other flow measuring and control equipment.
- The installation of a 480Y/277 Volt, 3-phase, 4-wire, 650 KVA Diesel Engine Generator Set with sub-base diesel fuel tank and remote annunciator for emergency backup power.
- The installation of lighting and security items are also included in the project.
- Installation of electrical primary and secondary conduit ductbanks, secondary service conductors, metering stand as directed by electric utility company.
- Lightning Protection for the electrical / control building.
- The Phase 1 lift station will have an electric overhead travelling crane for servicing the pumps and any equipment situated in the valve vaults. The Phase 2 crane is not included in this contract.
- A concrete pump washdown pad is provided for Phase 1 at the end of the crane nearest the access drive. Four-inch PVC gravity drain lines will convey washdown water from the concrete pad back to the wet wells. The Phase 2 pump washdown pad is not included in this project.
- The installation of odor control for the splitter manhole and Phase 1 wet well. An I-BOx-42 is proposed for the splitter manhole with a 4-in FRP intake line. The Phase 1 wet well will have an I-Box-7000 unit with a 10-in FRP intake line. Water service to the Phase 1 unit will be by a 3/4" service tap from the proposed 8-

inch on-site water system. Liquid waste from the Phase 1 unit will by a 4-inch PVC gravity drain. The Phase 1 unit will drain back to the structure it serves.

- The installation of a proposed 730 LF of 8-in WL to service the site connected to the existing 12-in WL along the off-site easement, 8-in reduced pressure principal backflow preventer in an aluminum enclosure, a 3/4" water service with meter and reduced pressure principle backflow preventer in a fiberglass enclosure for on-site domestic use, 4 – 5-1/4-in fire hydrants with respective 8-in WL, 6 - 8-in gate valves, 4 – 6-in gate valves, 2 – 2-in post hydrants. Small quantities of 6-inch water line and 2" copper line are also included along with various valves, fittings, and appurtenances required to provide the anticipated level of service at the site.

Clarification of work included/excluded for the Phase 2 process train

Items not included in contract:

1. NP 3301.185 LT 3~624 pumps and associated power/sensor cables/ENM-10 level floats
2. Electrical and control components, j-boxes, disconnects, and uni-strut stands for Phase 2 pumps
3. Local electrical disconnects for Phase 2 overhead crane and odor control unit.
4. Phase 2 upstream flow measuring manhole laser flow meter and cable
5. Wet well radar level sensor and cable
6. 18" valves, piping, and appurtenances, and adjustable pipe/valve supports in Phase 2 valve vault
7. Valve vault sump pump and control panel with associated valves, fittings, and appurtenances.
8. Erect-a-Step pipe crossover system
9. 24" mag meter and cable
10. Phase 2 I-Box-7000 odor control unit
11. Phase 2 NOMAD crane system
12. Pump washdown pad

Items included for each Phase 2 pump location:

1. 12" base
2. 3" guiderails
3. Intermediate brackets
4. Upper bracket
5. 12" x 18" SCH 40 316L SS reducer (FL x PE) w/Protecto 401 lining
6. 18" SCH 40 316L SS vertical discharge pipe (PE x PE) w/Protecto 401 lining
7. 18" SCH 40 90° bend (PE x PE) w/Protecto 401 lining
8. 18" SCH 40 316L SS horizontal discharge piping (FL x PE) w/Protecto 401 lining
9. 18" 316L blind flange to close off stainless steel pump discharge piping
10. 18" ductile iron flange to close off 18" DI wall flange and discharge end of valve vault

Additional items included in contract for Phase 2 train:

1. 1-1-ft long 24" PC350 DI flanged spool piece in place of mag meter to provide temporary connection in Phase 2 Meter Manhole
2. All conduit required for Phase 2 electrical/control/sensing equipment including, capped-off conduit through all wet/well/valve vault wall and floor penetration suitable for removal of cap and extension of conduit at a future date.
3. Phase 2 10" PC150 FRP odor control piping. Extend 10" PC150 FRP 6 inches inside Phase 2 wet well and install a blind flange as a temporary seal off to be removed when Phase 2 wet well placed in operation. Extend from wet well to buried 90° bend at Phase 2 odor control unit location. Cap for future connection.
4. 4" SCH 40 DWV piping for Phase 2 pump washdown pad and odor control unit. Cap the discharge into the Phase 2 wet well and future connections at Phase 2 pump washdown pad and odor control unit.
5. Valve vault overhead exhaust fan with electrical connection and on/off switch.
6. Underground conduit from control building out to the first pullboxes serving phase 2 pumps and sensors.

Nighttime, Weekend, and Holiday work: This project may require that the Contractor work outside their normal working day including working outside the hours of 7:00 a.m. to 5:00 p.m.; exceeding an eight-hour work day, Monday through Friday or working on Saturdays, Sundays, or legal Holidays. Working outside the Contractors

normal hours may be required by a property owner with special needs, a business owner, a school or governmental agency, or a regulating agency. The Contractor should take this matter into account when visiting the project site and estimating the time and cost to complete the project. The Contractor should feel comfortable that they can complete the job in the time allotted. If the Contractor does not feel that the time allotted is sufficient, they should raise this question before the bid opening. After a low bidder is accepted and a notice to proceed is given, no additional time will be granted for incidents related to this matter.

a. If the Contractor desires to perform any work between the hours of 5 p.m. and 7 a.m., or Saturdays, Sundays or national holidays, and this work is not required by a property owner with special needs, the Contractor shall make the request in writing to do so at least one week before it starts such work. The Contractor shall acquire any necessary permits associated with the work and comply with all permit conditions, and all laws and ordinances relating thereto.

b. The Contractor shall reimburse the Owner for additional costs incurred as a result of providing additional inspection personnel when the Contractor performs the nighttime, weekend or holiday work. Additional inspection costs will be at the rate of $70.00 per hour, or the amount sufficient to compensate Owner for its additional expense. Additional inspection costs will be recovered in the form of a credit to the Owner from each month's Pay Application and settled in a subsequent Change Order.

c. The Contractor shall reimburse the El Paso Water for additional costs incurred as a result of providing additional inspection personnel when the Contractor performs the nighttime, weekend or holiday work. Additional inspection costs will be at a per hour rate as called out by the El Paso Water applicable city department from which inspection services are needed.

Plans for the Contractor: The Contractor will be furnished ten (10) full size sets of plans and specifications for his use during construction. Should additional sets of plans and/or specifications be desired, they may be requested and picked up at the El Paso Water Utilities Purchasing Department.

Construction Sequence: The Contractor will submit a construction sequencing plan for approval by the Engineer and Owner before beginning construction.

Materials and Workmanship: The fact that the specifications may fail to be sufficiently complete in some detail will not relieve the Contractor of full responsibility for providing all necessary materials, of high quality, required to produce a fully functional project and protecting them adequately until they are incorporated in the work.

The specifications for materials, methods and workmanship set the minimum standards of quality which the Owner believes necessary to procure satisfactory facilities. The presence or absence of the Engineer, or his representative, on the construction site does not in any manner relieve the Contractor of full responsibility for complying with these specifications.

Approval of Materials: All materials shall be new and shall be designed for the function and service specified. No equipment nor materials shall be used in the project except that which has been approved by the Engineer. Approval for installation, or incorporation in the project, will be made only after submittal and examination of shop and installation drawings, manufacturers' specifications, test results or other data required. Final approval and acceptance of material will be made only after such material has met all specified tests.

Protection of Existing Utilities and Structures: The Contractor shall exercise care to prevent damage to, and shall be liable for any damage to, and for maintenance and protection of such lines and structures as are shown on the drawings or otherwise brought to the attention of the Contractor or of which he should reasonably be aware of. The Contractor shall not cut, remove, change, or disturb any existing lines or structures, except as provided by the plans and these specifications, without the express permission of the owner of any such line. Utility adjustments or relocations will be accomplished by the owner of each utility. The Contractor shall provide the utility owner with reasonable advance notice to perform the required adjustments and relocations. If damage occurs, the Contractor

shall immediately correct or replace existing structures or facilities that are damaged in any way as a result of his operations.

Construction and Support Facilities: Locate field storage sheds and other support facilities for easy access to the work at sites approved by the Engineer.

Maintain storage and fabrication sheds, temporary sanitary facilities, waste disposal systems, and project signs until substantial completion. Immediately after substantial completion remove these facilities.

Sanitary Facilities: Sanitary facilities include temporary toilets, wash facilities, and drinking water facilities. Comply with governing regulations including safety and health codes for the type, number, location, operation, and maintenance of fixtures and facilities; provide not less than specified requirements. Install facilities in locations that will best serve the project's needs.

Supply and maintain toilet tissue, paper towels, paper cups, and similar disposable materials as appropriate for each facility. Provide appropriate covered waste containers for used material.

Contractor's Use of Premises: Limit use of the premises to construction activities in areas indicated; allow for Owner occupancy and use by the public.

Confine operations to areas within Contract limits indicated. Portions of the site beyond areas in which construction operations are indicated are not to be disturbed.

Keep driveways and entrances serving the premises clear and available to the Owner and the Owner's employees at all times. No storage of construction materials will be allowed within City of El Paso right-of-way (streets, alleys, and parkways).

Water for Construction:

1. PROJECT WATER: The contractor shall make his own arrangements for a supply of potable drinking water for his employees and shall keep such supply available at all times.

   Water to be used for construction and testing shall be furnished to the Contractor by the Owner under set conditions and charges contained in the Rules and Regulations adopted by the Public Service Board, specified as Instructions to Contractors Requesting Fire Hydrant Meter. The Contractor shall pay for water used at cost, with no mark up.

   1.2 Instructions to Contractors Requesting Fire Hydrant Meter:

   1.2.1 The Contractor must complete a Fire Hydrant Meter Application for a fire hydrant meter with Engineering Developer Services Section of the El Paso Water, located on the third floor of the El Paso Water Utilities Building, 1154 Hawkins Blvd. For information, please contact 594-5635 or 594-5539. Deposit and Set-up/Removal fee are due at application. Deposit for a fire hydrant meter is $2,000.00, as may be amended by PSB Rules and Regulations. Set-up/Removal fee is $125.00. Billing rate for construction water will be as established in the latest Rules and Regulations.

   1.2.2 The Engineering Developer Services Section will forward the application form to the Fire Department for approval. The Fire Department will approve within 48 hours of receipt of the application.

   1.2.3 Water Distribution Section will have the meter installed within 48 hours after approval by the Fire Department and Engineering Developer Services Section. The Contractor must coordinate with Water Supply Section at 594-5782 to have a Contractor's Representative at the specified fire hydrant for the installation of the meter. The Contractor shall be responsible to secure the valve on the meter to ensure unauthorized use.

1.2.4 **Readings will be taken monthly from the fire hydrant meter by Utility Personnel. Consumption will be billed monthly by the 15th of the month. Payment is due 10 working days later. If not paid, fire hydrant meter will be removed.**

1.2.5 Immediately after completion of the construction project, the Contractor must complete the attached **Meter Removal Form** requesting removal of the meter. The Utility will remove the meter within two working days.

1.2.6 A final bill will be consolidated for any damages to the fire hydrant or the fire hydrant meter in addition to any assessments due to violations. Charges will be deducted from the original deposit. Any shortages must be paid before Final Acceptance of the project will be made; any overages will be refunded within 15 days of payment of the final bill.

1.3 Additional Instructions for Requesting Fire Hydrant Meter:

1.3.1 Additional fire hydrant meters will not be issued for other fire hydrants within a 2000-foot radius of the fire hydrant requested. Deposits and Set-up/Removal fees are due for each meter on a project.

1.3.2 The fire hydrant meter shall not be moved for any reason by the Contractor. If the Contractor needs to move the meter to another fire hydrant, the Contractor must contact Engineering Developer Services Section at 594-5635 or 594-5539 for a revised Application Form. Fire Department approval for the new meter location is also required.

1.3.3 Neither non-metered consumption, removal of the meter, nor tampering with the Fire Hydrant or valve will be allowed under any circumstances. The Contractor agrees that by executing the Fire Hydrant Meter Application any violations of these requirements shall be grounds for immediate removal of the meter and a $500 assessment for water losses for each occurrence.

The Contractor may, with approval of the Engineer, make other arrangements and secure water for construction purposes from a source of his own choosing. Said water will be potable.

Electric Power for Construction: The Contractor shall make his own arrangements for electric power for construction purposes, at his expense. Safety shall be practiced when working under/around the EPEC transmission lines.

Emergency Communication Procedures: Since it is necessary that prompt action be taken in case of an emergency which threatens the operation of the existing facilities, the Contractor shall maintain, at all times during construction, a local telephone listing where responsible supervisory personnel may be contacted twenty-four hours a day. The telephone number shall be given to the Engineer so that contact can be made in the event of an emergency.

Coordination with the City of El Paso: During the construction of this project, El Paso City Engineering and Streets & Maintenance Departments requires compliance with the following items. The City Code and the Subdivision Improvement Design Standards of the City of El Paso are hereby incorporated by reference.

1. Limits of excavation and pavement repair in roadway shall comply with City Code requirements in Sections 13.08.170 and 13.08.160.0, and Subdivision Improvement Design Standards, Title 19, current revision of plates 3-40, 3-41, and 3-42. Further, the entire lane width of pavement section shall be repaved when excavation exceeds half of the lane width.

2. All Traffic Control Plans shall be prepared and submitted to the City's Engineering Department, Traffic Division for approval, prior to the start of construction.

3. The City's Engineering Department shall be notified 48 hours in advance of any construction activities within the City's R.O.W., and all results of density tests taken shall be forwarded to the Department by CONTRACTOR.

4. Potholing requirements are as follows:
   - Obtain excavation permit from the City's Engineering Department-Construction Division.
   - All potholes made within asphalt or concrete finished surface shall be backfilled with 2-sack cement mix. The backfill shall be placed all the way to the surface of the pothole (full depth).
   - Surface of pothole shall be neatly cored or saw cut. Cuts made by hand tools or jack hammer will not be allowed.
   - Location of potholes shall be at the trench location of the proposed route.

5. Construction methods to support City's drainage structures located along the proposed route shall be provided, along with the measures to be taken to eliminate voids under these structures.

SECTION 01010 – SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SCOPE OF WORK

The Contractor shall take all reasonable means to minimize inconvenience and injury to the public by dust, noise, diversion of storm water, or other agencies under his control.

1.2 DUST CONTROL

The Contractor shall take proper steps and procedures to prevent abnormal dust conditions caused by his operations in connection with this Contract on unpaved roads used by the Contractor or his subcontractors, excavation or fill areas, demolition operations, or other activities. Dust control shall be achieved either by sprinkling, the use of dust palliative, the modification of operations, or any other means acceptable to the Health or Environmental Control Agency having jurisdiction.

1.3 NOISE ABATEMENT

In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation. In residential areas, particular consideration shall be given to noise generated by repair and service activities during the early morning or night hours. Contractor shall comply with limits set by the El Paso City County Health Municipal Code, Chapter 9.40.

1.4 REMOVED MATERIALS

Salvaged materials removed (if any) during the course of the work shall be returned and delivered by the Contractor to the El Paso Water Utilities storage facilities, located at 8930 Roseway Drive, El Paso Texas 79907. The equipment submittal must be coordinated with Water Distribution Assistant Superintendent. The Contractor should obtain a receipt for the equipment submitted.

1.5 DAMAGE TO PRIVATE PROPERTY

The Contractor shall be responsible for any damage to private property caused by the construction project. The Contractor upon receipt of a complaint of damage shall, within ten (10) working days, respond in writing with a proposal to repair said damage or a letter stating the reason why the damage was not caused by the construction. The Contractor will provide the Engineer with a copy of the letter.

Except for extenuating circumstances beyond the control of the Contractor, the damage shall be repaired completely within fifteen (15) working days of the complaint.

SECTION 01016- TRENCH SAFETY SYSTEMS

PART 1 – SPECIAL CONDITIONS

A. The Contractor will be required to install a trench safety system to provide for the safe excavation of all trenches exceeding a depth of five (5) feet as per OSHA standards.

B. It shall be the duty and responsibility of the Contractor and all of its subcontractors to be familiar and comply with all requirements of Public Law 91-596, 29 U.S.C. Secs. 651 et. Seq., the Occupational Safety and Health Act of 1970 (OSHA), and all amendments thereto, and to enforce and comply with all of the provisions of this Act. In addition, on projects in which trench excavation will exceed a depth of five feet, the Contractor and all of its subcontractors shall comply with all requirements of 29 C.F.R. Secs., 1926.652 and 1926.653, OSHA Safety and Health Standards, which are more fully described herein.

C. The successful responsible bidder will be required to submit 3 sets of trench excavation plans with a trench safety system to the Owner for review within 15 consecutive days after Award of Contract.

Plans must be designed and sealed by a professional engineer registered in the State of Texas with professional experience in geotechnical engineering. The Contractor is responsible for obtaining borings and soil analysis as required for the design and preparation of the trench excavation plan and trench safety system. The trench excavation plan and the trench safety system is to be designed in conformance with OSHA standards and regulations. No trenching in excess of five (5) feet below existing grade will be allowed until the trench excavation plan is reviewed and returned to the Contractor. Any changes in the trench excavation plan after initiation of construction will not cause an Extension of Time or Change Order but such changes will require the same review process as the original excavation plan.

The Contractor accepts sole responsibility for compliance with all applicable safety requirements. The review is only for general conformance with OSHA safety standards; and review of the trench excavation plan does not relieve the Contractor of any or all construction means, methods, techniques and procedures. Any property damage or bodily injury, including death, that arises from use of the trench excavation plan shall remain the sole responsibility and liability of the Contractor

D. **Indemnification** - The Contractor shall indemnify and hold harmless the Owner, its employees and agents, from any and all damages, costs (including without limitation, legal fees, court costs, and the cost of investigation), judgments or claims, by anyone, including workers or the general public, for injury or death of persons resulting from the collapse or failure of trenches constructed under this contract.

The Contractor acknowledges and agrees that this indemnity provision provides indemnity for the Owner in case that claims are made that the Owner is negligent either by act or omission in providing for trench safety, including, but not limited to inspections, failure to issue stop work orders, and the hiring of the Contractor.

PART 2 - TECHNICAL SPECIFICATIONS:

A. **Description**: This item shall govern the Trench Safety Systems required for the construction of all trench excavation to be utilized in the project including all additional excavation and backfill necessitated by the safety system. The trench safety systems shall be suitable for construction of pipe-lines, utilities, etc. that are installed below grade and shall be sufficient to fully protect public or private property including other existing utilities and structures below, or above grade. Trench Safety Systems include but are not limited to sloping side of excavation, sheeting, trench boxes or trench shields, sheet piling, cribbing, bracing, shoring, dewatering, or diversion of water to provide adequate drainage.

The Contractor shall be responsible for the design of systems, and procedures such as the use of sheet piling, shoring, or other means of temporary support to protect existing buildings, streets, highways, water conveying structures, or any other structures. In the case of existing utilities, the contractor may elect to remove the utilities under the stipulated condition that the removal and subsequent replacement of these utilities shall meet with the approval of the Engineer, the Owner, the Utility Owner, and all agencies having jurisdiction of the structure or property. In all cases, the Contractor shall be fully responsible for the protection of public, or private property and for the protection of any person or persons, who, as a result of the Contractor's work, may be injured.

B. **Construction Methods**: Trench safety systems shall be accomplished in accordance with the detailed specifications set out in the provisions of Excavations, Trenching, and Shoring, Federal Occupational Safety and Health Administration (OSHA) Standards, 29 CFR, Part 1926. Subpart P, as amended including proposed Rules published in the Federal Register (Vol.54, No, 209) on Tuesday, October 31, 1989. The sections that are incorporated into these specifications by reference include Sections 1926-650 through 1926-652. Legislation that has been enacted by the Texas Legislature (H.B. No. 662 and H.B. No. 665) with regard to Trench Safety Systems, is hereby also incorporated, by reference, into these specifications.

C. **Safety Program**: The Contractor shall submit a safety program specifically for the construction of trench excavations together with the trench excavation plans for Trench Safety Systems. The trench safety program shall be in accordance with OSHA standards governing the presence and activities of individuals working in and around trench excavation.

Contractors have two generally accepted methods, or combinations thereof, to meet OSHA Standards for Trench Excavations:

1. Utilization of Trench Box.

2. Shoring, Sheeting, and Bracing Methods.

A Contractor electing to utilize a Trench Box must submit physical dimensions, materials, position in the trench, expected loads, and the strength of the box. The Trench Box shall be designed by a professional engineer. No claims delay will be permitted.

A Contractor electing to utilize Shoring, Sheeting, and Bracing must submit dimensions and materials of all uprights, stringers, cross-bracing, and spacing required to meet OSHA requirements, all designed by a Professional Engineer. No Claims for delay will be permitted.

D. **Inspection**: The Contractor shall provide a qualified person to make daily inspections of the Trench Safety Systems to ensure that the systems meet OSHA requirements. The Contractor shall maintain a permanent record of daily inspections.

If evidence of possible cave-ins, or slides, is apparent, all work in the trench shall cease until the necessary precautions have been taken by the contractor to safeguard personnel entering the trench. It is the sole duty, responsibility, and prerogative of the contractor, not the Owner or the Owner's designated representative, to determine the specific applicability of the designed trench safety systems to each field condition encountered on the project.

E. **Emergencies**: In an emergency situation, which may threaten or affect the safety or welfare of persons or property, the Contractor shall act at his discretion to prevent possible damage, injury, on loss. Any additional compensation or extension of time claimed for such action shall be considered in view of the cause of the emergency and in accordance with the General Conditions.

F. **OSHA Safety and Health Regulations Part 1926**: (See Attached).

• OSHA REGULATIONS •

• REGARDING TRENCH SAFETY (FROM FEDERAL REGISTER)

(2) The employer shall ensure that there is in the vicinity of each barge in use at least one U.S. Coast Guard-approved 30-inch lifering with not less than 90 feet of line attached, and at least one portable or permanent ladder which will reach the top of the apron to the surface of the water. If the above equipment is not available at the pier, the employer shall furnish it during the time that he is working the barge.

(3) Employees walking or working on the unguarded decks of barges shall be protected with U.S. Coast Guard-approved work vests or buoyant vests.

(e) *Commercial diving operations.* Commercial diving operations shall be subject to subpart T of part 1910, §§ 1910.401-1910.441, of this chapter.

[39 FR 22801, June 24, 1974, as amended at 42 FR 37674, July 22, 1977]

§ 1926.606 Definitions applicable to this subpart.

(a) *Apron*—The area along the waterfront edge of the pier or wharf.

(b) *Bulwark*—The side of a ship above the upper deck.

(c) *Coaming*—The raised frame, as around a hatchway in the deck, to keep out water.

(d) *Jacob's ladder*—A marine ladder of rope or chain with wooden or metal rungs.

(e) *Rail*, for the purpose of § 1926.605, means a light structure serving as a guard at the outer edge of a ship's deck.

Subpart P—Excavations

AUTHORITY: Sec. 107, Contract Worker Hours and Safety Standards Act (Construction Safety Act) (40 U.S.C. 333); Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 12-71 (36 FR 8754), 8-76 (41 FR 25059), or 9-83 (48 FR 35736), as applicable, and 29 CFR part 1911.

SOURCE: 54 FR 45959, Oct. 31, 1989, unless otherwise noted.

§ 1926.650 Scope, application, and definitions applicable to this subpart.

(a) *Scope and application.* This subpart applies to all open excavations made in the earth's surface. Excavations are defined to include trenches.

(b) *Definitions applicable to this subpart.*

Accepted engineering practices means those requirements which are compatible with standards of practice required by a registered professional engineer.

Aluminum Hydraulic Shoring means a pre-engineered shoring system comprised of aluminum hydraulic cylinders (crossbraces) used in conjunction with vertical rails (uprights) or horizontal rails (walers). Such system is designed, specifically to support the sidewalls of an excavation and prevent cave-ins.

Bell-bottom pier hole means a type of shaft or footing excavation, the bottom of which is made larger than the cross section above to form a belled shape.

Benching (Benching system) means a method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

Cave-in means the separation of a mass of soil or rock material from the side of an excavation, or the loss of soil from under a trench shield or support system, and its sudden movement into the excavation, either by falling or sliding, in sufficient quantity so that it could entrap, bury, or otherwise injure and immobilize a person.

Competent person means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Cross braces mean the horizontal members of a shoring system installed perpendicular to the sides of the excavation, the ends of which bear against either uprights or wales.

Excavation means any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Faces or *sides* means the vertical or inclined earth surfaces formed as a result of excavation work.

Failure means the breakage, displacement, or permanent deformation of a structural member or connection so as to reduce its structural integrity and its supportive capabilities.

Hazardous atmosphere means an atmosphere which by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen deficient, toxic, or otherwise harmful, may cause death, illness, or injury.

Kickout means the accidental release or failure of a cross brace.

Protective system means a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

Ramp means an inclined walking or working surface that is used to gain access to one point from another, and is constructed from earth or from structural materials such as steel or wood.

Registered Professional Engineer means a person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

Sheeting means the members of a shoring system that retain the earth in position and in turn are supported by other members of the shoring system.

Shield (Shield system) means a structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either premanufactured or job-built in accordance with § 1926.652 (c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

Shoring (Shoring system) means a structure such as a metal hydraulic, mechanical or timber shoring system that supports the sides of an excavation and which is designed to prevent cave-ins.

Sides. See "Faces."

Sloping (Sloping system) means a method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

Stable rock means natural solid mineral material that can be excavated with vertical sides and will remain intact while exposed. Unstable rock is considered to be stable when the rock material on the side or sides of the excavation is secured against caving-in or movement by rock bolts or by another protective system that has been designed by a registered professional engineer.

Structural ramp means a ramp built of steel or wood, usually used for vehicle access. Ramps made of soil or rock are not considered structural ramps.

Support system means a structure such as underpinning, bracing, or shoring, which provides support to an adjacent structure, underground installation, or the sides of an excavation.

Tabulated data means tables and charts approved by a registered professional engineer and used to design and construct a protective system.

Trench (Trench excavation) means a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m). If forms or other structures are installed or constructed in an excavation so as to reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 m) or less (measured at the bottom of the excavation), the excavation is also considered to be a trench.

Trench box. See "Shield."

Trench shield. See "Shield."

Uprights means the vertical members of a trench shoring system placed in contact with the earth and usually positioned so that individual members do not contact each other. Uprights placed so that individual members are closely spaced, in contact with or

interconnected to each other, are often called "sheeting."

Wales means horizontal members of a shoring system placed parallel to the excavation face whose sides bear against the vertical members of the shoring system or earth.

§ 1926.651 Specific excavation requirements.

(a) *Surface encumbrances.* All surface encumbrances that are located so as to create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

(b) *Underground installations.* (1) The estimated location of utility installations, such as sewer, telephone, fuel, electric, water lines, or any other underground installations that reasonably may be expected to be encountered during excavation work, shall be determined prior to opening an excavation.

(2) Utility companies or owners shall be contacted within established or customary local response times, advised of the proposed work, and asked to establish the location of the utility underground installations prior to the start of actual excavation. When utility companies or owners cannot respond to a request to locate underground utility installations within 24 hours (unless a longer period is required by state or local law), or cannot establish the exact location of these installations, the employer may proceed, provided the employer does so with caution, and provided detection equipment or other acceptable means to locate utility installations are used.

(3) When excavation operations approach the estimated location of underground installations, the exact location of the installations shall be determined by safe and acceptable means.

(4) While the excavation is open, underground installations shall be protected, supported or removed as necessary to safeguard employees.

(c) *Access and egress*—(1) *Structural ramps.* (i) Structural ramps that are used solely by employees as a means of access or egress from excavations shall be designed by a competent person. Structural ramps used for access or egress of equipment shall be designed by a competent person qualified in structural design, and shall be constructed in accordance with the design.

(ii) Ramps and runways constructed of two or more structural members shall have the structural members connected together to prevent displacement.

(iii) Structural members used for ramps and runways shall be of uniform thickness.

(iv) Cleats or other appropriate means used to connect runway structural members shall be attached to the bottom of the runway or shall be attached in a manner to prevent tripping.

(v) Structural ramps used in lieu of steps shall be provided with cleats or other surface treatments on the top surface to prevent slipping.

(2) *Means of egress from trench excavations.* A stairway, ladder, ramp or other safe means of egress shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so as to require no more than 25 feet (7.62 m) of lateral travel for employees.

(d) *Exposure to vehicular traffic.* Employees exposed to public vehicular traffic shall be provided with, and shall wear, warning vests or other suitable garments marked with or made of reflectorized or high-visibility material.

(e) *Exposure to falling loads.* No employee shall be permitted underneath loads handled by lifting or digging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Operators may remain in the cabs of vehicles being loaded or unloaded when the vehicles are equipped, in accordance with § 1926.601(b)(6), to provide adequate protection for the operator during loading and unloading operations.

(f) *Warning system for mobile equipment.* When mobile equipment is operated adjacent to an excavation, or when such equipment is required to approach the edge of an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized such as barricades, hand or mechanical signals, or stop logs. If possible, the grade should be away from the excavation.

(g) *Hazardous atmospheres*—(1) *Testing and controls.* In addition to the requirements set forth in subparts D and E of this part (29 CFR 1926.50–1926.107) to prevent exposure to harmful levels of atmospheric contaminants and to assure acceptable atmospheric conditions, the following requirements shall apply:

(i) Where oxygen deficiency (atmospheres containing less than 19.5 percent oxygen) or a hazardous atmosphere exists or could reasonably be expected to exist, such as in excavations in landfill areas or excavations in areas where hazardous substances are stored nearby, the atmospheres in the excavation shall be tested before employees enter excavations greater than 4 feet (1.22 m) in depth.

(ii) Adequate precautions shall be taken to prevent employee exposure to atmospheres containing less than 19.5 percent oxygen and other hazardous atmospheres. These precautions include providing proper respiratory protection or ventilation in accordance with subparts D and E of this part respectively.

(iii) Adequate precaution shall be taken such as providing ventilation, to prevent employee exposure to an atmosphere containing a concentration of a flammable gas in excess of 20 percent of the lower flammable limit of the gas.

(iv) When controls are used that are intended to reduce the level of atmospheric contaminants to acceptable levels, testing shall be conducted as often as necessary to ensure that the atmosphere remains safe.

(2) *Emergency rescue equipment.* (i) Emergency rescue equipment, such as breathing apparatus, a safety harness and line, or a basket stretcher, shall be readily available where hazardous atmospheric conditions exist or may reasonably be expected to develop during work in an excavation. This equipment shall be attended when in use.

(ii) Employees entering bell-bottom pier holes, or other similar deep and confined footing excavations, shall wear a harness with a life-line securely attached to it. The lifeline shall be separate from any line used to handle materials, and shall be individually attended at all times while the employee wearing the lifeline is in the excavation.

(h) *Protection from hazards associated with water accumulation.* (1) Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions have been taken to protect employees against the hazards posed by water accumulation. The precautions necessary to protect employees adequately vary with each situation, but could include special support or shield systems to protect from cave-ins, water removal to control the level of accumulating water, or use of a safety harness and lifeline.

(2) If water is controlled or prevented from accumulating by the use of water removal equipment, the water removal equipment and operations shall be monitored by a competent person to ensure proper operation.

(3) If excavation work interrupts the natural drainage of surface water (such as streams), diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Excavations subject to runoff from heavy rains will require an inspection by a competent person and compliance with paragraphs (h)(1) and (h)(2) of this section.

(i) *Stability of adjacent structures.* (1) Where the stability of adjoining buildings, walls, or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning shall be provided to ensure the stability of such structures for the protection of employees.

(2) Excavation below the level of the base or footing of any foundation or retaining wall that could be reasonably expected to pose a hazard to employees shall not be permitted except when:

(i) A support system, such as underpinning, is provided to ensure the safety of employees and the stability of the structure; or

(ii) The excavation is in stable rock; or

(iii) A registered professional engineer has approved the determination that the structure is sufficently removed from the excavation so as to be

unaffected by the excavation activity; or

(iv) A registered professional engineer has approved the determination that such excavation work will not pose a hazard to employees.

(3) Sidewalks, pavements, and appurtenant structure shall not be undermined unless a support system or another method of protection is provided to protect employees from the possible collapse of such structures.

(j) *Protection of employees from loose rock or soil.* (1) Adequate protection shall be provided to protect employees from loose rock or soil that could pose a hazard by falling or rolling from an excavation face. Such protection shall consist of scaling to remove loose material; installation of protective barricades at intervals as necessary on the face to stop and contain falling material; or other means that provide equivalent protection.

(2) Employees shall be protected from excavated or other materials or equipment that could pose a hazard by falling or rolling into excavations. Protection shall be provided by placing and keeping such materials or equipment at least 2 feet (.61 m) from the edge of excavations, or by the use of retaining devices that are sufficient to prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary.

(k) *Inspections.* (1) Daily inspections of excavations, the adjacent areas, and protective systems shall be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection shall be conducted by the competent person prior to the start of work and as needed throughout the shift. Inspections shall also be made after every rainstorm or other hazard increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated.

(2) Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees shall be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

(l) Walkways shall be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with § 1926.502(b) shall be provided where walkways are 6 feet (1.8 m) or more above lower levels.

[54 FR 45959, Oct. 31, 1989, as amended by 59 FR 40730, Aug. 9, 1994]

§ 1926.652 Requirements for protective systems.

(a) *Protection of employees in excavations.* (1) Each employee in an excavation shall be protected from cave-ins by an adequate protective system designed in accordance with paragraph (b) or (c) of this section except when:

(i) Excavations are made entirely in stable rock; or

(ii) Excavations are less than 5 feet (1.52m) in depth and examination of the ground by a competent person provides no indication of a potential cave-in.

(2) Protective systems shall have the capacity to resist without failure all loads that are intended or could reasonably be expected to be applied or transmitted to the system.

(b) *Design of sloping and benching systems.* The slopes and configurations of sloping and benching systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (b)(1); or, in the alternative, paragraph (b)(2); or, in the alternative, paragraph (b)(3), or, in the alternative, paragraph (b)(4), as follows:

(1) *Option (1)—Allowable configurations and slopes.* (i) Excavations shall be sloped at an angle not steeper than one and one-half horizontal to one vertical (34 degrees measured from the horizontal), unless the employer uses one of the other options listed below.

(ii) Slopes specified in paragraph (b)(1)(i) of this section, shall be excavated to form configurations that are in accordance with the slopes shown for Type C soil in Appendix B to this subpart.

(2) *Option (2)—Determination of slopes and configurations using Appendices A and B.* Maximum allowable slopes, and allowable configurations for sloping

and benching systems, shall be determined in accordance with the conditions and requirements set forth in appendices A and B to this subpart.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of sloping or benching systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and shall include all of the following:

(A) Identification of the parameters that affect the selection of a sloping or benching system drawn from such data;

(B) Identification of the limits of use of the data, to include the magnitude and configuration of slopes determined to be safe;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Sloping and benching systems not utilizing Option (1) or Option (2) or Option (3) under paragraph (b) of this section shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include at least the following:

(A) The magnitude of the slopes that were determined to be safe for the particular project;

(B) The configurations that were determined to be safe for the particular project; and

(C) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite while the slope is being constructed. After that time the design need not be at the jobsite, but a copy shall be made available to the Secretary upon request.

(c) *Design of support systems, shield systems, and other protective systems.* Designs of support systems shield systems, and other protective systems shall be selected and constructed by the employer or his designee and shall be in accordance with the requirements of paragraph (c)(1); or, in the alternative, paragraph (c)(2); or, in the alternative, paragraph (c)(3); or, in the alternative, paragraph (c)(4) as follows:

(1) *Option (1)—Designs using appendices A, C and D.* Designs for timber shoring in trenches shall be determined in accordance with the conditions and requirements set forth in appendices A and C to this subpart. Designs for aluminum hydraulic shoring shall be in accordance with paragraph (c)(2) of this section, but if manufacturer's tabulated data cannot be utilized, designs shall be in accordance with appendix D.

(2) *Option (2)—Designs Using Manufacturer's Tabulated Data.* (i) Design of support systems, shield systems, or other protective systems that are drawn from manufacturer's tabulated data shall be in accordance with all specifications, recommendations, and limitations issued or made by the manufacturer.

(ii) Deviation from the specifications, recommendations, and limitations issued or made by the manufacturer shall only be allowed after the manufacturer issues specific written approval.

(iii) Manufacturer's specifications, recommendations, and limitations, and manufacturer's approval to deviate from the specifications, recommendations, and limitations shall be in written form at the jobsite during construction of the protective system. After that time this data may be stored off the jobsite, but a copy shall be made available to the Secretary upon request.

(3) *Option (3)—Designs using other tabulated data.* (i) Designs of support systems, shield systems, or other protective systems shall be selected from and be in accordance with tabulated data, such as tables and charts.

(ii) The tabulated data shall be in written form and include all of the following:

(A) Identification of the parameters that affect the selection of a protective system drawn from such data;

(B) Identification of the limits of use of the data;

(C) Explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data.

(iii) At least one copy of the tabulated data, which identifies the registered professional engineer who approved the data, shall be maintained at the jobsite during construction of the protective system. After that time the data may be stored off the jobsite, but a copy of the data shall be made available to the Secretary upon request.

(4) *Option (4)—Design by a registered professional engineer.* (i) Support systems, shield systems, and other protective systems not utilizing Option 1, Option 2 or Option 3, above, shall be approved by a registered professional engineer.

(ii) Designs shall be in written form and shall include the following:

(A) A plan indicating the sizes, types, and configurations of the materials to be used in the protective system; and

(B) The identity of the registered professional engineer approving the design.

(iii) At least one copy of the design shall be maintained at the jobsite during construction of the protective system. After that time, the design may be stored off the jobsite, but a copy of the design shall be made available to the Secretary upon request.

(d) *Materials and equipment.* (1) Materials and equipment used for protective systems shall be free from damage or defects that might impair their proper function.

(2) Manufactured materials and equipment used for protective systems shall be used and maintained in a manner that is consistent with the recommendations of the manufacturer, and in a manner that will prevent employee exposure to hazards.

(3) When material or equipment that is used for protective systems is damaged, a competent person shall examine the material or equipment and evaluate its suitability for continued use. If the competent person cannot assure the material or equipment is able to support the intended loads or is otherwise suitable for safe use, then such material or equipment shall be removed from service, and shall be evaluated and approved by a registered professional engineer before being returned to service.

(e) *Installation and removal of support*—(1) *General.* (i) Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.

(ii) Support systems shall be installed and removed in a manner that protects employees from cave-ins, structural collapses, or from being struck by members of the support system.

(iii) Individual members of support systems shall not be subjected to loads exceeding those which those members were designed to withstand.

(iv) Before temporary removal of individual members begins, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.

(v) Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.

(vi) Backfilling shall progress together with the removal of support systems from excavations.

(2) *Additional requirements for support systems for trench excavations.* (i) Excavation of material to a level no greater than 2 feet (.61 m) below the bottom of the members of a support system shall be permitted, but only if the system is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the support system.

(ii) Installation of a support system shall be closely coordinated with the excavation of trenches.

(f) *Sloping and benching systems.* Employees shall not be permitted to work on the faces of sloped or benched excavations at levels above other employees except when employees at the lower levels are adequately protected from

the hazard of falling, rolling, or sliding material or equipment.

(g) *Shield systems*—(1) *General.* (i) Shield systems shall not be subjected to loads exceeding those which the system was designed to withstand.

(ii) Shields shall be installed in a manner to restrict lateral or other hazardous movement of the shield in the event of the application of sudden lateral loads.

(iii) Employees shall be protected from the hazard of cave-ins when entering or exiting the areas protected by shields.

(iv) Employees shall not be allowed in shields when shields are being installed, removed, or moved vertically.

(2) *Additional requirement for shield systems used in trench excavations.* Excavations of earth material to a level not greater than 2 feet (.61 m) below the bottom of a shield shall be permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench, and there are no indications while the trench is open of a possible loss of soil from behind or below the bottom of the shield.

APPENDIX A TO SUBPART P—SOIL CLASSIFICATION

(a) *Scope and application*—(1) *Scope.* This appendix describes a method of classifying soil and rock deposits based on site and environmental conditions, and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils.

(2) *Application.* This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in §1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with appendix C to subpart P of part 1926, and when aluminum hydraulic shoring is designed in accordance with appendix D. This Appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in §1926.652(c), and the use of the data is predicated on the use of the soil classification system set forth in this appendix.

(b) *Definitions.* The definitions and examples given below are based on, in whole or in part, the following: American Society for Testing Materials (ASTM) Standards D653–85 and D2488; The Unified Soils Classification System, The U.S. Department of Agriculture (USDA) Textural Classification Scheme; and The National Bureau of Standards Report BSS–121.

Cemented soil means a soil in which the particles are held together by a chemical agent, such as calcium carbonate, such that a hand-size sample cannot be crushed into powder or individual soil particles by finger pressure.

Cohesive soil means clay (fine grained soil), or soil with a high clay content, which has cohesive strength. Cohesive soil does not crumble, can be excavated with vertical sideslopes, and is plastic when moist. Cohesive soil is hard to break up when dry, and exhibits significant cohesion when submerged. Cohesive soils include clayey silt, sandy clay, silty clay, clay and organic clay.

Dry soil means soil that does not exhibit visible signs of moisture content.

Fissured means a soil material that has a tendency to break along definite planes of fracture with little resistance, or a material that exhibits open cracks, such as tension cracks, in an exposed surface.

Granular soil means gravel, sand, or silt, (coarse grained soil) with little or no clay content. Granular soil has no cohesive strength. Some moist granular soils exhibit apparent cohesion. Granular soil cannot be molded when moist and crumbles easily when dry.

Layered system means two or more distinctly different soil or rock types arranged in layers. Micaceous seams or weakened planes in rock or shale are considered layered.

Moist soil means a condition in which a soil looks and feels damp. Moist cohesive soil can easily be shaped into a ball and rolled into small diameter threads before crumbling. Moist granular soil that contains some cohesive material will exhibit signs of cohesion between particles.

Plastic means a property of a soil which allows the soil to be deformed or molded without cracking, or appreciable volume change.

Saturated soil means a soil in which the voids are filled with water. Saturation does not require flow. Saturation, or near saturation, is necessary for the proper use of instruments such as a pocket penetrometer or sheer vane.

Soil classification system means, for the purpose of this subpart, a method of categorizing soil and rock deposits in a hierarchy of Stable Rock, Type A, Type B, and Type C, in decreasing order of stability. The categories are determined based on an analysis of the properties and performance characteristics of the deposits and the environmental conditions of exposure.

Stable rock means natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

Submerged soil means soil which is underwater or is free seeping.

Type A means cohesive soils with an unconfined compressive strength of 1.5 ton per square foot (tsf) (144 kPa) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay, clay loam and, in some cases, silty clay loam and sandy clay loam. Cemented soils such as caliche and hardpan are also considered Type A. However, no soil is Type A if:

(i) The soil is fissured; or

(ii) The soil is subject to vibration from heavy traffic, pile driving, or similar effects; or

(iii) The soil has been previously disturbed; or

(iv) The soil is part of a sloped, layered system where the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or greater; or

(v) The material is subject to other factors that would require it to be classified as a less stable material.

Type B means:

(i) Cohesive soil with an unconfined compressive strength greater than 0.5 tsf (48 kPa) but less than 1.5 tsf (144 kPa); or

(ii) Granular cohesionless soils including: angular gravel (similar to crushed rock), silt, silt loam, sandy loam and, in some cases, silty clay loam and sandy clay loam.

(iii) Previously disturbed soils except those which would otherwise be classed as Type C soil.

(iv) Soil that meets the unconfined compressive strength or cementation requirements for Type A, but is fissured or subject to vibration; or

(v) Dry rock that is not stable; or

(vi) Material that is part of a sloped, layered system where the layers dip into the excavation on a slope less steep than four horizontal to one vertical (4H:1V), but only if the material would otherwise be classified as Type B.

Type C means:

(i) Cohesive soil with an unconfined compressive strength of 0.5 tsf (48 kPa) or less; or

(ii) Granular soils including gravel, sand, and loamy sand; or

(iii) Submerged soil or soil from which water is freely seeping; or

(iv) Submerged rock that is not stable, or

(v) Material in a sloped, layered system where the layers dip into the excavation or a slope of four horizontal to one vertical (4H:1V) or steeper.

Unconfined compressive strength means the load per unit area at which a soil will fail in compression. It can be determined by laboratory testing, or estimated in the field using a pocket penetrometer, by thumb penetration tests, and other methods.

Wet soil means soil that contains significantly more moisture than moist soil, but in such a range of values that cohesive material will slump or begin to flow when vibrated. Granular material that would exhibit cohesive properties when moist will lose those cohesive properties when wet.

(c) *Requirements*—(1) *Classification of soil and rock deposits.* Each soil and rock deposit shall be classified by a competent person as Stable Rock, Type A, Type B, or Type C in accordance with the definitions set forth in paragraph (b) of this appendix.

(2) *Basis of classification.* The classification of the deposits shall be made based on the results of at least one visual and at least one manual analysis. Such analyses shall be conducted by a competent person using tests described in paragraph (d) below, or in other recognized methods of soil classification and testing such as those adopted by the America Society for Testing Materials, or the U.S. Department of Agriculture textural classification system.

(3) *Visual and manual analyses.* The visual and manual analyses, such as those noted as being acceptable in paragraph (d) of this appendix, shall be designed and conducted to provide sufficient quantitative and qualitative information as may be necessary to identify properly the properties, factors, and conditions affecting the classification of the deposits.

(4) *Layered systems.* In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

(5) *Reclassification.* If, after classifying a deposit, the properties, factors, or conditions affecting its classification change in any way, the changes shall be evaluated by a competent person. The deposit shall be reclassified as necessary to reflect the changed circumstances.

(d) *Acceptable visual and manual tests.*—(1) *Visual tests.* Visual analysis is conducted to determine qualitative information regarding the excavation site in general, the soil adjacent to the excavation, the soil forming the sides of the open excavation, and the soil taken as samples from excavated material.

(i) Observe samples of soil that are excavated and soil in the sides of the excavation. Estimate the range of particle sizes and the relative amounts of the particle sizes. Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

(ii) Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular.

(iii) Observe the side of the opened excavation and the surface area adjacent to the excavation. Crack-like openings such as tension cracks could indicate fissured material. If chunks of soil spall off a vertical side, the soil could be fissured. Small spalls are evidence of moving ground and are indications of potentially hazardous situations.

(iv) Observe the area adjacent to the excavation and the excavation itself for evidence of existing utility and other underground structures, and to identify previously disturbed soil.

(v) Observe the opened side of the excavation to identify layered systems. Examine layered systems to identify if the layers slope toward the excavation. Estimate the degree of slope of the layers.

(vi) Observe the area adjacent to the excavation and the sides of the opened excavation for evidence of surface water, water seeping from the sides of the excavation, or the location of the level of the water table.

(vii) Observe the area adjacent to the excavation and the area within the excavation for sources of vibration that may affect the stability of the excavation face.

(2) *Manual tests.* Manual analysis of soil samples is conducted to determine quantitative as well as qualitative properties of soil and to provide more information in order to classify soil properly.

(i) *Plasticity.* Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as ⅛-inch in diameter. Cohesive material can be successfully rolled into threads without crumbling. For example, if at least a two inch (50 mm) length of ⅛-inch thread can be held on one end without tearing, the soil is cohesive.

(ii) *Dry strength.* If the soil is dry and crumbles on its own or with moderate pressure into individual grains or fine powder, it is granular (any combination of gravel, sand, or silt). If the soil is dry and falls into clumps which break up into smaller clumps, but the smaller clumps can only be broken up with difficulty, it may be clay in any combination with gravel, sand or silt. If the dry soil breaks into clumps which do not break up into small clumps and which can only be broken with difficulty, and there is no visual indication the soil is fissured, the soil may be considered unfissured.

(iii) *Thumb penetration.* The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. (This test is based on the thumb penetration test described in American Society for Testing and Materials (ASTM) Standard designation D2488—"Standard Recommended Practice for Description of Soils (Visual—Manual Procedure).") Type A soils with an unconfined compressive strength of 1.5 tsf can be readily indented by the thumb; however, they can be penetrated by the thumb only with very great effort. Type C soils with an unconfined compressive strength of 0.5 tsf can be easily penetrated several inches by the thumb, and can be molded by light finger pressure. This test should be conducted on an undisturbed soil sample, such as a large clump of spoil, as soon as practicable after excavation to keep to a miminum the effects of exposure to drying influences. If the excavation is later exposed to wetting influences (rain, flooding), the classification of the soil must be changed accordingly.

(iv) *Other strength tests.* Estimates of unconfined compressive strength of soils can also be obtained by use of a pocket penetrometer or by using a hand-operated shearvane.

(v) *Drying test.* The basic purpose of the drying test is to differentiate between cohesive material with fissures, unfissured cohesive material, and granular material. The procedure for the drying test involves drying a sample of soil that is approximately one inch thick (2.54 cm) and six inches (15.24 cm) in diameter until it is thoroughly dry:

(A) If the sample develops cracks as it dries, significant fissures are indicated.

(B) Samples that dry without cracking are to be broken by hand. If considerable force is necessary to break a sample, the soil has significant cohesive material content. The soil can be classified as a unfissured cohesive material and the unconfined compressive strength should be determined.

(C) If a sample breaks easily by hand, it is either a fissured cohesive material or a granular material. To distinguish between the two, pulverize the dried clumps of the sample by hand or by stepping on them. If the clumps do not pulverize easily, the material is cohesive with fissures. If they pulverize easily into very small fragments, the material is granular.

APPENDIX B TO SUBPART P—SLOPING AND BENCHING

(a) *Scope and application.* This appendix contains specifications for sloping and benching when used as methods of protecting employees working in excavations from cave-ins. The requirements of this appendix apply when the design of sloping and benching protective systems is to be performed in accordance with the requirements set forth in § 1926.652(b)(2).

(b) *Definitions.*

Actual slope means the slope to which an excavation face is excavated.

Distress means that the soil is in a condition where a cave-in is imminent or is likely to occur. Distress is evidenced by such phenomena as the development of fissures in the face of or adjacent to an open excavation; the subsidence of the edge of an excavation; the slumping of material from the face or the bulging or heaving of material from the bottom of an excavation; the spalling of material from the face of an excavation; and ravelling, i.e., small amounts of material such as pebbles or little clumps of material suddenly separating from the face of an excavation and trickling or rolling down into the excavation.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H:V).

Short term exposure means a period of time less than or equal to 24 hours that an excavation is open.

(c) *Requirements*—(1) *Soil classification.* Soil and rock deposits shall be classified in accordance with appendix A to subpart P of part 1926.

(2) *Maximum allowable slope.* The maximum allowable slope for a soil or rock deposit shall be determined from Table B-1 of this appendix.

(3) *Actual slope.* (i) The actual slope shall not be steeper than the maximum allowable slope.

(ii) The actual slope shall be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope shall be cut back to an actual slope which is at least ½ horizontal to one vertical (½H:1V) less steep than the maximum allowable slope.

(iii) When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope, and shall assure that such reduction is achieved. Surcharge loads from adjacent structures shall be evaluated in accordance with § 1926.651(i).

(4) *Configurations.* Configurations of sloping and benching systems shall be in accordance with Figure B-1.

TABLE B-1

MAXIMUM ALLOWABLE SLOPES

SOIL OR ROCK TYPE	MAXIMUM ALLOWABLE SLOPES (H:V) [1] FOR EXCAVATIONS LESS THAN 20 FEET DEEP [3]
STABLE ROCK TYPE A [2] TYPE B TYPE C	VERTICAL (90°) 3/4 : 1 (53°) 1:1 (45°) 1½: 1 (34°)

NOTES:

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. A short-term maximum allowable slope of 1/2H:1V (63°) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth shall be 3/4H:1V (53°).
3. Sloping or benching for excavations greater than 20 feet deep shall be designed by a registered professional engineer.

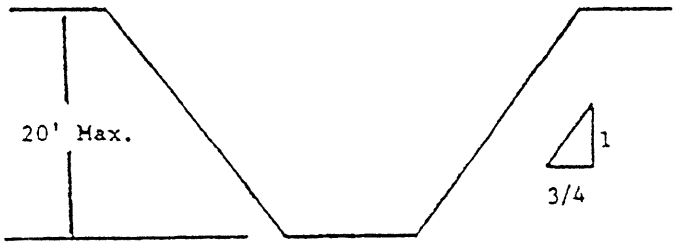
Figure B-1

Slope Configurations

(All slopes stated below are in the horizontal to vertical ratio)

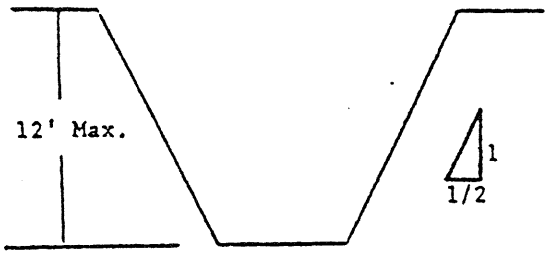
B-1.1 Excavations made in Type A soil.

1. All simple slope excavation 20 feet or less in depth shall have a maximum allowable slope of ¾:1.



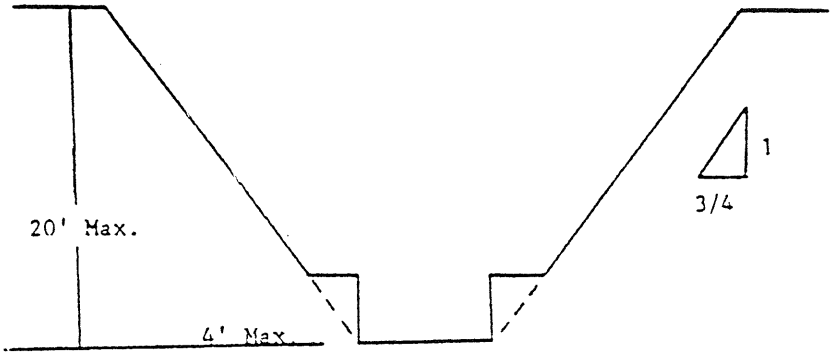
SIMPLE SLOPE—GENERAL

Exception: Simple slope excavations which are open 24 hours or less (short term) and which are 12 feet or less in depth shall have a maximum allowable slope of ½:1.

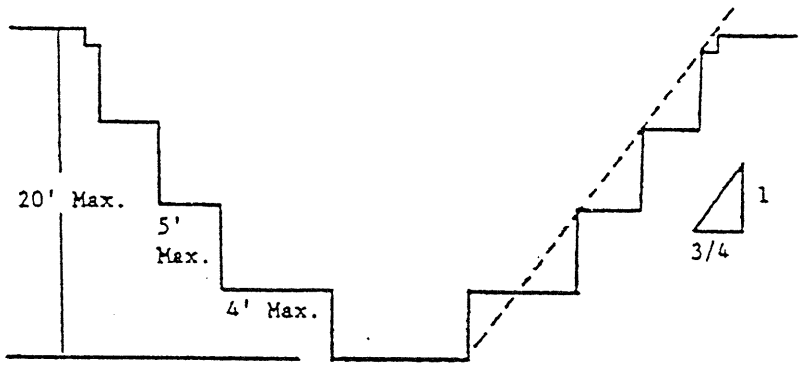


SIMPLE SLOPE—SHORT TERM

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of ¾ to 1 and maximum bench dimensions as follows:

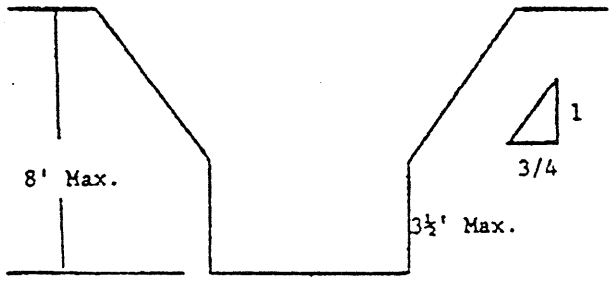


SIMPLE BENCH



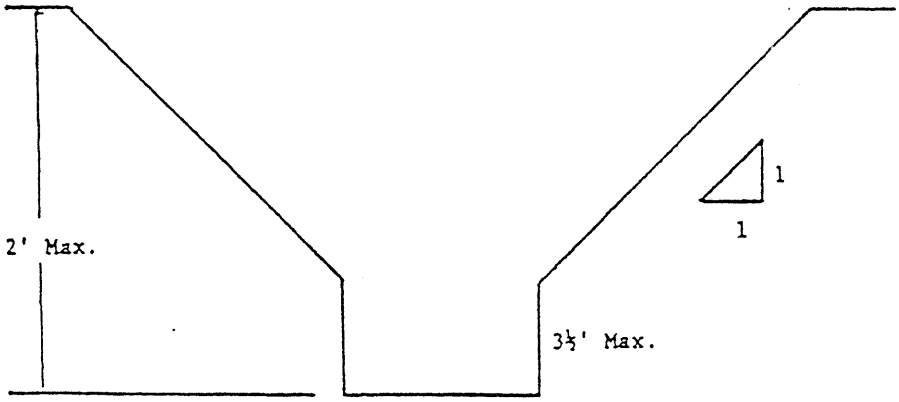
MULTIPLE BENCH

3. All excavations 8 feet or less in depth which have unsupported vertically sided lower portions shall have a maximum vertical side of 3½ feet.



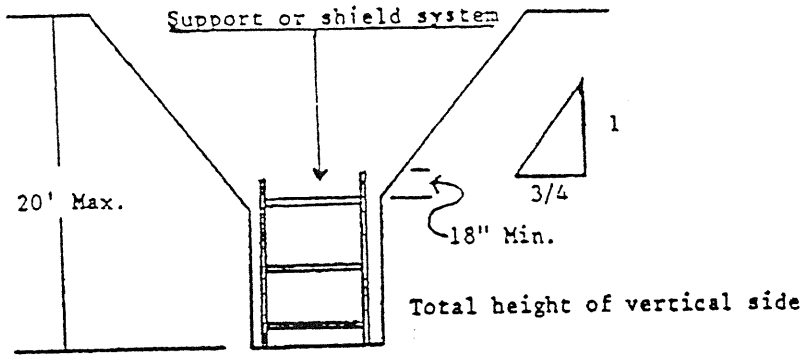
UNSUPPORTED VERTICALLY SIDED LOWER PORTION—MAXIMUM 8 FEET IN DEPTH

All excavations more than 8 feet but not more than 12 feet in depth which unsupported vertically sided lower portions shall have a maximum allowable slope of 1:1 and a maximum vertical side of 3½ feet.



UNSUPPORTED VERTICALLY SIDED LOWER PORTION—MAXIMUM 12 FEET IN DEPTH

All excavations 20 feet or less in depth which have vertically sided lower portions that are supported or shielded shall have a maximum allowable slope of ¾:1. The support or shield system must extend at least 18 inches above the top of the vertical side.

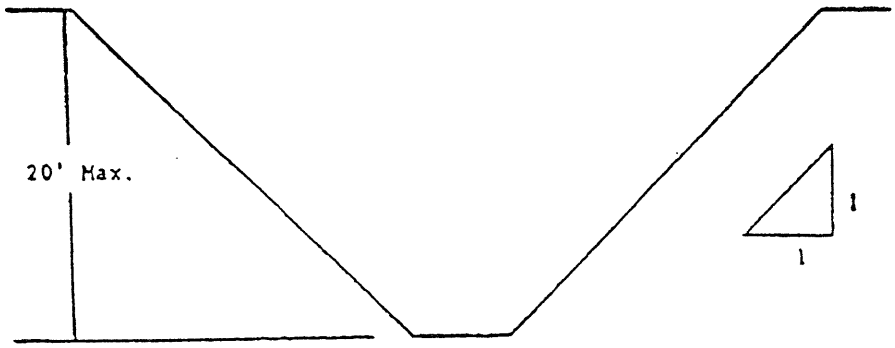


SUPPORTED OR SHIELDED VERTICALLY SIDED LOWER PORTION

4. All other simple slope, compound slope, and vertically sided lower portion excavations shall be in accordance with the other options permitted under § 1926.652(b).

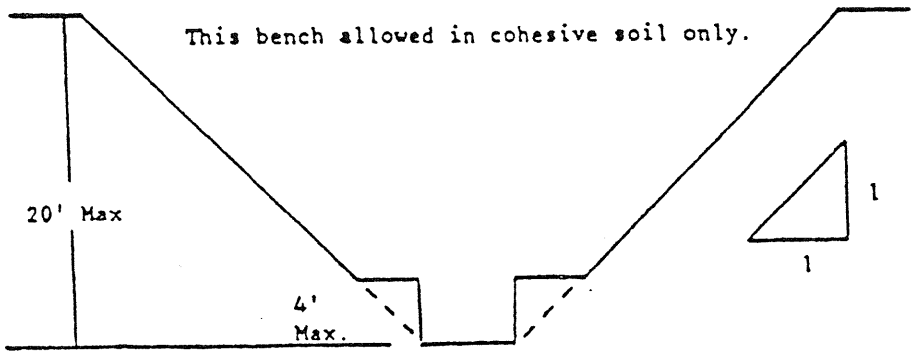
B-1.2 Excavations Made in Type B Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1.

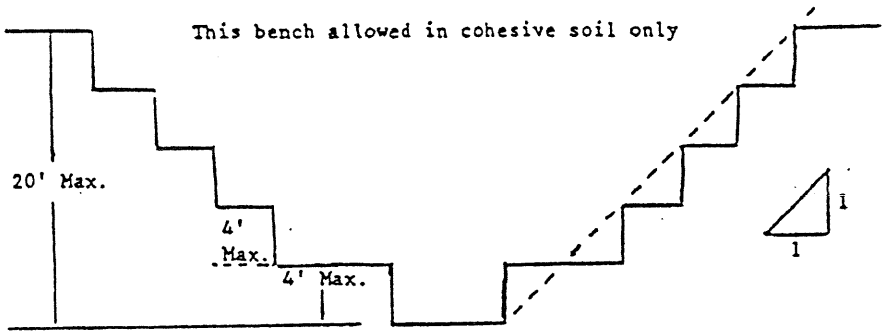


SIMPLE SLOPE

2. All benched excavations 20 feet or less in depth shall have a maximum allowable slope of 1:1 and maximum bench dimensions as follows:

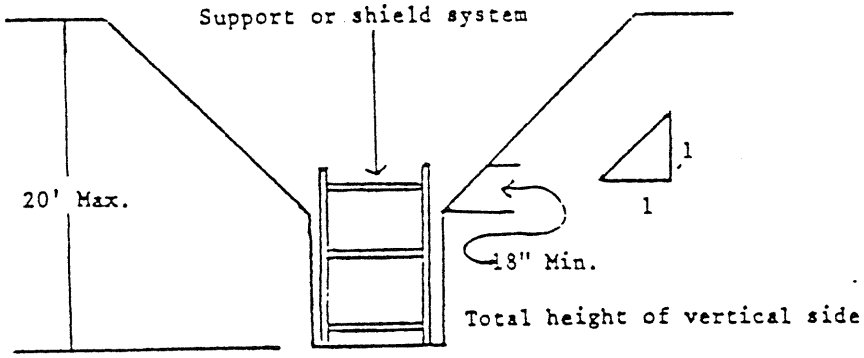


SINGLE BENCH



MULTIPLE BENCH

3. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1:1.

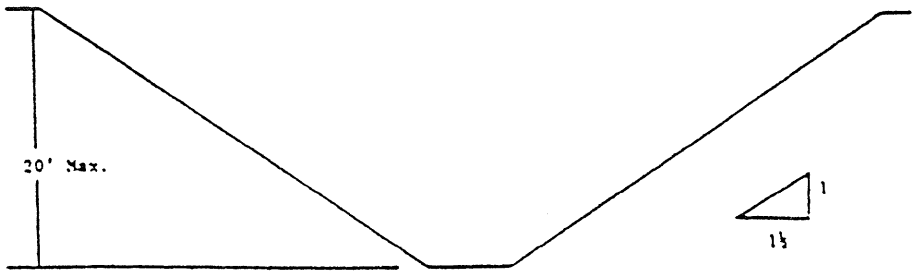


VERTICALLY SIDED LOWER PORTION

4. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

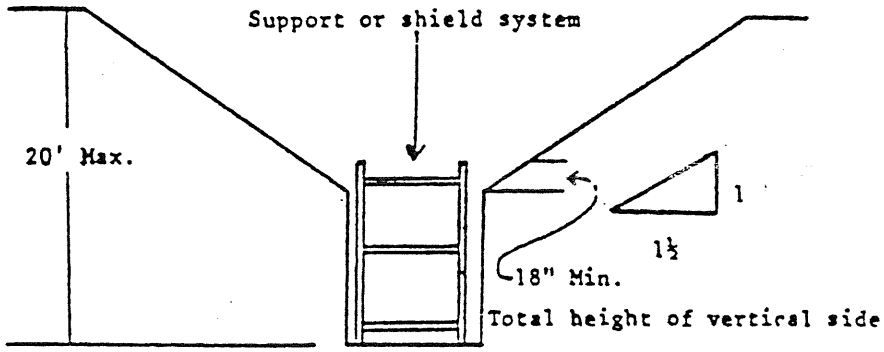
B-1.3 Excavations Made in Type C Soil

1. All simple slope excavations 20 feet or less in depth shall have a maximum allowable slope of 1½:1.



SIMPLE SLOPE

2. All excavations 20 feet or less in depth which have vertically sided lower portions shall be shielded or supported to a height at least 18 inches above the top of the vertical side. All such excavations shall have a maximum allowable slope of 1½:1.

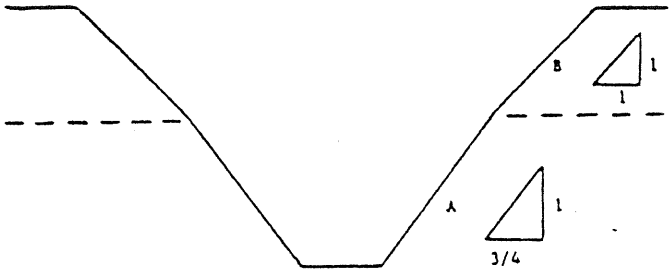


VERTICAL SIDED LOWER PORTION

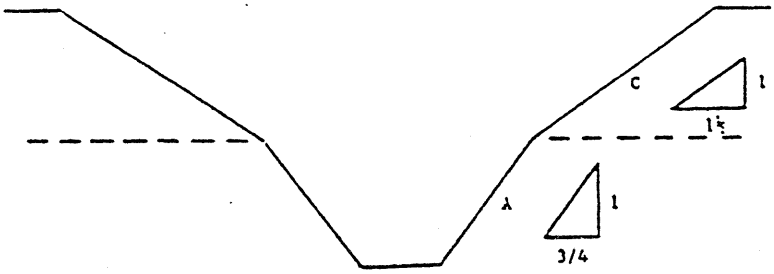
3. All other sloped excavations shall be in accordance with the other options permitted in § 1926.652(b).

B-1.4 Excavations Made in Layered Soils

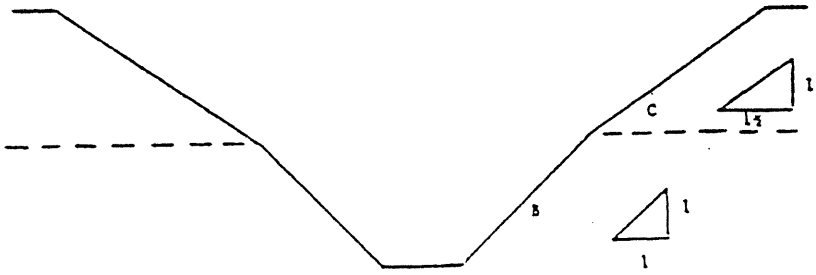
1. All excavations 20 feet or less in depth made in layered soils shall have a maximum allowable slope for each layer as set forth below.



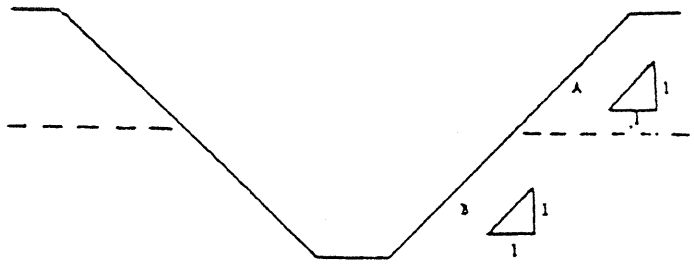
B OVER A



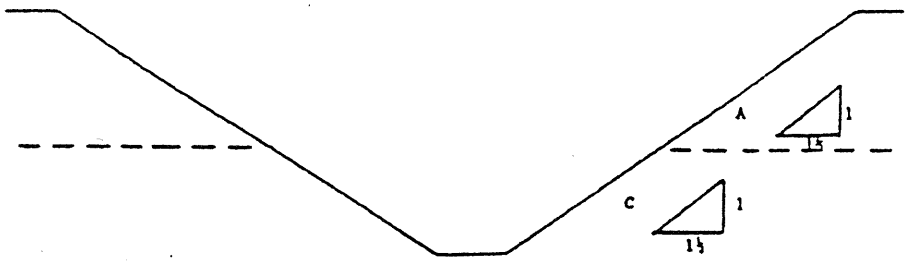
C OVER A



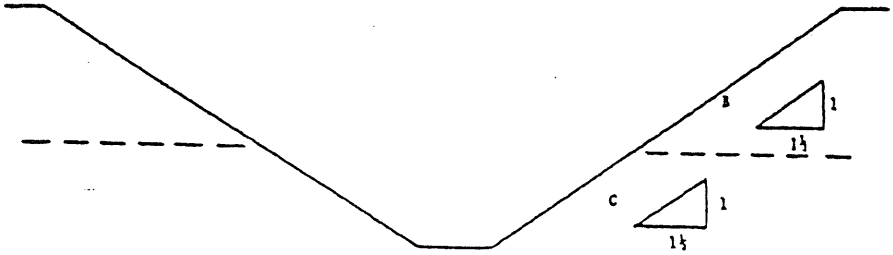
C OVER B



A OVER B



A OVER C



B OVER C

2. All other sloped excavations shall be in accordance with the other options permitted in §1926.652(b).

APPENDIX C TO SUBPART P—TIMBER SHORING FOR TRENCHES

(a) *Scope.* This appendix contains information that can be used timber shoring is provided as a method of protection from cave-ins in trenches that do not exceed 20 feet (6.1 m) in depth. This appendix must be used when design of timber shoring protective systems is to be performed in accordance with §1926.652(c)(1). Other timber shoring configurations; other systems of support such as hydraulic and pneumatic systems; and other protective systems such as sloping, benching, shielding, and freezing systems must be designed in accordance with the requirements set forth in §1926.652(b) and §1926.652(c).

(b) *Soil Classification.* In order to use the data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of this part.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables C-1.1, C-1.2, and C-1.3, and Tables C-2.1, C-2.2 and C-2.3 following paragraph (g) of the appendix. Each table presents the minimum sizes of timber members to use in a shoring system, and each table contains data only for the particular soil

type in which the excavation or portion of the excavation is made. The data are arranged to allow the user the flexibility to select from among several acceptable configurations of members based on varying the horizontal spacing of the crossbraces. Stable rock is exempt from shoring requirements and therefore, no data are presented for this condition.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix, and on the tables themselves.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations regarding Tables C-1.1 through C-1.3 and Tables C-2.1 through C-2.3 are presented in paragraph (g) of this Appendix.

(d) *Basis and limitations of the data.*—(1) *Dimensions of timber members.* (i) The sizes of the timber members listed in Tables C-1.1 through C-1.3 are taken from the National Bureau of Standards (NBS) report, "Recommended Technical Provisions for Construction Practice in Shoring and Sloping of Trenches and Excavations." In addition, where NBS did not recommend specific sizes of members, member sizes are based on an analysis of the sizes required for use by existing codes and on empirical practice.

(ii) The required dimensions of the members listed in Tables C-1.1 through C-1.3 refer to actual dimensions and not nominal dimensions of the timber. Employers wanting to use nominal size shoring are directed to Tables C-2.1 through C-2.3, or have this choice under § 1926.652(c)(3), and are referred to The Corps of Engineers, The Bureau of Reclamation or data from other acceptable sources.

(2) *Limitation of application.* (i) It is not intended that the timber shoring specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be designed as specified in § 1926.652(c).

(ii) When any of the following conditions are present, the members specified in the tables are not considered adequate. Either an alternate timber shoring system must be designed or another type of protective system designed in accordance with § 1926.652.

(A) When loads imposed by structures or by stored material adjacent to the trench weigh in excess of the load imposed by a two-foot soil surcharge. The term "adjacent" as used here means the area within a horizontal distance from the edge of the trench equal to the depth of the trench.

(B) When vertical loads imposed on cross braces exceed a 240-pound gravity load distributed on a one-foot section of the center of the crossbrace.

(C) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(D) When only the lower portion of a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables.* The members of the shoring system that are to be selected using this information are the cross braces, the uprights, and the wales, where wales are required. Minimum sizes of members are specified for use in different types of soil. There are six tables of information, two for each soil type. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is then made. The selection is based on the depth and width of the trench where the members are to be installed and, in most instances, the selection is also based on the horizontal spacing of the crossbraces. Instances where a choice of horizontal spacing of crossbracing is available, the horizontal spacing of the crossbraces must be chosen by the user before the size of any member can be determined. When the soil type, the width and depth of the trench, and the horizontal spacing of the crossbraces are known, the size and vertical spacing of the crossbraces, the size and vertical spacing of the wales, and the size and horizontal spacing of the uprights can be read from the appropriate table.

(f) *Examples to Illustrate the Use of Tables C-1.1 through C-1.3.*

(1) *Example 1.*

A trench dug in Type A soil is 13 feet deep and five feet wide.

From *Table C-1.1*, for acceptable arrangements of timber can be used.

Arrangement #1

Space 4x4 crossbraces at six feet horizontally and four feet vertically.

Wales are not required.

Space 3x8 uprights at six feet horizontally. This arrangement is commonly called "skip shoring."

Arrangement #2

Space 4x6 crossbraces at eight feet horizontally and four feet vertically.

Space 8x8 wales at four feet vertically.

Space 2x6 uprights at four feet horizontally.

Arrangement #3

Space 6x6 crossbraces at 10 feet horizontally and four feet vertically.

Space 8x10 wales at four feet vertically.

Space 2x6 uprights at five feet horizontally.

Arrangement #4

Space 6x6 crossbraces at 12 feet horizontally and four feet vertically.

Space 10x10 wales at four feet vertically.

Spaces 3x8 uprights at six feet horizontally.

(2) *Example 2.*

A trench dug in Type B soil in 13 feet deep and five feet wide. From Table C-1.2 three acceptable arrangements of members are listed.

Arrangement #1

Space 6x6 crossbraces at six feet horizontally and five feet vertically.

Space 8x8 wales at five feet vertically.

Space 2x6 uprights at two feet horizontally.

Arrangement #2

Space 6x8 crossbraces at eight feet horizontally and five feet vertically.

Space 10x10 wales at five feet vertically.

Space 2x6 uprights at two feet horizontally.

Arrangement #3

Space 8x8 crossbraces at 10 feet horizontally and five feet vertically.

Space 10x12 wales at five feet vertically.

Space 2x6 uprights at two feet vertically.

(3) *Example 3.*

A trench dug in Type C soil is 13 feet deep and five feet wide.

From Table C-1.3 two acceptable arrangements of members can be used.

Arrangement #1

Space 8x8 crossbraces at six feet horizontally and five feet vertically.

Space 10x12 wales at five feet vertically.

Position 2x6 uprights as closely together as possible.

If water must be retained use special tongue and groove uprights to form tight sheeting.

Arrangement #2

Space 8x10 crossbraces at eight feet horizontally and five feet vertically.

Space 12x12 wales at five feet vertically.

Position 2x6 uprights in a close sheeting configuration unless water pressure must be resisted. Tight sheeting must be used where water must be retained.

(4) *Example 4.*

A trench dug in Type C soil is 20 feet deep and 11 feet wide. The size and spacing of members for the section of trench that is over 15 feet in depth is determined using Table C-1.3. Only one arrangement of members is provided.

Space 8x10 crossbraces at six feet horizontally and five feet vertically.

Space 12x12 wales at five feet vertically.

Use 3x6 tight sheeting.

Use of Tables C-2.1 through C-2.3 would follow the same procedures.

(g) *Notes for all Tables.*

1. Member sizes at spacings other than indicated are to be determined as specified in §1926.652(c), "Design of Protective Systems."

2. When conditions are saturated or submerged use Tight Sheeting. Tight Sheeting refers to the use of specially-edged timber planks (e.g., tongue and groove) at least three inches thick, steel sheet piling, or similar construction that when driven or placed in position provide a tight wall to resist the lateral pressure of water and to prevent the loss of backfill material. Close Sheeting refers to the placement of planks side-by-side allowing as little space as possible between them.

3. All spacing indicated is measured center to center.

4. Wales to be installed with greater dimension horizontal.

5. If the vertical distance from the center of the lowest crossbrace to the bottom of the trench exceeds two and one-half feet, uprights shall be firmly embedded or a mudsill shall be used. Where uprights are embedded, the vertical distance from the center of the lowest crossbrace to the bottom of the trench shall not exceed 36 inches. When mudsills are used, the vertical distance shall not exceed 42 inches. Mudsills are wales that are installed at the toe of the trench side.

6. Trench jacks may be used in lieu of or in combination with timber crossbraces.

7. Placement of crossbraces. When the vertical spacing of crossbraces is four feet, place the top crossbrace no more than two feet below the top of the trench. When the vertical spacing of crossbraces is five feet, place the top crossbrace no more than 2.5 feet below the top of the trench.

TABLE C-1.1

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A $P_a = 25 \times H + 72$ psf (2 ft Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				2X6	
	UP TO 8	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---					2X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			2X6		
	UP TO 12	4X6	4X6	6X6	6X6	6X6	4	8X8	4				2X6	
10 TO 15	UP TO 6	4X4	4X4	4X6	6X6	6X6	4	Not Req'd	---				3X8	
	UP TO 8	4X6	4X6	6X6	6X6	6X6	4	8X8	4		2X6			
	UP TO 10	6X6	6X5	6X6	6X8	6X8	4	8X10	4			2X6		
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	10X10	4				3X8	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X8	6X8	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X8	6X8	4	8X8	4	3X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	4	8X10	4	3X6				
	UP TO 12	8X8	8X8	8X8	8X8	8X10	4	10X10	4	3X6				
OVER 20	SEE NOTE 1													

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B $P_a = 45 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3			
5 TO 10	UP TO 6	4X6	4X6	6X6	6X6	6X6	5	6X8	5			2X6			
	UP TO 8	6X6	6X6	6X6	6X8	6X8	5	8X10	5			2X6			
	UP TO 10	6X6	6X6	6X6	6X8	6X8	5	10X10	5			2X6			
	See Note 1														
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5		2X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5		2X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X10	5	10X12	5		2X6				
	See Note 1														
15 TO 20	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	3X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	3X6					
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6					
	See Note 1														
OVER 20	SEE NOTE 1														

* Mixed oak or equivalent with a bending strength not less than 850 psi.
** Manufactured members of equivalent strength may by substituted for wood.

TABLE C-1.3

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C $P_a = 80 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (ACTUAL) AND SPACING OF MEMBERS**													
	CROSS BRACES									UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET) (See Note 2)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE				
5 TO 10	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	8X10	5	2X6				
	UP TO 8	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6				
	UP TO 10	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
10 TO 15	UP TO 6	8X8	8X8	8X8	8X8	8X10	5	10X12	5	2X6				
	UP TO 8	8X10	8X10	8X10	8X10	10X10	5	12X12	5	2X6				
	See Note 1													
	See Note 1													
15 TO 20	UP TO 6	8X10	8X10	8X10	8X10	10X10	5	12X12	5	3X6				
	See Note 1													
	See Note 1													
	See Note 1													
OVER 20	SEE NOTE 1													

* Mixed Oak or equivalent with a bending strength not less than 850 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.1

TIMBER TRENCH SHORING — MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE A P_a = 25 X H ± 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	4	5	6	8
5 TO 10	UP TO 6	4X4	4X4	4X4	4X4	4X6	4	Not Req'd	Not Req'd				4X6	
	UP TO 8	4X4	4X4	4X4	4X6	4X6	4	Not Req'd	Not Req'd					4X8
	UP TO 10	4X6	4X6	4X6	6X6	6X6	4	8X8	4			4X6		
	UP TO 12	4X6	4X6	4X6	6X6	6X6	4	8X8	4				4X6	
10 TO 15	UP TO 6	4X4	4X4	4X4	6X6	6X6	4	Not Req'd	Not Req'd				4X10	
	UP TO 8	4X6	4X6	4X6	6X6	6X6	4	6X8	4		4X6			
	UP TO 10	6X6	6X6	6X6	6X6	6X6	4	8X8	4			4X8		
	UP TO 12	6X6	6X6	6X6	6X6	6X6	4	8X10	4		4X6		4X10	
15 TO 20	UP TO 6	6X6	6X6	6X6	6X6	6X6	4	6X8	4	3X6				
	UP TO 8	6X6	6X6	6X6	6X6	6X6	4	8X8	4	3X6	4X12			
	UP TO 10	6X6	6X6	6X6	6X6	6X8	4	8X10	4	3X6				
	UP TO 12	6X6	6X6	6X6	6X8	6X8	4	8X12	4	3X6	4X12			
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.2

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE B P_a = 45 X H + 72 psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **													
	CROSS BRACES							WALES		UPRIGHTS				
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)				
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE	2	3	4	6
5 TO 10	UP TO 6	4X6	4X6	4X6	6X6	6X6	5	6X8	5			3X12 4X8		4X12
	UP TO 8	4X6	4X6	6X6	6X6	6X6	5	8X8	5		3X8		4X8	
	UP TO 10	4X6	4X6	6X6	6X6	6X8	5	8X10	5			4X8		
	See Note 1													
10 TO 15	UP TO 6	6X6	6X6	6X6	6X8	6X8	5	8X8	5	3X6	4X10			
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X10	5	3X6	4X10			
	UP TO 10	6X8	6X8	8X8	8X8	8X8	5	10X12	5	3X6	4X10			
	See Note 1													
15 TO 20	UP TO 6	6X8	6X8	6X8	6X8	8X8	5	8X10	5	4X6				
	UP TO 8	6X8	6X8	6X8	8X8	8X8	5	10X12	5	4X6				
	UP TO 10	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6				
	See Note 1													
OVER 20	SEE NOTE 1													

* Douglas fir or equivalent with a bending strength not less than 1500 psi.

** Manufactured members of equivalent strength may be substituted for wood.

TABLE C-2.3

TIMBER TRENCH SHORING -- MINIMUM TIMBER REQUIREMENTS *

SOIL TYPE C $P_a = 80 \times H + 72$ psf (2 ft. Surcharge)

DEPTH OF TRENCH (FEET)	SIZE (S4S) AND SPACING OF MEMBERS **														
	CROSS BRACES							WALES		UPRIGHTS					
	HORIZ. SPACING (FEET)	WIDTH OF TRENCH (FEET)					VERT. SPACING (FEET)	SIZE (IN)	VERT. SPACING (FEET)	MAXIMUM ALLOWABLE HORIZONTAL SPACING (FEET)					
		UP TO 4	UP TO 6	UP TO 9	UP TO 12	UP TO 15				CLOSE					
5 TO 10	UP TO 6	6X6	6X6	6X6	6X6	8X8	5	8X8	5	3X6					
	UP TO 8	6X6	6X6	6X6	8X8	8X8	5	10X10	5	3X6					
	UP TO 10	6X6	6X6	8X8	8X8	8X8	5	10X12	5	3X6					
	See Note 1														
10 TO 15	UP TO 6	6X8	6X8	6X8	8X8	8X8	5	10X10	5	4X6					
	UP TO 8	8X8	8X8	8X8	8X8	8X8	5	12X12	5	4X6					
	See Note 1														
	See Note 1														
15 TO 20	UP TO 6	8X8	8X8	8X8	8X10	8X10	5	10X12	5	4X6					
	See Note 1														
	See Note 1														
	See Note 1														
OVER 20	SEE NOTE 1														

* Douglas fir or equivalent with a bending strength not less than 1500 psi.
** Manufactured members of equivalent strength may be substituted for wood.

APPENDIX D TO SUBPART P—ALUMINUM HYDRAULIC SHORING FOR TRENCHES

(a) *Scope.* This appendix contains information that can be used when aluminum hydraulic shoring is provided as a method of protection against cave-ins in trenches that do not exceed 20 feet (6.1m) in depth. This appendix must be used when design of the aluminum hydraulic protective system cannot be performed in accordance with §1926.652(c)(2).

(b) *Soil Classification.* In order to use data presented in this appendix, the soil type or types in which the excavation is made must first be determined using the soil classification method set forth in appendix A of subpart P of part 1926.

(c) *Presentation of Information.* Information is presented in several forms as follows:

(1) Information is presented in tabular form in Tables D-1.1, D-1.2, D-1.3 and E-1.4. Each table presents the maximum vertical and horizontal spacings that may be used with various aluminum member sizes and various hydraulic cylinder sizes. Each table contains data only for the particular soil type in which the excavation or portion of the excavation is made. Tables D-1.1 and D-1.2 are for vertical shores in Types A and B soil. Tables D-1.3 and D1.4 are for horizontal waler systems in Types B and C soil.

(2) Information concerning the basis of the tabular data and the limitations of the data is presented in paragraph (d) of this appendix.

(3) Information explaining the use of the tabular data is presented in paragraph (e) of this appendix.

(4) Information illustrating the use of the tabular data is presented in paragraph (f) of this appendix.

(5) Miscellaneous notations (footnotes) regarding Table D-1.1 through D-1.4 are presented in paragraph (g) of this appendix.

(6) Figures, illustrating typical installations of hydraulic shoring, are included just prior to the Tables. The illustrations page is entitled "Aluminum Hydraulic Shoring; Typical Installations."

(d) *Basis and limitations of the data.*

(1) Vertical shore rails and horizontal wales are those that meet the Section Modulus requirements in the D-1 Tables. Aluminum material is 6061-T6 or material of equivalent strength and properties.

(2) Hydraulic cylinders specifications. (i) 2-inch cylinders shall be a minimum 2-inch inside diameter with a minimum safe working capacity of no less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufaturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe working capacity of not less than 30,000 pounds axial compressive load at extensions as recommended by product manufacturer.

(3) Limitation of application.

(i) It is not intended that the aluminum hydraulic specification apply to every situation that may be experienced in the field. These data were developed to apply to the situations that are most commonly experienced in current trenching practice. Shoring systems for use in situations that are not covered by the data in this appendix must be otherwise designed as specified in §1926.652(c).

(ii) When any of the following conditions are present, the members specified in the Tables are not considered adequate. In this case, an alternative aluminum hydraulic shoring system or other type of protective system must be designed in accordance with §1926.652.

(A) When vertical loads imposed on cross braces exceed a 100 Pound gravity load distributed on a one foot section of the center of the hydraulic cylinder.

(B) When surcharge loads are present from equipment weighing in excess of 20,000 pounds.

(C) When only the lower portion or a trench is shored and the remaining portion of the trench is sloped or benched unless: The sloped portion is sloped at an angle less steep than three horizontal to one vertical; or the members are selected from the tables for use at a depth which is determined from the top of the overall trench, and not from the toe of the sloped portion.

(e) *Use of Tables D-1.1, D-1.2, D-1.3 and D-1.4.* The members of the shoring system that are to be selected using this information are the hydraulic cylinders, and either the vertical shores or the horizontal wales. When a waler system is used the vertical timber sheeting to be used is also selected from these tables. The Tables D-1.1 and D-1.2 for vertical shores are used in Type A and B soils that do not require sheeting. Type B soils that may require sheeting, and Type C soils that always require sheeting are found in the horizontal wale Tables D-1.3 and D-1.4. The soil type must first be determined in accordance with the soil classification system described in appendix A to subpart P of part 1926. Using the appropriate table, the selection of the size and spacing of the members is made. The selection is based on the depth and width of the trench where the members are to be installed. In these tables the vertical spacing is held constant at four feet on center. The tables show the maximum horizontal spacing of cylinders allowed for each size of wale in the waler system tables, and in the vertical shore tables, the hydraulic cylinder horizontal spacing is the same as the vertical shore spacing.

(f) *Example to Illustrate the Use of the Tables:*

(1) Example 1:

A trench dug in Type A soil is 6 feet deep and 3 feet wide. From Table D-1.1: Find vertical shores and 2 inch diameter cylinders spaced 8 feet on center (o.c.) horizontally and 4 feet on center (o.c.) vertically. (See Figures 1 & 3 for typical installations.)

(2) Example 2:

A trench is dug in Type B soil that does not require sheeting, 13 feet deep and 5 feet wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinders spaced 6.5 feet o.c. horizontally and 4 feet o.c. vertically. (See Figures 1 & 3 for typical installations.)

(3) A trench is dug in Type B soil that does not require sheeting, but does experience some minor raveling of the trench face. The trench is 16 feet deep and 9 feet wide. From Table D-1.2: Find vertical shores and 2 inch diameter cylinder (with special oversleeves as designated by footnote #2) spaced 5.5 feet o.c. horizontally and 4 feet o.c. vertically, plywood (per footnote (g)(7) to the D-1 Table) should be used behind the shores. (See Figures 2 & 3 for typical installations.)

(4) Example 4: A trench is dug in previously disturbed Type B soil, with characteristics of a Type C soil, and will require sheeting. The trench is 18 feet deep and 12 feet wide. 8 foot horizontal spacing between cylinders is desired for working space. From Table D-1.3: Find horizontal wale with a section modulus of 14.0 spaced at 4 feet o.c. vertically and 3 inch diameter cylinder spaced at 9 feet maximum o.c. horizontally. 3x12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(5) Example 5: A trench is dug in Type C soil, 9 feet deep and 4 feet wide. Horizontal cylinder spacing in excess of 6 feet is desired for working space. From Table D-1.4: Find horizontal wale with a section modulus of 7.0 and 2 inch diameter cylinders spaced at 6.5 feet o.c. horizontally. Or, find horizontal wale with a 14.0 section modulus and 3 inch diameter cylinder spaced at 10 feet o.c. horizontally. Both wales are spaced 4 feet o.c. vertically. 3x12 timber sheeting is required at close spacing vertically. (See Figure 4 for typical installation.)

(g) *Footnotes, and general notes, for Tables D-1.1, D-1.2, D-1.3, and D-1.4.*

(1) For applications other than those listed in the tables, refer to §1926.652(c)(2) for use of manufacturer's tabulated data. For trench depths in excess of 20 feet, refer to §1926.652(c)(2) and §1926.652(c)(3).

(2) 2 inch diameter cylinders, at this width, shall have structural steel tube (3.5x3.5x0.1875) oversleeves, or structural oversleeves of manufacturer's specification, extending the full, collapsed length.

(3) Hydraulic cylinders capacities. (i) 2 inch cylinders shall be a minimum 2-inch inside diameter with a safe working capacity of not less than 18,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(ii) 3-inch cylinders shall be a minimum 3-inch inside diameter with a safe work capacity of not less than 30,000 pounds axial compressive load at maximum extension. Maximum extension is to include full range of cylinder extensions as recommended by product manufacturer.

(4) All spacing indicated is measured center to center.

(5) Vertical shoring rails shall have a minimum section modulus of 0.40 inch.

(6) When vertical shores are used, there must be a minimum of three shores spaced equally, horizontally, in a group.

(7) Plywood shall be 1.125 in. thick softwood or 0.75 inch. thick, 14 ply, arctic white birch (Finland form). Please note that plywood is not intended as a structural member, but only for prevention of local raveling (sloughing of the trench face) between shores.

(8) See appendix C for timber specifications.

(9) Wales are calculated for simple span conditions.

(10) See appendix D, item (d), for basis and limitations of the data.

ALUMINUM HYDRAULIC SHORING
TYPICAL INSTALLATIONS

FIGURE NO. 1

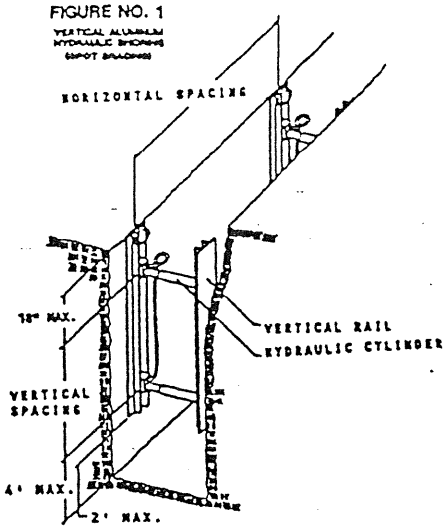


FIGURE NO. 2

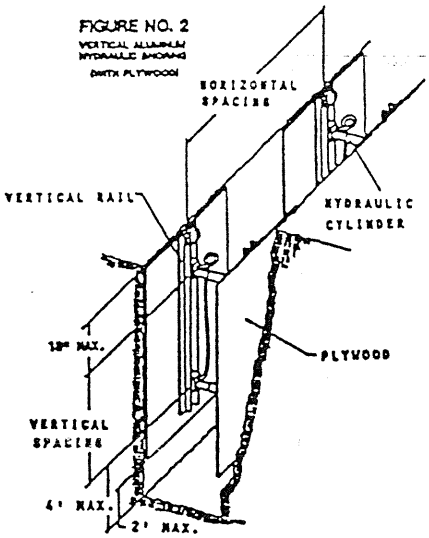


FIGURE NO. 3

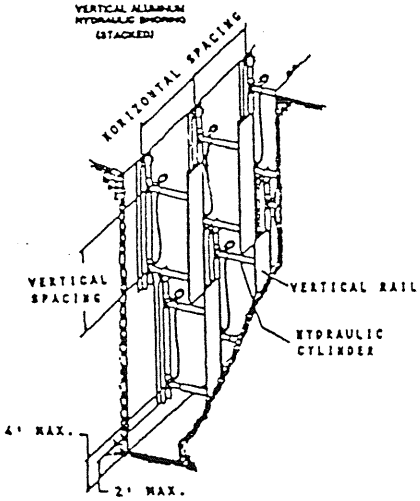


FIGURE NO. 4

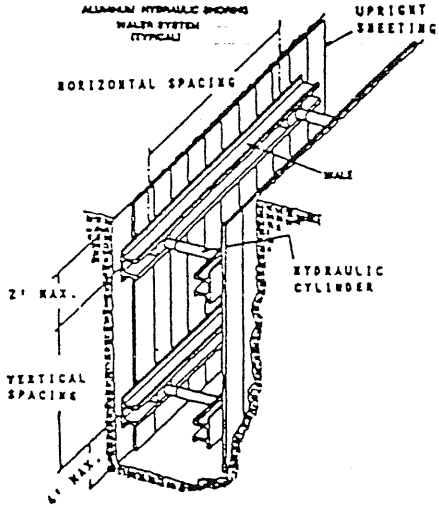


TABLE D - 1.1
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE A

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	8				
OVER 15 UP TO 20	7				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.2
ALUMINUM HYDRAULIC SHORING
VERTICAL SHORES
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	HYDRAULIC CYLINDERS				
	MAXIMUM HORIZONTAL SPACING (FEET)	MAXIMUM VERTICAL SPACING (FEET)	WIDTH OF TRENCH (FEET)		
			UP TO 8	OVER 8 UP TO 12	OVER 12 UP TO 15
OVER 5 UP TO 10	8	4	2 INCH DIAMETER	2 INCH DIAMETER NOTE (2)	3 INCH DIAMETER
OVER 10 UP TO 15	6.5				
OVER 15 UP TO 20	5.5				
OVER 20	NOTE (1)				

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Note (1): See Appendix D, Item (g) (1)
Note (2): See Appendix D, Item (g) (2)

TABLE D - 1.3
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE B

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX.HORIZ.SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	* SECTION MODULUS (IN^3)	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	8.0	2 IN	8.0	2 IN NOTE(2)	8.0	3 IN	—	—	3x12
		7.0	9.0	2 IN	9.0	2 IN NOTE(2)	9.0	3 IN			
		14.0	12.0	3 IN	12.0	3 IN	12.0	3 IN			
OVER 10 UP TO 15	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	—	3x12	—
		7.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 15 UP TO 20	4	3.5	5.5	2 IN	5.5	2 IN NOTE(2)	5.5	3 IN	3x12	—	—
		7.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
		14.0	9.0	3 IN	9.0	3 IN	9.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

TABLE D - 1.4
ALUMINUM HYDRAULIC SHORING
WALER SYSTEMS
FOR SOIL TYPE C

DEPTH OF TRENCH (FEET)	WALES		HYDRAULIC CYLINDERS						TIMBER UPRIGHTS		
			WIDTH OF TRENCH (FEET)						MAX.HORIZ SPACING (ON CENTER)		
	VERTICAL SPACING (FEET)	* SECTION MODULUS (IN³)	UP TO 8		OVER 8 UP TO 12		OVER 12 UP TO 15		SOLID SHEET	2 FT.	3 FT.
			HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER	HORIZ. SPACING	CYLINDER DIAMETER			
OVER 5 UP TO 10	4	3.5	6.0	2 IN	6.0	2 IN NOTE(2)	6.0	3 IN	3x12	—	—
		7.0	6.5	2 IN	6.5	2 IN NOTE(2)	6.5	3 IN			
		14.0	10.0	3 IN	10.0	3 IN	10.0	3 IN			
OVER 10 UP TO 15	4	3.5	4.0	2 IN	4.0	2 IN NOTE(2)	4.0	3 IN	3x12	—	—
		7.0	5.5	3 IN	5.5	3 IN	5.5	3 IN			
		14.0	8.0	3 IN	8.0	3 IN	8.0	3 IN			
OVER 15 UP TO 20	4	3.5	3.5	2 IN	3.5	2 IN NOTE(2)	3.5	3 IN	3x12	—	—
		7.0	5.0	3 IN	5.0	3 IN	5.0	3 IN			
		14.0	6.0	3 IN	6.0	3 IN	6.0	3 IN			
OVER 20	NOTE (1)										

Footnotes to tables, and general notes on hydraulic shoring, are found in Appendix D, Item (g)
Notes (1): See Appendix D, item (g) (1)
Notes (2): See Appendix D, Item (g) (2)
* Consult product manufacturer and/or qualified engineer for Section Modulus of available wales.

APPENDIX E TO SUBPART P—ALTERNATIVES TO TIMBER SHORING

Figure 1. Aluminum Hydraulic Shoring

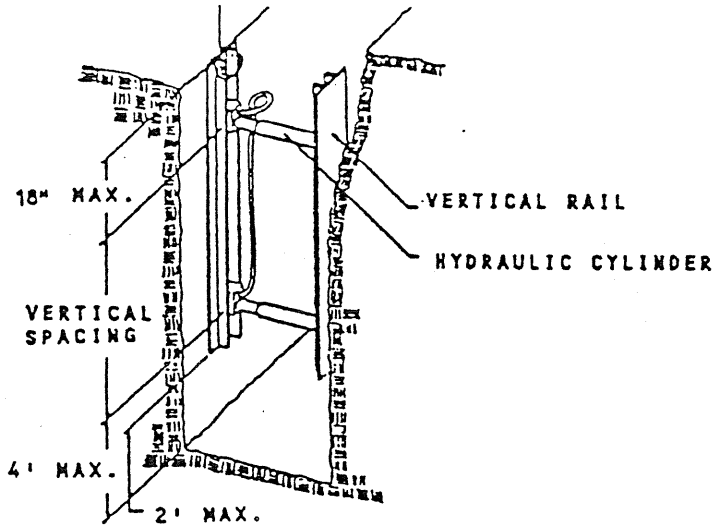


Figure 2. Pneumatic/hydraulic Shoring

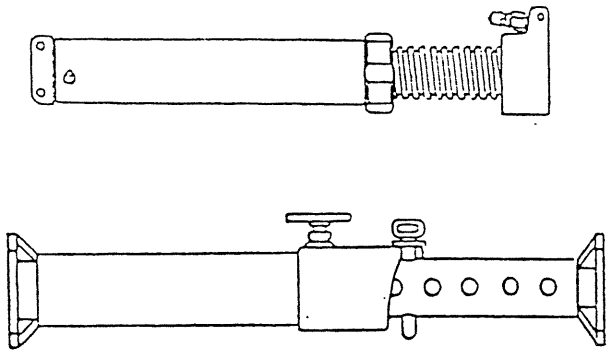


Figure 3. Trench Jacks (Screw Jacks)

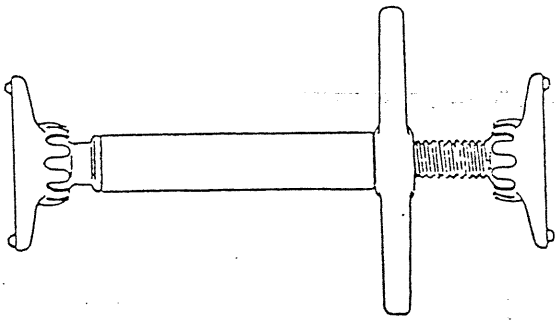
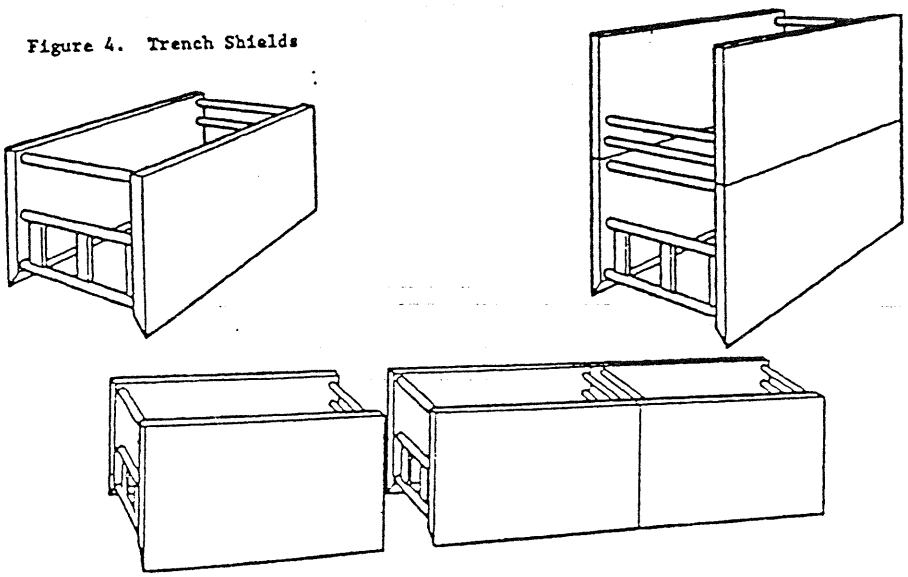


Figure 4. Trench Shields



APPENDIX F TO SUBPART P—SELECTION OF PROTECTIVE SYSTEMS

The following figures are a graphic summary of the requirements contained in subpart P for excavations 20 feet or less in depth. Protective systems for use in excavations more than 20 feet in depth must be designed by a registered professional engineer in accordance with § 1926.652 (b) and (c).

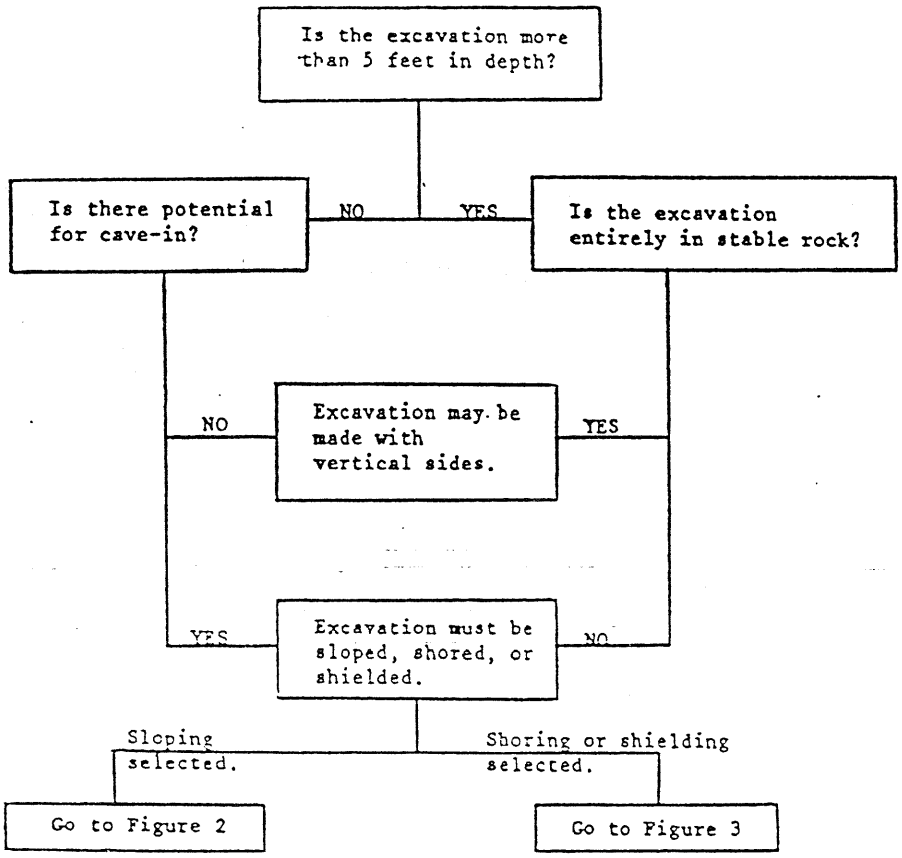


FIGURE 1 - PRELIMINARY DECISIONS

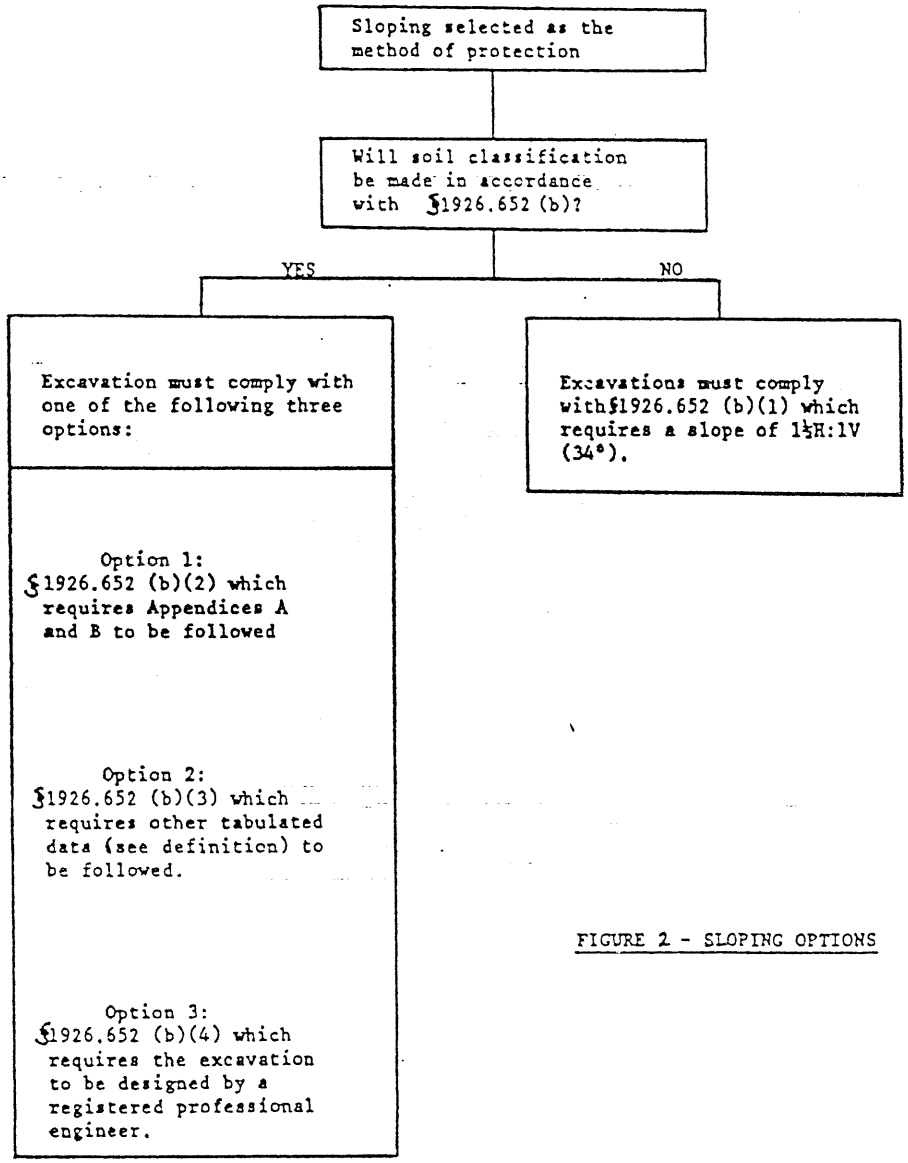


FIGURE 2 - SLOPING OPTIONS

Shoring or shielding selected as the method of protection.

Soil classification is required when shoring or shielding is used. The excavation must comply with one of the following four options:

Option 1
§1926.652 (c)(1) which requires Appendices A and C to be followed (e.g. timber shoring).

Option 2
§1926.652 (c)(2) which requires manufacturers data to be followed (e.g. hydraulic shoring, trench jacks, air shores, shields).

Option 3
§1926.652 (c)(3) which requires tabulated data (see definition) to be followed (e.g. any system as per the tabulated data).

Option 4
§1926.652 (c)(4) which requires the excavation to be designed by a registered professional engineer (e.g. any designed system).

FIGURE 3 - SHORING AND SHIELDING OPTIONS

SECTION 01020 - TPDES REQUIREMENTS

PART 1—GENERAL

The Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit No. TXR 150000, was issued March 5, 2003 (Construction General Permit). The Construction General Permit allows operators to obtain permit coverage for storm water conveyance from Small and Large Construction Activities. The TPDES program implements the federal National Pollutant Discharge Elimination System (NPDES) program in the state of Texas, which requires that operators of Small or Large Construction Activities obtain permit coverage prior to the commencement of construction activities.

The engineer has estimated that the project will disturb approximately 0.47 acres of land. **Therefore, a Storm Water Pollution Prevention Plan (SWP3) is not required. However, if required by the State's TPDES Program, the Contractor needs to provide and adequately implement an SWP3 as required for his construction support activities and proposed construction means and methods at no additional cost to the owner.**

1.01 SECTION INCLUDES

A. Documentation to be prepared and signed by Contractor before conducting construction operations, in accordance with the Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit Number TXR 150000, issued on March 5, 2003 (Construction General Permit).

B. Implementation, maintenance inspection, and termination of storm water pollution prevention control measures including, but not limited to, erosion and sediment controls, storm water management plans, waste collection and disposal, and other applicable practices shown on the drawings or specified elsewhere in the Contract.

1.02 DEFINITIONS

A. Commencement of Construction Activities: The exposure of soil resulting from activities such as clearing, grading, and excavating.

B. Large Construction Activity is defined as a project that:

1. disturbs five acres or more, or

2. disturbs less than five acres but is part of a large common plan of development that will disturb five acres or more of land.

C. Small Construction Activity is a project that:

1. disturbs one or more acres but less than five acres, or
2. disturbs less than one acre but is part of a larger common plan of development that will ultimately disturb one or more acres but less than five acres.

D. Operator is a person or persons who have day-to-day operation control of the construction activities, which are necessary to ensure compliance with the SWP3 for the site.

PART 2—PRODUCTS – Not Used

PART 3—EXECUTION

3.05 STORM WATER POLLUTION PREVENTION PLAN (SWP3) – Not Required for this Size Project

A The Contractor shall have an SWP3 prepared in accordance with Part III of the Construction General Permit for Small or Large Construction Activities. A professional engineer licensed in the state of Texas shall prepare the SWP3, in accordance with City of El Paso ordinance.

B Support Activities within 1-mile distance of project boundary of the permitted construction site, which directly supports the project, should be included in the Storm Water Pollution Prevention Plan prepared for the Contractor. These activities include but are not limited to:
(a) Equipment Staging Areas
(b) Material Storage yards
(c) Material Borrow areas
(d) Excavated material disposal areas
(e) Concrete batch plants
(f) Asphalt batch plants
Refer to Part II, Section A of the Construction General Permit for a description of Discharges Eligible for Authorization under the Construction General Permit.

C The SWP3 will be updated as needed during construction following Part III, Section E of the Construction General Permit.

D The SWP3 shall be submitted to the engineer 15 days after award of the contract. Any comments provided shall be addressed prior to commencing construction activities.

E The SWP3 shall be submitted to the City of El Paso Municipal Services for Review and Approval seven (7) days prior to commencement of construction activities. Refer to Part 3.01, Section E and Part 3.02, Section B for additional submittal requirements for Large and Small Construction Activities, respectively.

F The SWP3 shall be implemented prior to commencement of construction activities and maintained through the duration of construction.

3.01 LARGE CONSTRUCTION ACTIVITY – Not Required for this Size Project

A NOTICE OF INTENT (NOI)

1 The Contractor shall fill out, sign, and date the TCEQ Form 20022 (02/03) Notice of Intent for Storm Water Discharges Associated with Construction Activity under the TPDES Construction General Permit (TXR 150000), included at the end of this Section.

2 The Contractor shall submit a copy of the Notice of Intent (NOI) form, along with a signed check for $100.00, made out to the Texas Commission on Environmental Quality, and completed payment submittal form to the TCEQ. A copy of the package will be submitted to the engineer.

3 The engineer will complete a separate Notice of Intent (NOI) Form for the El Paso Water Utilities for submittal to the TCEQ.

4 Submission of the NOI form by both the El Paso Water Utilities and Contractor to TCEQ is required a minimum of two days before Commencement of Construction Activities.

5 The Contractor shall submit to the City of El Paso Municipal Services Department copies of the NOI.

6 Post a signed copy of the NOI near the main entrance of a construction site in a prominent place for viewing by the general public and local, state, and federal authorities prior to commencing construction activities, and maintain it in that location until completion of the construction. Post name and telephone number of Contractor's local contact person, brief project description and location of SWP3.

If Project is a linear construction project (e.g.: road, utilities, etc), post notice in a publicly accessible location near active construction. Move notice as necessary.

B NOTICE OF CHANGE (NOC) LETTER

If the operator becomes aware that he failed to submit any relevant facts or submitted incorrect information in the NOI, the correct information must be provided to the executive director in a NOC letter within 14 days after discovery. If relevant information provided in the NOI changes, a NOC letter must be submitted within 14 days of the change. A copy of the NOC must be provided to the engineer and City of El Paso Municipal Services Department.

C ANNUAL WATER QUALITY FEES

Large Construction activities authorized under the construction general permit must pay an annual Water Quality Fee of $100 per Part VII, Section B of the Construction General Permit.

D NOTICE OF TERMINATION (NOT)

1 Submit a Notice of Termination (NOT) to the TCEQ and the engineer ten (10) days after:

(a) Final stabilization has been achieved on all portions of the site that are the responsibility of the Contractor; or

(b) Another operator has assumed control over all areas of the site that have not been stabilized.

(c) All silt fences and other temporary erosion controls have either been removed, scheduled to be removed as defined in the SWP3, or transferred to a new operator if the new operator has sought permit coverage.

2 Submittal of the NOT to the engineer is required for final acceptance of the project.

3 The engineer will complete the El Paso Water Utilities NOT for submittal to TCEQ.

4 The Contractor shall submit a signed copy of the NOT to the City of El Paso Municipal Services Department.

E STORM WATER POLLUTION PREVENTION PLAN APPLICATION

1 Fill out and sign the City of El Paso Municipal Services Department Storm Water Pollution Prevention Plan Application.

2 Provide the engineer with a copy of the signed application 10 days prior to commencing construction activities.

3 Submit the original signed application along with a $100 fee and two copies of the SWP3 to Municipal Services for review and approval seven (7) days prior to commencing construction activities.

4 The Municipal Services point of contact is Mr. Steve Teran (541-4202).

3.02 SMALL CONSTRUCTION ACTIVITY – Not Required for this Size Project

A. CONSTRUCTION SITE NOTICE

1. Fill out, sign, and date the Construction Site Notice, included at the end of this Section. Submit the signed copy of the Construction Site Notice to the Engineer at least two days before commencement of construction activities.

2. Post a signed copy of the Construction Site Notice near the main entrance of a construction site in a prominent place for viewing by the general public and local, state, and federal authorities prior to commencing construction activities, and maintain it in that location until completion of the construction. Post name and telephone number of Contractor's local contact person, brief project description and location of SWP3.

   If Project is a linear construction project (e.g.: road, utilities, etc), post notice in a publicly accessible location near active construction. Move notice as necessary.

3. The Contractor shall submit a signed copy of the Construction Site Notice to the City of El Paso Municipal Services Department.

B. STORM WATER POLLUTION PREVENTION PLAN APPLICATION

   1. Fill out and sign the City of El Paso Municipal Services Department Storm Water Pollution Prevention Plan Application.

   2. Provide the engineer with a copy of the signed application 10 days prior to commencing construction activities.

   3. Submit the original signed application along with a $100 fee and two copies of the SWP3 to Municipal Services for review and approval seven (7) days prior to commencing construction activities.

   4. The Municipal Services point of contact is Mr. Steve Teran (541-4202).

3.03 CERTIFICATION REQUIREMENTS – Not Required for this Size Project

A. Fill out Pollution Prevention Plan Certification Form to include the Operator's signature, name, title and organization.

B. Contractor and Subcontractors shall sign and date Contractor's / Subcontractor's Certification for TPDES Permitting included at the end of this Section including Contractor's name, address, and telephone number, and the names of persons or firms responsible for maintenance and inspection of erosion and sediment control measures. Use multiple copies as required to document full information. Include this certification with other Project certification forms.

C. Submit properly completed certification forms to the engineer for review before commencing construction.

D. Conduct inspections in accordance with TCEQ requirements. Ensure persons or firms responsible for maintenance and inspection of erosion and sediment control measure read, fill out, sign, and date the Erosion Control Contractor's Certification for Inspection and Maintenance. Use EPA's NPDES Construction Inspection Form included at the end of this Section. Controls must be inspected once every fourteen (14) calendar days and within twenty four (24) hours of the end of a storm event of 0.5 inches or greater, in accordance with Part III, Section F, of the Construction General Permit.

3.04 RETENTION OF RECORDS – Not Required for this Size Project

A. Keep a copy of this document and the SWP3 in a readily accessible location at the construction site from Commencement of Construction Activity, and maintain it in that location until completion of the construction. Contractors with day-to-day operational control over SWP3 implementation shall have a copy of the SWP3 available at a central location, on-site, for the use of all operators and those identified as having responsibilities under the SWP3.

3.05 ON-SITE WASTE MATERIAL STORAGE

A. On site waste material storage shall be self-contained and shall satisfy appropriate local, state, and federal rules and regulations.

B. Prepare list of waste material to be stored on-site. Update list as necessary to include up-to-date information. Keep a copy of the updated list with the SWP3.

C. Prepare description of controls to reduce pollutants generated from on-site storage. Include storage practices necessary to minimize exposure of materials to storm water, and spill prevention and response measures consistent with best management practices. Keep a copy of the description with the SWP3.

SECTION 01021 – FIELD ENGINEERING

PART 1 - GENERAL

1.1 SCOPE OF WORK

Provide such field engineering services as required for proper completion of the Work including, but not necessarily limited to:

A. Structural design of shores, forms, braces and similar items provided by the Contractor as part of his means and methods of construction.

B. Using adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary skills and who are completely familiar with the specified requirements and methods for completion of the project.

1.2 CONSTRUCTION STAKING

A. The Contractor shall provide competent, suitably qualified personnel to survey and layout the work and perform construction as specified. The owner will provide on-site markings of existing water and sewer mains to be used as reference control for new pipeline fittings. The Contractor should take care to use the markings, efficiently so that re-markings will not be required or will be kept down to a maximum of one. Excess re-markings required from Owner shall be reimbursed to Owner by change order action.

1.3 SUBMITTALS

A. Upon request, the following shall be submitted:

1. Documentation verifying the accuracy of the field engineering work.

2. Certification, signed by the Contractor's Surveyor, stating that elevations and locations of improvements are in conformance with the requirements of the Contract Documents.

1.4 SURVEY MONUMENTS AND REFERENCE POINTS

A. In addition to the procedures directed by the Contractor, the Surveyor shall have the following responsibilities:

1. Locate all survey control monuments, points and reference points before starting work on the site.

2. Preserve and protect all permanent reference points and survey monuments during progress of the construction.

3. Do not change or relocate points without specific approval by the Engineer.

1.5 SUPPLIER'S/MANUFACTURER'S SPECIAL SERVICES

A. Installation Assistance: Competent and experienced technical personnel shall represent the manufacturers of all equipment and systems as may be necessary to resolve assembly or installation problems at the work site which are attributable to, or associated with, the equipment furnished.

B. Functional Testing: Where functional testing services are called for in the Technical Specifications, or when technical assistance is necessary to resolve performance problems that may become apparent during the performance test, the manufacturer's representative shall provide such assistance as necessary to demonstrate the specified performance.

C. Training of Owner's Personnel: Where training is called for in the Technical Specifications, the manufacturer's or supplier's representative shall provide classroom and on-the-job training for the Owner's personnel in the operation and maintenance of the specified equipment.

D. Scheduling and Coordination of Services: The Contractor shall designate and provide one person to be responsible for scheduling, coordinating, and expediting the specified services. Scheduling the services shall be done in cooperation with, and with the approval of the Engineer and Owner's operating personnel. Such schedule shall be arranged with the appropriate subcontractors, manufacturers, and suppliers in sufficient time to assure their compliance with the service requirements.

E. Costs for Services: Costs for providing services during installation, testing and for the training of Owner's personnel shall be included in the costs for providing the applicable specified equipment.

SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1 – GENERAL

1.1 REQUIREMENTS INCLUDED

A. Measurement and payment shall be as specified in this Section. Information regarding measurement and payment is further supplemented in each technical specification section. Work to be performed under this contract will be paid for on the basis specified under the appropriate Bid Items on the Bid Form.

B. The Contractor shall, within fifteen (15) days of receipt of Notice of Award, submit a complete breakdown of lump sum and other bid items showing the value assigned to each part of the Work including overhead and profit. Payment for materials delivered but not fully incorporated in the Work will be made only if such materials are listed and assigned a value in the Contractor's submittal, a paid receipt is provided, and the application for payment has been approved. The Engineer will review and approve the schedule of values prior to Owner's issuance of a Notice to Proceed.

C. General Scope of Work under each Bid Item includes labor, materials, and all incidental costs required for the construction of a completely functional and operational facility as detailed on the Drawings and in these Specifications.

1.2 ITEM DESCRIPTION

This is a description of the work included and the method of measurement and payment to be applied for the work in each proposal item. Measurement will be for work in place with no allowance for waste.

1. **Mobilization and Demobilization**: Measurement and payment shall be made at the stated lump sum for the mobilization/demobilization expenses associated with this Project. Payment shall include all costs for Contractor's 50 percent mobilization and 50 percent demobilization, insurance and bond, construction permits and fees, job trailers, staging area fencing, site administration expenses, stand pipe and temporary meter service, and utilities to the job trailers including power, telephone, construction water needs, etc. for the entire Project. This shall include all costs for Contract Close-out, site clean-up, and all costs associated with Contractor's demobilization from the site. Mobilization/Demobilization shall not exceed 5% of the total of the below Item Descriptions, 2-24.

2. **Earthwork - Excavation of Existing Soils and Regrading:** Measurement and payment for Excavation shall be made at the stated unit price per cubic yard (CY) and will include full compensation for excavating natural and original ground, clearing, grubbing, and hauling, for site grading and excavation required under the proposed finish grades, concrete slabs, sidewalks, proposed building, and proposed wet well structures (phase 1 and/or 2). This shall also include all ancillary requirements necessary to satisfactorily complete the work. The Contract price paid also includes shaping and trimming slopes to solid material and to the lines and elevations shown in the plans. The material to be removed may include existing rock and soil, and new fill material up to the elevation shown in plans. No additional compensation will be allowed for proof rolling subgrade as directed by the EPWater or Engineer. No additional compensation will be allowed for removing unsuitable material from the work site. No additional compensation will be allowed for placing unsuitable material in the embankment.

3. **Earthwork - Excavation of Retention Basin:** Measurement and payment for Excavation shall be made at the stated unit price per cubic yard (CY) and will include full compensation for excavating natural and original ground, clearing, grubbing, and hauling, for excavation of proposed retention pond. This shall also include all ancillary requirements necessary to satisfactorily complete the work. The Contract price paid also includes shaping and trimming slopes to solid material and to the lines and elevations shown in the plans. The material to be removed may include existing rock and soil, and new fill material up to the elevation shown in plans. No additional compensation will be allowed for proof rolling subgrade as directed by the EPWater or Engineer. No additional compensation will be allowed for removing unsuitable material from the work site. No additional compensation will be allowed for placing unsuitable material in the embankment.

4. **Earthwork - Placement of Fill and Compaction:** Measurement and payment for Earthwork placement of fill shall be made at the stated unit price per cubic yard (CY) and will include full compensation for importing (if needed), placement and compaction of select fill to finish grades and slope as indicated in the plans. Excavated soils may be replaced or reprocessed to meet the requirements of select fill in geotechnical report. No additional compensation will be allowed for placing unsuitable material in the embankment. No additional compensation will be allowed for reprocessing and placement of excavated material. Payment for geotextile fabric used in the backfill of unacceptable material encountered during sediment basin excavation and construction of the new spillway will be subsidiary to this line item at no additional cost.

5. **Asphalt Paving:** Measurement and payment for Asphalt Paving shall be made at the stated unit price per lump sum (LS) and will include full compensation for constructing a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant (D-GR HMA TY-D SAC-A PG70-22). Placement and compaction of HMA layer to finish grades and slope as indicated in the plans and in accordance with specifications. It will also include full compensation for applying an emulsified asphalt and water mixture as a base or subgrade treatment; as a prime coat; and full compensation for constructing a foundation course composed of flexible base FL BS (CMP IN PLC) (TY A GR 3) 6-in thick. This shall include but not be limited to all materials, equipment, tools, labor, superintendence, and incidentals required to complete the work.

6. **Std. 6-in concrete curb:** Measurement and payment shall be made at the stated unit price per linear feet (LF). This shall include but not be limited to all labor, material equipment, forming, base preparation, curing and clean-up and any other incidental items not specifically mentioned in the specifications or plans, which are necessary for the proper installation of standards 6-in curb as noted on plans.

7. **Concrete header curb:** Measurement and payment shall be made at the stated unit price per linear feet (LF). This shall include but not be limited to all labor, material equipment, forming, base preparation, curing and clean-up and any other incidental items not specifically mentioned in the specifications or plans, which are necessary for the proper installation of header curb as noted on plans.

8. **Concrete sidewalk:** Measurement and payment shall be made at the stated unit price per square yard (SY). This shall include but not be limited to all labor, material equipment, forming, base preparation, curing and clean-up and any other incidental items not specifically mentioned in the specifications or plans, which are necessary for the proper construction of hydraulic cement concrete sidewalks and/or slabs.

9. **8-ft Rockwall, Complete in Place:** Measurement and payment shall be made at the stated unit price per linear feet (LF) and will include required excavation and installation of concrete footing, uniform stone, and expansion joints. This will also include all labor, material equipment, forming, base preparation, curing and clean-up and any other incidental items not specifically mentioned in the specifications or plans, which are necessary for the proper construction an 8-ft rock wall.

10. **Iron Swing Gate, Complete in Place:** Measurement and payment shall be made at the stated unit price per each (EA). This shall include but not be limited to all labor, material equipment, welding, and any other incidental items not specifically mentioned in the specifications or plans, which are necessary for the proper installation of the iron swing gate.

11. **On-Site Water System Lines:** Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to trenching, pipe, piping connections, fittings, fittings for tie-ins, appurtenances, pipe embedment and backfill, detection tape, concrete blocking, restrained joints, labor, equipment, and any other incidental items not specifically mentioned in the specifications which are necessary for proper operation of the water system. This shall also include any other incidental items to install 730 LF of 8-inch DR-18 PVC Water Line, including connection to existing off-site 12-inch water main, 5-8-inch gate valves, 1-8-inch BFP and cover, 4-Fire Hydrant Assemblies, and 2-2-inch post hydrants, as called for in the plans and specifications. This shall also include all 3/4-inch and 2-inch service connections required for the operation of equipment. Refer to plans and specifications for other components required for the completion and operation of this item.

12. **Electrical Building (697 SF):** Measurement and payment shall be made at the stated lump sum (LS) and will include all labor, materials, equipment, fees required, and any other incidental items to construct a complete building structure and install the exterior building envelope and finishes as called for in the Architectural plans and specifications. This shall also include but not limited to roofing assembly, exterior sheathing, thermal insulation, joint sealants, rough carpentry, scuppers & gutters, hollow metal frames & doors, and door hardware. Refer to structural, electrical, and civil for other components required to the completion of this building, including HVAC system, louvers, light fixtures, electrical power, etc.

13. **Installation of 650 KVA, 277/480 Volt, 3 Phase Diesel Generator Set:** Measurement and payment shall be made at the stated lump sum (LS) and will include all labor, materials, equipment, fees required, and any other incidental items to install the generator set. This shall include other incidentals, as called for in the plans and specifications (Division 26). Refer to plans sheets and specifications for other components related and required for the completion and operation of this item.

14. **Installation of Electrical Power Distribution Equipment:** Measurement and Payment shall be made at the stated lump sum (LS) to include all labor, equipment, fees and any other incidental items to install a complete electrical distribution system as called for in the plans and specifications. This includes 277/480 volt, 3-phase, 800 amp combination Main Service Disconnect and ATS, distribution and branch circuit panels including overcurrent devices, equipment disconnect switches, low voltage transformers and variable frequency drives for phase 1 scope. Provide overcurrent devices for both phase 1 and phase 2 equipment. Provide equipment disconnects and branch circuits for all phase 1 equipment. Provide empty conduits and pull boxes for phase 2 equipment.

15. **Installation of Light Fixtures and Poles:** Measurement and Payment shall be made at the stated lump sum (LS) to include all labor, equipment, fees and any other incidental items to install interior and exterior lighting as called for in the plans and specifications. This includes fixtures, lamps, poles and lighting controls.

16. **Installation of Branch Circuits and Feeders:** Measurement and Payment shall be made at the stated lump sum (LS) to include all labor, equipment, fees and any other incidental items to install all branch and feeder circuits as called for in the plans and specifications. This includes underground conduits for utility-provided primary cables, underground secondary service conduit and cable, underground power and control circuits with pull boxes out to equipment installed in phase one and empty conduit and pull boxes for future phase 2 power and control circuits. Also includes all interior power and control/monitoring circuits within the electrical building.

17. **Installation of Equipment and Material for Obtaining Electrical Utility Service:** Measurement and Payment shall be made at the stated lump sum (LS) to include all labor, equipment, fees and any other incidental items to install electrical utility service to the facility as called for in the plans, specifications and as required by El Paso Electric. Scope includes primary conduit and secondary conduit and cable, transformer pad, separate support structure for utility metering including conduit and cable between meter and transformer and transformer grounding.

18. **Installation of Control and Monitoring Equipment:** Measurement and Payment shall be made at the stated lump sum (LS) to include all labor, equipment, fees and any other incidental items to install control and monitoring equipment as called for in the plans and specifications. Scope includes a Station Control Cabinet (RTU Cabinet) with 120 volt and 24 volt DC power supply and terminal blocks, PLC modules, relays, Ethernet switch, Ethernet / serial interface, integral UPS, station wireless transceiver, antenna and antenna support, lightning and surge protection, overload fusing, cabinet with interior LED panel light and switch. Include all Components as required to operate as indicated in the PNID control diagram and other drawing details and specifications. PLC will include Discrete Inputs and Output Modules for digital or relay communications and an analog input module for 0V – 10V or 4 – 20mA signals. Provide appropriate communications cabling between controller and lift station equipment, sensors, system control panels, security devices, fire/smoke detection devices, VFD's and pump controllers. Provide additional power and input/output addresses and terminals phase 2 equipment.

19. **Lift Station Phase 1:** Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to all labor, material, equipment, required fees, testing, and any other incidental items related to the installation of Lift Station Phase 1 components as called for in the plans and specifications (Divisions 9 – 23). Refer to plans and specifications for other components required for the proper completion and operation of this item.

20. **Gravity Sewer Lines:** Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to trenching, pipe, piping connections, fittings, fittings for tie-ins, appurtenances, pipe embedment and backfill, detection tape, concrete blocking, restrained joints, labor, equipment, and any other incidental items not specifically mentioned in the specifications which are necessary for proper operation of the sewer lines. This shall also include but not limited to any additional excavation, the installation of 6-ft manholes, 8-ft manholes, 10-ft manholes, 36-inch and 24-inch F679 PVC sewer pipe, all metering equipment, and equipment required for the operation of the sewer line and its components. Refer to plans and specifications for other components required for the proper completion and operation of this item.

21. **Force Main Sewer Lines:** Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to trenching, pipe, piping connections, fittings, fittings for tie-ins, appurtenances, pipe embedment and backfill, detection tape, concrete blocking, restrained joints, labor, equipment, and any other incidental items not specifically mentioned in the specifications which are necessary for proper operation of the force main lines as indicated on plans. This shall also include but not limited to any additional excavation, the installation of 10-ft manholes, 14, 16, 18, and 24-inch DI and DR-18 C-905 FM pipe, all metering equipment, and equipment required for the operation of the force main and its components. Refer

to plans and specifications for other components required for the proper completion and operation of this item.

22. **Phase 1 Odor Control, Washdown, and Overhead Crane:** Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to all labor, materials, equipment, fees required, and any other incidental items for the installation of equipment. This also includes the installation of all 4" SCH 40 DWV required for drainage and any excavation required, the installation of I-BOx-42 and I-BOx-7000 equipment, and the installation of EMH 5-ton, 75-ft, 3-cell, free standing NOMAD runway system. Refer to plans and specifications for other components required for the proper completion and operation of this item.

23. **Structural:** Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to all labor, materials, equipment, testing, and any other incidental items for the construction of concrete footings, walls, slabs on grade, and all other structural items required as called for in the Structural plans and specifications (Division 3 – 5). Refer to related sections in plans and specification for other components required in this item.

24. **Trench Safety System:** Trench Safety System: Measurement and payment shall be made at the stated unit price per lump sum (LS). This shall include but not be limited to all labor, materials, equipment, and incidentals required for the installation of proper trench safety system by Trench Box Method or Shoring, Sheeting, and Bracing Method as required.

SECTION 01200 – PROJECT MEETINGS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **Work Included**: To enable the orderly review during the progress of the work and to provide for the systematic discussion of problems, the Engineer will conduct project bi-weekly meetings throughout the construction period until substantial completion day. The meetings will be held at the Engineer's office located at 5822 Cromo Drive, Suite 210, El Paso, Texas 79912-5502. Meeting minutes will be prepared by the Engineer and provided to all attendees and Owner.

1.2 QUALITY ASSURANCE

Persons designated by the Contractor to attend and participate in the project meetings shall have all the required authority to commit the Contractor to solutions agreed upon in the project meetings.

PART 2 – PRODUCTS

2.1 MEETING SCHEDULE

Except as noted for the Pre-construction Meeting, project meetings will be held bi-weekly. Coordinate with the Owner, the Engineer, and others as necessary to establish a mutually acceptable schedule for the meetings.

2.2 PRE-CONSTRUCTION MEETING

A. A Pre-construction Meeting will be held at the Owner's main office. Attendance by authorized representatives of the Contractor, including the Project Superintendent, Foreman, Scheduler, and Project Manager, and all major subcontractors is required. The Engineer will advise other interested parties and request their attendance.

B. **Minimum Agenda**: Distribute data and discuss the following topics:

1. Organizational arrangements of Contractor's forces and personnel as well as those of the subcontractors, the materials suppliers, and the Engineer.

2. The channels and procedures for communications.

3. Finalize the construction schedule, schedule of submittals, dewatering, by-pass plan, and the trench safety system to be used prior to commencing construction.

4. Finalize the Preliminary Schedule of Values and closing date for monthly Applications for Payment.

5. The contract documents, including times of distribution of the required copies of the original documents and Notice to Proceed.

6. Finalize schedule of submittals and discuss the processing of Shop Drawings and other data submitted to the Engineer for review.

7. The processing of field decisions, work directive changes, and change orders.

8. The Rules and Regulations governing the performance of work.

9. The construction water and power supply; record drawings; etc.

10. Coordination with EPWU, and other Utilities representatives.

2.3 PROGRESS MEETINGS

A. **Attendance:** To the maximum extent practicable, assign the same person or persons to represent the Contractor at project meetings throughout progress of the work. At a minimum the Project Superintendent is to attend. Subcontractors, materials suppliers, and others may be invited to attend those project meetings in which their aspects of the work are involved.

B. **Minimum Agenda**:

1. Review, revise as necessary, and approve Engineer's minutes of the previous meeting.

2. Review progress of the work since the last meeting, including the status of submittals for approval.

3. Identify problems which impede planned progress and which impact the schedule.

4. Develop corrective measures and procedures to regain the planned schedule.

5. Complete other current business.

SECTION 01300 – SUBMITTALS AND SUBSTITUTIONS

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **Work Included**:

1. Wherever possible throughout the contract documents the minimum acceptable quality of workmanship and materials has been defined by the manufacturer's name and catalog number, reference to recognized industry and government standards, or description of required attributes and performance.

2. To ensure that the specified products are finished and installed in accordance with the design intent, procedures have been established for advance submittal of design data and for its review by the Engineer.

3. Make all submittals required by the contract documents, and revise and resubmit as necessary to establish compliance with the specified requirements.

B. **Related Work Described Elsewhere**: Individual requirements for submittals are described in other pertinent sections of these specifications.

1.2 QUALITY ASSURANCE

A. **Coordination of Submittals**: Prior to each submittal, carefully review and coordinate all aspects of each item being submitted and verify that each item and the submittal for it conform in all respects with the requirements of the contract documents. By affixing the Contractor's signature to each submittal, the Contractor certifies that this coordination has been performed. No submittals will be accepted by Engineer unless Contractor's certification is included therein.

B. **Certificates of Compliance**:

1. Certify that all materials used in the work comply with the specified provisions thereof. Certification shall not be construed as relieving the Contractor from furnishing satisfactory materials if, after tests are performed on selected samples, the materials are found to not meet specified requirements.

2. Show on each certification the name and location of the work, the name and address of the Contractor, the quantity and date or dates of shipment or delivery to which the certificate applies, and the name of the manufacturing or fabricating company. Certification shall be in the form of a letter or of a company-standard form containing all required data. Certificates shall be signed by an officer of the manufacturing or fabricating company.

3. In addition to the above information, all laboratory test reports submitted with Certificates of Compliance shall show the dates of testing, the specified requirements for which testing was performed, and results of the test or tests.

PART 2 - PRODUCTS

2.1 SUBMITTAL SCHEDULE

A. **General**: Compile a complete and comprehensive schedule of all submittals anticipated to be made during progress of the work. Include a list of each type of item for which the Contractor's drawings, Shop Drawings, Certificates of Compliance, material samples, guarantees, or other types of submittals are required. The submittal schedule will be finalized at the pre-construction meeting. Upon approval by the Engineer this schedule will become a part of the contract and the Contractor will be required to adhere to the schedule except when specifically otherwise permitted.

B. **Coordination:** Coordinate the schedule with all necessary subcontractors and materials suppliers to ensure their understanding of the importance of adhering to the approved schedule and their ability to so adhere. Coordinate as required to ensure the grouping of submittals as described in Paragraph 2.1 A above.

C. **Revisions**: Revise and update the schedule on a monthly basis as necessary to reflect conditions and sequences. Promptly submit revised schedules to the Engineer for review and approval.

2.2 SUBSTITUTIONS

A. Approved Required:

1. The Contract is based on the standards of quality established in the contract documents.
2. All products proposed for use including those specified by required attributes and performance, shall be approved by the Engineer before being incorporated into the work.

3. Do not substitute materials, equipment or methods unless, such substitution has been specifically approved by the Engineer.

B. "Or Equal":

1. Where the phrase "or equal" or "or equal as approved by the Engineer" occurs in the contract documents, do not assume that materials, equipment or methods will be approved as equal unless the item has been specifically approved by the Engineer through the submittal process.

2. Certain items of equipment in the specifications have been designated by the name of the manufacturer(s). Substitute equipment will be subject to review by the Engineer including, but not limited to, the following factors:

   a. References from existing users;
   b. Manufacturer's support available in the project vicinity;
   c. Availability of spare parts;
   d. Life cycle cost;
   e. Extended warranties.

   The contractor shall provide sufficient information for the Engineer to perform the evaluation objectively.

3. The decision of the Engineer shall be final.

2.3 IDENTIFICATION OF SUBMITTALS

A. **General**: Consecutively number all submittals. Accompany each submittal with a letter of transmittal containing all pertinent information required for identification and checking of submittals.

B. **Internal Identification**: On at least the first page of each submittal, and elsewhere as required for positive identification, clearly indicate the submittal number.

C. **Resubmittals**: When material is resubmitted for any reason, transmit under a new letter of transmittal and with a new submittal number.

D. **Submittal Log**: Maintain an accurate submittal log for the duration of the contract, showing current status of all submittals at all times. The submittal log must be available for the Engineer's review upon request.

2.4 COORDINATION OF SUBMITTALS

A. **General**: Prior to submittal for approval, use all means necessary to fully coordinate all material including but not limited to:

1. Determine and verify all interface conditions, catalog numbers and similar data.

2. Coordinate with other trades as required.

3. Clearly indicate all deviations from the requirements of the contract documents, guarantees, and warranties.

B. **Grouping of Submittals**: Unless otherwise specified, make all submittals in groups containing all associated items to ensure that information is available for checking each item.

2.5 TIMING OF SUBMITTALS

A. **General**: Make all submittals in advance of scheduled dates in accordance with approved schedule of submittals for installation to provide the time required for reviews, for securing the necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

B. **Engineer's Review Time**: In scheduling, allow fourteen (14) working days for review by the Engineer following the receipt of the submittal.

C. **Delays**: Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the contract completion date. The Contractor will be allowed two reviews per submittal, the initial review and one resubmittal. The Contractor will be charged for submittals over the first two. The charge will be according to the time required for review and will be reimbursed to owner by Change Order.

2.6 ENGINEER'S REVIEW

A. **General**: Review by the Engineer shall not be construed as a complete check, but only that the general method of construction and detailing is satisfactory. Review shall not relieve the Contractor from responsibility for errors which may exist.

B. **Authority to Proceed**: The notations "Approved, no exceptions noted" or "Approved, exceptions noted" authorize the Contractor to proceed with fabrication, purchase, or both, of the items so noted, subject to the revisions, if any, required by the Engineer's review comments.

C. **Revisions**: Make all revisions required by the Engineer. If the Contractor considers any required revision to be a change, he shall so notify the Engineer as provided for under "Changes" in the General Conditions. Show each drawing revision by number, date and description in a revision block on the drawing. Make only those revisions directed or approved by the Engineer.

D. **Revisions After Approval**: When a submittal has been reviewed by the Engineer, resubmittal for substitution of materials or equipment will not be considered unless accompanied by an acceptable explanation as to why the substitution is necessary.

SECTION 01350 – SCHEDULING AND ORDER OF CONSTRUCTION

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. **Work Included**: To assure adequate planning and execution of the Work so that the Work is completed within the number of calendar days allowed in the Contract, and to assist the Owner in appraising the reasonableness of the proposed schedule and in evaluating progress of the Work, prepare a detailed work plan and schedule indicating critical paths and milestone completion dates. The foregoing is due 14 days after Notice to Proceed. Engineer's approval of an acceptable schedule is required as a condition precedent to approval of the first pay application.

B. **Definitions**:

1. "Day", as used throughout the Contract unless otherwise stated, means "calendar day", including Saturdays, Sundays, and legal holidays authorized by the City of El Paso.

1.2 SUBMITTALS

A. **Preliminary Schedule**: Submit a copy of the preliminary construction schedule to the Engineer no later than fifteen (15) days after award. The schedule will be finalized at or before the pre-construction meeting. Work may not begin without an approved schedule. After approval submit four (4) prints of a final schedule indicating all construction activities and milestone completion dates. A baseline should be incorporated into the schedule and the schedule updated throughout the conduct of the project.

B. **Periodic Reports**: Submit with each month's Pay Application as a condition precedent to review of the Pay Application. At the project meetings following submittal of the above revised schedule, submit progress update to the schedule status reports to the Owner updating the construction progress. The reports will include but not be limited to:

1. Revised schedule showing actual progress.

2. Activities or portions of activities completed during the reporting period, and their total value as basis for Contractor's periodic request for payment.

3. State the percentage of the Work actually completed and scheduled as of the report date.

4. The Contractor will provide information including the number and location of potholes he needs to excavate to verify the location of underground utilities.

5. If the Contractor foresees that a portion of the existing sanitary sewer main system will have to be temporarily taken out of service, he should include a plan on how he will perform this work. It is possible this work will have to be done during periods of low demand, generally between the hours of 11:00 pm - 4:00 a.m._____.

   a. Shut-downs of the existing sanitary sewer main system for connections must be planned and scheduled.

      1) The Contractor will submit a written plan of action for approval by the Engineer to shut down the existing sanitary sewer main to connect to it.

      2) The Plan of Action shall be submitted a minimum of 14 calendar days of notice to proceed and shall include a description of the following:

(a) Construction necessary
(b) List of equipment and necessary manpower
(c) Shut-off times and duration of time the service or utility will be disturbed
(d) Utilities, piping, or services affected
(e) Estimation of the area to be put out of service
(f) Procedures to be used to carry out the work
(g) Traffic Control Plan
(h) Excavation limits
(i) Thrust block curing times
(J) Plan of Action to handle emergencies
(k) Contingency plan that will be used if the original schedule cannot be met

3) After the Plan of Action is submitted, a meeting will be held to discuss the various items listed on the plan and any issues related to the connection.

4) Contractor will be responsible for the preparation and distribution of flyers to residents and businesses in areas that will be affected by the construction.
The following criteria shall apply to the distribution of flyers:
(a) Contractor will distribute flyers at least two weeks prior to the planned disruption and again 24 hours before each disruption
(b) Flyer information shall include the day, time, and duration of water shut-off. They shall be attached to the door handle with a rubber band and/or string.
(c) The Owner, Engineer, and Contractor shall decide which target areas need to have flyers distributed. The Contractor will also distribute to customers outside and adjacent to the target area. These areas will be identified at the meeting held to discuss the proposed Plan of Action.
(d) The flyers must be reviewed and approved by the Owner and Engineer before being distributed.
(e) The Contractor shall not disrupt service until he has confirmed that the above requirements have been met.

5) Once the contractor begins a connection to the existing sanitary sewer main, work must be continuous until the connection is complete and the facility is back in operation.

6. If the work is behind schedule, include a narrative report which shows, but is not limited to:
a. A description of problem areas, anticipated and current;
b. Delaying factors and their impacts;
c. An explanation of corrective actions taken or proposed.

C. **Revisions**: Based on periodic reports, submit four (4) prints of the revised schedule showing progress updates compared to the approved baseline schedule. The revised schedule shall be submitted monthly as part of the application for payment and as a condition precedent to review and approval of such application for payment.

2.0 CONTINUITY OF OPERATIONS AND SEQUENCE CONSTRUCTION

A. **Continuity of Operations**: The existing sanitary sewer system is currently and continuously providing sewer service to the contiguous service area; those functions shall not be interrupted except as specified herein.

SECTION 01400 – TESTING LABORATORY SERVICES

PART 1 – GENERAL

1.1 SCOPE OF WORK

Where tests of materials or any portions of the Work are required by law/ordinance or public authority, the Contractor shall bear all costs of such tests, shall give timely notice of readiness therefore and shall furnish to the Engineer the required certification of testing or approval.

The tests in the fourth category shall include test normally performed by a commercial laboratory for materials such as: density tests for pipe bedding, trench and/or structural backfill, sub-grade, base course, and hot mix; proctor tests and Atterberg Limits for pipe bedding, trench and/or structural backfill, sub-grade and base course; in place densities for Asphalt pavement, including Marshall stability, Asphalt extraction and gradation tests; cylinders for concrete compressive strength, mortar cubes and prisms for grout strength.

Tests specified in the Technical Specifications shall fall into four categories: (1) those required for approval of materials prior to use, which serve the same purpose as shop drawings or samples; (2) those required by law; (3) those necessary for acceptance of equipment, or facilities, and (4) those made during the progress of the Work to check compliance with the requirements of the Contract Documents. The Contractor shall bear all the costs of the tests in the first three categories.

Tests conducted in the fourth category shall be carried out at the discretion of the Engineer. The cost for testing materials in this category shall be paid for by the Owner, with the following exception. The Contractor shall furnish the materials for any samples and shall fully cooperate with the Engineer or Testing Laboratory in securing such samples. In addition, all failing tests under category (4) shall be paid for by the Contractor. Any re-work necessary by the Contractor to obtain passing tests shall be at the Contractor's cost and at no time extension for delays will be considered by the Owner.

1.2 QUALITY ASSURANCE

A. Qualifications of Testing Laboratory: The testing laboratory will be qualified in accordance with ASTM E329. The testing laboratories qualifications shall be submitted to the Engineer for approval before testing begins.

B. Codes and Standards: Testing, when required, will be in accordance with pertinent codes and regulations and with selected standards of the American Society for Testing on Materials.

1.3 COORDINATION

The testing representative shall process and distribute to the Engineer, the Owner, and to City Engineering required copies of test reports and related instructions to ensure necessary retesting and replacement of materials with the least possible delay in progress of the work.

1.4 CODE COMPLIANCE TESTING

Inspections and tests required by codes or ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the contract documents.

1.5 INSPECTION BY OWNER'S PERSONNEL

From time to time, personnel employed by the Owner may inspect the work where the work is in progress, but shall have no authority to direct the Contractor or request changes in the work except through the Engineer.

1.6 TAKING SPECIMENS

Specimens and samples for testing, unless otherwise provided in the contract documents, will be taken by the testing personnel. Sampling equipment and personnel will be provided by the testing laboratory. Deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

1.7 SCHEDULES FOR TESTING

A. **Establishing the Schedule**: By advance discussion with the testing laboratory, the Contractor will determine the time required for the laboratory to perform its tests, to issue each of its findings and the lead time required for the laboratory to collect specimens. The Owner will provide the required time to the Contractor, so that it can be incorporated in the construction schedule.

B. **Revising the Schedule**: When changes on the testing schedule are necessary, coordinate such changes of schedule with the Engineer as required.

1.8 MINIMUM REQUIREMENTS FOR TESTS

The Contractor shall be required to meet the following minimum requirements for the tests:

A. **Sanitary Sewer Main**:

1. Field Densities (backfill):
   a. Pipe Lines and Conduits — 1 density per 200 linear feet (l.f.) from top of pipe bedding zone and 18" below subgrade
2. Modified Proctors: As required by change in material.

B. **Street Construction**:

1. Field Densities:
   a. Subgrade — 2 densities per 200 l.f.
   b. Subbase — 2 densities per 200 l.f.
   c. Base Course — 2 densities per 200 l.f.
   d. Asphalt Pavement — 2 densities per 200 l.f. per layer
2. Concrete: 1 set (four specimens) per each 8 cy or less
3. Sieve Analysis: Base course and subbase 1 gradation per 1,000 l.f.
4. Asphalt Pavement: 1 gradation, extraction and set of briquettes per 500 feet of roadway and in-place density of asphalt every 250 feet of roadway or as recommended by the Materials Testing Engineer representing the Testing Laboratory.

SECTION 01750 – PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 SCOPE OF WORK

Throughout progress of the work of this contract, maintain an accurate record of all changes in the contract documents, as described in Article 1.6 below.

1.2 QUALITY ASSURANCE

A. **General**: Delegate the responsibility for maintenance of record documents to one key person on the Contractor's on-site staff as approved in advance by the Engineer.

B. **Accuracy of Records**: Thoroughly coordinate all changes within the record documents, making adequate and proper entries on each page of the specifications and each sheet of drawings and other documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the contract documents may reasonably rely on information obtained from the approved record documents.

C. **Timing of Entries**: Make all entries within 24 hours after receipt of information. One (1) set is to be maintained at the Contractor's job trailer at all times. One set will be maintained by the Engineer. Record documents are to be updated as a condition precedent to review and approval of each pay application

1.3 SUBMITTALS

A. **General**: The Engineer's approval of the current status of record documents will be a prerequisite to the Engineer's approval of requests for each progress payment and request for final payment under the contract.

B. **Progress Submittals**: Prior to submitting each request for progress payment, secure the Engineer's approval of the record documents as currently maintained.

C. **Final Submittal**: Prior to submitting requests for final payments, as part of the contract close-out requirements, submit the final record documents to the Engineer and secure his approval.

1.4 PRODUCT HANDLING

Use all means necessary to maintain the job set of record documents completely protected from deterioration and from loss and damage until completion of the Work and transfer of the recorded data to the final record documents. In the event of loss of recorded data, use all means necessary to secure the data to the Engineer's approval; such means shall include, if necessary in the opinion of the Engineer, removal and replacement of concealing materials and, in such case, all replacements shall be to the standards originally specified in the contract documents.

1.5 RECORD DOCUMENTS

A. **Job Set**: Promptly following Notice to Proceed, secure from the Owner's Purchasing Agent, at no charge to the Contractor ten (10) complete sets of all documents comprising the contract.

1.6 MAINTENANCE OF JOB SET

A. **Identification**: Immediately upon receipt of the job set described in Paragraph 1.5 above, identify each of the documents with the title "**RECORD DOCUMENTS** – Job Set".

B. **Preservation**:

1. Considering the contract completion time, the probable number of occasions upon which the job set must be taken out for new entries and for examination, and the conditions under which these activities will be performed, devise a suitable method for protecting the job set.

2. Do not use the job set for any purpose except entry of new data and for review by the Engineer, until the data is transferred to final record documents by the Engineer.

C. **Making Entries on Drawings**: Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by note and by graphic line, as required. Date all entries. Call attention to the entry by highlighting around the area or areas affected. In the event of overlapping changes, different colors may be used for each of the changes.

D. **Making Entries on Other Documents**:

1. Where changes are caused by directive issued by the Owner through the Engineer, clearly indicate the change by a note in ink, colored pencil or rubber stamp.

2. Where changes are caused by Contractor-originated proposals approved by the Owner, including inadvertent errors by the Contractor which have been accepted by the Engineer, clearly indicate the change by a note in erasable colored pencil.

3. Make entries in the pertinent documents as approved by the Engineer.

E. **Layouts**:

1. In most cases on the drawings, arrangement of piping, fittings and appurtenances are shown schematically and are not intended to portray precise physical layout. Final physical arrangement is as determined by the Contractor, subject to the Engineer's approval. However, design of future modifications of the facility will require accurate information as to the final physical arrangement of items which are shown only schematically on the drawings.

2. Show on the job set of record drawings, by dimension accurate to within 6", the centerline of each run of items such as are described in Paragraph 1 above. Clearly identify the item by accurate note such as "gate valve", "center of water line", etc. Show, by symbol or note, the vertical location of the item ("under pavement", "exposed", etc.). Make all identification sufficiently descriptive that it may be related reliably to the specifications.

3. The Engineer may waive the requirements for conversion of schematic data where, in the Engineer's judgement, such conversion serves no beneficial purpose. However, do not rely upon waivers being issued except as specifically issued in writing by the Engineer.

F. **Accuracy of Entries**: Use all means necessary, including the proper tools for measurement, to determine actual locations of the installed items.

PART 2 – PRODUCTS

2.1 FINAL RECORD DOCUMENTS

A. **Transfer of Data to Other Documents**: If the documents have successfully been kept clean during progress of the work, and if entries have been sufficiently orderly it will facilitate the transfer of changed data to a new copy. Obtain the approval of the Engineer.

B. **Review and Approval:** Submit the completed final set of record documents to the Engineer. Participate in review meeting or meetings as required by the Engineer, make all required changes in the record documents, and promptly deliver the final record documents to the Engineer.

DIVISION 2

SITE WORK

SECTION 02000

SECTION 02001 – MOBILIZATION

PART 1 – GENERAL

1.1 SCOPE OF WORK

This work shall consist of preparatory work and operations, including but not limited to those necessary for the movement of personnel, equipment, supplies and incidentals to the project site; for the establishment of all offices, buildings and other facilities necessary for work on the project, and for all other work and operations, which must be performed or costs incurred prior to beginning work on various contract items on the project site.

PART 2 – PRODUCTS

2.1 There are no specific products in this section of the specifications.

PART 3 – MEASUREMENT AND PAYMENT

3.1 PAYMENT FOR MOBILIZATION SERVICES

Measurement and payment shall be made at the stated lump sum for the mobilization/demobilization expenses associated with this Project. Payment shall include all costs for Contractor's 50 percent mobilization and 50 percent demobilization, insurance and bond, construction permits and fees, job trailers, staging area fencing, site administration expenses, stand pipe and temporary meter service, and utilities to the job trailers including power, telephone, construction water needs, etc. for the entire Project. This shall include all costs for Contract Close-out, site clean-up, and all costs associated with Contractor's demobilization from the site. Mobilization/Demobilization shall not exceed 5% of the total of Bid Items 2 through 19.

END OF SECTION 02001

SECTION 02100 – SITE PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cleaning site of debris, grass, trees, and other plant life in preparation for site or building earthwork.

B. Protection of existing structures, trees, or vegetation indicated on the Construction Drawings to remain.

C. Stripping topsoil from areas that are to be incorporated into limits of project and where so indicated on Construction Drawings.

1.02 RELATED SECTIONS

A. Section 02200 – Earthwork

B. Section 02221 - Excavation Backfill and Compaction for Structures

C. Section 02222 - Excavation Backfill and Compaction for Utilities

D. Section 02223 - Excavation Backfill and Compaction for Pavement

E. Section 02511 – Asphaltic Concrete Paving

F. Section 02525 – Curbs and Sidewalks

G. Construction Drawings

1.03 ENVIRONMENTAL REQUIREMENTS

A. Construct temporary erosion control systems as shown on Construction Drawings or as directed by "Storm Water Pollution Prevention Plan" (SWPPP) to protect adjacent properties and water resources from erosion and sedimentation. The Contractor shall be familiar with all criteria and requirements of Federal Register, Part II, E.P.A. reissuance of NPDES General Permits for Storm Water Discharges from Construction Activities in Region 6, Notice 7/6/98.

B. Contractor shall perform all required inspections of erosion control measures in the SWPPP.

C. Contractor shall notify consulting engineer at once if site conditions warrant additional erosion control measures. Contractor is responsible for taking immediate action to remedy erosion control while consulting engineer is preparing response.

D. Contractor shall not begin construction without "National Pollution Discharge Elimination System" (NPDES) permit governing discharge of storm water from site for entire construction period. NPDES permit requires SWPPP to be in place during construction. Contractor shall file a Notice of Intent (NOI) at least 48 hours prior to start of construction. A copy of the filed NOI shall be submitted to the Engineer

E. Contractor shall be totally responsible for conducting storm water management practices in accordance with NPDES permit and for enforcement action taken or imposed by Federal or State agencies, including cost of fines, construction delays, and remedial actions resulting from Contractor's failure to comply with provisions of NPDES permit.

1.04 PROJECT CONDITIONS

A. Conditions existing at time of inspection for bidding purposes will be maintained by Owner in so far as practical.

B. Variations to conditions or discrepancy in actual conditions as they apply to site preparation operations

are to be brought to attention of Owner prior to commencement of sitework.

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Off-site materials shall be transported to project using well-maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify existing plant life that is to remain and verify clearing limits are clearly tagged, identified, and marked in such manner as to ensure their safety throughout construction operations.

3.02 PROTECTION

A. Locate and identify existing utilities that are to remain and protect these from damage.

B. Conduct operations with minimum interference to public or private accesses and facilities. Maintain ingress and egress at all times and clean or sweep roadways daily as required by SWPPP or governing authority. Dust control shall be provided with sprinkling systems or equipment provided by Contractor.

C. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

D. Provide traffic control as required, in accordance with the U.S. Department of Transportation's "Manual on Uniform Traffic Control Devices" and applicable state highway department requirements.

3.03 CLEARING

A. Clear areas required for access to site and execution of work.

B. Unless otherwise indicated on Construction Drawings, remove trees, shrubs, grass, other vegetation, improvements, or obstructions interfering with installation of new construction. Removal includes digging out stumps and roots. Depressions caused by clearing and grubbing operations are to be filled to subgrade elevation to avoid ponding of water. Satisfactory fill material shall be placed in accordance with Section 02200.

C. Remove grass, trees, plant life, stumps, and other construction debris from site to dump site that is suitable for handling such material according to state laws and regulations.

3.04 TOPSOIL EXCAVATION

A. Topsoil shall consist of organic surficial soil found in depth of not less than 6-inches. Satisfactory topsoil shall be reasonably free of subsoil, clay lumps, stones and other objects over 2-inches in diameter, weeds, roots, and other objectionable material.

B. Cut heavy growths of grass from areas before stripping and remove cuttings with remainder of cleared vegetative material.

C. Strip topsoil from areas that are to be filled, excavated, landscaped, or re-graded to such depth that it prevents intermingling with underlying subsoil or questionable material.

D. Stockpile topsoil in storage piles in areas shown on Construction Drawings or where directed by Owner. Construct storage piles to freely drain surface water. Cover storage piles as required to prevent windblown dust. Dispose of unsuitable topsoil as specified for waste material, unless otherwise specified by Owner. Excess topsoil shall be removed from site by Contractor unless specifically noted otherwise on Construction Drawings.

END OF SECTION 02100

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Protection, modification, or installation of utilities as sitework progresses with particular attention to grade changes and necessary staging or phasing of work.

B. Cutting, filling, and grading to required lines, dimensions, contours, and elevations for proposed improvements.

C. Scarifying, compacting, drying, and removal of unsuitable material to ensure proper preparation of areas for fills or proposed improvements.

1.02 RELATED SECTIONS

A. Section 02100 – Site Preparation

B. Section 02221 – Excavation, Backfill, and Compaction for Structures.

C. Section 02222 – Excavation, Backfill, Compaction for Utilities

D. Section 02223 – Excavation, Backfill, and Compaction for Pavement.

E. Construction Drawings

1.03 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM) latest edition

1. D 698 Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN.m/m^3))
2. D 1556 Density and Unit Weight of Soil in Place by the Sand-Cone Method
3. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 Kn.m/m^3))
4. D 2167 Density and Unit Weight of Soil in Place by the Rubber Balloon Method
5. D 2216 Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
6. D 2487 Classification of Soils for Engineering Purposes
7. D 2922 Density of Soil and Soil-Aggregarte in Place by Nuclear Methods (Shallow Depth)
8. D 3017 Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
9. D 4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils

B. American Association of State Highway and Transportation Officials (AASHTO) latest edition

1. T 88 Particle Size Analysis of Soils

1.04 QUALITY ASSURANCE

A. An independent testing laboratory, selected and paid by Owner, shall be retained to perform construction testing on site.

1. The independent testing laboratory shall prepare test reports that indicate test location, elevation data, and test results. Owner, Civil Engineering Consultant, and Contractor shall be provided with copies of reports within 96 hours of time that test was performed. In event that test performed fails to meet Specifications, Owner and Contractor shall be notified immediately by the independent testing laboratory.

2. Costs related to retesting due to failures shall be paid for by Contractor at no additional expense to Owner. Contractor shall provide free access to site for testing activities.

1.05 SUBMITTALS

A. Submit 100-pound sample of each type of off-site fill material that is to be used at the site in air tight container(s) for the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.

B. Submit name of each material supplier and specific type and source of each material. Change in source throughout project requires approval of Owner.

C. If fabrics or geogrids are to be used, design shall be submitted for approval to Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Excavated and re-used material for subsoil fill as specified herein.

B. Aggregate fill as specified in Section 02227.

C. Imported fill material approved by Owner and specified herein.

D. Topsoil fill as specified in Section 02100.

E. Acceptable stabilization fabrics and geogrids as specified in Section 02245.

F. Filter and drainage fabrics as specified in Section 02270.

2.02 EQUIPMENT

A. Transport off-site materials to project using well maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

2.03 SOURCE QUALITY CONTROL

A. In areas to receive pavement, California Bearing Ratio (CBR) or Limerock Bearing Ratio (LBR) test shall be performed for each type of material that is imported from off-site.

B. Following tests shall be performed as part of construction testing requirements on each type of on-site or imported soil material used as compacted fill:

1. Moisture and Density Relationship: ASTM D 698 (or ASTM D 1557)
2. Mechanical Analysis: AASHTO T 88
3. Plasticity Index: ASTM D 4318

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Locate and identify existing utilities that are to remain and protect from damage.

C. Notify utility companies to remove or relocate utilities that are in conflict with proposed improvements.

D. Protect plant life, lawns, fences, existing structures, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Protect benchmarks, property corners, and other survey monuments from damage or displacement. If market needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same

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F. Remove from site, material encountered in grading operations that, in opinion of Owner, is unsuitable or undesirable for backfilling, subgrade, or foundation purposes. Dispose of in manner satisfactory to Owner. Backfill areas with layers of suitable material and compact as specified herein.

G. Prior to placing fill in low areas, such as previously existing creeks, ponds, or lakes, perform following procedures:

1. Drain water out by gravity with ditch having flow line lower than lowest elevation in low area. If drainage cannot be performed by gravity ditch, use adequate pump to obtain the same results.

2. After drainage of low area is complete, remove mulch, mud, debris, and other unsuitable material by using acceptable equipment and methods that will keep natural soils underlying low area dry and undisturbed.

3. If proposed for fill, muck, mud, and other materials removed from low areas shall be dried on-site by spreading in thin layers for observation by Owner. Material shall be inspected and, if found to be suitable for use as fill material, shall be incorporated into lowest elevation of site filling operation, but not under building subgrade or within 10'-0" of perimeter of building subgrade or paving subgrade. If, after observation by Owner, material is found to be unsuitable, unsuitable material shall be removed from site.

3.02 EXCAVATION FOR FILLING AND GRADING

A. Classification of Excavation: By submitting bid, Contractor acknowledges that site has been investigated to determine type, quantity, quality, and character of excavation work to be performed. Excavation shall be considered unclassified excavation, except as indicated in the Contract Documents.

B. When performing grading operations during periods of wet weather, provide adequate drainage and ground water management to control moisture of soils.

C. Shore, brace, and drain excavations as necessary to maintain excavation as safe, secure, and free of water at all times.

D. Select Fill: The material used as select fill should be a very sandy clay or clayey sand with a liquid limit of less than 35, a plasticity index between 4 and 15, and a minimum dry unit weight of 110 pcf. It should be spread in loose lifts, less than 9 inches thick, and uniformly compacted to a minimum of 95 percent of maximum dry density within –2 to +3 percent of optimum moisture content as determined in accordance with ASTM D 698.

E. Excavated material containing rock or stone greater than 6-inches in largest dimension is unacceptable as fill within proposed building subgrade and paving subgrade.

F. Rock or stone less than 6-inches in largest dimension is acceptable as fill to within 24-inches of surface of proposed subgrade when mixed with suitable material.

G. Rock or stone less than 2-inches in largest dimension and mixed with suitable material is acceptable as fill within the upper 24-inches of proposed subgrade.

H. The various on-site clay soils may be used for general site grading and filling under pavement areas and in open areas. Fills beneath structures should consist of select fill as described in Section 7.3.4 of the Geotechnical Report unless otherwise called for in the Architectural/Structural specifications.

3.03 FILLING AND SUBGRADE PREPARATION

A. Fill areas to contours and elevations shown on Construction Drawings with unfrozen materials.

B. Place fill in continuous lifts specified herein.

C. Refer to Section 02221 for filling requirements for structures.

D. Refer to Section 02222 for filling requirements for utilities.

E. Refer to Section 02223 for filling requirements pavements.

F. Refer to Section 02245 for soil stabilization using lime, cement, fly ash, and geotextile fabrics.

G. Refer to section 02229 for rock excavation.

H. Areas exposed by excavation or stripping and on which subgrade preparations are to be performed shall be scarified to minimum depth of 8-inches and compacted to minimum of 95 percent of optimum density, in accordance with ASTM D 698 (or 92 percent of optimum density, in accordance with ASTM D 1557) at moisture content of not less than 1 percent below and not more than 4 percent above optimum moisture content. These areas shall then be proofrolled to detect areas of insufficient compaction. Proofrolling shall be accomplished by making minimum of 2 complete passes with fully-loaded tandem-axle dump truck, or approved equal, in each of 2 perpendicular directions while under the supervision and direction of the independent testing laboratory. Areas of failure shall be excavated and recompacted as specified herein.

I. Fill materials used in preparation of subgrade shall be placed in lifts or layers not to exceed 8-inches loose measure and compacted to minimum density of 95 percent of optimum density, in accordance with ASTM D 698, (or 92 percent of the optimum density, in accordance with ASTM D 1557) at moisture content of not less than 1 percent below and not more than 3 percent above optimum moisture content.

J. Material imported from off-site shall have CBR or LBR value equal to or above pavement design subgrade CBR or LBR value indicated on Construction Drawings.

3.04 MAINTENANCE OF SUBGRADE

A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.

C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.05 BORROW AND SPOIL SITES

A. Contractor shall be responsible for compliance with NPDES and local erosion control permitting requirements for any and all off-site, disturbed spoil and borrow areas. Contractor shall make Owner aware of any off-site spoil sites and measures taken to comply with NPDES criteria. Upon completion of spoil and/or borrow operations, clean up spoil and/or borrow areas in a neat and reasonable manner to the satisfaction of property owner, Owner, and Civil Engineering Consultant.

3.06 RIP-RAP

A. Place rip-rap in areas where indicated on Construction Drawings. Stone for rip-rap shall conform to TxDOT specifications (1995 edition) Item 432 with 75% of total stone in each given area conforming to stone (Type R) and 25% conforming to stone (common.)

B. Slopes and other areas to be protected shall be dressed to line and grade shown on Construction Drawings prior to placing of rip-rap. Undercut areas to receive rip-rap to elevation equal to final elevation less average diameter of stones before placing rip-rap.

C. Stones shall be placed in accordance with TxDOT specifications (1993 edition) Item 432.4(2).(A) and

top dressed with the 25% stone (common) acting as spalls.

3.07 FINISH GRADING

A. Grade areas where finish grade elevations or contours are indicated on Construction Drawings, other than paved areas and buildings, including excavated areas, filled and transition areas, and landscaped areas. Graded areas shall be uniform and smooth, free from rock, debris, or irregular surface changes. Finished subgrade surface shall not be more than 0.10-feet above or below established finished subgrade elevation. Ground surfaces shall vary uniformly between indicated elevations. Grade finished ditches to allow for proper drainage without ponding and in a manner that will minimize erosion potential. For topsoil sodding and seeding requirements, refer to Section 02900.

B. Correct settled and eroded areas within 1 year after date of completion at no additional expense to Owner. Bring grades to proper elevation. Replant or replace grass, shrubs, bushes, or other vegetation that appears dead, dying, or disturbed by construction activities. Refer to Section 02270 for slope protection and erosion control.

3.08 FIELD QUALITY CONTROL

A. Field density tests for in-place materials shall be performed as part of construction testing requirements according to one of the following standards:

1. Sand-Cone Method: ASTM D 1556
2. Balloon Method: ASTM D 2167
3. Nuclear Method: ASTM D 2922 (Method B-Direct Transmission)

B. Perform Density test as follows:

1. Building Subgrade Areas, including 10’-0” Outside Exterior Building Lines: In cut areas, not less than 1 compaction test for every 2,500 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.

2. Areas of Construction Exclusive of Building Subgrade Areas: In cut areas, not less than 1 compaction test for every 10,000 sq. ft. In fill areas, same rate of testing for each 8-inch lift, measured loose.

C. Corrective measures for non-complying compaction:

1. Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.

END OF SECTION 02200

SECTION 02221 – EXCAVATION, BACKFILL, AND COMPACTION FOR STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation to line, grade, and configuration as shown on Construction Drawings for proposed structures and future expansion areas

B. Fill to line, grade, and configuration as shown on Construction Drawings for proposed structures and future expansion areas

C. Compacting for materials in acceptable manner as specified herein.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Construction drawings

1.03 REFERENCE STANDARDS

A. See Section 02200

1.04 QUALITY ASSURANCE

A. An independent testing laboratory, selected and paid by Owner, shall be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 02200 and as specified herein.

1.05 SUBMITTALS

A. Shop drawings or details pertaining to excavating and filling for structures are not required unless otherwise shown on Construction Drawings or if contrary procedures to Contract Documents are proposed.

B. Submit 100-pound sample of each type of off-site fill material that is to be used in backfilling in airtight container(s) to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Select fill material from off-site as specified in Section 02200 and approved by Owner.

B. Aggregate fill as specified in Section 02227.

C. Topsoil fill as specified in Section 02100.

2.02 EQUIPMENT

A. Transport off-site materials to project using well maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify lines, elevations, and grades necessary to construct building subgrades as shown on Construction Drawings.

B. Project benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

C. Locate and identify utilities that have previously been installed and protect from damage.

D. Locate and identify existing utilities that are to remain and protect from damage.

E. Overexcavate and properly prepare areas of subgrade that are not capable of supporting proposed structures. Stabilize these areas by using acceptable geotextile fabrics or aggregate materials placed and compacted as specified in Section 02245.

3.02 EXCAVATION

A. Excavate building areas to line and grade as shown on Construction Drawings being careful not to overexcavate beyond elevations needed for building subgrades.

B. Place suitable excavated material into project fill areas as specified in Section 02200.

C. Unsuitable excavated material is to be disposed of in manner and location that is acceptable to Owner and local governing agencies.

D. Perform excavation using capable, well-maintained equipment and methods acceptable to Owner and local governing agencies.

3.03 FILLING AND SUBGRADE PREPARATION

A. Building area subgrade pad shall be that portion of site directly beneath and 5-feet beyond building and appurtenances including limits of future building expansion areas as shown on Construction drawings.

B. Prepare building area subgrade pad in strict accordance with “Foundation Subsurface Preparation” as shown on the Construction Drawings and/or the architectural-structural drawings, whichever is more stringent. Rock larger than 6-inches shall not be part of building subgrade fill.

C. Areas exposed by excavation or stripping and on which building subgrade preparation are to be performed shall be scarified to a minimum depth of 6-inches and compacted to minimum of 95 percent of maximum dry density, in accordance with ASTM D 698, (or 92 percent of optimum density, in accordance with ASTM D 1557) at moisture content at or to +4 percent above optimum. Proofroll these areas to detect areas of insufficient compaction. Accomplish proofrolling by making a minimum of 2 complete passes with a fully-loaded tandem-axle dump truck, or approved equal, in each of 2 perpendicular directions while under supervision and direction of the independent testing laboratory. Excavation and recompact areas of failure as specified herein. Continual failure areas shall be stabilized in accordance with Section 02245 at no additional cost to Owner.

D. Any fills placed within building area subgrade pad shall be select fill and shall be placed as described in Section 02200, Paragraph 3.02.D.

3.04 COMPACTION

A. Maintain optimum moisture content as specified above of fill materials to attain required compaction density.

B. Test materials in accordance with Section 02200.

C. Corrective measures for non-complying compaction: Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.

3.05 MAINTENANCE OF SUBGRADE

A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks, dump trucks, and other construction equipment.

C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of materials equal to or better than best subgrade material on site. Surface or subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.06 FINISH GRADING

A. Finish grading shall be in accordance with Section 02200 and as more specifically specified herein.

B. Check grading of building subgrades by string line from grade stakes (blue tops) set at not more than 50-foot centers. Tolerance of 0.10-feet, more or less, will be permitted. Contractor to provide engineering and field staking necessary for verification of lines, grades, and elevations.

END OF SECTION 02221

SECTION 02222 - EXCAVATION, BACKFILL, AND COMPACTION FOR UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation of trenches for installation of utilities.

B. Backfilling trenches with bedding material as specified and filling trenches with suitable material to proposed subgrade.

C. Compacting backfill materials in acceptable manner.

D. Borings and casings under roads.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02227 – Aggregate Materials

C. Construction Drawings.

1.03 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction, North Central Texas, 11/16/95, North Central Texas Council of Governments (NCTCOG Specifications).

B. American Society for Testing and Materials (ASTM) latest edition

1. D 2321 Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

C. American Association of State Highway and Transportation Officials (AASHTO) latest edition

1. T 180 Moisture-Density Relations of Soils Using a 10 pounds (4.54 kg) Rammer and an 18-inch (457 mm) Drop

D. National Fire Protection Association (NFPA) latest edition

1. Chapter 70 National Electric Code

E. American Water Works Association (AWWA) latest edition

1. C200 Steel Water Pipe – 6 in. (150 mm) and Larger
2. C206 Field Welding of Steel Water Pipe

F. American Welding Society (AWS) latest edition

1. D7-0-62

G. National Electric Code (NEC) latest edition

1. 300-5
2. 710-36

H. Additional references per Section 2200

1.04 QUALITY ASSURANCE

A. An independent testing laboratory will perform testing at intervals not exceeding 200-feet of trench for first and every other 8-inch lift of compacted trench backfill and furnish copies of results as specified herein. Compact backfill in accordance with Construction Drawings and Section 02200.

1.05 SUBMITTALS

A. Shop drawings or details pertaining to site utilities are not required unless required by regulatory authorities or unless use of materials, methods, equipment, or procedures that are contrary to Construction Drawings or Specifications are proposed. Do not perform work until required shop drawings have been accepted by the Owner.

B. Contact utility companies and determine if additional easements will be required to complete project. Provide written confirmation of the status of all easements to Owner at time of Preconstruction Conference or no later than 90 days prior to project possession date.

C. Submit 100-pound sample of each type of off-site fill material that is to be used in backfilling in airtight container(s) to the independent testing laboratory or submit gradation and certification of aggregate material that is to be used at the site to the independent testing laboratory for review.

1.06 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of subsurface utilities, structures, and obstructions encountered.

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PART 2 - PRODUCTS

2.01 MATERIALS

A. Bedding Material: Class I granular material in accordance with ASTM D2321 which is free from clay lumps, organic, or other deleterious material.

B. Haunching Material: Class I or II granular material in accordance with ASTM D2321 which is free from clay lumps, organic, or other deleterious material.

C. Backfill material from the site as specified in Section 02200 and approved by Owner

D. Backfill material from off-site as specified in Section 02200 and approved by Owner.

E. Steel Casing Pipe: Comply with AWWA C200 minimum grade B, size, and wall thickness as indicated on Construction Drawings.

2.02 EQUIPMENT

A. Transport off-site materials to project using well maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.01 PREPARATION

A. Set lines, elevations, and grades for proposed systems.

B. Protect project benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

C. Maintain in operating condition existing utilities, previously installed utilities, and drainage systems encountered in utility installation. Repair surface or subsurface improvements shown on Construction Drawings.

D. Verify location, size, elevation, and other pertinent data required to make connections to existing utilities and drainage systems as indicated on Construction Drawings.

E. Overexcavate and properly prepare areas of subgrade that are not capable of supporting proposed structures. Stabilize these areas by using acceptable geotextile fabrics or additional bedding material placed and compacted as specified in Section 02245.

F. Provide dewatering systems as required for utility excavations. Dewatering systems shall comply with requirements of Section 02200.

3.02 EXCAVATION

A. Contact local utility companies before excavation begins. Dig trench at proper width and depth for laying pipe, conduit, or cable. Cut trench banks vertical, if possible, and remove stones from bottom of trench as necessary to avoid point bearing. Overexcavate wet or unstable soil, if encountered, from trench bottom as necessary to provide suitable base for continuous and uniform bedding.

B. Trench excavation sidewalls greater than 5-feet in depth shall be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the Department of Labor, Occupational Safety and health Administration (OSHA), and by local ordinances. Lateral travel distance to exit ladder or steps shall not be greater than 25-feet in trenches 4-feet or deeper.

C. Perform excavation as indicated on Construction Drawings for specified depths. During excavation, stockpile materials suitable for backfilling in orderly manner far enough from bank of trench to avoid overloading, slides, or cave-ins.

D. Remove excavated material not required or not suitable for backfill or embankments and waste as specified in Section 02200. Dispose of structures discovered during excavation as specified in Section 02050.

E. Prevent surface water from flowing into trenches or other excavations by temporary grading or other methods, as required. Remove accumulated water in trenches or other excavations as specified in Section 02200.

F. Open cut excavation with trenching machine or backhoe. Where machines other than ladder or wheel-type trenching machines are used, do not use clods for backfill. Dispose of unsuitable material and provide other suitable material at no additional cost to Owner.

G. Accurately grade trench bottom to provide uniform bearing and support for each section of pipe on bedding material at every point along entire length, except where necessary to excavate for bell holes, proper sealing of pipe joints, or other required connections. Dig bell holes and depressions for joints after trench bottom has been graded. Dig no deeper, longer, or wider than needed to make joint connection properly.

H. Trench width below top of pipe shall not be less than 12-inches or more than 18-inches wider than outside surface of pipe or conduit that is to be installed to designated elevations and grades. Other trench width for pipe, conduit, or cable shall be least practical width that will allow for proper compaction of trench backfill.

I. Trench depth requirements measured from finished grade or paved surface shall meet the following requirements or applicable codes or NCTCOG Specifications and ordinances, whichever is more stringent:

1. Water Mains: 36-inches to top of pipe barrel or 6-inches below frost line, established by local building official, whichever is deeper.

2. Sanitary Sewer: Elevations and grades as indicated on Construction Drawings.

3. Storm Sewer: Elevations and grades as indicated on Construction Drawings.

4. Electrical Conduits: 24-inches minimum to top of conduit or as required by NEC 300-5, NEC 710-36 codes, or local utility company requirements, whichever is deeper.

5. TV Conduits: 18-inches minimum to top of conduit or as required by local utility company, whichever is deeper.

6. Telephone Conduits: 18-inches minimum to top of conduit, or as required by local utility company, whichever is deeper.

7. Gas Mains and Service: 30-inches minimum to top of pipe, or as required by local utility company, whichever is deeper.

3.03 PIPE BEDDING

A. Accurately cut trenches for pipe or conduit that is to be installed to designated elevations, 4-inches below bottom of pipe and to the width as specified herein. Place 4-inches of bedding material, compact in bottom of trench, and accurately shape to conform to lower portion of pipe barrel.

3.04 BACKFILLING

A. Criteria: Do not backfill trenches until required tests are performed and utility systems comply with and are accepted by applicable governing authorities. Backfill trenches as specified herein. If improperly backfilled, reopen to depth required to obtain proper compaction. Backfill and compact, as specified herein, to properly correct the condition in an acceptable manner.

B. Backfilling: After pipe or conduit has been installed, bedded, and tested as required backfill trench or structure excavation with specified material placed as shown on Construction Drawings and in accordance with Section 02200.

C. Backfill trenches to contours and elevations shown on Construction Drawings with unfrozen materials.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet frozen, or spongy subgrade surfaces.

3.05 COMPACTION

A. Exercise proper caution when compacting immediately over top of pipes or conduits. Water jetting or flooding is not permitted as method of compaction.

B. Maintain optimum moisture content of fill materials as specified in Section 02200 to attain required compaction density.

C. Materials used for backfill shall comply with requirements of ASTM D 2321 and Section 02200.

3.06 BORINGS AND CASINGS UNDER ROADS, HIGHWAYS, AND RAILROAD CROSSINGS

A. When indicated by Construction Drawings, street, road, highway, or railroad crossings for utility mains installed by jacking and boring method shall be in accordance with area specifications and governing authorities.

B. Excavation of approach pits and trenches within right-of-way of street, road, highway, or railroad shall be of sufficient distance from paving or railroad tracks to permit traffic to pass without interference. Tamp backfill for approach pits and trenches within right-of-way in layers not greater than 6-inches thick for entire length and depth of trench or pit. Compact backfill to 95 percent of maximum density obtained at optimum moisture as determined by AASHTO T 180. Mechanical tampers may be used after cover of 6-inches has been obtained over top of barrel of pipe.

C. Accomplish boring operation using commercial type boring rig. Bore hole to proper alignment and grade and within 2-inches of same diameter as largest outside joint diameter of pipe installed. Install pipe in hole immediately after bore has been made and in no instance shall hole be left unattended while open.

D. In event subsurface operations result in failure or damage to pavement or railroad tracks within 1 year of construction, make necessary repairs to pavement or railroad tracks at nor additional cost to Owner.

If paving cracks on either side of pipe line or is otherwise disturbed or broken due to construction operations, repair or replace disturbed or broken area at no additional cost to Owner.

E. Clean, prime, and line interior and exterior of casing pipe with two coats of asphalt in accordance with area specifications and governing authorities.

F. Butt weld steel casing. Welds shall be full penetration single butt-welds in accordance with AWWA C206 and AWS D7-0-62.

G. Install casing and utility pipe with end seals, vent pipe, and other special equipment in accordance with area specifications and governing authorities.

END OF SECTION 02222

SECTION 02223 - EXCAVATION, BACKFILL, AND COMPACTION FOR PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Excavation to line, grade, and configuration as shown on Construction Drawings for proposed and future pavement areas.

B. Fill to line, grade, and configuration as shown on Construction Drawings for proposed and future pavement areas.

C. Compacting fill materials in acceptable manner as specified herein.

1.02 RELATED SECTIONS

A. Section 02200 - Earthwork

B. Section 02227 – Aggregate Materials

C. Section 02511 – Asphaltic Concrete Paving

D. Section 02525 – Curbs and Sidewalks

E. Construction Drawings

1.03 REFERENCE STANDARDS

A. See Section 02200

1.04 QUALITY ASSURANCE

A. Independent Testing Laboratory, selected and paid by owner, will be retained to perform construction testing on filling operations and subgrade analysis as specified in Section 02200 and as specified herein.

1.05 SUBMITTALS

A. Shop drawings or details pertaining to excavating and filling for pavement are not required unless otherwise shown on Construction Drawings or if contrary procedures to Construction Documents are proposed.

B. Submit 100-pound sample of each type of off-site fill material that is to be used in backfilling in air-tight container to independent testing laboratory or submit gradation and certification of aggregate material that is to be used to independent testing laboratory for review.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fill material from on-site as specified in Section 02200 and approved by Owner.

B. Fill material from off-site as specified in Section 02200 and approved by Owner.

C. Aggregate material as specified in Section 02227.

D. Acceptable geotextile fabrics and geogrids as specified in Section 02245.

2.02 EQUIPMENT

A. Transport off-site materials to project using well maintained and operating vehicles. Once on site, transporting vehicles shall stay on designated haul roads and shall at no time endanger improvements by rutting, overloading, or pumping.

PART 3 - EXECUTION

3.01 PREPARATION

A. Identify lines, elevations, and grades necessary to construct pavements, curb, curb and gutter, bases, sidewalk, and roadways as shown on Construction Drawings.

B. Protect project benchmarks, property corners, and other survey monuments from damage or displacement. If marker needs to be removed it shall be referenced by licensed land surveyor and replaced, as necessary, by same.

C. Locate and identify site utilities that have previously been installed and protect from damage.

D. Locate and identify existing utilities that are to remain and protect from damage.

E. Overexcavate and properly prepare areas of subgrade that are not capable of supporting proposed systems. Stabilize these areas by using acceptable geotextile fabrics or additional bedding material placed and compacted as specified in Section 02245.

3.02 EXCAVATION

A. Excavate roadway and pavement areas to line and grade as shown on Construction Drawings.

B. Place suitable material into project fill areas as specified in Section 02200.

C. Unsuitable excavated material is to be disposed of in manner and location that is acceptable to Owner and local governing agencies.

D. Perform excavation using capable, well maintained equipment and methods acceptable to Owner and local governing agencies.

3.03 FILLING AND SUBGRADE PREPARATION

A. Areas exposed by excavation or stripping and on which subgrade preparations for paving are to be performed, including future pavement areas, shall be scarified to a minimum depth of 8-inches and compacted to minimum of 95 percent of maximum dry density, in accordance with ASTM D 698 (or 92 percent of optimum density, in accordance with ASTM D 1557) as determined by Standard Proctor at moisture content at or +4 percent above optimum moisture content for cohesive soils. Proofroll these areas to detect areas of insufficient compaction. Accomplish proofrolling by making minimum of 2 complete passes with full-loaded tandem-axle dump truck, or approved equal, in each of 2 perpendicular directions under supervision and direction of the independent testing laboratory. Excavate and recompact areas of failure as specified herein. Continual failure areas shall be stabilized in accordance with Section 02245 at no additional cost to Owner.

B. Place fill materials used in preparation of the subgrade shall be placed in lifts or layers not to exceed 8-inches loose measure and compacted to minimum density of 95 percent of optimum density, in accordance with ASTM D 698, (or 92 percent of optimum density, in accordance with ASTM D 1557) at moisture content of not less than 1 percent below and not more than 4 percent above optimum moisture content.

C. Fill material imported from off-site or fill material removed from onsite cut areas shall have CBR or LBR value equal to or greater than pavement design subgrade CBR or LBR value indicated on Construction Drawings.

3.04 COMPACTION

A. Maintain optimum moisture content of fill materials as specified herein to attain required compaction density.

B. Tests materials in accordance with Section 02200.

C. Corrective measures for non-complying compaction: Remove and recompact deficient areas until proper compaction is obtained at no additional expense to Owner.

3.05 MAINTENANCE OF SUBGRADE

A. Verify finished subgrades to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction including concrete trucks, dump trucks, and other construction equipment.

C. Remove areas of finished subgrade found to have insufficient compaction density to depth necessary and replace in manner that will comply with compaction requirements by use of material equal to or better than best subgrade material on site. Surface of subgrade after compaction shall be hard, uniform, smooth, stable, and true to grade and cross-section.

3.06 FINSIH GRADING

A. Finish grading shall be in accordance with Section 02200 and as specified herein.

B. Check grading of paving areas by string line from grade stakes (blue tops) set at not more than 50-foot centers. Tolerances of 0.10-foot, more or less, will be permitted. Contractor is to provide engineering and field staking necessary for verification of lines, grades, and elevations.

END OF SECTION 02223

SECTION 02511 ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparation and placement of asphaltic concrete binder course.

B. Preparation and placement of asphaltic concrete surface course.

1.02 RELATED SECTIONS

A. Section 02223 - Excavation, Backfill, and Compaction for Pavement

B. Section 02505 - Paving Base Course

C. Section 02520 - Portland Cement Concrete Paving

D. Section 02525 - Curbs and Sidewalks

E. Section 02584 - Pavement Markings

F. State Highway Department Standard Specifications

G. Construction Drawings

1.03 REFERENCE STANDARDS

A. Texas Department of Transportation

1. Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 1995 Edition.

B. The Asphalt Institute (AI) latest edition

1. MS 2 Mix Design Methods for Asphaltic Concrete and Other Hot Mix Types
2. MS 3 Asphalt Plant Manual
3. MS 19 Basic Asphalt Emulsion Manual

C. U.S. Army Corps of Engineers

1. UN-13 Hot Mix Asphalt Paving Handbook, (CE MP-ET)

D. American Society of Testing and Materials (ASTM) latest edition

1. D 946 Penetration - Graded Asphalt Cement for use in Pavement Construction
2. D 1188 Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
3. D 1559 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
4. D 2726

E. American Association of State Highway and Transportation Officials (AASHTO) latest edition

1. M 117 Mineral Filler "Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing"
2. M 140 Tack Coat "Emulsified Asphalt"

3. M 208 Tack Coat "Cationic Emulsified Asphalt"
4. M 226 Viscosity Graded Asphalt Cement
5. T 245 Marshall Mix Design

F. APWA

1. Section 2204

1.04 QUALITY ASSURANCE

A. An independent testing laboratory, selected and paid by Owner, will be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness, compaction, and surface smoothness.

B. Establish and maintain required lines and elevations.

C. In-place compacted thickness shall not be less than thickness specified on Construction Drawings. Areas of deficient paving thickness shall receive tack coat and minimum 1-in. overlay; or shall be removed and replaced to proper thickness, at discretion of Owner; until specified thickness of course is met or exceeded at no additional expense to Owner.

D. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.

1.05 SUBMITTALS

A. Before asphaltic concrete paving is constructed, submit actual design mix to Owner for review and approval. Design mix submittal shall follow a format as indicated in Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include type/name of mix, gradation analysis, grade of asphalt cement used, Marshall Stability in pounds (lb.) flow, effective asphalt content in percent (%), and direct references to state highway department specifications sections for each material. Design shall be for mixture listed in current edition of state highway department specifications. Mix designs over 3 years old will not be accepted by Owner.

B. Submit materials certificate to the independent testing laboratory which is signed by materials producer and Contractor, certifying that materials comply with, or exceed, requirements specified herein.

1.06 PROJECT CONDITIONS

A. Weather Limitations:

1. Apply prime and tack coats when ambient temperature is above 40 degrees Fahrenheit, and when temperature has been above 35 degrees Fahrenheit for 12 hours immediately prior to application. Do not apply when base is wet, contains excess moisture, or during rain.

2. Construct asphaltic concrete paving when atmospheric temperature is above 40 degrees Fahrenheit.

B. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide asphalt-aggregate mixture according to TxDOT Item 340, Type D, surface course. Use locally available materials and gradations which meet state highway department specifications and exhibit satisfactory records of previous installations.

B. Asphalt Cement: Comply with AASHTO M 226; Table 2 AC-10, AC-20, or AC-30, viscosity grade, depending on local mean annual air temperature. See chart below:

Temperature Condition	Asphalt Grades
Cold, mean annual air temperature at 45 degrees Fahrenheit or lower	AC-10 85/100 pen.
Warm, mean annual air temperature between 45 degrees Fahrenheit and 75 degrees Fahrenheit	AC-20 60/70 pen.
Hot, mean annual air temperature at 75 degrees Fahrenheit or higher	AC-30

C. Prime Coat: Medium curing cut-back asphalt or asphalt penetrating prime coat consisting of either MC-30 or SS-1h.

D. Tack Coat: Emulsified asphalt; AASHTO M 140 or AASHTO M 208, SS-1h, CSS-1, or CSS-1h, diluted with 1 part water to 1 part emulsified asphalt.

E. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M 117, if recommended by state highway department specifications.

F. Asphalt-Aggregate Mixture: Unless otherwise noted on Construction Drawings, Design Mix shall have minimum stability based on 50-blow Marshall complying with ASTM D 1559 of 1000 pounds with flow between 8 and 16. The Design Mix shall be within sieve analysis and bitumen ranges specified below unless approved otherwise by Owner prior to placement.

1. Per Table 2, Item 340.3 (Page 387), TxDOT Standard Specifications, 1995 Edition.

2.02 EQUIPMENT

A. Maintain equipment in satisfactory operating condition and correct breakdowns in manner that will not delay or be detrimental to progress of paving operations.

PART 3 - EXECUTION

3.01 PREPARATION

A. Proofroll prepared base material surface to check for unstable areas. Paving work shall begin only after unsuitable areas have been corrected and are ready to receive paving.

B. Remove loose material from compacted base material surface immediately before applying prime coat.

3.02 APPLICATIONS

A. Prime Coat:

1. Apply bituminous prime coat to base material surfaces where asphaltic concrete paving will be constructed.

2. Apply bituminous prime coat in accordance with APWA Section 2204 and state highway department specifications.

3. Apply at minimum rate of 0.25 gal per sq. yd over compacted base material. Apply to penetrate and seal, but not flood surface.

4. Take necessary precautions to protect adjacent areas from overspray.

5. Cure and dry as long as necessary to attain penetration of compacted base and evaporation of volatile substances.

B. Tack Coat:

1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or portland cement concrete and surfaces abutting or projecting into asphaltic concrete or into asphaltic concrete pavement.

2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat between each lift or layer of full depth asphaltic concrete and sand asphalt bases and on surface of bases where asphaltic concrete paving will be constructed.

3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 and state highway department specifications.

4. Apply at minimum rate of 0.05 gal per sq. yd of surface.

5. Allow to dry until at proper condition to receive paving.

3.03 ASPHALTIC CONCRETE PLACEMENT

A. Place asphaltic concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures:

1. Ambient temperature between 40 degrees Fahrenheit and 50 degrees Fahrenheit, mixture temp. = 285 degrees Fahrenheit

2. Ambient temperature between 50 degrees Fahrenheit and 60 degrees Fahrenheit, mixture temp. = 280 degrees Fahrenheit

3. Ambient temperature higher than 60 degrees Fahrenheit, mixture temp. = 275 degrees Fahrenheit

B. Whenever possible, spread pavement by finishing machine; however, inaccessible or irregular areas may be placed by hand methods. Spread hot mixture uniformly to required depth with hot shovels and rakes. After spreading, carefully smooth hot mixture to remove segregated course aggregate and rake marks. Rakes and lutes used for hand spreading shall be type designed for use on asphalt mixtures. Do not dump loads faster that they can be properly spread. Workers shall not stand on loose mixture while spreading.

C. Paving Machine Placement: Apply successive lifts of asphaltic concrete in transverse directions with surface course placed parallel to flow of traffic. Place in typical strips not less than 10'-0" wide.

D. Joints: Make joints between old and new pavements, or between successive days and work in manner that will provide continuous bond between adjoining work. Construction joints shall have same texture, density, and smoothness as other sections of asphaltic concrete course. Clean contact surfaces of joints and apply tack coat.

3.04 ROLLING AND COMPACTION

A. Mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of rollers without undue displacement. Number, weight, types of rollers, and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in workable condition.

B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling with hot material.

D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.

F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphaltic concrete. Compact by rolling to maximum surface density and smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked. Any masked or marred finish surfaces shall be repaired or smoothed.

3.05 FIELD QUALITY CONTROL

A. Asphaltic surface and base courses will be randomly cored at minimum rate of 1 core per 20,000 sq. ft of paving. However, a minimum of 3 cores in light duty areas and 3 cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphaltic concrete. Asphaltic concrete pavement samples will be tested for conformance with mix design.

B. Testing will be performed on finished surface of each asphalt concrete course for smoothness, using 10'-0" straightedge applied parallel with, and at right angles to centerline of paved area. Results of tests will be made available to Owner upon request. Surfaces will not be accepted if the following 10-foot straightedge tolerances for smoothness are exceeded:

Base Course Surface:	1/4-inch
Wearing Course Surface:	3/16-inch

C. Field density test for in-place materials shall be performed by examination of field cores in accordance with one of following standards:

1. AASHTO Test Method T 245 (Percent of Laboratory Density)

   a. Temperature equal to temperature at paving machine with reheating.
   b. Compactive blows (35.50 or 75) equal to mix design blows.
   c. Minimum density = 96% of laboratory density.

2. AASHTO Test Method T 209 (Percent of Theoretical Maximum Density)

   a. Minimum density = 92% of Theoretical Maximum Density.

D. Rate of density testing shall be 1 core per 20,000 sq. ft of pavement, with minimum of 3 cores from heavy duty areas and 3 cores from light duty areas. Cores shall be cut from areas representative of project.

E. Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with Specifications at no additional expense to Owner.

END OF SECTION 02511

SECTION 02525 - CURBS AND SIDEWALKS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparation and placement of combination Portland cement concrete curb and gutter.

B. Preparation and placement of Portland cement concrete curb.

C. Preparation and placement of Portland cement concrete sidewalk.

1.02 RELATED SECTIONS

A. Section 02100 - Site Preparation

B. Section 02200 - Earthwork

C. Section 02227 - Aggregate Material

D. Section 02505 - Paving Base Course

E. Section 03300 - Cast-in-place Concrete (See Architectural/Building Specifications)

F. State Highway Department Standard Specifications

G. Construction Drawings

1.03 REFERENCE STANDARDS

A. American Concrete Institute (ACI) latest edition

1. 304R Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
2. 308 Standard Practice for Curing Concrete

B. American Society for Testing and Materials (ASTM) latest edition

1. A 615 Deformed and Plain Billet-Steel for Concrete Reinforcement
2. C 33 Concrete Aggregates
3. C 94 Ready-Mixed Concrete
4. C 150 Portland Cement
5. C 260 Air-Entraining Admixtures for Concrete
6. C 309 Liquid Membrane-Forming Compounds for Curing Concrete
7. C 494 Chemical Admixtures for Concrete
8. D 1751 Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

C. FS TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.

1.04 QUALITY ASSURANCE

A. Establish and maintain required lines and elevations.

B. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable work as directed by Owner.

1.05 SUBMITTALS

A. Submit materials certificate to the independent testing laboratory which is signed by materials producer and Contractor, certifying that materials comply with, or exceed, requirements specified herein.

1.06 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Forms shall be of depth equal to depth of curbing or sidewalk, and so designed as to permit secure fastening together at tops. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.

B. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 40.

C. Concrete Materials: Comply with requirements of Section 03300 for concrete materials, admixtures, bonding materials, curing materials, and others as required.

D. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A.

E. Joint Sealers: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant" Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 245", or Woodmont Products "Chem-Caulk".

2.02 MIX DESIGN AND TESTING

A. Concrete mix design and testing shall comply with requirements of Section 02520.

B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce following:

1. Compressive Strength: 3,000 psi, minimum at 28 days, unless otherwise indicated on Construction Drawings.

2. Slump Range: 2 to 5-inches at time of placement

3. Air Entrainment: 4 to 6 percent

PART 3 - EXECUTION

3.01 PREPARATION

A. Proofroll prepared base material surface to check for unstable areas. Begin paving work only after unsuitable areas have been corrected and are ready to receive paving.

B. Remove loose material from compacted base material surface to produce firm, smooth surface immediately before placing concrete.

3.02 INSTALLATION

A. Form Construction

1. Set forms to required grades and lines, rigidly braced and secured.

2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place minimum of 24 hours after concrete placement.

3. Check completed formwork for grade and alignment to following tolerances:

a. Top of forms not more than 1/8-inch in 10'-0"
b. Vertical face on longitudinal axis, not more than 1/4-inch in 10'-0"

4. Clean forms after each use and coat with form release agent as often as required to ensure separation from concrete without damage.

B. Concrete Placement

1. Place concrete in accordance with requirements of Section 03300.

2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until set at required finish elevation and alignment.

3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hour, place construction joint. Automatic machine may be used for curb and gutter placement. Machine placement shall be at required cross section, line, grade, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified herein.

C. Joint Construction

1. Contraction Joints: Construct concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, in uniform sections of length specified on Construction Drawings. Form joints between sections either by steel templates, 1/8-inch in thickness, of length equal to width of curb and gutter, and with depth which will penetrate at least 2-inches below surface of curb and gutter; or with 3/4-inch thick performed expansion joint filler cut to exact cross section of curb and gutter; or by sawing to depth of at least 2-inches while concrete is between 4 and 24 hours old. If steel templates are used, they shall be left in place until concrete has set enough to hold it's shape, but shall be removed while forms are still in place.

2. Longitudinal Construction Joints: Tie concrete curb or combination concrete curb and gutter, where specified on Construction Drawings, to concrete pavement with 1/2-inch round deformed reinforcement bars of length and spacing shown on Construction Drawings.

3. Transverse Expansion Joints: Concrete curb, combination concrete curb and gutter, or concrete sidewalk shall have filler cut to exact cross section of curb, gutter, or sidewalk. Joints shall be similar to type of expansion joint used in adjacent pavement.

D. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint fillers in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

E. Joint Sealants: Seal joints with approved exterior pavement joint sealants. Install in accordance with manufacturer's recommendations.

3.03 CONCRETE FINISHING

A. After striking off and consolidating concrete, smooth surface by screeding and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.

B. Work edges of sidewalks, gutters, back top edge of curb, and formed joints with edging tool, rounding edge to 1/2-inch radius. Eliminate tool marks on concrete surface. After completion of floating and trowelling, when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

1. Curbs, gutters, and sidewalks: Broom finish by drawing fine-hair broom across surface perpendicular to flow of traffic. Repeat operation as necessary to produce fine line texture.

C. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up minor honeycombed areas. Remove and replace areas or sections with major defects, as directed Owner.

D. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in "water-curing" section of ACI 308.

3.04 BACKFILL

A. After concrete has set sufficiently, spaces on either side of concrete curb, combination concrete curb and gutter, or concrete sidewalk shall be refilled to required elevation with suitable material compacted in accordance with Section 02200.

3.05 CLEANING AND ADJUSTING

A. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.

B. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

END OF SECTION 02525

DIVISION 3

CONCRETE

SECTION 03000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

03 31 50 CONCRETE FOR UTILITY CONSTCRUCTION

PART 1 GENERAL

1.01 SUMMARY

A. Description

Cast-in-place concrete work for utility construction or rehabilitation, such as slabs on grade, small vaults, site-cast bases for precast units, and in-place liners for manhole rehabilitation.

1.02 REFERENCES

A. ACI 117 - Standard Tolerances for Concrete Construction and Materials.

B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.

C. ACI 302.1R - Guide for Concrete Floor and Slab Construction.

D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

E. ACI 308 - Standard Practice for Curing Concrete.

F. ACI 309R - Guide for Consolidation of Concrete.

G. ACI 311.5R - Batch Plant Inspection and Field Testing of Ready Mixed Concrete.

H. ACI 315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.

I. ACI 318 - Building Code Requirements for Reinforced Concrete.

J. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.

K. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

L. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

M. ASTM A 767 - Standard Specifications for Zinc-coated (Galvanized) Bars for Concrete Reinforcement.

N. ASTM A 775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

O. ASTM A 884 - Specification for Epoxy-coated Steel Wire and Welded Wire Fabric for Reinforcement.

P. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

Q. ASTM C33 - Standard Specification for Concrete Aggregates.

R. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

S. ASTM C42 - Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

T. ASTM C94 - Standard Specification for Ready-Mixed Concrete.

U. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

V. ASTM C138 - Standard Test Method for Unit Weight Yield and Air Content (Gravimetric) of Concrete.

W. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

X. ASTM C150 - Standard Specification for Portland Cement.

Y. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.

Z. ASTM C191 - Standard Test Methods for Time of Setting of Hydraulic Cement AA. ASTM

C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method.

AB. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

AC. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.

AD. ASTM C309 - Standard Specifications for Liquid Membrane-Forming Compounds for Curing Concrete.

AE. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.

AF. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

AG. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.

AH. ASTM C1077 - Standard Practice for Laboratory Testing of Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory

Evaluation.

AI. CRSI MSP-1 - Manual of Standard Practice. AJ. CRSI - Placing Reinforcing Bars.

AK. NRMCA - Concrete Plant Standards.

AL. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

1.03 SUBMITTALS

A. Conform to Section 01300 – Submittals and Substitutions.

B. Submit proposed mix design and test data for each type and strength of concrete in the Work.

C. Submit laboratory reports prepared by an independent testing laboratory stating that materials used comply with requirements of this Section.

D. Submit manufacturer's mill certificates for reinforcing steel. Provide specimens for testing when required by the Engineer.

E. Submit certification from concrete supplier that materials and equipment used to produce and deliver concrete comply with this Specification.

F. Submit shop drawings showing reinforcement type, quantity, size, length, location, spacing, bending, splicing, support, fabrication details, and other pertinent information.

G. For waterstops, submit product information sufficient to indicate compliance with this Section, including manufacturer's descriptive literature and specifications.

1.04 HANDLING AND STORAGE

A. Cement: Store cement off of the ground in a well-ventilated, weatherproof building.

B. Aggregate: Prevent mixture of foreign materials with aggregate and preserve gradation of aggregate.

C. Reinforcing Steel: Store reinforcing steel to protect it from mechanical injury and formation of rust. Protect epoxy-coated steel from damage to the coating.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

A. Cementitious Material:

1. Portland Cement: ASTM C150, Type II cement.

2. When aggregates are potentially reactive with alkalis in cement, use cement not exceeding 0.6 percent alkali content in the form of $Na_2O + 0.658K_20$.

B. Water: Clean, free from harmful amounts of oils, acids, alkalis, or other deleterious substances, and meeting requirements of ASTM C94.

C. Aggregate:

1. Coarse Aggregate: ASTM C33. Unless otherwise indicated, use the following ASTM standard sizes: No. 357 or No. 467; No. 57 or No. 67, No. 7. Maximum size: Not larger than 1/5 of the narrowest dimension between sides of forms, nor larger than 3/4 of minimum clear spacing between reinforcing bars.

2. Fine Aggregate: ASTM C33.

3. Determine the potential reactivity of fine and coarse aggregate in accordance with the Appendix to ASTM C33.

D. Air Entraining Admixtures: ASTM C260.

E. Chemical Admixtures:

1. Water Reducers: ASTM C494, Type A.

2. Water Reducing Retarders: ASTM C494, Type D.

3. High Range Water Reducers (Superplasticizers): ASTM C494, Types F and G.

F. Prohibited Admixtures: Admixtures containing calcium chloride, thiocyanate, or materials that contribute free chloride ions in excess of 0.1 percent by weight of cement.

G. Reinforcing Steel:

1. Use new billet steel bars conforming to ASTM A615, ASTM A767, or ASTM A 775, grade 40 or grade 60, as shown on Drawings. Use deformed bars except where smooth bars are specified. When placed in work, keep steel free of dirt, scale, loose or flaky rust, paint, oil or other harmful materials.

2. Where shown, use welded wire fabric with wire conforming to ASTM A185 or ASTM A884. Supply the gauge and spacing shown, with longitudinal and transverse wires electrically welded together at points of intersection with welds strong enough not to be broken during handling or placing.

3. Wire: ASTM A82. Use 16-1/2 gauge minimum for tie wire, unless otherwise indicated.

H. Curing Compounds: Type 2 white-pigmented liquid membrane-forming compounds conforming to ASTM C309.

I. Non-Shrink Grout

Grout shall be non-shrink in the plastic state and show no expansion after set as tested in accordance with ASTM C827 and shall develop compressive strength not less than 3,000 psi with a trowel able mix within 24 hours per ASTM C109. The placement time shall be not less than 45 minutes based on initial set per ASTM C191. Test results shall be furnished by the manufacturer and submitted to the Engineer.

2.02 FORMWORK MATERIALS

A. Lumber and Plywood: Seasoned and of good quality, free from loose or unsound knots, knot holes, twists, shakes, decay and other imperfections which would affect strength or impair the finished surface of concrete. Use S4S lumber for facing or sheathing. Forms for bottoms of caps: At least
2-inch (nominal) lumber, or 3/4-inch form plywood backed adequately to prevent misalignment. For general use, provide lumber of 1-inch nominal thickness or form plywood of approved thickness.

B. Formwork for Exposed Concrete Indicated to Receive Rubbed Finish: Form or form-lining surfaces free of irregularities; plywood of 1/4-inch minimum thickness, preferably oiled at the mill.

C. Chamfer Strips and Similar Moldings: Redwood, cypress, or pine that will not split when nailed and which can be maintained to true line. Use mill-cut molding dressed on all faces.

D. Form Ties: Metal or fiberglass of approved type with tie holes not larger than 7/8 inch in diameter. Do not use wire ties or snap ties.

E. Metal Forms: Clean and in good condition, free from dents and rust, grease, or other foreign materials that tend to disfigure or discolor concrete in a gauge and condition capable of supporting concrete and construction loads without significant distortion. Countersink bolt and rivet heads on facing sides. Use only metal forms which present a smooth surface and which line up properly.

2.03 PRODUCTION METHODS

A. Use either ready-mixed concrete conforming to requirements of ASTM C94, or concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685.

2.04 MEASUREMENT OF MATERIALS

A. Measure dry materials by weight, except volumetric proportioning may be used when concrete is batched and mixed in accordance with ASTM C685.

B. Measure water and liquid admixtures by volume.

2.05 DESIGN MIX

A. Use design mixes prepared by a certified testing laboratory in accordance with ASTM C1077 and conforming to requirements of this section.

B. Proportion concrete materials based on ACI 211.1 to comply with durability and strength requirements of ACI 318, Chapters 4 and 5, and this specification. Prepare mix design of Class A concrete so minimum cementitious content is 564 pounds per cubic yard. Submit concrete mix designs to the Engineer for review.

C. Proportioning based on field experience or trial mixtures in accordance with requirements at Section 5.3 of ACI 318 may be used, if approved by the Engineer.

D. Classification:

CLASS	TYPE	MINIMUM COMPRESSIVE STRENGTH (LBS/SQ. IN.)		MAXIMUM W/C RATIO	AIR CONTENT (PERCENT)	CONSISTENCY RANGE IN SLUMP (INCHES)
		7-DAY	28-DAY			
A	Structural	3200	4000	0.45	4+ 1	2 to 4
B	Pipe Block Fill, Thrust Block	----	1500	----	4± 1	5 to 7
G	Encasement	----	2000	----	4+ 1	3 to 6

E. Determine air content in accordance with ASTM C138, ASTM C173 or ASTM C231.

F. Use of Concrete Classes: Use classes of concrete as indicated on the Drawings and other Specifications. Use Class B for unreinforced concrete used for plugging pipes, seal slabs, thrust blocks, trench dams, and concrete fill unless indicated otherwise. Use Class G for concrete encasement. Use Class A for all other applications.

PART 3 EXECUTION

3.01 FORMS AND SHORING

A. Provide mortar-tight forms sufficient in strength to prevent bulging between supports. Set and maintain forms to lines designated such that finished dimensions of structures are within the tolerances specified in ACI 117. Construct forms to permit removal without damage to concrete. Forms may be given slight draft to permit ease of removal. Provide adequate cleanout openings. Before placing concrete, remove extraneous matter from within forms.

B. Install rigid shoring having no excessive settlement or deformation. Use sound timber in shoring centering. Shim to adjust and tighten shoring with hardwood timber wedges.

C. Design Loads for Horizontal Surfaces of Forms and Shoring: Minimum fluid pressure, 175 pounds per cubic foot; live load, 50 pounds per square foot. Maximum unit stresses: 125 percent of allowable stresses used for form materials and for design of support structures.

D. Back formwork with a sufficient number of studs and wales to prevent deflection.

E. Re-oil or lacquer the liner on the job before using. Facing may be constructed of 3/4-inch plywood made with waterproof adhesive backed by adequate studs and wales. In such cases, form lining will not be required.

F. Unless otherwise indicated, form outside corners and edges with triangular 3/4-inch chamfer strips (measured on sides).

G. Remove metal form ties to depth of at least 3/4 inch from surface of concrete. Do not burn off ties. Do not use pipe spreaders. Remove spreaders which are separate from forms as concrete is being placed.

H. Treat facing of forms with approved form coating before concrete is placed. When directed by Engineer, treat both sides of face forms with coating. Apply coating before reinforcement is placed. Immediately before the concrete is placed, wet surface of forms which will come in contact with concrete.

3.02 PLACING REINFORCEMENT

A. Place reinforcing steel accurately in accordance with approved Drawings. Secure steel adequately in position in forms to prevent misalignment. Maintain reinforcing steel in place using approved concrete and hot-dip galvanized metal chairs and spacers. Place reinforcing steel in accordance with CRSI Publication "Placing Reinforcing Bars." Request inspection of reinforcing steel by the Engineer and obtain acceptance before concrete is placed.

B. Minimum spacing center-to-center of parallel bars: 2-1/2 times nominal bar diameter. Minimum cover measured from surface of concrete to face of reinforcing bar unless shown otherwise on the Drawings: 3 inches for surfaces cast against soil or subgrade, 2 inches for other surfaces.

C. Detail bars in accordance with ACI 315. Fabricate reinforcing steel in accordance with CRSI Publication MSP-1, "Manual of Standard Practice." Bend reinforcing steel to required shape while steel is cold. Excessive irregularities in bending will be cause for rejection.

D. Do not splice bars without written approval of the Engineer. Approved bar bending schedules or placing drawings constitute written approval. Splice and development length of bars shall conform to ACI 318, Chapters 7 and 12, and as shown on Drawings. Stagger splices or locate at points of low tensile stress.

3.03 BATCHING, MIXING AND DELIVERY OF CONCRETE

A. Measure, batch, mix, and deliver ready-mixed concrete in accordance with ASTM C94, Sections 8 through 11. Produce ready-mixed concrete using an automatic batching system as described in NRMCA Concrete Plant Standards, Part 2 - Plant Control Systems.

B. Measure, mix and deliver concrete produced by volumetric batching and continuous mixing in accordance with ASTM C685, Sections 6 through 8.

C. Maintain concrete workability without segregation of material and excessive bleeding. Obtain approval of the Engineer before adjustment and change of mix proportions.

D. Ready-mixed concrete delivered to the site shall be accompanied by batch tickets providing the information required by ASTM C94, Section 16. Concrete produced by continuous mixing shall be accompanied by batch tickets providing the information required by ASTM C685, Section 14.

E. When adverse weather conditions affect quality of concrete, postpone concrete placement. Do not mix concrete when air temperature is at or below 40 degrees F and falling. Concrete may be mixed when temperature is 35 degrees F and rising. Take temperature readings in the shade, away from artificial heat. Protect concrete from temperatures below 32 degrees F until the concrete has cured for a minimum of 3 days at 70 degrees F or 5 days at 50 degrees F.

F. Clean, maintain and operate equipment so that it thoroughly mixes material as required.

G. Hand-mix only when approved by the Engineer.

3.04 PLACING CONCRETE

A. Give sufficient advance notice to the Engineer (at least 24 hours prior to commencement of operations) to permit inspection of forms, reinforcing steel, embedded items and other preparations for placing concrete. Place no concrete prior to the Engineer's approval.

B. Schedule concrete placing to permit completion of finishing operations in

daylight hours. However, if necessary to continue after daylight hours, light the site as required. If rainfall occurs after placing operations are started, provide covering to protect the work.

C. Use troughs, pipes and chutes lined with approved metal or synthetic material in placing concrete so that concrete ingredients are not separated. Keep chutes, troughs and pipes clean and free from coatings of hardened concrete. Allow no aluminum material to be in contact with concrete.

D. Limit free fall of concrete to 4 feet. Do not deposit large quantities of concrete at one location so that running or working concrete along forms is required. Do not jar forms after concrete has taken an initial set; do not place any strain on projecting reinforcement or anchor bolts.

E. Use tremies for placing concrete in walls and similar narrow or restricted locations. Use tremies made in sections, or provide in several lengths, so that outlet may be adjusted to proper height during placing operations.

F. Place concrete in continuous horizontal layers approximately 12 inches thick. Place each layer while layer below is still plastic.

G. Compact each layer of concrete with concrete spading implements and mechanical vibrators of approved type and adequate number for the size of placement. When immersion vibrators cannot be used, use form vibrators. Apply vibrators to concrete immediately after depositing. Move the vibrator vertically through the layer of concrete just placed and several inches into plastic layer below. Do not penetrate or disturb layers previously placed which have partially set. Do not use vibrators to aid lateral flow concrete. Closely supervise consolidation to ensure uniform insertion and duration of immersion.

H. Handling and Placing Concrete: Conform to ACI 302.1R, ACI 304R and ACI 309R.

3.05 CONSTRUCTION JOINTS

A. Definitions:

1. Construction joint: Contact surface between plastic (fresh) concrete and concrete that has attained initial set.

2. Monolithic: Manner of concrete placement to reduce or eliminate construction joints; joints other than those indicated on Drawings will not be permitted without written approval of Engineer. Where so approved, make additional construction joints with details equivalent to those indicated for joints in similar locations.

3. Preparation for Construction Joints: Roughen surface of concrete previously placed, leaving some aggregate particles exposed. Remove laitance and loose materials by sandblasting or high-pressure water blasting. Keep surface wet for several hours prior to placing of plastic concrete.

3.06 WATER STOPS

A. Embed waterstops in concrete across joints as shown. Waterstops shall be continuous for the extent of the joint; make splices necessary to provide such continuity in accordance with manufacturer's instructions. Support and protect waterstops during construction operations; repair or replace water stops damaged during construction.

B. Install waterstops in concrete on one side of joints, leaving other side exposed until the next pour. When a waterstop will remain exposed for 2 days or more, shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

C. Splicing PVC Water stops:

1. Splice waterstops by heat-sealing adjacent waterstop sections in accordance with the manufacturer's printed instructions.

2. Butt end-to-end joints of two identical waterstop sections may be made in the forms during placement of water stop material.

3. Prior to placement in formwork, prefabricate waterstop joints involving more than two ends to be joined together, an angle cut, an alignment change, or the joining of two dissimilar waterstop sections, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon inspection and approval by the Engineer, install prefabricated waterstop joint assemblies in formwork, and butt-weld ends of the 24-inch strips to the straight-run portions of water stop in the forms.

D. Setting PVC Water stops:

1. Correctly position waterstops during installation. Support and anchor waterstops during progress of the work to ensure proper embedment in concrete and to prevent folding over of the waterstop by concrete placement. Locate symmetrical halves of waterstops equally between concrete pours at joints, with center axis coincident with joint openings. Thoroughly work concrete in joint vicinity for maximum density and imperviousness.

2. Where a waterstop in a vertical wall joint does not connect with any other waterstop, and is not intended to be connected to a waterstop in a future concrete placement, terminate the waterstop 6 inches below the top of the wall.

E. Replacement of Defective Field Joints: Replace waterstop field joints showing evidence of misalignment, offset, porosity, cracks, bubbles, inadequate bond or other defects with products and joints complying to the Specifications.

F. Resilient Water stop:

1. Install resilient waterstop in accordance with manufacturer's instructions and recommendations.

2. When requested by the Engineer, provide technical assistance by manufacturer's representative in the field at no additional cost to the District.

3. Use resilient waterstop only where complete confinement by concrete is provided; do not use in expansion or contraction joints.

4. Where resilient waterstop is used in combination with PVC waterstop, lap resilient waterstop over PVC waterstop a minimum of 6 inches and place in contact with the PVC waterstop. Where crossing PVC at right angles, melt PVC ribs to form a smooth joining surface.

5. At the free top of walls without connecting slabs, stop the resilient waterstop and grooves (where used) 6 inches from the top in vertical wall joints.

6. Bentonite Water stop:

   a. Locate bentonite waterstop as near as possible to the center of the joint and extend continuous around the entire joint. Minimum distance from edge of waterstop to face of member: 5 inches.

   b. Where thickness of concrete member to be placed on bentonite waterstop is less than 12 inches, place waterstop in grooves at least 3/4 inch deep and 1-1/4 inches wide formed or ground into concrete. Minimum distance from edge of waterstop placed in groove to face of member: 2.5 inches.

   c. Do not place bentonite waterstop when waterstop material temperature is below 40 degrees F. Waterstop material may be warmed so that it remains above 40 degrees F during placement but means used to warm it shall in no way harm the material or its properties. Do not install waterstop where air temperature falls outside manufacturer's recommended range.

   d. Place bentonite waterstop only on smooth and uniform surfaces; grind concrete smooth if necessary to produce satisfactory substrate, or bond waterstop to irregular surfaces using an epoxy grout which completely fills voids and irregularities beneath the waterstop material. Prior to installation, wire brush the concrete surface to remove laitance and other substances that may interfere with bonding of epoxy.

   e. In addition to the adhesive backing provided with the waterstop, secure bentonite waterstop in place with concrete nails and washers at 12-inch maximum spacing.

7. Adhesive Waterstop:

a. With a wire brush thoroughly clean the concrete surface on which the waterstop is to be placed and then coat with primer.

b. If the surface is too rough to allow the waterstop to form a complete contact, grind to form an adequately smooth surface.

c. Install the waterstop with the top protective paper left in place. Overlap joints between strips a minimum of 1 inch and cover back over with protective paper.

d. Do not remove protective paper until just before final formwork completion. Concrete shall be placed immediately. The time that the waterstop material is uncovered prior to concrete placement shall be minimized and shall not exceed 24 hours.

3.07 CURING

A. Comply with ACI 308. Cure by preventing loss of moisture, rapid temperature change and mechanical injury for a period of 7 curing days when Type II or IP cement has been used and for 3 curing days when Type III cement has been used. Start curing as soon as free water has disappeared from the concrete surface after placing and finishing. A curing day is any calendar day in which the temperature is above 50 degrees F for at least 19 hours. Colder days may be counted if air temperature adjacent to concrete is maintained above 50 degrees F. In continued cold weather, when artificial heat is not provided, removal of forms and shoring may be permitted at the end of calendar days equal to twice the required number of curing days. However, leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.

B. Cure formed surfaces by leaving forms in place for the full curing period.
Keep wood forms wet during the curing period. Add water as needed for other types of forms. Or, at Contractor's option, forms may be removed after 2 days and curing compound applied.

C. Unformed Surfaces: Cure by membrane curing compound method.

1. After concrete has received a final finish and surplus water sheen has disappeared, immediately seal surface with a uniform coating of approved curing compound, applied at the rate of coverage recommended by manufacturer or as directed by the Engineer. Do not apply less than 1 gallon per 180 square feet of area. Provide satisfactory means to properly control and check rate of application of the compound.

2. Thoroughly agitate the compound during use and apply by means of approved mechanical power pressure sprayers equipped with atomizing nozzles. For application on small miscellaneous items, hand-powered spray equipment may be used. Prevent loss of

compound between nozzle and concrete surface during spraying operations.

3. Do not apply compound to a dry surface. If concrete surface has become dry, thoroughly moisten surface immediately prior to application. At locations where coating shows discontinuities, pinholes or other defects, or if rain falls on a newly coated surface before film has dried sufficiently to resist damage, apply an additional coat of compound at the specified rate of coverage.

3.08 REMOVAL OF FORMS AND SHORING

A. Remove forms from surfaces requiring rubbing only as rapidly as rubbing operation progresses. Remove forms from vertical surfaces not requiring rubbed-finish when concrete has aged for the required number of curing days. When curing compound is used, do not remove forms before 2 days after concrete placement.

B. Leave soffit forms and shores in place until concrete has reached the specified 28-day strength, unless directed otherwise by the Engineer.

3.09 DEFECTIVE WORK

A. Immediately repair any defective work discovered after forms have been removed. If concrete surface is bulged, uneven, or shows excess honeycombing or form marks which cannot be repaired satisfactorily through patching, remove and replace the entire section. Payment for defective work is the sole responsibility of the Contractor.

3.10 FINISHING

A. Patch honeycomb, minor defects and form tie holes in concrete surfaces with cement mortar mixed one part cement to two parts fine aggregate. Repair defects by cutting out unsatisfactory material and replacing with new concrete, securely keyed and bonded to existing concrete. Finish to make junctures between patches and existing concrete as inconspicuous as possible. Use a stiff mixture and thoroughly tamp into place. After each patch has stiffened sufficiently to allow for greatest portion of shrinkage, strike off mortar flush with the surface.

B. Apply a rubbed finish to exposed surfaces of formed concrete structures as noted on Drawings. After pointing has set sufficiently, wet the surface with a brush and perform first surface rubbing with No. 16 carborundum stone, or approved equal. Rub sufficiently to bring surface to paste, to remove form marks and projections, and to produce a smooth, dense surface. Add cement to form surface paste as necessary. Spread or brush material, which has been ground to paste, uniformly over surface and allow to reset. In preparation for final acceptance, clean surfaces and perform final finish rubbing with No. 30 carborundum stone or approved equal. After rubbing,

allow paste on the surface to reset; then wash surface with clean water. Leave structure with a clean, neat and uniform-appearing finish.

C. Apply a wood float finish to concrete slabs.

3.11 FIELD QUALITY CONTROL

A. Unless otherwise directed by Engineer, the following minimum testing of concrete is required. Testing shall be performed by qualified individuals employed by an approved independent testing agency, and conform to the requirements of ASTM C1077.

1. Take concrete samples in accordance with ASTM C172.

2. Make one set of four compression test specimens for each mix design at least once per day and for each 150 cubic yards or fraction thereof. Make, cure and test the specimens in accordance with ASTM C31 and ASTM C39.

3. When taking compression test specimens, test each sample for slump according to ASTM C143, for temperature according to ASTM C1064, for air content according to ASTM C231, and for unit weight according to ASTM C138.

4. Inspect, sample and test concrete in accordance with ASTM C94, Section 13, 14, and 15, and ACI 311-5R.

B. Test Cores: Conform to ASTM C42.

C. Testing High Early Strength Concrete: When Type III cement is used in concrete, the specified 7-day and 28-day compressive strengths shall be applicable at 3 and 7 days, respectively.

D. If 7-day or 3-day test strengths (as applicable for type of cement being used) fail to meet established strength requirements, extended curing or resumed curing on those portions of structure represented by test specimens may be required. If additional curing fails to produce the required strength, strengthening or replacement of portions of structure which fail to develop required strength may be required by the Engineer, at no additional cost to the District.

3.12 PROTECTION

A. Protect concrete against damage until final acceptance.

B. Protect fresh concrete from damage due to rain, hail, sleet, or snow. Provide such protection while the concrete is still plastic, and whenever such precipitation is imminent or occurring.

C. Do not backfill around concrete structures or subject them to design loadings until components of the structure needed to resist the loading are complete and have reached the specified 28-day compressive strength, except as authorized otherwise by the Engineer.

PART 4 MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT

Will be in accordance with Section 01025.

END OF SECTION

SECTION 03200--CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

A. American Concrete Institute (ACI):
315, Details and Detailing of Concrete Reinforcement
318, Building Code Requirements for Reinforced Concrete

B. American Society for Testing and Materials (ASTM):
A 615, Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

C. Concrete Reinforcing Steel Institute (CRSI):
Placing Reinforcing Bars

1.2 MEASUREMENT AND PAYMENT

A. No payment will be made for concrete reinforcement under this Section. Include payment for concrete reinforcement in unit price for applicable cast-in-place concrete structures, sidewalks, and curbs.

1.3 SUBMITTALS

A. Shop Drawings: Show reinforcing bar configuration, bar numbers, spacing, and location, and splicing details.

B. Test Reports: Submit copies of mill test reports.

1.4 QUALITY ASSURANCE

A. Tolerances:

1. Fabricating tolerances:
   a. Sheared length: Plus or minus 1-in.
   b. Depth of truss bars: Plus 0, minus 1/2-in.
   c. Overall dimensions of stirrups and ties: Plus or minus 1/2-in.
   d. Other bends: Plus or minus 1-in.
2. Placing tolerances:
   a. Clear distance to formed surfaces: Plus or minus 1/4-in.
   b. Minimum spacing between bars: Plus or minus 1/4-in.
   c. Top bars in slabs and beams:
      1) Members 8-in. deep or less: Plus or minus 1/4-in.
      2) Members more than 8-in. but not over 2 ft. deep: Plus or minus 1-in.
   d. Crosswise of members: Spaced evenly within 2-in.
   e. Lengthwise of member: Plus or minus 2-in.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Reinforcing Bars:

1. ASTM A 615, Grade 60.
2. Bend test requirements: For bars size No. 3 through No. 6, base on 180 deg. bends of full size bars around pins with diameters as follows:
   a. Bar Nos. 3, 4, and 5: 3-1/2 bar diameters.
   b. Bar No. 6: 5 bar diameters.

2.2 FABRICATION

A. Fabricate details of concrete reinforcement and accessories complying with ACI 315.

PART 3 - EXECUTION

3.1 HANDLING AND PLACING

A. Place reinforcing bars in accordance with CRSI "Placing Reinforcing Bars" and ACI 318, with provisions of ACI 318 governing.

B. Move bars as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.

C. If bars are moved more than one bar diameter or enough to exceed tolerances, submit resulting arrangement of bars to Engineer for review.

D. After fabrication, reinforcing bars shall be delivered to the Work properly identified in accordance with the approved shop drawings.

E. Place reinforcement, at time of concrete placing, free of mud, oil, or other materials that adversely affect or reduce bond.

F. Reinforcement with rust, mill scale, or both shall be considered satisfactory, provided minimum dimensions, including height of deformation, and weight of hand-wire-brushed test specimen are not less than ASTM A 615 requirements.

G. Support reinforcement and fasten together to prevent displacement by construction loads of placing concrete.

H. Use metal or plastic bar chairs and spacers to support reinforcement.

I. Where concrete surface will be exposed to weather in finished structure, use noncorrosive or corrosion protected accessories within 1/2-in. of concrete surface.

J. Bars having splices not shown on shop drawings will be rejected.

K. Do not bend reinforcement after being embedded in hardened concrete.

END OF SECTION 03200

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete Subcontractor.
    e. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semi rigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

F. Samples: For waterstops and vapor retarder.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.
8. Floor and slab treatments.
9. Bonding agents.
10. Adhesives.
11. Vapor retarders.
12. Semi rigid joint filler.
13. Joint-filler strips.
14. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates**:** Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301.

2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

    a. High-density overlay, Class 1 or better.
    b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    c. Structural 1, B-B or better; mill oiled and edge sealed.
    d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

3. Overlaid Finnish birch plywood.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60,deformed bars, ASTM A 767/A 767M, Class I zinc coated after fabrication and bending.

D. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

E. Stainless-Steel Reinforcing Bars: ASTM A 955/A 955M, Grade 60, Type 304, deformed.

F. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.

G. Plain-Steel Wire: ASTM A 1064/A 1064M, galvanized.

H. Deformed-Steel Wire: ASTM A 1064/A 1064M.

I. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, deformed-steel wire, with less than 2 percent damaged coating in each 12-inch wire length.

J. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

K. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

L. Galvanized-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from galvanized-steel wire into flat sheets.

M. Epoxy-Coated Welded-Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, deformed steel.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Zinc Repair Material: ASTM A 780/A 780M.

E. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type II or modified TypeV, gray.
2. Fly Ash: ASTM C 618, Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
4. Silica Fume: ASTM C 1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Lightweight Aggregate: ASTM C 330/C 330M, 3/4-inch nominal maximum aggregate size.

E. Air-Entraining Admixture: ASTM C 260/C 260M.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

G. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

H. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

I. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Color: As selected by Architect from manufacturer's full range.

J. Water: ASTM C 94/C 94M and potable.

2.6 FIBER REINFORCEMENT

A. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 1, cold-drawn wire, deformed, minimum of 1.5 inches long, and aspect ratio of 35 to 40

B. Carbon-Steel Fiber: ASTM A 820/A 820M, Type 2, cut sheet, deformed, minimum of 1.5 inches long, and aspect ratio of 35 to 40.

C. Synthetic Micro-Fiber: Monofilament polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

D. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

E. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1 to 2-1/4 inches long.

2.7 WATERSTOPS

A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a) Grace Construction Products

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A, 10 mil thickness, except with maximum water-vapor permeance of 0.01. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a) Stego Industries, LLC.

2.9 FLOOR AND SLAB TREATMENTS

A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.

B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.

C. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.

1. Color: As selected by Architect from manufacturer's full range.

D. Metallic Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.

1. Color: As selected by Architect from manufacturer's full range.

E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.

F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

1. Color: As selected by Architect from manufacturer's full range.

2.10 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

2.11 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

2.12 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 or aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

   1. Types I and II, nonload bearing or Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

E. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
2. Combined Fly Ash and Pozzolan: 25 percent.
3. Slag Cement: 50 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

E. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

1. Minimum Compressive Strength: 4000 psi at 28 days or as indicated on drawings.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi at 28 days or as indicated on drawings.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi at 28 days or as indicated on drawings.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 520lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.16 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 48 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.6 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

G. Zinc-Coated Reinforcement: Repair cut and damaged zinc coatings with zinc repair material according to ASTM A 780/A 780M. Use galvanized-steel wire ties to fasten zinc-coated steel reinforcement.

3.7 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.8 WATERSTOP INSTALLATION

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.9 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.10 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

3.11 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.12 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 6 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.13 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing

operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.14 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.15 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.16 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test

area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.

b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

3.18 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 03 34 13 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

1.00 GENERAL

1.01 SUMMARY

A. Section Includes

1. Controlled low strength material (CLSM) for use in the following:

a. Flowable backfill.

B. Related Specification Sections include but are not necessarily limited to:

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
2. Division 1 - General Requirements.

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement

a. Measurement for this Item shall be by the face cubic yard to the depth specified of material complete in place. Volume will be computed based on the measured area and type, verified by field measurements.

2. Payment

a. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid per cubic yard of "CLSM" installed for:

1. Various thicknesses

1.03 REFERENCES

A. Reference Standards

1. Reference standards cited in this specification refer to the current reference standard published at the time of the latest revision date logged at the end of this specification, unless a date is specifically cited.
2. American Society for Testing and Materials (ASTM):

a. C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.

b. C 33 - Standard Specification for Concrete Aggregates.

c. C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

d. C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

e. C 231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.

f. C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.

g. C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

h. D 1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft3).

1.04 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data

Submit data completely describing products.

B. Shop Drawings

Submit full mix details, including mix design calculations for mix proposed for use.

C. Test and Evaluation Reports

1. Sieve Analysis

a. Submit sieve analyses of fine and coarse aggregates being used. Resubmit at any time there is a significant change in grading of materials.

2. Trial Batch Test Data

a. Submit data for each test cylinder.

b. Submit data that identifies mix and slump for each test cylinder.

1.05 QUALITY ASSURANCE

A. Preconstruction Testing

1. Compression Testing

a. Test 8 cylinders, four (4) at three (3) days and four (4) at 28 days.

2. Slump Test

B. Field Samples

Not less than three (3) cylinder specimens will be tested for each 150 cubic yards of controlled low strength material and not less than three (3) specimens for each half-day's placement

2.00 PRODUCTS

2.01 CONTROLLED LOW STRENGTH MATERIAL (CLSM)

A. Performance / Design Criteria

1. Total calculated air content

a. Not less than 8.0 percent or greater than 12.0 percent.

2. Minimum unconfined compressive strength

a. Not less than 50 pounds per square inch measured at 28 days.

3. Maximum unconfined compressive strength

a. Not greater than 150 pounds per square inch measured at 28 days.

b. The long-term strength (90 days) shall be limited to 200 psi such that material could be re-excavated with conventional excavation equipment in the future if necessary.

4. Wet density

a. No greater than 132 pounds per cubic foot.

5. Color
    a. No coloration required unless noted.
    b. Submit dye or other coloration means for approval.

B. Materials
1. Portland cement
    a. Type II low alkali Portland cement.
2. Fly ash
    a. Class F fly ash in accordance with ASTM C 618.
3. Admixture
    a. Air entraining admixture in accordance with ASTM C 260.
4. Fine aggregate
    a. Concrete sand (does not need to be in accordance with ASTM C 33).
    b. No more than 12 percent of fine aggregate shall pass a No. 200 sieve
    c. No plastic fines shall be present.
5. Coarse aggregate
    a. Pea gravel no larger than 3/8 inch.

C. Mixes
1. Suggested design mix

Material	Weight	Specific Gravity	Absolute Volume Cubic Foot
Cement	30 pounds	3.15	0.15
Fly Ash	300 pounds	2.30	2.09
Water	280 pounds	1.00	4.54
Coarse Aggregate	1,465 pounds	2.68	8.76
Fine Aggregate	1,465 pounds	2.68	8.46
Admixture	4-6 ounces	-	2.70
TOTAL	3,543 pounds	-	27.00

3.00 EXECUTION

3.01 PRE-CONSTRUCTION TESTING

A. Preparing Trial Batch
1. After mix design has been accepted by Engineer, have trial batch of the accepted mix

design prepared by testing laboratory acceptable to Construction Manager.

2. Prepare trial batches using specified cementitious materials and aggregates proposed to be used for the Work.
3. Prepare trial batch with sufficient quantity to determine slump, workability, consistency, and to provide sufficient test cylinders.

B. Trial Batch Test Cylinders

1. Prepare test cylinders in accordance with ASTM C 31 with the following exceptions:
   a. Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.
   b. Do not rod the concrete mix.
   c. Strike off the excess material.
2. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
3. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.
4. The test cylinders may be capped with standard sulfur compound or neoprene pads:
   a. Perform the capping carefully to prevent premature fractures.
   b. Use neoprene pads a minimum of 1/2 inch thick and 1/2 inch larger in diameter than the test cylinders.
   c. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.

C. Compression Testing

1. Test 4 test cylinders at 3 days and 4 at 28 days in accordance with ASTM C 39 except as modified herein:
   a. The compression strength of the 4 test cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.
   b. If the trial batch tests do not meet the Specifications for strength or density, revise and resubmit the mix design, and prepare additional trial batch and tests. Repeat until an acceptable trial batch is produced that meets the Specifications.
   c. All the trial batches and acceptability of materials shall be paid by the Contractor.
   d. After acceptance, do not change the mix design without submitting a new mix design, trial batches, and test information.

D. Slump Testing

1. Determine slump in accordance with ASTM C 143 with the following exceptions:
   a. Do not rod the concrete material.
   b. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.

3.02 INSTALLATION

A. Prior to placement, soils located below controlled low strength material placement shall be scarified to a depth of 8 inches, uniform moisture conditioned to or above the optimum moisture content, and compacted to a minimum of 95 percent relative compaction in accordance with ASTM D 1557 at the direction of the Engineer.

B. Place controlled low strength material by any method which preserves the quality of the material in terms of compressive strength and density:

1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to the lesser of four (4) feet or the lift height indicated on the Drawings. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent lateral load due to the weight of the next lift of CLSM.

2. The basic requirement for placement equipment and placement methods is the maintenance of its fluid properties.

3. Transport and place material so that it flows easily around, beneath, or through walls, pipes, conduits, or other structures.

4. Use a slump of the placed material greater than nine (9) inches, and sufficient to allow the material to flow freely during placement:

a. After trial batch testing and acceptance, maintain slump developed during testing during construction at all times within plus or minus one (1) inch.

5. Use a slump, consistency, workability, flow characteristics, and pump ability (where required) such that when placed, the material is self-compacting, self-densifying, and has sufficient plasticity that compaction or mechanical vibration is not required.

6. When using as embedment for pipe take appropriate measures to ensure line and grade of pipe.

3.03 FIELD QUALITY CONTROL

A. General

1. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the Engineer in preparing said specimens.

2. Be responsible for the care of and providing curing condition for the test specimens.

B. Tests

1. During the progress of construction, perform tests as directed by the Owner to determine whether the controlled low strength material, as being produced, complies with the requirements specified hereinbefore. Testing shall be in accordance with Section 01 45 23 – TESTING AND INSPECTING SERVICES.

2. Test cylinders

a. Prepare test cylinders in accordance with ASTM C 31 with the following exceptions:

i. Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.

ii. Do not rod the concrete mix.

iii. Strike off the excess material.

3. Place the cylinders in a safe location away from the construction activities. Keep the cylinders moist by covering with wet burlap, or equivalent. Do not sprinkle water directly on the cylinders.

   a. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.

4. Not less than 3 cylinder specimens will be tested for each 150 cubic yards of controlled low strength material and not less than 3 specimens for each half day's placement:

   a. Test 1 cylinder at 3 days and 2 at 28 days in accordance with ASTM C 39 except as modified herein.

   b. The compression strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.

END OF SECTION

SECTION 03600 – GROUTGROUT

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies grout for uses other than masonry. Masonry grout is specified in Section 04200.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY CONTRACTOR:

To demonstrate conformance with the specified requirements for grout, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test grout materials as required in this section. Costs of testing laboratory services shall be borne by the Contractor.

B. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C33	Concrete Aggregates
ASTM C40	Organic Impurities in Fine Aggregates for Concrete
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Material Finer Than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136 REV A	Sieve Analysis of Fine and Coarse Aggregates
ASTM C150	Portland Cement
ASTM C289	Potential Reactivity of Aggregates (Chemical Method)
ASTM C494	Chemical Admixtures for Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM E329 REV C	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
CRD-C621	Corps of Engineers Specification for Nonshrink Grout

PART 2 - PRODUCTS

2.01 MATERIALS

A. CEMENT:

Portland cement shall be ASTM C150, Type II or Type V, low alkali, containing less than 0.60 percent alkalies.

B. AGGREGATE:

1. GENERAL: Aggregate shall be nonreactive and shall be washed before use.

When sources of aggregate are changed, test reports shall be provided for the new material. The tests specified shall be performed prior to commencing grout work.

2. FINE AGGREGATE: Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine and shall conform to ASTM C33 as modified herein. When tested in accordance with ASTM C136, gradation shall be such that

100 percent by weight will pass a standard No. 8 mesh sleeve and no less than 45 percent by weight will pass a standard No. 40 mesh sieve.

Variation from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

U.S. standard sieve size	Permissible variation in individual tests, percent
30 or coarser	2
50 or finer	0.5

Other tests shall be in accordance with the following specifications:

Test	Test method	Requirements
Organic Impurities	ASTM C40	Color lighter than standard
Amount of Material Passing No. 200 Sieve	ASTM C117	3% maximum by weight
Soundness	ASTM C88	10% maximum loss with sodium sulfate
Reactivity	ASTM C289	Innocuous aggregate
Sand Equivalent	ASTM D2419	Minimum 80

C. ADMIXTURES:

1. GENERAL: Admixtures shall be compatible with the grout. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the grout mix.

2. WATER REDUCING RETARDER: Water reducing retarder shall be ASTM C494 Type D and shall be Master Builders Pozzolith 300-R, Sika Corporation Plastiment, or equal.

3. LUBRICANT FOR CEMENT PRESSURE GROUTING: Lubricant additive for cement pressure grouting shall be Intrusion Prepakt Intrusion Aid, Sika Intraplast N, or equal.

D. WATER:

Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalies, and organic materials; shall not contain more than 1000 mg/1 of chlorides as Cl, nor more than 1300 mg/1 of sulfates as SO_4; and shall not contain an amount of

impurities that may cause a change of more than 25 percent in the setting time of the cement nor a reduction of more than 5 percent in the compressive strength of the grout at 14 days when compared with the result obtained with distilled water. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the grout.

2.02 GROUT

A. CEMENT GROUT:

Cement grout shall be a mixture of one part cement, two parts sand, proportioned by volume, admixtures for pressure grouting, and sufficient water to form a workable mix.

B. NONSHRINK GROUT:

See Section 03300.

C. EPOXY GROUT FOR CRACK REPAIR AND DOWEL ANCHORAGE:

See epoxy adhesives in Section 03300.

D. POLYMER CONCRETE (FOR RESURFACING OR PATCHING):

Polymer concrete (for resurfacing or patching) shall consist of a liquid binder and dry aggregate mixed together to make a mortar or grout of a consistency as required for the application. The liquid binder shall be a chemical and oil resistant, stress relieved, low modulus, moisture insensitive, two-component epoxy-resin compound. The consistency shall be similar to lightweight oil for proper mixing with aggregate. Material shall conform to ASTM C881, Type 3, Grade 1, such as Sika Corporation Sikadur Lo-Mod series, Adhesive Engineering Concresive 1470, Adhesive Technology Corporation 400 series, or equal.

The aggregate shall be oven dry in sealed packages until time of mixing, and shall be of size and consistency compatible with recommendations of manufacturer of liquid binder for intended application.

E. ADHESIVE CAPSULES FOR DOWEL ANCHORAGE:

Adhesive resin capsules shall consist of sealed glass capsules containing premeasured amounts of a polyester or vinylester resin, quartz sand aggregate and a hardener contained in a separate vial within the capsule. Adhesive capsules shall be Hilti HEA Capsules, Molly Parabond Capsules, or equal.

2.03 PRESSURE GROUTING EQUIPMENT

Pressure grouting equipment shall include a mixer and holdover agitator tanks and shall be designed to place grout at pressures up to 50 psi. Gages shall be provided to indicate pressure used.

The mixer shall be provided with a meter capable of indicating to one-tenth of a cubic foot the volume of grout used.

2.04 PRODUCT DATA

The following information shall be provided in accordance with Section 01300.

A. MANUFACTURER'S DATA:

Manufacturer's data shall be provided for the following:

1. Nonshrink grout
2. Pressure grout
3. Epoxy grout
4. Polymer concrete

B. LABORATORY TEST REPORTS:

Test reports on previously tested materials shall be accompanied by the manufacturer's statement that the previously tested material is the same type, quality, manufacture, and make as that proposed for use in this project. Test reports are required for the following:

1. Cement
2. Aggregates
3. Epoxy resin

C. EVIDENCE OF TESTING LABORATORY COMPETENCE:

The Contractor shall require that the laboratory provide directly to the Engineer evidence of the most recent inspection of its facilities by the Cement and Concrete Reference Laboratory of the National Bureau of Standards. The evidences shall show that deficiencies mentioned in the report of that inspection have been corrected. The evidence of inspection shall be provided prior to delivery of materials to the job site.

PART 3 - EXECUTION

3.01 GENERAL

Bonding compound for use with grout is specified in Section 03300. Primer, if required for polymer concrete, shall be provided per manufacturer's recommendation.

3.02 CEMENT GROUT

Cement grout shall be used for filling nonbearing portions of equipment pads and pressure grouting. Except for the specialized equipment for pressure grouting, mixing and placing apparatus

shall be similar to that normally used for cast-in-place concrete. Grout shall be mixed for a period of at least 1 minute. Diluted grout shall be agitated to keep ingredients mixed.

3.03 NONSHRINK GROUT

Nonshrink, nonmetallic aggregate grout shall be used for the bearing surfaces of machinery and equipment bases, column base plates and bearing plates. Nonshrink metallic aggregate grout shall be used for setting anchor bolts and grouting reinforcing steel holes. Grout shall meet the requirements of CRD-C621 and shall be placed in accordance with manufacturer's instructions.

Holes required for grouting shall be blown clean with compressed air and left free of dust or standing water. Horizontal holes for grouting shall be drilled at a slight downward angle to facilitate holding the grout until setting is complete. Bolts or reinforcing steel installed in horizontal grout holes shall be bent slightly accordingly.

3.04 EPOXY ADHESIVE OR GROUT

Epoxy adhesive or grout shall be used for repairing cracks by pressure grouting or gravity flow, repairing structural concrete, and may be used for setting reinforcing dowels or anchor bolts into holes for grouting. Concrete shall be primed in accordance with the grout manufacturer's instructions.

Use of epoxy adhesive or grout for anchorage of bolts or reinforcing dowels shall be subject to the following conditions:

1. Use shall be limited to locations where exposure, on an intermittent or continuous basis, to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is extremely unlikely.

2. Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above the product's heat deflection temperature or 120 degrees F (whichever is less) is extremely unlikely. Overhead applications (such as pipe supports) because of the above concerns, shall be disallowed.

3. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.

4. Anchor diameter and grade of steel shall be per contract documents or per equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.

5. Embedment depth and hole diameter shall be as specified.

6. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill. Smooth wall holes will not be acceptable.

7. Holes shall be blown clean with compressed air and be free of dust or standing water prior to application of grout.

8. Anchor shall be left undisturbed and unloaded for full curing period.

9. Anchors shall not be placed in concrete below 25 degrees F.

3.05 ADHESIVE CAPSULES

Adhesive resin capsules may be used for setting and anchoring reinforcing dowels or anchor bolts into predrilled holes in concrete. Use of the adhesive resin capsules for anchorage of reinforcing dowels or bolts shall be as specified in paragraph 05501-3.03.

3.06 PRESSURE GROUTING

Prior to grouting, systems and holes to be grouted shall be washed clean. Washing is not required for grouting soil voids outside pipe cylinders or casing pipes. Grouting, once commenced, shall be completed without stoppage. In case of breakdown of equipment, the Contractor shall wash out the grouting system sufficiently to ensure fresh grout and adequate bond and penetration will occur upon restarting the grouting operation. Grout pressure shall be maintained until grout has set.

END OF SECTION

DIVISION 4

MISCELANEOUS MATERIALS

SECTION 04000

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Pre-faced concrete masonry units.
4. Mortar and grout.
5. Steel reinforcing bars.
6. Masonry-joint reinforcement.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Masonry-cell fill.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Decorative CMUs, in the form of small-scale units.
2. Pre-faced CMUs.
3. Colored mortar.
4. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. Exposed and Decorative CMUs.
2. Pre-faced CMUs.
3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.

   a. Include data on material properties and material test reports substantiating compliance with requirements.
   b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Integral water repellant used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.

2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602/ACI 530.1/ASCE 6.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high by full thickness.
2. Build sample panels facing south.
3. Where masonry is to match existing, build panels adjacent and parallel to existing surface.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

    a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless Architect specifically approves such deviations in writing.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for each type of exposed unit masonry construction in sizes approximately 60 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.

    a. Include a sealant-filled joint at least 16 inches long in each exterior wall mockup.
    b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
    c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).

3. Protect accepted mockups from the elements with weather-resistant membrane.

4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

    a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

    1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.

C. Insulated CMUs: Where indicated, units shall contain rigid, specially shaped, cellular thermal insulation units complying with ASTM C 578, Type I, designed for installing in cores of masonry units.

D. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi.
2. Density Classification: Normal weight unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
5. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

E. Concrete Building Brick: ASTM C 55.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: Normal weight.
3. Size (Actual Dimensions): 3-5/8 inches wide by 3-5/8 inches high by 7-5/8 inches long.

F. Decorative CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
4. Pattern and Texture:

   a. Standard pattern, ground-face finish. Match Architect's samples.
   b. Standard pattern, split-face finish. Match Architect's samples.
   c. Standard pattern, split-ribbed finish. Match Architect's samples.
   d. Scored vertically so units laid in running bond appear as square units laid in stacked bond, standard finish. Match Architect's samples.
   e. Triple scored vertically so units laid in running bond appear as vertical units laid in stacked bond (soldier courses), standard finish. Match Architect's samples.

5. Colors: As selected by Architect from manufacturer's full range.
6. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

G. Pre-faced CMUs: Lightweight hollow concrete units complying with ASTM C 90, with manufacturer's standard smooth resinous facing complying with ASTM C 744.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Size: Manufactured to dimensions specified in "CMUs" Paragraph but with pre-faced surfaces having 1/16-inch-wide returns of facing to create 1/4-inch-wide mortar joints with modular coursing.
3. Colors and Patterns: Match Architect's samples or as selected by Architect from manufacturer's full range.

2.5 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91/C 91M.

E. Mortar Cement: ASTM C 1329/C 1329M.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Colored Cement Products: Packaged blend made from portland cement and hydrated lime and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix:
2. Colored Masonry Cement:
3. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
4. Pigments shall not exceed 10 percent of portland cement by weight.
5. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.

H. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Aggregate for Grout: ASTM C 404.

J. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.

K. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

L. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

M. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 316.
4. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
6. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 316.
7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication.

    a. 0.064-inch thick, galvanized-steel sheet may be used at interior walls unless otherwise indicated.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

    a. 0.064-inch- thick, galvanized sheet may be used at interior walls unless otherwise indicated.

E. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual", Section 076200 "Sheet Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch thick.
2. Copper: ASTM B 370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick or ASTM B 370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. weight or 0.0162 inch thick.
3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
5. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
6. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
7. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
8. Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with

hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.

9. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
10. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
11. Fabricate metal expansion-joint strips from stainless steel to shapes indicated.
12. Solder metal items at corners.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
2. Asphalt-Coated Copper Flashing: 5-oz./sq. ft. copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
3. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.

    a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

4. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch.

    a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

5. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.

    a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
    b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch-thick coating of adhesive.
    c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch-thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.

        1) Color: Gray.

    d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

6. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch thick.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.

E. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless-steel sheet manufacturer.
2. Solder for Copper: ASTM B 32, Grade Sn50 with maximum lead content of 0.2 percent.
3. Elastomeric Sealant: ASTM C 920, chemically curing urethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and remain watertight.

F. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

2.11 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C 549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.
3. For mortar parge coats, use Type S.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints with the following units:

   a. Decorative CMUs.
   b. Pre-faced CMUs.
   c. Cast-stone trim units.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

   a. Decorative CMUs.
   b. Pre-faced CMUs.
   c. Cast-stone trim units.

F. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4 inches. Bond and interlock each course of each wythe at corners. Do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.
3. Rake out mortar joints for pointing with sealant.

D. Rake out mortar joints at pre-faced CMUs to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-CELL FILL

A. Pour lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

B. Install molded-polystyrene insulation units into masonry unit cells before laying units.

3.7 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.9 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.10 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 48 inches.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform

tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.14 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.16 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Crush masonry waste to less than 4 inches in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

DIVISION 5

METALS

SECTION 05000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:
1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other steel items not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.

C. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

D. Protected Zone: Structural members or portions of structural members indicated as "Protected Zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.

E. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators, professional engineer, testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE or Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 572/A 572M, Grade 50.

B. Channels, Angles, M, S-Shapes: ASTM A572/A 572M, Grade50.

C. Plate and Bar: ASTM A 36/A 36M, Grade 36.

D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: Standard unless noted otherwise.
2. Finish: Black except where indicated to be galvanized.

H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A 668/A 668M.

J. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Unheaded Anchor Rods: ASTM A 572/A 572M, Grade 50.

1. Configuration: Hooked.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain.

F. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.

4. Finish: Plain.

G. Threaded Rods: ASTM A 572/A 572M, Grade 50.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M, carbon steel.
3. Finish: Plain.

H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.4 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting., Section 099600 "High-Performance Coatings.", Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

C. Primer: SSPC-Paint 25 BCS, Type I, zinc oxide, alkyd, linseed oil primer.

D. Primer: SSPC-Paint 23, latex primer.

E. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

F. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20, ASTM A 780/A 780M.

2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.

2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, " Solvent Cleaning" or SSPC-SP 2, "Hand Tool Cleaning" or SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity

to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

SECTION 052100 - STEEL JOISTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 MEASUREMENT AND PAYMENT

A. No payment will be made for steel joists and joist girders under this Section. Include payment in related items listed on the Unit Price Schedule.

B. Measurement and payment is as noted on the Unit Price Schedule.

1.3 SUMMARY

A. This Section includes the following:

1. Open-web steel joists.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer, fabricate, and erect joists and connections to withstand design loads within limits and under conditions required.

1. Design Loads: As indicated.
2. Design joists to withstand design loads without deflections greater than the following:
   a. Roof Joists: Vertical deflection of 1/360 of the span.

B. Engineering Responsibility: Engage a joist manufacturer who utilizes a qualified professional engineer to prepare design calculations, shop drawings, and other structural data for steel joists.

1.5 SUBMITTALS

A. Product Data for each type of joist, accessory, and product specified.

B. Shop Drawings showing layout, mark, number, type, location, and spacings of joists. Include joining and anchorage details, bracing, bridging, accessories, splice and connection details, and attachments to other units of Work.

1. Indicate locations and details of anchorage devices and bearing plates to be embedded in other construction.

C. Material certificates signed by joist manufacturer certifying that joists comply with SJI's "Specifications."

D. Mill certificates signed by manufacturers of bolts certifying that their products comply with specified requirements.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

F. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing joists similar to those indicated for this Project and that have a record of successful in-service performance.

1. Manufacturer must be certified by SJI to manufacture joists conforming to SJI standard specifications and load tables.

B. SJI Design Standard: Comply with recommendations of SJI's "Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders," applicable to types of joists indicated.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel: Comply with requirements of SJI's "Specifications" for chord and web section material.

B. Steel Bearing Plates: ASTM A 36 (ASTM A 36M).

C. High-Strength Bolts and Nuts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating, ASTM A 153, Class C.

D. Welding Electrodes: Comply with AWS standards.

E. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.2 STEEL JOISTS

A. Manufacture joists according to SJI's "Specifications," with steel angle top and bottom chord members, and as follows:

1. Joist Type: K-series steel joists.
2. End Arrangement: Underslung.
3. Top Chord Arrangement: Parallel.

B. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

C. Extend top chords of joists with SJI Type S top chord extensions where indicated, complying with SJI's "Specifications" and load tables.

D. Camber series steel joists and joist girders according to SJI's "Specifications."

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes when joist slope exceeds 1/4 inch in 12 inches (1:48).

2.3 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span.

1. Supply additional bridging to ensure stability of structure during construction period.

B. Fabricate steel bearing plates with integral anchorages as indicated and finish as follows:

1. Finish: Hot-dip zinc coating, ASTM A 123.

C. Supply ceiling extensions, either extended bottom chord elements or a separate extension unit of sufficient strength to support ceiling construction. Extend ends to within 1/2 inch (13 mm) of finished wall surface, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of joists. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's recommendations, and the requirements of this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and bridging, connections, and anchors to ensure joists are stabilized during construction.

C. Field weld joists to supporting steel framework and steel bearing plates. Coordinate welding sequence and procedure with placing of joists.

1. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts at columns not framed in at least two directions.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords where terminating at walls or beams.

F. The top chord of the joists shall extend on the entire flange of the lateral beam to avoid eccentricity on beam flange caused by joist reaction. The joist manufacturer will design and reinforce the extension to support the uniform load indicated in the K-series Joist Load Table for the span of the joist.

G. All dead loads shall be applied to the joist girders before the bottom chord struts are welded to the stabilizer plates.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing agency employed and paid by Owner will perform field quality-control testing.

B. Testing agency will report test results promptly and in writing to Contractor and Architect.

C. Testing and verification procedures will be required of high-strength bolted connections and field welds.

1. Bolted connections will be visually inspected.
2. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."
3. Field welds will be visually inspected.

D. Correct deficiencies in Work that inspections and test reports have indicated are not in compliance with specified requirements.

E. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.4 REPAIRS AND PROTECTION

A. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

B. Touch Up Painting: Following installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by hand tool cleaning, SSPC-SP 2, or power tool cleaning, SSPC-SP 3.
2. Apply a compatible primer of the same type as the shop primer used on adjacent surfaces.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.

B. Related Requirements:
1. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
2. Section 099100 "Paints & Coatings" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Epic Metals Corporation.
2. Nucor Corp.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33.
2. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard.

3. Deck Profile: As indicated
4. Profile Depth: As indicated
5. Design Uncoated-Steel Thickness: As indicated
6. Span Condition: As indicated.
7. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, [**0.0598 inch**] [**0.0747 inch**] thick, with factory-punched hole of 3/8-inch minimum diameter.

J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

L. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.
3. Fasten with a minimum of 1-1/2-inch-long welds.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 053100

SECTION 055000 -METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Shop drawings detailing fabrication and erection of each metal fabrication indicated. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections.

1.2 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

B. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel."

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Steel Plates, Shapes, and Bars: ASTM A 36 (ASTM A 36M).

1. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.

C. Steel Pipe: ASTM A 53, standard weight (schedule 40), unless otherwise indicated, or another weight required by structural loads.

1. Black finish, unless otherwise indicated.
2. Galvanized finish for exterior installations and where indicated.

D. Gray-Iron Castings: ASTM A 48, Class 30.

E. Malleable-Iron Castings: ASTM A 47, Grade 32510 (ASTM A 47M, Grade 22010).

F. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

2.2 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20.

2.3 FASTENERS

A. General: Provide plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls. Select fasteners for the type, grade, and class required.

2.4 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 CONCRETE FILL

A. Concrete Materials and Properties: Comply with requirements of Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless other strengths are indicated.

2.6 FABRICATION, GENERAL

A. Form metal fabrications from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

E. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

F. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

2.7 ROUGH HARDWARE

A. Furnish bent, or otherwise custom-fabricated, bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required for framing and supporting woodwork, and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Division 6 Sections.

B. Fabricate items to sizes, shapes, and dimensions required.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.9 STEEL LADDERS

A. General: Fabricate ladders for locations shown, with dimensions, spacings, details, and anchorages as indicated.

1. Comply with ANSI A14.3, unless otherwise indicated.

B. Siderails: Continuous, ½-by-2½- inch (12-by 64-mm) steel flat bars, with eased edges, spaced 20 inches apart.

C. Bar Rungs: ¾- inch- (19-mm-) diameter steel bars, spaced 12 inches (300 mm) o.c.

D. Fit rungs in centerline of side rails; plug-weld and grind smooth on outer rail faces.

E. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets. Size brackets to support design loads specified in ANSI A14.3.

F. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung by a proprietary process.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Mebac; IKG Borden.
   b. SLIP-NOT; W.S. Molnar Company.

G. Prime Coat ladders, including brackets and fasteners, for field applied finish coats.

2.10 PIPE BOLLARDS

A. Fabricate pipe bollards from steel pipe, per detail on the drawings.

2.11 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to applying and designing finishes.

B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES

A. Galvanizing: For those items indicated for galvanizing, apply zinc coating by the hot-dip process complying with the following requirements:

1. ASTM A 153 for galvanizing iron and steel hardware.
2. ASTM A 123 for galvanizing both fabricated and unfabricated iron and steel products made of uncoated rolled, pressed, and forged shapes, plates, bars, and strip 0.0299 inch (0.76 mm) thick or thicker.

B. Preparation for Shop Priming: Prepare uncoated ferrous metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6 "Commercial Blast Cleaning."
2. Interiors (SSPC Zone 1A): SSPC-SP 3 "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes or to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with requirements of SSPC-PA 1 "Paint Application Specification No. 1" for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, sleeves, anchor bolts, and

miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

B. Set sleeves in concrete with tops flush with finish surface elevations. Protect sleeves from water and concrete entry.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors as required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing miscellaneous metal fabrications. Set metal fabrication accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete masonry or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop-welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.3 INSTALLING PIPE BOLLARDS

A. Anchor bollards in concrete.

B. Fill bollards solidly with concrete, mounding top surface.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section "Painting."

C. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 055000

DIVISION 6

WOODS, PLASTICS, AND COMPOSITES

SECTION 06000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY:

A. Work of this section includes rough carpentry and blocking as indicated in drawings.

B. Related work specified elsewhere:
1. Concrete formwork.
2. Finish Carpentry and Millwork.
3. Gypsum board.
4. Toilet accessories.
5. Roofing.

1.2 ACTION SUBMITTALS:

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516-09.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.3 INFORMATIONAL SUBMITTALS:

A. Evaluation Reports: For following products, from ICC-ES:
1. Preservative-treated plywood.
2. Fire-retardant-treated plywood.

1.4 QUALITY ASSURANCE:

A. Applicable standards:
1. ASTM International (ASTM), standards as referenced herein.
2. Wood products; comply with the following standards published by the U. S. Department of Commerce, National Bureau of Standards:
a. Lumber: PS 20-10.
b. Construction and Industrial Plywood: PS 1-95.
3. Preservative-treated wood: American Wood Protection Association (AWPA); current standards, as referenced herein, shall apply to preservative-treated wood products.
4. Plywood: APA The Engineered Wood Association (APA), current standards.
5. Grading rules; current grading rules of the following associations apply as applicable to wood products:
a. Southern Pine Inspection Bureau (SPIB).
b. Western Wood Products Association (WWPA).
c. West Coast Lumber Inspection Bureau (WCLIB).
d. National Lumber Grades Authority (NLGA).

B. Product identification:
1. Lumber: Lumber shall bear the grade stamp of a listed grading rules association certified by the Board of Review of the American Lumber Standards Committee (ALSC), identifying species or species combination, grade, moisture condition at time of surfacing, mill of origin and grading agency.
2. Plywood: Plywood shall bear the stamp of the APA The Engineered Wood Association (APA), indicating type, grade, thickness, exposure durability, span rating, agency compliance, species group, edging, finish and glue type.
3. Preservative-treated wood products: Preservative-treated lumber and plywood shall bear the quality standard stamp of the applicator, indicating preservative type, exposure conditions, year of treatment, treatment plant and treatment supervising agency.
4. Fire-retardant-treated wood products: Fire-retardant-treated lumber and plywood shall bear the stamp of Underwriters Laboratories, Inc., (UL) or other approved independent inspection agency, indicating treatment type or name, flame spread and treatment plant.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Upon delivery to project site, place materials in areas protected from weather.

B. Store materials a minimum of 6" above ground on blocking and cover with waterproof covering. Provide for air circulation and ventilation.

C. Store no seasoned materials in wet or damp portions of building.

D. Protect sheet materials from breaking corners and damaging surfaces.

PART 2 - PRODUCTS

2.1 LUMBER:

A. Species and standards: Grade-stamped commercial softwood conforming to PS 20 and referenced grading rules, unless otherwise indicated.

B. Seasoning: 19% maximum moisture content at time of building enclosure, unless otherwise noted.

C. Surfacing: Surfaced four sides (S4S).

D. Dimensions: Indicated lumber dimensions are nominal. Comply with PS 20.

E. Framing lumber; 2" to 4" thickness, 2" to 4" wide, any commercial softwood species, except as noted:
1. Plates, blocking, bracing and nailers: Utility Grade or #3 Southern Pine.
2. General framing: Standard Grade or #2 Southern Pine.
3. General utility purposes: Utility Grade or #3 Southern Pine.

2.2 SHEET MATERIALS:

A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.

B. Plywood:
1. Plywood Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels with grade, C-D Plugged Exposure 1, in thickness indicated or, if not otherwise indicated, not less than 3/4" thick.
2. Plywood: Exterior type, APA A-C EXT, thickness indicated on drawings.

3. Plywood wall panels at IDF/MDF Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4" thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84-18.
   a. Cover walls floor to ceiling, with fire-rated 3/4-inch plywood and painted with two coats of neutral color fire-retardant paint specified in Section 09 9100 - Painting and Coating.

2.3 TREATED WOOD PRODUCTS:

A. Pressure-preservative-treated wood:
1. Treatment type: Water-borne preservative registered with EPA.
2. AWPA standard:
   a. Lumber, timber and plywood shall conform to applicable requirements of AWPA Standard U1-07 and T1-07 for species, product and end use.
   b. Handling and care of pressure treated wood products shall conform to AWPA Standard M4-06.
   c. Preservatives shall conform to AWPA P5-07.
3. Preservative retention: As required by treatment type in accord with AWPA Standards for below- or above-ground use.
4. Seasoning; re-dry after treatment to 19% maximum moisture content.
5. Use:
   a. Wood products in contact with concrete slabs-on-grade or foundations.
   b. Nailers or blocking cast or built into concrete or masonry.
   c. Wood products in contact with exterior walls.
   d. Blocking, nailers, plates and similar wood products in conjunction with roof decks, roofing and roof parapets.

B. Interior fire-retardant-treated wood:
1. Acceptable product; subject to compliance with specified requirements:
   a. Hickson Corporation, Dricon.
   b. Hoover Treated Wood Products, Pyro-Guard.
   c. Viance, LLC, D-Blaze.
2. Description: Pressure-impregnated with a chemical retardant tested and listed by Underwriters Laboratories, Inc., (UL). When tested in accord with ASTM E84-12a treated products shall have a flame spread of 25 or less and show no evidence of significant progressive combustion when the test is continued for an additional twenty minute period. In addition, flame front shall not progress more than 10'-6" beyond centerline of burners at any time during test.
3. Surface burning characteristics: F.R.-S rating in accord with Underwriters Laboratories, Inc. (UL).
4. AWPA standard: AWPA U1-07, T1-07 and P17-02.
5. Seasoning; kiln-dried after treatment to the following maximum moisture content:
   a. Lumber: 19%.
   b. Plywood: 15%.
6. Hygroscopicity: Maximum 28% equilibrium moisture content when tested in accord with ASTM D3201-08a at 92% relative humidity.
7. Use: As required by codes.

2.4 HARDWARE:

A. Provide nails, bolts, nuts, washers, screws, expansion bolts, clips, powder-actuated fasteners and similar hardware necessary for complete installation of rough carpentry items.
1. Material and finish for use with non-pressure treated and fire-retardant-treated components shall be G90 hot dip galvanized steel or Type 304 stainless steel, except nails shall be hot dip galvanized.
2. Material and finish for use with pressure-preservative-treated components shall be one of the following:
   a. G185 hot-dip galvanized steel.
   b. Type 316L stainless steel.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. Install wood framing and rough carpentry work cut square on bearings, fitted and set to required lines and levels, and secured in place.

B. Lay out the work to provide correct openings to receive work of other trades.

C. Preservative-treated wood:
1. Prior to installation, brush-apply preservative to cut edges and ends of wood, using same type of preservative used for pressure treatment.
2. Handle and install in accord with AWPA standards.

D. Fire-retardant-treated wood:
1. Prevent exposure to water or moisture, and do not use if so exposed.
2. Only end cuts shall be made. Do not rip or re-surface.
3. Attach using only hot dip galvanized nails and anchors.

E. Plates, blocking, nailers and miscellaneous framing:
1. Provide 2" nominal thickness members to support and secure finishing materials, fixtures, toilet accessories and grab bars, partitions, specialty items and trim.
2. Bolt to structural steel or metal framing at 4'-0" o. c., maximum.
3. Secure to concrete and masonry using cast-in bolts, powder-activated stud, sleeve or wedge type anchors spaced at 4'-0" o. c., maximum.
4. Provide anchors within 3" of ends of members.
5. Provide linear runs in maximum practicable lengths, with joints in multiple members offset 3'-0", minimum.
6. Around roof perimeter and at roof penetrations, provide blocking equal to roof insulation thickness. Attach through decking into structural members at 2'-0" o. c., maximum, starting within 3" of each end. Space ends 1/2" for venting.
7. Provide wood blocking behind grab bars and toilet accessories.

F. Site tolerances:
1. Variation from plumb: 1/4" in 10'-0" height, non-cumulative,
2. Variation from horizontal squaring diagonals: 1/2".
3. Variation from indicated location of framing: ± 1/4".
4. Location of dimensioned openings: ± 3/8".
5. Variation from indicated rough opening size: +1/4", -1/8".

END OF SECTION

SECTION 06 1643 - EXTERIOR SHEATHING

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:
1. Plywood and gypsum wall sheathing.
2. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS:

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3 INFORMATIONAL SUBMITTALS:

A. Evaluation Reports: For the following, from ICC-ES:
1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Post-installed anchors.

B. Warranties: Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.5 WARRANTIES:

A. Fiberglass-faced gypsum sheathing:
1. Provide manufacturer's standard warranty for sheathing to be free of manufacturing defects including, but not limited to, delamination, sagging and warping. Warranty period shall be five years, beginning at Date of Substantial Completion.
2. Provide manufacturer's standard warranty for sheathing to remain free of delamination, sagging and warping, and stating that sheathing will remain suitable for its intended purpose under normal weathering conditions when left exposed. Warranty period shall be six months, beginning upon application of sheathing.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS**:**

A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.
1. Wall sheathing: APA Rated Sheathing, Exterior, Exposure 1, Group 1, thickness indicated.
2. Roof Sheathing: APA Structural I Rated Sheathing, Exterior, 48/24 or 40/20, 3/4" thick; veneer plywood only.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 FIBERGLASS-FACED GYPSUM SHEATHING:

A. Acceptable products:
1. Basis of design; G-P Gypsum Products, Dens-Glass Gold Gypsum Sheathing.
2. CertainTeed Corp., GlasRoc Sheathing.
3. National Gypsum, Gold Bond eXP Extended Exposure Sheathing.
4. United States Gypsum Co., Securock Glass-Mat Sheathing.

B. Characteristics:
1. Composition: Conforming to ASTM C1177-08; incombustible, silicone treated and water-resistant gypsum core with inorganic fiberglass mat face treated with alkali-resistant polymer coating.
2. Type: Minimum 5/8" thickness. Face size shall be 4'-0" wide by 8'-0", 9'-0" or 10'-0" length, square ends and edges.
3. Weight: Minimum 2300 lbs./msf.
4. Mold resistance: Resistant to mold growth when tested in accord with ASTM D3273-12.

C. Joint tape: 2" wide 10x10 glass mesh tape in accord with sheathing manufacturer's product data.

D. Fasteners: Screws for application of fiberglass-faced gypsum sheathing to cold-formed metal framing shall be minimum 1-1/4" long, No. 6, Type S or S-12, non-corrosive coated bugle head, self-drilling fasteners complying with ASTM C1002-07 and ASTM C954-11.

E. Joint sealant: Medium modulus silicone sealant as specified in Section 07 9200 - Joint Sealants.

2.3 FIRE-RATED FIBERGLASS FACED GYPSUM SHEATHING:

A. Acceptable products:
1. CertainTeed Corp., GlasRoc Sheathing, Type X.
2. G-P Gypsum Products, Dens-Glass Gold FireGuard Gypsum Sheathing.
3. National Gypsum, Gold Bond eXP Extended Exposure Fire-Shield Sheathing.
4. United States Gypsum Co., Securock Firecode Type X Glass-Mat Sheathing.

B. Characteristics:
1. Composition: Conforming to ASTM C1177-13; noncombustible water-resistant core, essentially gypsum, surfaced with glass mat partially or completely embedded in the core.
2. Mold resistance: Resistant to mold growth when tested in accord with ASTM D3273-12.
3. Type: Type X Grade fire-rated board, minimum 5/8" thickness. Face size shall be 4'-0" wide by 8'-0", 9'-0" or 10'-0" length, square ends and edges.
4. Weight: Minimum 2300 lbs./msf.

C. Fasteners: Screws for application of fiberglass-faced gypsum sheathing to cold-formed metal framing shall be minimum 1-1/4" long, non-corrosive coated, self-drilling fasteners as recommended by manufacturer, complying with ASTM C1002-14 and ASTM C954-11.

D. Power-driven fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Joint treatment and air barrier: Install in accord with Section 07 2726 - Fluid-Applied Vapor-Permeable Air Barriers.

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Power-Driven Fasteners: NES NER-272.

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C. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954-11, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
   1. For wall sheathing panels, provide screws with organic-polymer or other corrosion protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117-11.
   2. Material and finish for use with pressure-preservative-treated components shall be Type 316L stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine installed framing and furring members to receive sheathing to verify that surfaces of framing and furring to receive sheathing does not vary more than 1/8" from adjacent surfaces.

3.2 INSTALLATION, GENERAL**:**

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, “Fastening Schedule,” in ICC's “International Building Code.”

D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.3 WOOD STRUCTURAL PANEL INSTALLATION;

A. General: Comply with applicable recommendations in APA Form No. E30, “Engineered Wood Construction Guide,” for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten wall sheathing panels as indicated below:
   1. Screw to cold-formed metal framing.
   2. Space panels 1/8" apart at edges and ends.

3.4 INSTALLATION OF GYPSUM SHEATHING:

A. Install gypsum sheathing in accord with manufacturer's product data and applicable provisions of GA-253, and ASTM C1280-12a and as follows.

B. Install exterior gypsum sheathing specified herein with colored or logo side facing out to weather.

C. Use maximum lengths possible to minimize number of joints. Stagger vertical joints. Terminate vertical edges over framing members.

D. Space fasteners in accord with manufacturer's product data. Install fasteners so heads bear tight against face of sheathing boards but do not cut into facing.

E. Seal sheathing joints using specified sheathing joint tape and sealant in accord with sheathing board manufacturer's product data.

F. Fasteners may be reduced during sheathing installation when attachment of subsequent materials will provide specified attachment spacing and will follow sheathing installation immediately.

END OF SECTION

DIVISION 7

THERMAL AND MOISTURE PROTECTION

SECTION 07000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY:

A. Related work:
1. Concrete.
2. Cementitious decks.
3. Roofing system.
4. Roof insulation.
5. Firestopping.
6. Joint sealants.
7. Acoustical insulation.
8. Mechanical insulation.

1.2 ACTION SUBMITTALS:

A. Product data: Submit product data and installation instructions for each type installation. Include product data for manufacturer's recommended sheathing joint tape.

B. Samples: Submit minimum 1'-0" by 1'-0" sample of sprayed insulation in standard color as selected by Architect.

1.3 INFORMATIONAL SUBMITTALS:

A. Certification: Submit manufacturer's certification that expanded polystyrene wall insulation meets specified density and fire resistance requirements.

1.4 QUALITY ASSURANCE:

A. Applicable standards:
1. ASTM International (ASTM), standards as specified herein.
2. NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Apparatus.

PART 2 - PRODUCTS

2.1 BATT INSULATION:

A. Batt insulation at metal stud walls:
1. Walls:
a. Unfaced fiberglass batts complying with ASTM C665-12, Type I, rated minimum R-13 for thermal resistance.
b. Surface burning characteristics: Flame spread of 25 or less and smoke developed 50 or less when tested in accord with ASTM E84-13a.
c. Formaldehyde content: Zero.
d. Width: Equal to framing spacing.
2. Soffits:
a. Unfaced fiberglass batts complying with ASTM C665-12, Type I; rated R-19 for thermal resistance.
b. Surface burning characteristics: Flame spread of 25 or less and smoke developed 50 or less when tested in accord with ASTM E84-13a.
c. Critical radiant flux: 0.12 W/cm^2 (0.11 Btu/ft^2-s) when tested in accord with ASTM E970-10.
d. Formaldehyde content: Zero.
e. Width: Equal to framing spacing.
3. Acceptable products; subject to compliance with specified requirements:
a. Owens-Corning; Ecotouch Pink Fiberglass.
b. CertainTeed; CertaPro Series.

B. Acoustical insulation: Refer to Section 09 2900 - Gypsum Board.

C. Tape: Insulation manufacturer's standard foil-faced tape; width required to cover joints.

D. Fasteners: Stick-clip spindle fasteners; spindle length as required for insulation thickness.

2.2 EXTRUDED POLYSTYRENE CAVITY WALL AND CONTINUOUS INSULATION:

A. Acceptable products; subject to compliance with specified requirements:
1. The Dow Chemical Co., Styrofoam, Cavitymate.
2. Owens-Corning, Foamular 250, Square Edge.
3. Kingspan, GreenGuard CM XPS Insulation Board.

B. Characteristics:
1. Material: Extruded, closed cell polystyrene boards complying with ASTM C578-13, Type X.
2. Fire propagation characteristics: Insulation shall have been tested and passed NFPA 285 with regard to vertical and lateral fire propagation as part of an approved assembly.
3. Thickness: 2".
4. Density: 1.3 pcf, minimum.
5. Aged R value at 75 degrees F.: 5.0/in. for Total R-7.5.
6. Surface burning characteristics: Flame spread of 25 or less and smoke developed 450 or less when tested in accord with ASTM E84-13a.
7. Compressive strength: 15 minimum, tested in accord with ASTM D1621-10.
8. Flexural strength: Minimum 40 psi.
9. Water vapor permeance: Maximum 1.5 perm-inch, tested in accord with ASTM E96-13.
10. Water absorption: Maximum 0.3% by volume.
11. Sizes: 1'-4" by 8'-0".
12. Edges: Square.

C. Adhesive, joint sealant and joint tape: As recommended by insulation manufacturer.

2.3 SEMI-RIGID INSULATION:

A. Acceptable products; subject to compliance with specified requirements:
1. CertainTeed Corp., CertaPro Commercial Board CB 225 FSK.
2. Johns Manville International, Inc., Insul-Shield FSK-25 I/S 225.
3. Owens-Corning, Curtainwall Insulation/CW225.

B. Characteristics:
1. Material: 2.25 pcf density fiberglass with reinforced foil-scrim-kraft facing complying with ASTM C612-11.
2. Thickness: Indicated on drawings.
3. Size: 2'-0" by 4'-0".
4. R value at 75 degrees F.: 4.3/in. minimum.
5. Surface burning characteristics: Flame spread of 25 or less and smoke developed 50 or less when tested in accord with ASTM E84-13a.
6. Perm rating: 0.05 or less when tested in accord with ASTM E96-13.
7. Formaldehyde content: Zero.

C. Fasteners: Stick-clip spindle fasteners; spindle length as required for insulation thickness.

D. Tape: Insulation manufacturer's standard foil-faced tape; width required to cover joints.

2.4 SPRAYED THERMAL INSULATION, METAL SOFFITS:

A. Closed-cell sprayed polyurethane insulation:
1. Acceptable products; subject to compliance with specified requirements:
a. BASF Corp., SprayTite Spray Polyurethane Foam Insulation

b. Dow Chemical Co., Styrofoam Spray Polyurethane Foam Insulation.
c. Gaco Western, Gaco 183M Spray Polyurethane Foam Insulation.
d. Henry Co., Permax Spray Polyurethane Foam Insulation.
e. Icynene, Inc., Icynene ProSeal Spray Polyurethane Foam Insulation.
f. NCFI Polyurethanes, Insulstar Spray Polyurethane Foam Insulation.

2. Type: Two or three component closed-cell polyurethane foam insulation meeting ASTM C1029-13, providing tight adhesive bond with substrates, minimum 2.0 pcf density.
3. Thickness and thermal value: Minimum R-Value of 6 per inch when tested in accord with ASTM C518-10. Provide minimum 6-1/2" total thickness, with final thermal value of R-38.
4. Fire rating: 2 hrs. when tested in accord with ASTM E119-14.
5. Surface burning characteristics: Flame spread of 25 or less, smoke developed of 450 or less when tested in accord with ASTM E84-15.
6. Water vapor permeability: 2.3 perms per inch when tested in accord with ASTM E96-14.
7. Water absorption by volume: Maximum 1.7% when tested in accord with ASTM D2842-12.
8. Air infiltration: Maximum 0.004 cfm/sf at pressure of 1.57 psf, when tested in accord with ASTM E2178-11.
9. Closed cell content: Minimum 96% when tested in accord with ASTM D6226-10.
10. Compressive strength: Minimum 26 psi when tested in accord with ASTM D1621-10.
11. Blowing agents: Blowing agents shall not contain formaldehyde, CFCs, Penta-BDEs or VOCs.

B. Thermal barrier where required:

1. Basis of design; Isolatek International, CAFCO® TB 415™ Medium-Density Thermal Barrier.
2. Characteristics:
   a. Type: Medium-density wet-mix portland cement based product.
   b. V.O.C.: VOC compliant.
   c. Product shall have passed certified testing for both the (UL-1715) 15 minute Thermal Barrier and the NFPA 286 (AC-377 standards) as an Ignition Barrier.
   d. Coverage rates: As required to comply with and pass the following:
      1) UL 1715 Thermal Barrier at 3/8" thickness.
      2) ASTM E84, at 3/8" thickness.
      3) ASTM E119/UBS 26-2; at 3/4" thickness.
   e. Surfacing burning characteristics per ASTM E84::
      1) Flame: 25.
      2) Smoke: 450.
   f. Density: ASTM E605: 2 pcf.
   g. Cohesion/Adhesion: ASTM E736; 434 psf.
   h. Cohesion/Adhesion over SPF: 1,135 psf tested performance under controlled conditions of independent laboratory tests.
3. Other acceptable products:
   a. International Fireproof Technology, Inc., DC315.
   b. Specialty Products, Inc. (SPI), Flamesafe - TB.
   c. TPR Corp. (Thermal Product Research), Fireshell F10E.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. General: Comply with manufacturer's product data for each type installation. Install insulation fitted to adjacent construction and with tight joints to provide unbroken thermal barrier. Cut insulation around obstructions and protrusions; fill voids with insulation. Remove projections interfering with installation.

B. Batt insulation:
   1. Install batt insulation in exterior walls and soffits as indicated. Friction fit unfaced insulation and secure with tension wires.
   2. Install batt insulation with butted joints.

C. Extruded polystyrene cavity wall and continuous insulation:
   1. Secure extruded polystyrene insulation to substrates using adhesive of type recommended by insulation manufacturer.
   2. Install with end and edge joints butted tightly over clean, dry surfaces, using full application of adhesive applied in uniform thickness.
   3. Seal vertical and horizontal edges using sealant or joint tape as recommended by the insulation manufacturer.
   4. Install optional masonry tie washers at continuous insulation to prohibit penetrating and crushing of insulation.

D. Semi-rigid spandrel insulation:
   1. Friction fit rigid fiberglass insulation. After installation of insulation, secure with insulation manufacturer's clip utilizing center notches to secure directly on the wire ties as shown in manufacturer's installation instructions.
   2. Friction fit insulation between studs; typically at 16" o.c. Then secure insulation with insulation manufacturer's plastic clip.
   3. Install rigid fiberglass insulation with butted joints; tape joints when required to meet Energy Code for Ci requirements.

E. Sprayed polyurethane foam insulation: Apply spray foam insulation to underside of the concrete in metal soffits and other areas as shown on the drawings.
   1. Applicator shall be trained, certified and approved by insulation manufacturer.
   2. Areas to receive spray foam insulation shall be ventilated with fresh air and exhausting air continuously during and 24 hours after spray foam insulation application. Prevent spray and vapors from migrating into non-application areas.
   3. Surfaces to receive sprayed insulation shall be clean, dry and free from dirt, dust, grease, oil, loose paint, rust scale, projections, loose material and other conditions which would prevent adhesion.
   4. Spray apply insulation material in accord with manufacturer's product data and application procedures to achieve insulation thickness specified.
   5. Protect insulated areas from damage and moisture for the remainder of the construction period.
   6. Allow insulation to fully cure before covering with finish materials.
   7. Thermal barrier coating: Apply coating to sprayed polyurethane foam insulation in accord with manufacturer's product data to comply with requirements of UL-1715 and International Building Code requirement 2603.4 for 15 minute thermal barrier over foam plastic.

END OF SECTION

SECTION 07 5416 - POLYESTER REINFORCED MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Reinforced PVC Adhered membrane roofing system.

B. Cover board fully adhered.

C. Roof insulation mechanically fastened.

1.2 RELATED SECTIONS:

A. Division 05 Section "Steel Floor Decking".

B. Division 06 Section "Rough Carpentry" for wood nailers and blocking.

C. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.

D. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.3 REFERENCES:

A. Roofing Terminology: Refer to the following publications for definitions of roofing work related terms used in this Section:
1. ASTM D 1079 "Terminology Relating to Roofing and Waterproofing."
2. Glossary of NRCA's "The NRCA Roofing Manual."
3. Roof Consultants Institute "Glossary of Roofing Terms."
4. ASCE - American Society of Civil Engineers: Wind Uplift Requirements
5. ASTM - American Society for Testing Materials
6. FM - Factory Mutual
7. ES-1 Edge Securement for Texas wind zones

B. Sheet Metal Terminology and Techniques: SMACNA "Architectural Sheet Metal Manual."

C. Applicable standards:
1. ASTM International (ASTM), standards as referenced herein.
2. Factory Mutual Engineering Corp. (FM):
a. “Wind Forces on Buildings and Other Structures,” Loss Prevention Data Sheet 1-7.
b. “Wind Loads to Roof Systems and Roof Deck Securement,” Data Sheet 1-28.
c. “Roof Systems,” Loss Prevention Data Sheet 1-28R/1-29R.
d. “Above-Deck Roof Components,” Loss Prevention Data Sheet 1-29.
e. “Perimeter Flashing,” Loss Prevention Data Sheet 1-49.
3. National Roofing Contractors Association (NRCA): "Roofing and Waterproofing Manual," Fifth Edition, 2001 with 2003 Update.
4. Underwriters Laboratories, Inc. (UL): Building Materials Directory.

1.4 DESIGN CRITERIA:

A. General: Installed roofing membrane systems shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Wind Uplift Performance: Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7. Provide letter of compliance for insurance approval signed by a listed Texas Department of Insurance Windstorm Engineer.

D. Wind Loads; ASCE 7:
1. Wind loads for an ultimate wind speed of 150 mph 3-second gust.
2. Exposure: Exposure B.
3. Risk Category: III (ASCE 7 Method).

1.5 ACTION SUBMITTALS:

A. Product Data: Manufacturer's product data sheets for each product to be provided.

B. Shop Drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
1. Base flashings, cants, and membrane terminations.
2. Tapered insulation, including slopes.
3. Crickets, saddles, and tapered edge strips, including slopes.
4. Insulation fastening patterns.
5. Roofing Membrane terminations at scuppers and downspouts.

C. Verification Samples: Provide for each product specified.

1.6 INFORMATIONAL SUBMITTALS:

A. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

B. Guarantees: Provide manufacturer's current guarantee specimen.

1.7 CLOSEOUT SUBMITTALS:

A. Maintenance Procedures: deliver to the Owner the manufacturer's printed instructions regarding care and maintenance of the roof.

1.8 QUALITY ASSURANCE:

A. Installer Qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and is eligible to receive the specified manufacturer's guarantee.

B. Manufacturer Qualifications: Qualified manufacturer that has UL listing for roofing system identical to that used for this Project.

C. Testing Agency Qualifications: Independent testing agency with the experience and capability to conduct the testing indicated, as documented in accordance with ASTM E329.

D. Source Limitations: Obtain all components from the single source roofing system manufacturer guaranteeing the roofing system. All products used in the system shall be labeled by the single source roofing system manufacturer issuing the guarantee.

E. Fire-Test-Response Characteristics: Roofing materials shall comply with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

F. Manufacturer's observations: Manufacturer's Representative shall provide minimum one (1) visit per week for the duration of the roofing installation. Written documentation and photographs of the applications during each site visit shall be submitted to the Architect and to the Owner/Owner's Representative.

G. Pre-construction conference: Prior to commencing roofing work, conduct a pre-construction conference at job site to review work to be accomplished. Contractor, Roofing Subcontractor, Architect, roofing system manufacturer's representative, and subcontractors having equipment on or passing through roof shall be present.

1.9 DELIVERY, STORAGE, AND HANDLING:

A. Deliver roofing materials in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS:

A. Weather Limitations: Proceed with installation only when current and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written instructions and guarantee requirements.

1.11 GUARANTEES:

A. Provide manufacturer's system guarantee equal to as follows.
1. Single-Source special guarantee includes roofing membrane, base flashings, roofing membrane accessories, and other single-source components of roofing system marketed by the manufacturer.
2. Guarantee Period: 20 years with 120 mph peak gust wind coverage from date of Substantial Completion with no dollar limit.

B. Installer's Guarantee: Submit roofing Installer's guarantee signed by Installer, covering Work of this Section, including all components of roofing system, for the following guarantee period:
1. Guarantee Period: Two Years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS AND COMPONENTS:

A. Isocyanurate roof insulation:
1. Type: Rigid isocyanurate closed-cell foam boards, faced with a perlite insulation board on one major surface of the core foam and a glass fiber reinforced cellulosic felt on the other major surface of the foam core, permanently bonded to non-asphaltic glass facing sheets; minimum compressive strength of 20 psi, complying with requirements of ASTM C1289-08, Class 1, Type III.
2. Face size: Minimum 4'-0" by 8'-0", as required by manufacturer's product data.
3. Total thickness: Minimum two layer of 2.6" thickness each layer. Attached with Carlisle fasteners and insulation plates.
4. Long-term thermal resistance (LTTR) R-value in accord with ASTM C1289-08: R-25 for total thickness.
5. Fire hazard classification: FM Class I

B. Insulation fastener system; Type required by roofing system manufacturer and meeting characteristics and wind uplift further specified:
   1. Corrosion resistance: Pass FM 4470 Corrosion Test, modified DIN 50018 standard, with a maximum of 15 percent red rust after 15 wet and dry acidic atmosphere cycles in Kesternich cabinet.
   2. Plates: Non-corrosive material.

C. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board, or ASTM C1278/C1278M fiber-reinforced gypsum board.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
      b. National Gypsum Company; IDEXcell Glass Mat Roof Board.
      c. USG Corporation; Securock Glass Mat Roof Board.
   2. Thickness: 5/8 inch.
   3. Adhesive: Fast adhesive beads spaces 4-inches on center of full board.

2.2 POLYESTER REINFORCED ROOFING MEMBRANE:

A. PVC Sheet; Basis of Design: Carlisle SynTech Systems, Carlisle Sure-Flex Adhered Roofing System with 135 mil PVC KEE FleeceBack membrane. ASTM D 4434, Type III, fabric reinforced that contains KEE (Elvaloy) to reduce plasticizer migration.
   1. Certification, by letter, stating that the formulation has a minimum 20 years of performance history in North America.
   2. Thickness: 135 mils (80-mil thickness over fleece)
   3. Fabric Fleece Backed
   4. Exposed Face Color: White

B. Base Ply Sheet: Carlisle SureMB 90TG Base Ply torch-applied to the cover board.

C. Flashing materials: Same material as roof membrane or roof manufacturer's standard PVC-coated, minimum 24 gauge galvanized steel.

D. Other Acceptable Manufacturers: based on specified requirements. Provide substitution request for review and approval by Architect and Owner prior to bid.
   1. Carlisle SynTech Systems.
   2. GAF
   3. Johns Manville
   4. Flex Membranes International, Inc.
   5. Soprema

2.3 AUXILIARY ROOFING MATERIALS - SINGLE PLY:

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's internally reinforced or scrim reinforced, smooth backed membrane with same thickness and color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard water-based bonding adhesive for membrane, and solvent-based bonding adhesive for base flashings.

D. Urethane Adhesive: Manufacturer's standard two component no VOC adhesive for fleece backed membranes.

E. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, with anchors.

F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, , cover strips, sealants, and other accessories.

2.4 AUXILIARY ROOFING SYSTEM COMPONENTS:

A. Metal Flashing Sheet: Metal flashing sheet is specified in Section 07 6200 - Sheet Metal Flashing and Trim.

B. Splashblocks: Minimum 3000 p.s.i. pre-cast concrete, smooth formed, approximate 12" width by 18" length.

2.5 WALKWAYS AND SAFETY STRIPS:

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads sourced from membrane roofing system manufacturer.

B. Safety Strips: Manufacturer's minimum 45 mils, reinforced, UV-resistant PVC (polyvinyl chloride) with Elvaloy KEE (ketone ethylene ester) safety warning line for roof perimeters.
   1. Exposed Face Color: Yellow

2.6 ACCESSORIES:

A. Prefabricated accessories: Provide manufacturer’s premium quality walkway pads, prefabricated pipe boots, corners and other standard prefabricated elements.

B. Sealants and adhesive: Types recommended or manufactured by roofing membrane manufacturer’s product data. Provide solvent-based adhesives for horizontal and vertical adhesive applications.

C. Fastener system for perimeters and penetrations: Type required by roofing system manufacturer’s product data and meeting characteristics and wind uplift requirements.
   1. Corrosion resistance: Pass FM 4470 Corrosion Test, modified DIN 50018 standard, with a maximum of 15 percent red rust after 15 wet and dry acidic atmosphere cycles in Kesternich cabinet.
   2. Plates: Non-corrosive material.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates, areas, and conditions for compliance with the requirements affecting performance of roofing system.
   1. General:
      a. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
      b. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   2. Steel Decks:
      a. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 3113 - Steel Floor Decking.

B. Unacceptable panels should be brought to the attention of the General Contractor and Project Owner's Representative and must be corrected prior to installation of roofing system.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION:

A. Clean and remove from substrate sharp projections, dust, debris, moisture, and other substances detrimental to roofing installation in accordance with roofing system manufacturer's written instructions.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSULATION INSTALLATION:

A. Coordinate installation of roof system components so insulation and cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installation of roof insulation and cover board.

C. Install insulation boards with long joints in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4" with like material.

D. Install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation boards where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

G. Adhered Insulation: Install each layer of insulation and cover board and adhere to substrate as follows:
1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
2. Install each layer in a one-part urethane adhesive according to roofing system manufacturer's instruction.
3. Install each layer to resist uplift pressure at corners, perimeter, and field of roof.

H. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 COVER BOARD INSTALLATION:

A. Coordinate installing membrane roofing system components so cover board is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system manufacturer's written instructions for installing roof cover board.

C. Install cover board with long joints of cover board in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with cover board.
1. Cut and fit cover board within 1/4 inch (6 mm) of nailers, projections, and penetrations.

D. Trim surface of cover board where necessary at roof drains so completed surface is flush and does not restrict flow of water.
1. Install tapered edge strips at perimeter edges of roof that do not terminate at vertical surfaces.

E. Adhered Cover Board: Adhere cover board to substrate as follows:
1. Install each layer in a two-part urethane adhesive according to roofing system manufacturer's instruction.
2. Install each layer in a one-part urethane adhesive according to roofing system manufacturer's instruction.
3. Install to resist uplift pressure at corners, perimeter, and field of roof.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 ROOFING MEMBRANE INSTALLATION, GENERAL:

A. Install roofing membrane in accordance with roofing system manufacturer's written instructions, applicable recommendations of the roofing manufacturer and requirements in this Section.

B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

D. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is imminent.
1. Provide tie-offs at end of each day's work to cover exposed roofing membrane sheets and insulation with joints and edges sealed.
2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
3. Remove and discard temporary seals before beginning work on adjoining roofing.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.6 ADHERED ROOFING MEMBRANE INSTALLATION:

A. Install roofing membrane over area to receive roofing in accordance with membrane roofing system manufacturer's written instructions.
1. Unroll roofing membrane and allow to relax before installing.
2. Install sheet in accordance with roofing system manufacturer's written instructions.

B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

D. Bonding Adhesive: Apply water-based bonding adhesive to substrate at rate required by manufacturer and immediately install roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

E. Urethane Membrane Adhesive for fleece backed membranes: Apply 2-Part Urethane Adhesive substrate at rate required by manufacturer and install fleece-backed roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

F. Mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.
1. Test lap edges with probe to verify seam weld continuity.
2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
   a. Remove and repair any unsatisfactory sections before proceeding with Work.
3. Repair tears, voids, and lapped seams in roofing membrane that do not meet requirements.

I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

J. Install roofing membrane and auxiliary materials to tie in to existing roofing.

K. Proceed with installation only after unsatisfactory conditions have been corrected.

3.7 BASE FLASHING INSTALLATION:

A. Install sheet flashings and preformed flashing accessories and adhere to substrates in accordance with membrane roofing system manufacturer's written instructions.

B. Apply solvent-based bonding adhesive at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners per manufacturer's installation instructions.

D. Clean seam areas and overlap and firmly roll sheet flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.8 WALKWAY INSTALLATION:

A. Flexible Walkways: Install walkway products in locations indicated.Heat-weld walkway products to substrate according to roofing system manufacturer's written instructions.

B. Roof-Paver Walkways: Install walkway roof pavers according to manufacturer's written instructions in locations indicated, to form walkways. Leave 3 inches of space between adjacent roof pavers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.9 FIELD QUALITY CONTROL:

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Final Roof Inspection: Arrange for roofing system manufacturer's Registered Roof Observer (RRO) to inspect roofing installation on completion and submit report to Architect.
   1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Repair or remove and replace components of roofing system where test results or inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 PROTECTION AND CLEANING:

A. Protect roofing system from damage and wear during remainder of construction period.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:
1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed wall sheet metal fabrications.

B. Related work specified elsewhere:
1. Roofing system.
2. Joint sealants.

1.2 PERFORMANCE REQUIREMENTS:

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet metal standard for flashing and trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI wind design standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
1. Design pressure: As indicated on Drawings.

D. Thermal movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Wind Loads; ASCE 7:
1. Wind loads for an ultimate wind speed of 150 mph 3-second gust.
2. Exposure: Exposure B.
3. Risk Category: III (ASCE 7 Method).

1.3 ACTION SUBMITTALS:

A. Product Data: For each of the following
1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.

B. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.

9. Include details of special conditions.
10. Include details of connections to adjoining work.

C. Samples: Sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
1. 8-inch-square Samples of specified sheet materials to be exposed as finished surfaces.
2. 12-inch-long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish

1.4 INFORMATIONAL SUBMITTALS:

A. Product Certificates: For each type of roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.

B. Evaluation Reports: For roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

C. Sample warranty.

1.5 QUALITY ASSURANCE:

A. Applicable standards as referenced herein:
1. Aluminum Association (AA), "Aluminum Sheet Metal Work in Building Construction".
2. American Architectural Manufacturers Association (AAMA).
3. American Iron and Steel Institute (AISI), "Stainless Steel Data Manual".
4. American National Standard Institute/Single Ply Roofing Institute (ANSI/SPRI), as referenced herein.
5. ASTM International (ASTM).
6. National Roofing Contractors Association (NRCA): "The NRCA Roofing Manual: Membrane Roof Systems-2011".
7. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA), "Architectural Sheet Metal Manual," Seventh Edition - January, 2012.
8. Society for Protective Coatings (SSPC), standards as referenced herein.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Store materials off ground, under cover. Protect from damage and deterioration.

B. Handle materials to prevent damage to surfaces, edges and ends of sheet metal items. Damaged material shall be rejected and removed from site.

1.7 WARRANTIES:

A. Warrant sheet metal flashing and trim work to be free of defects in materials and workmanship. Warranty period shall be two years beginning at Date of Substantial Completion.

B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Delta units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion for fluoropolymer finishes.

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C. Coping and fascia warranty:
1. Warrant materials to be free of defects in material and workmanship for five years. If, after inspection, manufacturer agrees that materials are defective, manufacturer shall, at their option, repair or replace them.
2. Fabricator shall guarantee that a standard size roof edge system, when installed per roof manufacturer's instructions, will not blow off, leak, or cause membrane failure, even in wind conditions up to 120 mph, or the manufacturer shall replace or repair their materials.
3. Warranty periods shall begin at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS:

A. Aluminum: 0.063" thickness, 3003-H14 alloy, meeting ASTM B209-07.
1. Fascias and coping: Minimum 0.050" thickness, fluoropolymer finish.
2. Scuppers and conductor heads: Material thickness shall meet SMACNA Manual Table 1-5 requirements, minimum 0.063" thickness, fluoropolymer finish.
3. Miscellaneous flashing and sheet metal: 0.040" thickness; mill finish.

B. Roofing cement/mastic: As recommended by roof membrane manufacturer.

C. Stainless steel: AISI Type 304 alloy, 2B finish.
1. Scuppers: Minimum 24 gauge (0.025").
2. Edge strips and hook strips: Minimum 20 gauge (0.0375").Minimum 24 ga., AISI Type 302/304 alloy, 2B finish.

D. Fasteners: Stainless steel.
1. Nails: Flat head, needle point, not less than 12 ga. and of sufficient length to penetrate substrate 1" minimum.
2. Expansion shields: Lead or bronze sleeves.
3. Screws: Self-tapping type, with round heads.
4. Bolts: Furnished complete with nuts and washers.
5. Rivets: Round head, solid type.
6. Blind clips and cleats: Same gauge as sheet metal.

E. Silicone sealant for concealed joints:
1. Acceptable products:
a. Dow Corning Corp., DOWSIL #795.
b. Pecora Corp., #895.
c. Tremco, Inc., an RPM Company, SpecTrem 2.
2. Type: One-part silicone rubber; meeting ASTM C920-11, Type S, Grade NS, Class 25.

F. Waterproof membrane subflashing:
1. Acceptable products; subject to compliance with specified requirements:
a. Carlisle Coatings and Waterproofing, Inc., WIP 300HT.
b Polyguard Products, Inc., Polyguard Deck Guard HT.
c. Grace Construction Products, Grace Ice & Water Shield HT (High-Temperature)
2. Characteristics:
a. Type: Self-adhering rubberized asphalt sheet complying with ASTM D1970-11.
b. Thickness: Minimum 40 mils when tested in accord with ASTM D3767-03(2008), method A.
c. Tensile strength: 250 psi minimum when tested in accord with ASTM D412-06a.
d. Elongation: 250% when tested in accord with ASTM D412-06a, Die C Modified.
e. Provide primers, sealants and accessories required for a waterproof installation.

G. Bituminous coating for separation of dissimilar materials: Cold-applied, asphalt roofing cement meeting ASTM D1187-97(2011), minimum 30 mils thickness.

2.2 FINISHES:

A. Fluoropolymer coating finish:
1. Exposed aluminum flashing finish:
a. Two coat polyvinylidene fluoride (PVDF) 2-coat system that incorporates metal flakes in the color coat. A clear top coat protects the metal flakes and results in an outstanding metallic effect. shop-applied, baked-on, fluoropolymer coating system based on minimum 70% Arkema Group, Kynar 500 or Solvay Solexis, Inc., Hylar 5000 resin (Polyvinylidene fluoride, PVDF), formulated by a licensed manufacturer and applied by manufacturer's approved applicator to meet AAMA 2605-05.
b. Color: To be selected by Architect.
2. Finish on unexposed surfaces: Mill finish.
3. Work to receive fluoropolymer coating includes copings, fascias, and sheet metal flashing and trim exposed to view.

2.3 ALUMINUM COPINGS:

A. Copings shall not negatively impact specified roofing system warranty.

B. Acceptable manufacturers:
1. W. P. Hickman Co.
2. Innovative Metals Company, Inc. (IMETCO).
3. Metal-Era, Inc.

C. Characteristics:
1. Material: Formed aluminum alloy, smooth surface. Minimum thickness as follows:
a. Up to 4" face: Use 0.040".
b. From 4" to 8" face: Use 0.050".
c. From 8" to 10" face: Use 0.063".
d. Over 10" face: Use 0.080".
2. Finish: Fluoropolymer coating, as specified herein.
3. Face height: As indicated on drawings.
4. Lengths: 10'-0" minimum.
5. Joints: Splice plates, concealed, in accord with manufacturer's product data.

D. Accessories:
1. Splice plates: 0.050" thickness aluminum sheet, 6" minimum width, for concealed installation. Finish shall match copings.
2. Anchor plate: Hot dip galvanized steel of manufacturer's standard design.
3. Prefabricated sections: Factory-assembled, mitered, welded corners, to match copings in design and finish.

2.4 FLASHING REGLET SYSTEM:

A. Acceptable products:
1. Fry Reglet Corp., Springlok, SM Type.
2. W.P. Hickman, Surface-Mount Counter Flashing Type.
3. Metal-Era Roof edge Systems, CWF2-500 Surface Mount Type.

B. Characteristics:
1. Material for surface-mounted reglets: Aluminum alloy reglet and counterflashing; counterflashing minimum 0.032" thickness.
2. Finish: Factory applied fluoropolymer coating finish, colors as selected by Architect.
3. Accessories: Prefabricated interior and exterior corners and splice plates.
4. Reglet cover: Reglet for cast-in-place concrete shall have factory-installed temporary cover to prevent migration of concrete into reglet.

2.5 DOWNSPOUT BOOTS:

A. Acceptable manufacturers:
1. Barry Pattern & Foundry Company, Inc.
2. Downspoutboots.com, a division of J.R. Hoe and sons.
3. Jay R. Smith Mfg. Co.
4. Piedmont Pipe manufacturing.

B. Characteristics:
1. Material: One of the following:
a. Aluminum:
1) Cast aluminum shall be melted from the highest grade 319 alloy.
2) Extruded aluminum shall be made from 6063-T5 alloy base and heat treated.
b. Cast Iron: Castings shall be of gray cast iron, conforming to A.S.T.M., A-48-70, U.S. QQI-652c or A.A.S.H.O. M-105-621 specifications as required sghall be machineable.
c. Type 304 stainless steel.
2. Type: Coordinate configuration, size and length with downspouts and below grade drain pipe system.
3. Finish: Powder coat finish in color selected by Architect from manufacturer's full range.

2.6 SHEET METAL FABRICATION:

A. Fabricate sheet metal work in accord with approved shop drawings and applicable standards. Form sheet metal work with clear, sharp and uniform arrises. Hem exposed edges.

B. In aluminum sheets less than 0.040" thick, make joints using flatlock seams, 3/4" in width. Fill seams with exterior sealant. Make joints in thicker sheets using seaming or by Tungsten Arc Welding (TIG) or Gas Metal Arc Welding (MIG) processes, using appropriate filler alloy.

C. Provide linear sheet metal items in 10'-0" to 12'-0" sections, except as otherwise noted. Form flashing using single pieces for the full width. Provide shop-fabricated, one-piece corners and transition pieces, with maximum 2'-0" long legs.

D. Make riveted joints using solid shank rivets or pop rivets as applicable. Pop rivets shall be closed end type.

PART 3 - EXECUTION

3.1 SHEET METAL INSTALLATION:

A. Install work in accord with approved shop drawings and applicable standards. Sheet metal items shall be true to line, without buckling, creasing, warp or wind in finished surfaces.

B. Coordinate flashing at roof surfaces with roofing work to provide weathertight condition at roof terminations.

C. Perform field joining of lengths as specified for shop fabrication.

D. Isolate dissimilar materials to prevent electrolysis. Separate using bituminous coating.

E. Seaming: Form seams in direction of flow. Aluminum seams shall be filled with exterior sealant. Lap seams occurring in members sloping 45° or more than 4", minimum; bed in flashing cement.

F. Secure sheet metal items using continuous cleats, clips and fasteners as indicated. Perform no exposed face fastening.

G. Fastening:
1. Nails: Confine to one edge only of flashing 1'-0" or less in width. Space nails at 4" o. c., maximum. Provide neoprene washers for nails.
2. Cleats: Continuous, formed to profile of item being secured.
3. Clips: Minimum 2" wide by 3" long, formed to profile of item being secured. Space at 2'-0" o. c., maximum.

H. Joints:
1. Form joints in linear sheet metal to allow for 1/2" minimum expansion at 12'-0" o. c., maximum, and maximum 2'-0" from corners.
2. Form plates to profile of sheet metal item.
3. Install 1'-0" wide backup plate centered under joint. Set sheet metal over backup plate in two beads of specified silicone sealant, 1/4" in diameter, minimum.
4. For units with top width of 12" and wider, install 6" cover plate centered over joint. Set in two beads of specified silicone sealant, 1/4" in diameter, minimum.
5. Mate components for positive seal. Do not allow sealant to migrate onto exposed surfaces.

I. Where sheet metal is indicated as flashing above and below heads of doors, windows and other penetrations, extend flashing minimum 8" beyond opening, each side. Turn ends up minimum 2" to form end dams and to ensure drainage through weeps and not into cavity.

J. Scuppers and conductor heads:
1. Construct with welded joints, lapped 1" minimum, in direction of flow.
2. Install through-wall spillout scuppers in accord with SMACNA Manual, Figure 1-26, with Detail 2 Alternate connection to conductor heads, and Figure 1-27A. Seal perimeters.
2. Install overflow scuppers in accord with SMACNA Manual, Figure 1-30. Seal perimeters.

K. Roof penetration flashing: Refer to roof membrane system section.

3.2 COPING INSTALLATION:

A. Install prefabricated copings in accord with manufacturer's product data and ANSI/SPRI ES-1, true to line.

B. Install waterproof membrane subflashing under copings, secured under backup plates and continuous cleats.
1. Install membrane subflashing fully adhered to substrates in accord with manufacturer's product data, except where more stringent requirements are specified herein.
2. If required, prime surfaces to receive membrane materials. Allow primer to dry until tack-free. Prime only area which can be covered with sheet membrane during work period. Reprime surfaces which are not covered within 24 hours of primer application.
3. Install membrane materials with side and end laps recommended by product data. Begin installation at low points, lapping succeeding sheets to shed water.
4. Membrane applications shall be fully adhered, smooth, straight and free of blisters, buckles, fishmouths and wrinkles affecting the complete adherence of the membrane. Patch and repair defective work in accord with manufacturer's product data. Areas which exhibit defective areas or generally poor or improper workmanship shall be removed and replaced.
5. Double membrane at changes in plane by application of a centered membrane strip. Cover strip completely with full width sheet.
6. Seal around protrusions and at terminations in accord with product data.
7. Repair punctures and tears in membrane by patching with membrane material prior to protection board installation. Trowel-apply roofing cement at exposed edges of patch.

C. Install anchor plate at 5'-0" o. c. maximum under copings. Install concealed splice plates at intersections in accord with manufacturer's product data.

D. Install copings over anchor plates and splice plates, with minimum 3/8" wide joints over splice plate intersections. Set copings over splice plates in full bed of silicone sealant or extruded butyl tape, 1/2" from intersection edges.

E. Make weathertight fit, allowing for expansion and contraction as recommended by manufacturer's product data.

F. Attach materials using aluminum or stainless steel fasteners. Exposed fasteners shall match metal in finish.

3.3 REGLET INSTALLATION:

A. Install reglets as directed by manufacturer, level and true to line. Verify that flashing occurs at or above reglet locations.
   1. Surface-mounted and stucco reglets: Install reglets as walls are built.
   2. Install with top of reglet minimum of 8" above high point of cant strip.

B. Terminate reglet 2" from each side of expansion and control joints in substrates to which surface-applied reglets are installed. Provide 1'-0" wide cover plate of reglet material, overlapping adjacent reglet lengths 4". Attach cover plates to provide discontinuous joints.

C. Provide factory-fabricated corners at changes in direction.

D. Following installation of roofing, install counterflashing by snapping into reglet in accord with manufacturer's product data. Overlap adjacent lengths 6", minimum, to allow for expansion and contraction. Caulk top edge of reglet using exterior silicone sealant as specified in Section 07 9200 - Joint Sealants.

END OF SECTION

SECTION 07 72 33 TYPE TSG (Single leaf, Double leaf and Multiple leaf) ALUMINUM ACCESS HATCHES

I. PART ONE - GENERAL

1.01 SUMMARY

A. Work included: Furnishing and installing factory fabricated vault access doors

B. Related Work:

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM), 100 Bar Harbor Drive, West Conshocken, PA 19428-2959; (610) 832-9585, fax (610) 832-9555

1. ASTM A 36-93a: Standard Specification for Structural Steel

1.03 SUBMITTALS

A. Product Data: Provide manufacturer's product data for all materials in this specification.

B. Shop Drawings: Show profiles, accessories, location, and dimensions.

C. Samples: Manufacturer to provide upon request; sized to represent material adequately.

D. Contract Closeout: Vault access door manufacturer shall provide the manufacturer's Warranty prior to the contract closeout.

1.04 PRODUCT HANDLING

A. All materials shall be delivered in manufacturer's original packaging.

B. Store materials in a dry, protected, well-vented area. The contractor shall thoroughly inspect product upon receipt and report damaged material immediately to delivering carrier and note such damage on the carrier's freight bill of lading.

C. Remove protective wrapping immediately after installation.

1.05 SUBSTITUTIONS

A. Proposals for substitution products shall be accepted only from bidding contractors and not less than (10) working days before bid due date. Contractor guarantees that proposed substitution shall meet the performance and quality standards of this specification.

1.06 JOB CONDITIONS

A. Verify that other trades with related work are complete before installing vault access door(s).

B. Mounting surfaces shall be straight and secure; substrates shall be of proper width.

C. Refer to the construction documents, shop drawings, and manufacturer's installation instructions.

D. Observe all appropriate OSHA safety guidelines for this work.

1.07 WARRANTY/GUARANTEE

A. Manufacturer's standard warranty: Materials shall be free of defects in material and workmanship for a period of (10) Ten years from the date of purchase. Should a part fail to function in normal use within this period, manufacturer shall furnish a new part at no charge.

II. PART TWO - PRODUCTS

2.01 MANUFACTURER

A. U.S.F. Fabrication, Inc. 3200 W. 84 ST, Hialeah, FL 33018 – Toll Free: 800.258.6873 Fax: 305.882.1577

E-mail: service@usffab.com Website: www.usffab.com

B. Owner approved alternative.

2.02 ACCESS DOOR

A. Furnish and install where indicated on plans vault access door Type TSG (single, double or multiple leaf), see schedule at end. The entire assembly shall manufactured and assembled in the USA.

B. Performance characteristics:

1. Cover: Shall combine with the safety grate(s) to support 300 PSF pedestrian loads only.

2. The cover shall be opened using the flush lifting handle to insure controlled operation throughout the entire arc of opening and closing.

C. Cover: Shall be 1/4” (6.3 mm) aluminum diamond plate with integrated safety grating fall through protection reinforced for a 300 PSF combined live load.

D. Safety Grate: Aluminum grating with 4" x 6" openings that rotates on hinges that are welded to the hatch frame. Safety grating shall be powder coated with safety orange color. The safety grate shall automatically lock in its full upright position utilizing a 316 stainless steel hold-open arm. The safety grate will include a padlock staple to allow a padlock to lock the grates in their closed position.

E. Frame: The frame shall be manufactured from ¼” aluminum material.

F. Hinges: Shall be type 316 stainless steel bolts and locknuts.

G. **Lifting mechanisms:** Manufacturer shall provide the proper amount of stainless steel lift assist mechanisms to insure that the cover can be opened by one person with no more than **35 lbs** of force required. Torsion type lift assist will not be acceptable.

H. Hardware:

1. Hinges Type 316 stainless steel hinges shall be provided.

2. A flush lifting handle shall be provided

3. **Hold-open arm:** Doors and Safety grates shall be equipped with a 316 stainless steel hold-open arm with a secondary latch that insures that the hold-open arm properly engages when the door is brought to its full up right and locked position. Two piece hold-open devices, or those that require the manual insertion of pins as a means of engagement will not be allowed.

4. A recessed staple for an owner supplied padlock shall be provided

5. Hardware: Shall be Type 316 stainless steel throughout.

I. Finishes:

1. Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

2. An adhesive backed vinyl material, that protects the product during shipping and installation, shall cover the entire top of the door.

III. PART THREE - EXECUTION

3.01 INSPECTION

A. Verify that the vault access door installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.02 INSTALLATION

A. Submit product design drawings for review and approval to the architect or specifier before fabrication.

B. The installer shall check as-built conditions and verify the manufacturer's vault access door details for accuracy to fit the application prior to fabrication. The installer shall comply with the vault access door manufacturer's installation instructions. Installer shall insure that the entire unit is installed level and square to insure proper performance.

C. The installer shall furnish mechanical fasteners consistent with the vault access door manufacturer's instructions.

Hatch Schedule
(See Plans for Drawings)

Phase 1 (Include all hatches in this contract)

Location	Description	Drawing No.	Quantity
Wet Well Pump Hatch	TSG4 36 x 95-1/2 Alum	1000197293	3
Mag Meter Hatch	TSGT 48 x 96 Alum	1000198204	1
Bypass Hatch	TSGT 48 x 96 Alum	1000198204	1
Vault Manway Hatch	TSGS 30 x 30 C!G2K12N1fj1n1	1000197274	2
Wet Well Spillway Hatch	TSGS 32 x 36 C1G2K12N1fj1n1	1000197278	2
Vault Equipment Hatch	TSGD 54 x 60 Alum	1000198202	3
Splitter Manhole	TSGD 36 x 48 C1G2K10N1Tfj2n1	1000203753	1
Upstream Flow Measuring	TSGS 30 x 30 C!G2K12N1fj1n1	1000197274	1

Phase 2 (Include all hatches in this contract)

Location	Description	Drawing No.	Quantity
Wet Well Pump Hatch	TSG4 48 x 111 Alum	1000198217	3
Mag Meter Hatch	TSGT 48 x 96 Alum	1000198204	1
Bypass Hatch	TSG4 48 x 120 Alum	1000198211	1
Vault Manway Hatch	TSGS 30 x 30 C!G2K12N1fj1n1	1000197274	2
Wet Well Spillway Hatch	TSGD 36 x 47 C1G2K12N1Tfj2n1	1000198070	2
Vault Equipment Hatch	TSGD 60 x 72 Alum	1000198215	3
Junction Manhole	TSGD 36 x 48 C1G2K10N1Tfj2n1	1000203753	1
Upstream Flow Measuring	TSGS 30 x 30 C!G2K12N1fj1n1	1000197274	1

END SECTION

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Related work specified elsewhere:
1. Window framing internal sealants.
2. Glazing sealants.
3. Roofing and flashing sealants.
4. Firestopping.

B. Definitions:
1. Joint sealant:
a. A weatherproof elastomer used in filling and sealing joints, having properties of adhesion, cohesion, extensibility under tension, compressibility and recovery; designed to make joints air and watertight.
b. Material is designed generally for application in exterior joints and for joints subject to movement.
2. Joint sealant compound:
a. A material used in filling joints and seams, having properties of adhesion and cohesion; not required to have extensibility and recovery properties.
b. Material is designed generally for application in interior joints not subject to movement.
3. Caulk: The process of filling joints, without regard to type of material.
4. Joint failure: A caulked joint exhibiting one or more of the following characteristics:
a. Air and/or water leakage.
b. Migration and/or reversion.
c. Loss of adhesion.
d. Loss of cohesion.
e. Failure to cure.
f. Discoloration.
g. Staining of adjacent work.
h. Development of bubbles, air pockets or voids.

1.2 ACTION SUBMITTALS:

A. Product data: Submit manufacturer's product description, indicating conformance with specified requirements and installation instructions for each type of sealant. Indicate preparation and priming requirements for each substrate condition.

B. Color samples:
1. Samples for initial selection: Samples shall be actual materials or literature depicting actual colors of standard color materials showing full range of colors available for each product exposed to view.
2. Samples for verification: For each kind and color of joint sealant required, provide samples with joint sealants in 1/2" wide joints formed between two 6" long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
3. Submit samples of custom color sealant materials matching color sample selected by Architect.

C. Adhesion compatibility test results: Submit a letter from sealant manufacturer indicating adhesion and compatibility testing has been performed and that materials are compatible and that adhesion is acceptable. Indicate requirements for primers or special preparation.

D. Substrate staining test results: Submit a letter from sealant manufacturer indicating that substrate stain testing has been performed on actual samples of substrates indicated to receive joint sealant and that sealant was found to be non-staining to substrate. Indicate requirements for primers or special preparation to meet non-staining requirements.

E. Joint sealant schedule: Include the following information:
1. Joint sealant applications, joint locations, and designations.
2. Joint sealant manufacturers and product names.
3. Joint sealant formulations.
4. Joint sealant colors.

1.3 QUALITY ASSURANCE:

A. Applicable standards as referenced herein:
1. ASTM International (ASTM).

B. Adhesion compatibility tests: Perform tests on actual samples of aluminum framing system, storefront, precast concrete, stone components, to determine that materials are compatible and that adhesion is acceptable. Identify requirements for primers or special preparation.
1. Test structural sealants in accord with ASTM C1135.

C. Substrate staining test results: Perform test on actual samples of granite veneer to receive joint sealant to determine that sealant is non-staining to substrate. Identify requirements for primers or special preparation to meet non-staining requirements.
1. Test porous substances in accord with ASTM C1248.
2. Test non-porous substrates in accord with ASTM D2203.

D. VOC content of interior sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Architectural sealants: 250 g/L.
2. Sealant primers for nonporous substrates: 250 g/L.
3. Sealant primers for porous substrates: 775 g/L.

E. Architect reserves the right to reject work not in conformance with selected colors, based upon verification samples.

1.4 PROJECT/SITE CONDITIONS:

A. Weather conditions:
1. Install no materials under adverse weather conditions or when temperatures are below or above those recommended by manufacturer's product data or when substrate moisture content is above manufacturer's recommended level.
2. Proceed with work only when forecasted weather conditions are favorable for joint cure and development of high early bond strength.
3. Wherever joint width is affected by ambient temperature variations, install materials only when temperatures are in lower third of manufacturer's recommended installation temperature range.

B. Protection of adjacent surfaces:
1. Protect by applying masking material or manipulating application equipment to keep materials in joint. If masking materials are used, allow no tape to touch cleaned surfaces to receive sealant. Remove tape immediately after sealant application, before surface skin begins to form.
2. Remove misapplied materials from surfaces by using solvents and methods recommended by manufacturer.
3. At surfaces from which materials have been removed, restore to original condition and appearance.

1.5 WARRANTIES:

A. Installer's warranty: Warrant work to be watertight and free from defects in materials and workmanship, including joint failure, for a period of two years.

B. Exterior silicone sealant material warranty: Warrant exterior silicone sealants to be free from defects in materials and to provide structural adhesion, watertight weatherseal and non-staining of adjacent materials for a period of twenty years.

C. Exterior polyurethane sealant material warranty: Warrant exterior polyurethane sealants to be free from defects in materials and to provide a watertight weatherseal for a period of five (5) years.

D. Warranties shall begin at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL:

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content: Sealants and sealant primers shall comply with the following:
1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE SEALANTS:

A. Low modulus silicone sealant at cement plaster, masonry to masonry, concrete to concrete and other exterior porous substrates:
1. Acceptable products; subject to compliance with specified requirements:
a. Dow Corning Corp., DOWSIL #790.
b. Momentive Performance Materials, Inc., GE Silpruf LM SCS2700.
c. Pecora Corp., #890NST.
d. Tremco, Inc., an RPM Company, SpecTrem 1.
2. Type: One-part, low modulus silicone rubber; meeting ASTM C920, Type S, Grade NS, Class 50, for use NT.
3. Colors: Standard colors as selected by Architect.

B. Medium modulus silicone sealant at metal to metal framing, and other exterior non-porous substrates in aluminum framing; excluding dry joint system in metal panels:
1. Acceptable products; subject to compliance with specified requirements:
a. Dow Corning Corp., DOWSIL #795.
b. Momentive Performance Materials, Inc., GE Silpruf SCS2000.
c. Pecora Corp., #895NST.
d. Tremco, Inc., an RPM Company, SpecTrem 2.
2. Type: One-part silicone rubber; meeting ASTM C920, Type S, Grade NS, Class 50, for use NT.
3. Colors: Standard colors as selected by Architect.

C. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

2.3 SILICONE BATH SEALANT FOR WET AREAS:

A. Acceptable products:
1. Dow Corning Corp., DOWSIL 786 Mildew-Resistant Silicone Sealant.
2. Franklin International, Titebond Kitchen & Bath Sealant.
3. Momentive Performance Materials, Inc., GE Sanitary SCS1700.
4. Pecora Corp., #898NST Silicone Sanitary Sealant.

B. Characteristics:
1. Type: One-part silicone rubber, mildew- and stain-resistant, acid-curing silicone sealant; meeting ASTM C920, Type S, Grade NS, Class 25, for use NT.
2. Color: Clear, white or off-white, as selected by Architect.

2.4 TWO-PART POLYURETHANE SEALANT FOR EXTERIOR HORIZONTAL TRAFFIC-BEARING PAVEMENTS:

A. Acceptable products:
1. MBCC Group (Master Builders Construction Chemicals), MasterSeal SL 2.
2. Pecora Corp., Urexpan NR-200.
3. Tremco, Inc., an RPM Company, 45 SSL.
4. Lymtal International, Iso-Flex 880 Series.

B. Characteristics:
1. Type: Two-component polyurethane sealant for horizontal traffic-bearing surfaces meeting ASTM C920, Type M, Grade P or NS, minimum Class 25, for use T; self-leveling for flat surfaces and non-sag for sloped surfaces.
2. Colors: Standard colors as selected by Architect.

2.5 INTERIOR PEDESTRIAN TRAFFIC HORIZONTAL SEALANT:

A. Acceptable products; Heavy-duty sealant for horizontal traffic-bearing joints:
1. Pecora Corp., Dynatred.
2. Sika Corp., Sikaflex 2cSL.
3. Tremco, Inc., Vulkem 116.

B. Characteristics:
1. Type: Two-part polyurethane, chemical-curing, Shore A, 40 minimum hardness meeting C920, Type M, Grade P or NS, minimum Class 25, Uses T, M, A, O.
2. Colors: Standard colors as selected by Architect.

2.6 PAINTABLE ACRYLIC-LATEX JOINT SEALANT:

A. Acceptable products:
1. Bostik, Chem-Calk 600.
2. Franklin International, Titebond Painters Caulk.
3. Momentive Performance Materials, Inc., GE RCS20.
4. Pecora Corp., AC-20 Acrylic Latex.
5. Tremco, Inc., an RPM Company, Tremflex 834.

B. Characteristics: Flexible, paintable, non-staining, non-bleeding acrylic latex or siliconized acrylic emulsion, meeting ASTM C834, Type OP, Grade NF.

2.7 ONE-PART, NON-SAG POLYURETHANE SEALANT:

A. Acceptable products:
1. MBCC Group (Master Builders Construction Chemicals), MasterSeal NP-1.
2. Pecora Corp., Dynatrol I-XL.
3. Tremco, Inc., an RPM Company, Vulkem 116.
4. Tremco, Inc., an RPM Company, Dymonic.

B. Characteristics:
1. Type: One-part, non-sag polyurethane-based sealant; meeting ASTM C920, Type S, Grade NS, minimum Class 25.
2. Colors: Standard colors as selected by Architect.

2.8 SOLVENT-RELEASE-CURING ACRYLIC SEALANT:

A. Acceptable products:
1. Franklin International, Titebond Painters Plus Caulk.
2. Schnee-Morehead, Inc., Acryl-R Acrylic Sealant.
3. Tremco, Inc., an RPM Company, Mono 555.

B. Characteristics:
1. Type: One-part, acrylic polymer sealant, meeting ASTM C1311.
2. Colors: Standard colors as selected by Architect.

2.9 ACOUSTICAL SEALANTS:

A. Performance requirements:
1. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E90.
2. Sealant shall have a VOC content of 250 g/L or less.

B. Acoustical sealant for exposed joints:
1. Type: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.
2. Acceptable products:
a. Accumetric LLC; BOSS 826 Acoustical Sound Sealant.
b. GE Construction Sealants; RCS20 Acoustical.
c. Grabber Construction Products; Acoustical Sealant GSC.
d. Pecora Corporation; AC-20 FTR or AIS-919.
e. Tremco, Incorporated; Tremco Acoustical Sealant.
f. United State Gypsum Company; SHEETROCK Acoustical Sealant.
3. Colors: Standard colors as selected by Architect.

C. Acoustical sealant for concealed joints:
1. Type: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.
2. Acceptable products:
a. Pecora Corporation; BA-98.
b. Serious Energy Inc.; Quiet Seal 350.

D. Acoustical sealant tape for concealed joints:
1. Type: Preformed, precompressed, open-cell foam sealant in roll form, coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
2. Acceptable manufacturers:
a. Basis of design; Emseal Corp., Emseal Quiet Joint.
b. C. R. Laurence Co., Inc.
c. Sandell Manufacturing Co., Inc.
d. Schul International Company, Inc.
3. Thickness: As required by manufacturer's product data for actual joint width.

E. Miscellaneous materials:
1. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
2. Cleaners for nonporous surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

3. Masking tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

2.10 PRECOMPRESSED FOAM SEALANT:

A. Acceptable product:
1. Emseal Corp., Emseal Backerseal.
2. Sandell Manufacturing Co., Inc., Polyseal.
3. Schul International Company, Inc., Sealtite B.

B. Characteristics:
1. Type: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed roll or stick form; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
2. Thickness: As required by manufacturer's product data for actual joint width.

2.11 ACCESSORY MATERIALS:

A. Joint cleaner: Type recommended by material manufacturer for substrates indicated.

B. Joint primer/sealer: Type recommended by material manufacturer for substrates, conditions and exposures indicated.

C. Bond breaker tape: Plastic tape applied to contact surfaces where bond to substrate or joint filler must be avoided for material performance.

D. Sealant backer rod: Compressible rod stock as recommended by sealant manufacturer for compatibility with sealant. Provide size and shape of rod to control joint depth.

E. Tooling agent: Agent recommended by material manufacturer to ensure contact of material with inner joint faces.

F. Weep tubes and foam baffles for rain screen joints: Provide 1/4" inside diameter, clear plastic tubing and non-deteriorating foam baffles for rain screen caulk joints.

PART 3 - EXECUTION

3.1 JOB MOCK-UP:

A. Prepare, caulk and finish one mock-up sample of each joint condition.

B. Sample joints shall be approved by Architect prior to beginning work. Approved, undamaged mock-up joints shall serve as a standard of quality for the remainder of the work.

C. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

3.2 RE-CAULKING EXISTING PRECAST CONCRETE PANELS:

A. Re-caulk/re-seal procedures:
1. The original seals and backer rods are to be completely removed from the joint;
2. Joint interfaces be ground to produce a clean and even surface (10mm joint width);
3. Dust must be removed from interface;
4. Backing rod (over-sized 30-50%) be compressed in-between substrates;
5. Backer must be positioned (using a rolling tool) within the joint, maintaining a 5-mm joint thickness;

6. Panel surfaces must then be masked prior to applying sealant to joint;
7. Sealant compound is to be tooled after the sealant is applied to the joint;
8. Masking tape and excess sealant removed.
9. Application to be undertaken during dry conditions.
10. All joints and routed cracks will be prepared to produce a sound, dry, and clean surface for adhesion. All existing sealant from the panel and window perimeter joints will be removed; the concrete surface will then be ground free of all sealant.
11. All sealant tape and dirt will be removed from glazing. All contact surfaces will be cleaned with a recommended solvent using a clean lint free cloth.
12. Backing rod will be installed into the joint allowing for a 1:2 depth to width ratio. Areas surrounding the joint will be masked.

B. Installation:
1. Installation will only proceed if the environmental conditions are within the sealant manufacturer's specified tolerance. All multi-component sealants will be mixed thoroughly. Nozzles will be cut to suit joint width.
2. Sealant will be gunned into the joint and 'tooled off' to provide good adhesion onto the substrates.

C. Re-seal/Re-caulk inspection:
1. An independent consultant will undertake inspection of the re-sealed joints at regular intervals throughout the maintenance program.
2. The sealant supplier will undertake a minimum of one inspection. The supplier will provide written reports on preparation and installation methods immediately after the inspection. The consultant will be supplied with samples of proposed sealants; each sample will be clearly labeled showing material and application details.
3. An independent inspector will review of the resealed joint. A hand-pull test was used (2 weeks after application) to evaluate the performance and geometry of the joint.
   a. The test involves pulling a 50-mm strip of sealant at a 90 degree angle to the panel and the sample should elongate at least 100% before cohesive or adhesion failure. If the sample fails prematurely then the joint must be resealed.
   b. Once the test is complete, the sealant geometry can be measured for the correct depth to width ratio; if the geometry is incorrect then the joint must be resealed. Pull-tests of joint samples were taken at every floor level on all elevations; samples were taken at horizontal distances of 4m. Failure to meet the minimum performance criteria for pull tests or sealant geometry resulted in additional cuts being performed to establish the extent of any potential deficiencies.
4. Prior to the start of the maintenance program, the consultant will review methods of sealant removal. A sample window and cast-in-place panel will be prepared (i.e. facade mock-up) prior to the contractor undertaking the building re-sealing

D. Two-Stage Sealant Design at Parapet Conditions:
1. Install open cell rod behind the interior sealant.
2. Install closed cell rod behind the exterior sealant.

3.3 NEW CONSTRUCTION JOINT SURFACE PREPARATION:

A. Clean joints of debris and projections including shims.

B. Clean joint surfaces immediately before caulking joints. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond.

C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless material manufacturer's product data indicates that alkalinity does not interfere with bond and performance. Etch with 5% solution of muriatic acid; neutralize with dilute ammonia solution; rinse with clean water and allow to dry before caulking.

D. Roughen joint surfaces of non-porous materials, unless material manufacturer's product data indicates equal bond strength as porous surfaces. Rub with fine abrasive cloth or wool to produce dull sheen.

3.4 APPLICATION:

A. Comply with caulking material manufacturer's product data and ASTM C1193-09 except where more stringent requirements are specified.

B. Prime joint surfaces where recommended by material manufacturer. Do not allow primer/sealer to spill or migrate onto adjacent surfaces.

C. Install backer rod for caulking materials, except where recommended by material manufacturer to be omitted for application indicated.
1. Place backer rod to maintain recommended sealant thickness and profile.
2. Place rod at depth to provide sealant manufacturer’s recommended sealant depth.
3. Do not twist rod during installation.
4. Place rod to minimize possibility of extrusion when joint is compressed.
5. Install bond breaker tape in lieu of backer rod for shallow, closed joints and as recommended by manufacturer’s product data.

D. Employ installation techniques which will ensure that materials are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form slight cove so that joint will not trap moisture and debris.

E. Do not allow materials to overflow onto adjacent surfaces. Prevent staining of adjacent surfaces.

F. Remove excess and misplaced materials as work progresses. Clean the adjoining surfaces to remove misplaced materials, without damage to adjacent surfaces or finishes.

G. Interior joints: At interior joints and seams at abutting and adjacent materials, recess caulking compound 3/16" in joints wider than 1/4". At joints 1/4" or less in width, tool caulking flush.

H. Tool joints of non-sag sealant to concave profile and smooth, uniform surface, flush with edges of substrate. Maintain sealant depth-to-width ratio in accord with manufacturer's product data.

I. Cure sealants and caulking compounds in accord with manufacturer's product data to obtain high early bond strength, internal cohesive strength and surface durability. Protect uncured surfaces from contamination and physical damage.

J. Install weep tubes in rain screen joint configuration as detailed and at locations indicated. Position tubes to allow slope for drainage extending 1/8" beyond face of exterior surface. Install foam baffles as indicated.

3.5 CLEANING:

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION:

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 CAULKING SCHEDULE:

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces:
   1. Joint Locations:
      a. Weather seals at joints between window walls and metal frames.
      b. Perimeter joints between materials listed above and frames of windows.
      c. Control and expansion joints in overhead surfaces.
      d. Other joints as indicated on Drawings.
   2. Joint Sealant: Medium modulus silicone.
   3. Joint-Sealant Color: Match Architect's sample.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in masonry.
      c. Joints between different materials listed above.
      d. Perimeter joints between materials listed above and frames of windows.
      e. Control and expansion joints in overhead surfaces.
      f. Cement plaster.
      g. Other joints in porous substrates as indicated on Drawings.
   2. Joint Sealant: Low modulus silicone.
   3. Joint-Sealant Color: Match Architect's sample.

C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces
   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and millwork counters, between backsplash and walls.
      b. Joints between toilet accessories and adjoining walls, floors and counters.
      c. Control and expansion joints in or around surfaces of ceramic tile, solid surfacing materials, and plastic laminate in toilet rooms, and other wet areas subject to moisture and mildew.
      d. Other joints as indicated.
   2. Joint Sealant: Mildew resistant, single component, nonsag, neutral or acid curing, Silicone.
   3. Joint-Sealant Color: Match Architect's sample.

D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in tile flooring.
      c. Joints between different materials listed above.
      d. Other joints as indicated.
   2. Elastomeric, Urethane Joint Sealant.
   3. Joint-Sealant Color: Match Architect's samples for each area indicated.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
      b. Field-painted vertical and overhead gypsum board surfaces.
      c. Other interior locations not indicated otherwise.
      d. Other joints as indicated.
   2. Joint Sealant: Acrylic based.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of interior unit masonry concrete walls and partitions.
      e. Other joints as indicated.
   2. Urethane Joint Sealant: Single component, nonsag, Class 25.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.
   1. Joint Locations:
      a. Aluminum thresholds.
      b. Sill plates.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Butyl-rubber based.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

H. Exterior joints between wall finish and conduit and pipe penetrations, base plates of light fixtures, signage supports, and other items applied to exterior wall surface: Medium modulus silicone sealant.

END OF SECTION

DIVISION 8

OPENINGS

SECTION 08000

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY:

A. Related work specified elsewhere:
1. Masonry.
2. Glazing.
3. Gypsum board.
4. Painting and Coating.

1.2 PERFORMANCE REQUIREMENTS:

A. Physical endurance: Comply with performance level for specified level classification in accord with ANSI A250.8-2003(R2008) and ANSI A250.4-01 for doors and hardware reinforcing, ANSI A250.4-01 for doors, frames, frame anchors and hardware reinforcings, ANSI 861 for custom hollow metal work.

B. Finish: Comply with standard performance criteria of ANSI A250.10-98(R2004) for primed steel surfaces.

C. Fire-rated assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, and temperature-rise limits where required, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Smoke- and draft-control assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Fire-rated, borrowed-light assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

D. Thermal performance: Minimum aged value of U = 0.10 (R = 10.2) or better, apparent thermal performance in accord with SDI-113-01(R06).

E. Acoustical performance: STC of 25 or better in accord with SDI-128-09, ASTM E90-04 and ASTM E413-04.

1.3 ACTION SUBMITTALS:

A. Product data: Indicate that hollow metal doors and frames comply with specified requirements, including performance criteria.

B. Shop drawings: Indicate door and frame elevations and sections, materials, gauges and finishes, fabrication and erection details, location of finish hardware by dimension and locations, and fire rating requirements.

C. Samples: Submit as follows:
1. Door: 1'-0" by 1'-0" corner section showing door construction.
2. Welded frame: 1'-0" by 1'-0" head and jamb corner section showing welded corner construction.
3. Anchors: One of each type.

1.4 INFORMATIONAL SUBMITTALS:

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.5 QUALITY ASSURANCE:

A. Applicable standards; standards of the following, as referenced herein:
1. American National Standards Institute, Inc. (ANSI).
2. ASTM International (ASTM).
3. National Fire Protection Association (NFPA), National Fire Codes.
4. Society for Protective Coatings (SSPC).
5. Steel Door Institute (SDI).
6. Underwriters Laboratories, Inc. (UL).

B. Fabrication standard: Except for more stringent requirements specified, comply with ANSI A250.8-2003(R2008) including performance levels as referenced.

C. Fire door assemblies:
1. Door and frame assemblies in rated walls shall have been tested in accord with NFPA 252 or UL 10C; after 5 minutes into NFPA 252 test, neutral pressure shall have been established at 40" or less above sill.
2. Door and frame assemblies in corridors and smoke barriers shall have a minimum fire rating of 20 minutes and shall have been tested in accord with NFPA 252 or UL 10C without hose stream test. Assemblies shall comply with UL 1784 for draft and smoke control test; leakage may not exceed 3.0 CFM per foot of door at 0.10" of water column.

D. Labeling requirements:
1. Fire-rated components shall bear factory-applied labels showing name of manufacturer, name of third-party inspection agency, fire-protection rating, and where required for doors in exit enclosures, maximum transmitted temperature end point.
2. Smoke and draft doors complying with UL 1784 shall be labeled as a smoke and draft control door.
3. Permanently attach label to hinge stile of each fire-rated and smoke and draft control door.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Mark each hollow metal door and frame at top hinge and on outside of packaging with destination door mark indicated on door schedule.

B. Deliver hollow metal doors and frames palletized, packaged or crated for protection during transit and site storage.
1. Do not use nonvented plastic.
2. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
3. Provide additional protection to prevent damage to factory-finished units.

C. Inspect work upon delivery for damage. Reject damaged items.

D. Store materials under cover, on raised platforms.
1. Stack a maximum of five assembled frame units and doors vertically with minimum 1/4" spacers between units.
2. Protect from moisture but provide for cross ventilation. Remove units from wet containers if wetting occurs.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS:

A. Acceptable manufacturers:
1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Deansteel Manufacturing Company, Inc.
4. Republic Doors and Frames.

2.2 MATERIAL:

A. Steel:
1. Interior frames: Fabricate of cold-rolled steel sheet meeting ASTM A1008-08a.
2. Exterior doors and frames: Fabricate of commercial quality, hot dip galvanized or galvannealed steel sheet meeting ASTM A653-08 Designation A60 or G60; wipe coat not acceptable.
3. Recycled content of steel products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Finish: Prime painted steel surfaces shall comply with requirements for acceptance stated in ANSI A250.3-2011.
1. Interior frames: One coat of manufacturer's standard rust-inhibitive primer.
2. Exterior doors and frames: One coat of manufacturer's standard rust-inhibitive primer after chemical treatment of galvanized surfaces for paint adhesion.

C. Coating for inside of frames to be fully grouted in masonry and concrete construction: Field applied bituminous coating:
1. Cold-applied asphalt emulsion complying with ASTM D1187/D1187M-97(2011); compounded for 15-mil dry film thickness per coat.
2. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 DOORS:

A. Physical performance: Performance for each level shall be in accord with ANSI/SDI A250.4-2011.

B. Door classification:
1. Standard interior hollow metal doors (1-3/4" thickness): Level 2, Heavy-duty, 18 ga., Model 2 - Seamless.
2. Label fire-resistive composite metal doors:
a. Level 2, 18 ga., Heavy-Duty, Model 2-seamless, 1-3/4" thickness, with mineral fiberboard core for ratings over 20 minutes.
3. Exterior insulated composite metal doors: Level 3, 16 ga., Extra Heavy-Duty, Model 2-seamless, 1-3/4" thickness, with mineral fiberboard core.

C. Door construction:
1. Core:
a. Steel-stiffened door cores: Provide minimum thickness 0.026", steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6" apart. Spot weld to face sheets no more than 5" o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
b. Fire door cores: As required to provide fire-protection ratings indicated.
2. Edge bevel: Vertical edges beveled 1/8" in 2"; double-acting doors rounded on 2-1/8" radius. Non-handed door blanks with filler plates are not acceptable.
3. Top and bottom edges: Flush, welded, minimum 18 ga. steel. Provide weep holes in bottom edge of exterior doors.
4. Door faces and edge seams:
a. Full flush: Form each door face from a single sheet of steel of thickness specified herein. There shall be no visible seams on surface of faces. A full height vertical seam is permitted on door edges.
b. Seamless: In addition to requirements of Full Flush doors, no visible seams shall be permitted along vertical edges. Continuously weld seams and dress smooth.

2.4 FRAMES:

A. Frame construction:
1. Welded steel frames in all exterior construction: 14 ga., with backbend returns.
a. Setup arc welded, with all joints, including face, flange and throat, full welded, dressed and ground smooth; no mechanical interlocking allowed.

b. Provide welded frames with temporary spreaders during shipping, storage and erection. Spreaders shall span both rabbets of frame and be located at bottom and at middle of frame.

2. Transom bars and mullions: Shop fabricate from same material as door frames.
   a. Setup arc welded, with all joints, including face, flange and throat, full welded, dressed and ground smooth; no mechanical interlocking allowed.
   b. Fabricate in largest size sections allowed by shipping and installation restrictions. Field joints shall occur only as indicated on approved shop drawings.
3. Machine door frames for hardware scheduled for installation on that frame. Filler plates installed at unused openings will not be acceptable. Provide blockouts behind frame for continuous hinges.
4. Joints:
   a. Dress welded joints and ground smooth, indistinguishable in completed work.
   b. Make non-welded connections with tight fitting, closed joints.
   c. Make joints with aligned faces and arrises.
5. Inside of frames to be grouted in masonry and concrete construction shall receive protective coating as specified herein.
6. Loose glazing stops:
   a. Removable glazing stops shall be cold rolled steel, no less than 20 gage, butted at corner joints and secured to frame using cadmium or zinc plated #6 countersunk sheet metal screws at 1'-0" o.c. maximum.
   b. Frame underneath glazing stops and inside of glazing stop shall be treated for maximum paint adhesion and shall receive factory spray-applied high-build epoxy coating specified herein, 4 to 6 mils dft., prior to installation in frame.

B. Frame anchors:
1. Wall anchors for frame attachment to masonry construction: Adjustable, flat, minimum 18 gage corrugated or perforated, T-shaped steel anchors with leg not less than 2" wide by 10" long. Provide one anchor per jamb for each 2'-0" of height or fraction thereof. Anchors for fire-rated frames shall be labeled type.
2. Wall anchors for frame attachment to drywall partitions: Manufacturer's standard adjustable type for attachment to studs. Provide one anchor per jamb for each 2'-0" of height or fraction thereof. Anchors for fire-rated frames shall be labeled type.
3. Floor anchors: Provide frames, other than slip-on drywall type, with minimum 18 gage anchors for attachment to floor.
   a. For wall conditions that do not allow for the use of a floor anchor, provide an additional jamb anchor.
   b. Anchors for fire-rated frames shall be labeled type.
4. Head struts: For frames over 7'-0" high and not anchored to masonry or concrete construction, provide 1/4" by 2" steel struts spot welded to jambs, each side, extending to building structure. Attach to structure. For frames over 4'-0" in width, provide center strut at head.
5. In-place masonry and concrete: 3/8" countersunk, flat head, stove bolts in expansion shields, spaced 6" maximum from top and bottom of frame and at 2'-0" o. c., maximum, between. Anchors for fire-rated frames shall be labeled type.

2.5 ACCESSORIES:

A. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.6 PREPARATION FOR HARDWARE AND ANCHORS:

A. Reinforcement: Factory reinforce door and frame components for hardware installation in accord with ANSI A250.8-2003(R2008) and ANSI A250.6-2003.

B. Punch single leaf frames to receive three silencers; double leaf frames to receive two silencers per leaf, at head.

C. Provide grout shields where frames in masonry walls are cut or drilled.

D. Install hardware reinforcement and anchors without distortions or blemishes on exposed surfaces.

PART 3 - EXECUTION

3.1 FRAME INSTALLATION:

A. General:
1. Install hollow metal frames in accord with ANSI/SDI A250.8-2003(R2008), ANSI A250.11-2001, SDI-122-07, manufacturer's product data and approved shop drawings.
2. Frames in masonry and concrete walls and fire-rated frames shall be tightly butted to walls. For other frames, clearance between frame and interfacing wall surfaces shall be 1/16" maximum.
3. Shimming of door hinges is not an acceptable correction of door frames installed out of erection tolerance.

B. Welded frames:
1. Set welded frames in position prior to beginning partition work. Brace frames until permanent anchors are set.
2. Set anchors for frames as work progresses. Install anchors at hinge and strike levels. Install rubber bumpers and silencers in frames prior to grouting.
3. Grout frames in masonry walls as specified in Section 04 2200 - Concrete Unit Masonry.
4. Remove temporary spreaders before frame installation is complete.
5. Remove temporary braces after wall construction is complete.
6. Install welded frames in prepared openings in concrete and masonry walls using countersunk bolts and expansion shields.

C. Fire-rated frames: Install in accord with requirements of NFPA No. 80 and ANSI A250.11-2001.

3.2 DOOR INSTALLATION:

A. General:
1. Install doors in accord with SDI-122-07, ANSI A250.8-2003(R2008), manufacturer's product data and approved shop drawings.
2. Seal tops of exterior, out-swinging doors prior to painting. Paint bottoms of doors in accord with Section 09 9000 - Painting and Coating prior to hanging doors.
3. Install hollow metal doors in frames, using hardware specified in Section 08 7100 - Door Hardware.
4. Shimming of door hinges is not an acceptable repair of warped doors or door frames out of erection tolerances.

B. Edge clearances at doors:
1. Between door and frame, at head and jambs: 1/8".
2. At meeting edges of pairs of doors and at mullions: 1/8" to 1/4" (1/8" for fire rated doors).
3. At sills without thresholds: 3/8" maximum above finish floor.
4. At sills with thresholds: 3/8" maximum above top of threshold.
5. Between face of door and door stop: 1/16".

C. Fire-rated doors: Install in accord with requirements of NFPA No. 80, SDI-118-05 and ANSI A250.11-2001.

3.3 SITE TOLERANCES:

A. Allowable erection tolerances:
1. Variation from specified clearances: +1/32".
2. Variation in face alignment, pairs of doors: +1/16".
3. Variation in face alignment between door and frame: 1/8" maximum.

3.4 CLEANING AND PROTECTION:

A. Protect hollow metal doors and frames from damage and staining until Date of Substantial Completion. Replace or repair damaged or stained components.

B. Replace components which exhibit warp, buckle or broken welds.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:

1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames
3. Division 8: Hollow Metal Doors and Frames.
4. Division 8: Wood Doors.
5. Division 26 Electrical
6. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
2. NFPA 101 Life Safety Code
3. NFPA 80 -Fire Doors and Windows
4. ANSI-A156.xx- Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
6. ANSI-A117.1 – Accessible and Usable Buildings and Facilities
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
8. ICC – International Building Code

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances

1. Refer to Division 1 for allowance amount and procedures.

F. Alternates

1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
6. Mounting heights.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.

a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.

3. Copy of final keying schedule
4. As installed “Wiring Diagrams” for each piece of hardware connected to power, both low voltage and 110 volts.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Statement of qualification for distributor and installers.
2. Statement of compliance with regulatory requirements and single source responsibility.
3. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.

   a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
   b. Hardware Schedule shall be prepared and signed by an AHC.

4. Installer's Qualifications: Firm with 3 years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.

   a. Provide UL listed hardware for labeled and 20 minute openings in conformance with requirements for class of opening scheduled.
   b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.

6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Lifetime
2. Exit Devices: Five years
3. Locksets & Cylinders: Ten years
4. All other Hardware: Two years.

1.8 OWNER'S INSTRUCTION:

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

Item:	Manufacturer:
Hinges	Stanley
Continuous Hinges	Stanley
Locksets	Best
Cylinders	Best
Exit Devices	Precision
Closers	Stanley
Push/Pull Plates	Trimco
Push/Pull Bars	Trimco
Protection Plates	Trimco
Overhead Stops	ABH
Door Stops	Trimco
Flush Bolts	Trimco
Coordinator & Brackets	Trimco
Threshold & Gasketing	National Guard

2.2 MATERIALS:

A. Hinges: Shall be Five Knuckle Ball bearing hinges

1. Template screw hole locations
2. Bearings are to be fully hardened.
3. Bearing shell is to be consistent shape with barrel.
4. Minimum of 2 permanently lubricated non-detachable bearings on standard weight hinge and 4 permanently lubricated bearing on heavy weight hinges.
5. Equip with easily seated, non-rising pins.
6. Non Removable Pin screws shall be slotted stainless steel screws.
7. Hinges shall be full polished, front, back and barrel.
8. Hinge pin is to be fully plated.
9. Bearing assembly is to be installed after plating.
10. Sufficient size to allow 180-degree swing of door
11. Furnish five knuckles with flush ball bearings
12. Provide hinge type as listed in schedule.
13. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof.
14. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
15. UL10C listed for Fire rated doors.

B. Geared Continuous Hinges:

1. Tested and approved by BHMA for ANSI A156.26-1996 Grade 1
2. Anti-spinning through fastener
3. UL10C listed for 3 hour Fire rating
4. Non-handed
5. Lifetime warranty
6. Provide Fire Pins for 3-hour fire ratings
7. Sufficient size to permit door to swing 180 degrees

C. Exit Devices:

1. Exit devices to meet or exceed BHMA for ANSI 156.3, Grade 1.
2. Exit devices to be tested and certified by UL or by a recognized independent laboratory for mechanical operational testing to 10 million cycles minimum with inspection confirming Grade 1 Loaded Forces have been maintained.
3. Exit devices chassis to be investment cast steel, zinc dichromate.
4. Exit devices to have stainless steel deadlocking ¾” through latch bolt.
5. Exit devices to be equipped with sound dampening on touchbar.
6. Non-fire rated exit devices to have cylinder dogging.
7. Non-fire rated exit devices to have ¼” minimum turn hex key dogging.
8. Touchpad to be “T” style constructed of architectural metal with matching metal end caps.
9. Touchbar assembly on wide style exit devices to have a ¼” clearance to allow for vision frames.
10. All exposed exit device components to be of architectural metals and “true” architectural finishes.
11. Provide strikes as required by application.
12. Fire exit hardware to conform to UL10C and UBC 7-2. UL tested for Accident Hazard.
13. The strike is to be black powder coated finish.
14. Exit devices to have field reversible handing.
15. Provide heavy duty vandal resistant lever trim with heavy duty investment cast stainless steel components and extra strength shock absorbing overload springs. Lever shall not require resetting. Lever design to match locksets and latchsets.
16. Provide 9001-Quality Management and 14001-Environmental Management.

18. Exit Device Intruder Function Visual Indicator is to be used in conjunction with the ANSI “10” Function, which allows the outside lever trim to be locked from the inside while the door remains closed. Rim cylinder on the exterior/trim side retracts the latch from the outside.
    a. Indicator to be actuated by a rim cylinder equipped with a keyed core or thumb-turn.
    b. Directional indicator feature shall have a large status indicator window with directional pointer embossed into the active case cover to indicate key turn direction to lock and unlock outside lever trim. Labels or stickers are not acceptable.
    c. The status indicator window shall be integrated into the housing of the exit device and is to contain bright reflective material that may be seen in low light conditions.
    d. Indicator window to be protected by impact resistant lens cover.
    e. The action to lock down/unlock shall require a quarter turn (90°) of key or thumb turn.
        1) Locked status shall be indicated by a red indicator that will appear under the lens cover with an image of a locked padlock.
        2) Unlocked status shall be indicated by a green indicator that will appear under the lens of the cover with an image of an unlocked padlock.
19. Precision Apex 2000 Series - No Substitution

D. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

E. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
3. Provide 9001-Quality Management and 14001-Environmental Management.
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16 inch case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1½“ minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.
12. Stanley QDC100 Series – No Substitutions

F. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

G. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.

H. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

I. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1 inch on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

J. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

K. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.

1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

L. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.

1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
2. UL10C Positive Pressure rated seal set when required.

M. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½" for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Best CORMAX™ Patented 7-pin.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish 3 typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).

2. Recommended locations for Architectural Hardware for flush wood doors (DHI).

3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use “Riv-Nuts” or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

a. Verify levers are free from binding.
b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

Manufacturer List

Code	Name
BE	Best Access Systems
NA	National Guard
PR	Precision
ST	Stanley
TR	Trimco

Finish List

Code	Description
AL	Aluminum
626	Satin Chromium Plated
630	Satin Stainless Steel
689	Aluminum Painted
US26D	Chromium Plated, Dull

Option List

Code	Description
CSK	Counter Sunk Screw
LBR	Less Bottom Rod
B4E	Beveled 4 Edges

Hardware Sets

SET #1.0

Doors: 1, 2, 3

6	Hinges	FBB179 4 1/2 X 4 1/2 NRP	US26D	ST
1	Exit Device	2202 LBR	630	PR
1	Exit Device	2203 X 4903A LBR	630	PR
1	Rim Cylinder	12E-72 PATD	626	BE
2	Door Closer - Cush Stop	QDC119	689	ST
2	Kick Plate	K0050 10" x 1" LDW B4E CSK	630	TR
1	Astragal Set	115NA SET		NA
1	Weatherstrip	160SA Head & Jambs		NA
2	Door Sweep	200NA		NA
1	Handicap Threshold	513A	AL	NA

DIVISION 9

FINISHES

SECTION 09000

3.2 WORKMANSHIP:

A. Except where more stringent requirements are specified herein, comply with manufacturer's product data and with CRI Commercial Installation Standard 104, Standard for Installation of Commercial Textile Floorcovering Materials.

B. Lay carpet tile with pattern and texture running in direction as shown on the drawings and approved shop drawings, and as directed by the Architect.

C. Extend carpet tile under movable furniture and equipment and into closets of rooms indicated to be carpeted unless other floor finish is indicated in finish schedule.

D. Install carpet edge strip at locations where edge of carpet is exposed to traffic, except where another device, such as a threshold, is indicated.

E. Maintain edges and seams straight and square with adjacent surfaces.

3.3 CARPET TILE INSTALLATION:

A. Divide areas into grid pattern of maximum sizes recommended by manufacturer's product data. Center grid in each area, perpendicular to walls, but placed to avoid edge tiles of less than half tile size. Grids shall align continuously through door openings and visually adjacent areas.

B. Adhesively install first row of tiles in both directions along grid centerlines. Adhesively install remaining infill tiles.

C. Lay carpet tile with pattern and texture running in direction as shown on the drawings and approved shop drawings, and as directed by Architect. Locate perpendicular seams at doorways so as not to occur in doorways. Locate parallel seams at doorways directly under door.

D. Accurately scribe and cut tile to abutting surfaces. Maximum clearance shall be 1/32".

E. Use carpet tiles from only one side of "cut" and one single dye lot within each complete area, and align tiles with grain in one direction as indicated on backs of tiles.

F. Lay tiles with tightly abutted joints and corners, joint lines consistently straight and parallel.

G. Install carpet edge strip at locations where edge of carpet is exposed to traffic except where another device, such as a threshold, is indicated.

3.4 CLEANING AND PROTECTION:

A. At completion of installation, remove debris. Sort out scraps to be saved.

B. Vacuum carpet with a commercial type vacuum cleaner having a rotating agitator in nozzle. Use corner attachment for vacuuming in corners and crevices.

C. Remove stains with spot remover acceptable to carpet manufacturer.

D. Immediately after cleaning, cover carpeted areas with heavy kraft paper. Maintain in place for remainder of construction period.

E. Just prior to Date of Substantial Completion, remove protective covering and vacuum carpet. Steam clean areas if required to remove stains.

F. Replace carpet which cannot be cleaned.

END OF SECTION

SECTION 09 7813 - FIBERGLASS REINFORCED PLASTIC (FRP) WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section includes fiberglass reinforced plastic wall panels for back-of-house locations such as mop sink surrounds and other indicated locations.

1.2 ACTION SUBMITTALS:

A. Shop drawings: Submit detailed shop and erection drawings for wall panels and related trim. Include dimensioned plans, elevations and sections. Indicate panels to be erected as part of job mock-up. Indicate relationship to adjacent work. Indicate allowance for thermal movement.

B. Product data: Submit manufacturer's complete product and installation literature, marked as applicable to project. Include product performance characteristics and installation requirements.

C. Samples: Submit sample of 1'-0" by 1'-0" size, minimum, indicating color, texture and general appearance of finished panels and 1'-0" long section of each trim type and finish.

1.3 INFORMATIONAL SUBMITTALS:

A. Product Certificates: Signed by manufacturers certifying that the following products comply with requirements:
1. Adhesives.

B. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.4 CLOSEOUT SUBMITTALS:

A. Maintenance data: Submit as part of Closeout Procedures with copy included with product data submittal. Include instructions for cleaning, maintaining and replacing panels.

1.5 DELIVERY, STORAGE AND HANDLING:

A. Deliver panels to project after spaces are ready for installation. Do not store materials at project site.

B. Protect materials from damage, including deformation or staining. Reject damaged materials.

1.6 PROJECT/SITE CONDITIONS:

A. Coordinate work of this section with interfacing work, including substrate construction to which panels are to be installed. Take field measurements to ascertain required panel measurements.

B. Environmental requirements:
1. Install materials only when normal temperature and humidity conditions approximate interior conditions that will exist when the space is occupied. Do not install at temperatures below 65°F.
2. Remove materials from packaging and allow to acclimatize to installation area for 24 hours before application.
3. Maintain constant minimum temperature of 65°F. in spaces for at least 48 hours

PART 2 - PRODUCTS

2.1 FRP WALL PANELS; FRP-1:

A. Acceptable products; subject to compliance with specified requirements:
1. FRP-1 Basis of design: Crane Composites, Inc., a Crane Co. Company, Crane Composites, "Glasbord-FSI Smooth with Surfaseal".
2. Nudo Products, Inc., Fiber-Lite Liner Panels, LP-F9-FR.
3. Marlite, Induro FRP with SanilSEAL.

B. Characteristics:
1. Material: Fiberglass reinforced plastic (FRP).
2. Thickness: 0.090", minimum.
3. Size: 4'-0" by 10'-0" to provide full height vertical installation without horizontal seams.
4. Finish: Manufacturer's standard smooth surface on exposed side.
5. Color: As selected by Architect from manufacturer's standard color series.
6. Fire resistance rating: Class A when tested in accord with ASTM E94-04. Evidence of fire-resistance rating shall be clearly marked by embedded threads or markings on panel backs and faces; face threads or markings shall be discernible only under blacklight light source.

2.2 ACCESSORY PRODUCTS:

A. Adhesives: Waterproof mastic and contact type adhesives in accord with panel manufacturer’s product data for substrates involved.
1. VOC Content: 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Moldings for panel joints: Manufacturer's standard vinyl edge cap J-mold, H-mold divider, and both interior and exterior corner moldings; in color to match panel color.

C. Sealant: One-part, mildew-resistant, silicone as specified in Section 07 9200 - Joint Sealants.
1. VOC Content: 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SOURCE QUALITY CONTROL:

A. Allowable fabrication tolerances:
1. Finished panel sizes: ±1/16" in individual panel width or length.
2. Squareness: ±1/8" in diagonal measurement.
3. Location of cutouts: ±1/8".

PART 3 - EXECUTION

3.1 PREPARATION:

A. Prime or seal sub-surfaces to receive panels using materials recommended by panel and adhesive manufacturers’ product data.

B. Examine substrate conditions to verify that backer boards, grounds, anchors, accessories, door frames, electrical and mechanical work in or behind wall panels has been installed prior to proceeding with installation of wall panels.

3.2 INSTALLATION:

B. Install panels in full size sheets with minimum joints. Joint locations shall be indicated on approved shop drawings.

C. Cut, drill and form panels in accord with manufacturer's fabrication instructions. Edges shall be straight, smooth and square without chips, spalls, burns or imperfections.

D. Install wall panels vertically in full height sections in accord with approved product data and within allowable tolerances.
   1. Install using adhesive method, providing full coverage, without voids, in addition to edge trim.
   2. Allow minimum 1/16" space between edge of panel and bottom of trim or other abutting materials for panel expansion.

E. Coordinate installation with adjacent and interfacing surfaces. Align grain pattern with adjacent panels.

F. Provide edge molding at joints, exposed edges and corners.
   1. Seal back face of panel to molding leg, but do not allow sealant to enter edge expansion space. Seal using silicone bath sealant specified in Section 07 9200 - Joint Sealants.
   2. Adhere joint and edge trim using mastic in accord with panel manufacturer’s product data.
   3. Space edge trim 1/4" from abutting material and seal edge trim to adjacent abutting material using mildew-resistant silicone bath sealant as specified in Section 07 9200 - Joint Sealants.

G. Wall panels shall cover exposed interior wall surfaces not indicated to receive another finish. Install panels prior to installation of electrical cover plates and other miscellaneous surface mounted elements.

3.3 FIELD QUALITY CONTROL:

A. Allowable erection tolerances:
   1. Variation from plumb: 1/16" in total panel height.
   2. Variation from level: 1/8" in 10'-0", non-cumulative.
   3. Variation in face alignment of adjacent panels: 1/32".

3.4 CLEANING:

A. Just prior to Date of Substantial Completion, clean panel surfaces of soil and discolorations. Soiling that results in permanent discoloration will be cause for rejection of materials on which it occurs.

B. Replace panels which have become damaged or permanently stained.

END OF SECTION

SECTION 09 90 00 PAINTING

1.00 GENERAL

1.1 SECTION INCLUDES

A. The work of this section includes the coating of all interior and exterior surfaces.

1.2 RELATED SECTIONS

A. Section 01300 – Submittals and Substitutions

1.3 REFERENCES

A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.

B. ASTM D3359 - Method for Measuring Adhesion by Tape Test.

C. NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.

D. NPCA (National Paint and Coating Association) - Guide to U.S. Government Paint Specifications.

E. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

F. TACB (Texas Air Control Board) - 31 TAC Chapter 11.

G. TCEQ (Texas Commission on Environmental Quality) - 30 TAC Chapter 290

H. Paint manufacturer's printed instructions.

I. TAC - Texas Administrative Code.

1.4 DEFINITIONS

A. dft - dry film thickness

B. MDFT- minimum dry film thickness

C. mil(s) - a unit of measure equal to a thousandth of an inch (0.0254 mm).

D. VOC(s) - volatile organic compound(s)

1.5 INTERPRETATION

A. The Engineer's decision shall be final in the interpretation and/or conflict between any of the referenced Specifications and Standards contained herein.

1.6 SUBMITTALS

A. See Section 01 33 00, SUBMITTALS for submittal procedures.

B. Information to be provided: Provide a list of materials to be used under this Section. Submit the list before the materials are delivered to the job site. Cross reference the list to the coating systems identified. Furnish with the list, the coating manufacturer's standard product data and color chart for each material to be used.

C. Manufacturer's color charts shall be submitted to the Engineer at least 30 days or prior to paint application.

D. Coordinate work so as to allow sufficient time for paint to be delivered to the job site.

1.7 QUALITY ASSURANCE

A. General: Use quality assurance procedures and practices to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and accepted professional standards.

B. Surface Preparation: Surface preparation will be based upon comparison with: "Pictorial Surface Preparation Standards for Painting Steel Surfaces" SSPC-VIS 1-89 and ASTM Designation D2200, "Standard Methods of Evaluating Degree of Rusting on Painted Steel Surfaces" SSPC-VIS 2 and ASTM Designation D610; "Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive".

C. Application: No coating shall be applied: When the surrounding air temperature or the temperature of the surface to be coated or painted is below the minimum surface temperature for the products specified herein; or in rain, snow, fog or mist; when the temperature is less than 5 degrees F above the dew point; when the air temperature is expected to drop below 35 degrees F within six hours after application of coating. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce Weather Bureau Psychometric Tables. If the above conditions are forecast, coating or painting shall be completed in time to permit the film sufficient drying time prior to damage by atmospheric conditions.

D. Thickness and Holiday Checking (Steel Surfaces): Thickness of coatings shall be checked with a non-destructive, magnetic-type thickness gauge. Use as instrument such as a Tooke Gauge if a destructive tester is deemed necessary. The integrity of coated surfaces shall be checked with an approved inspection device. Non-destructive holidays shall not exceed 67½ volts nor shall destructive holiday detectors exceed the voltage recommended by the manufacturer of the coating system. For thickness between 10 and 20 mils, use a non-sudsing type wetting agent, such as Kodak Photo-Flow. Failures shall be marked, repaired in accordance with the manufacturer's printed recommendations and retested. No pinholes or other irregularities will be permitted in the final coating.

E. Inspection Devices: The contractor shall furnish, until final acceptance of coating and painting, inspection devices in good working condition for detection of holidays and measurement of dry film thickness (dft) of coating. The Contractor shall also furnish U.S.

Department of Commerce, National Bureau of Standards certified thickness calibration plates to test accuracy of dft gauges and certified instrumentation to test accuracy of holiday detector. Dry film thickness gauges and holiday detectors shall be made available for the Engineer's use at all times until final acceptance of application. Holiday detection devices shall be operated in the presence of the Engineer.

F. Warranty Inspection: Warranty inspection shall be conducted during the eleventh month following completion of all coating and painting work. All defective work shall be repaired in accordance with this specification and to the satisfaction of the Engineer/Owner.

1.8 QUALIFICATIONS

A. The Contractor shall have three years practical experience and successful history in the application of specified products to surfaces in water treatment.

1.9 SAFETY AND HEALTH REQUIREMENTS

A. General: The Contractor shall perform all work in accordance with applicable local, state, and federal laws and regulations, and material manufacturer's instructions and recommendations pertaining to the methods, materials, or activities in the work. The Contractor shall provide and require the use of personal protective equipment for persons working on or about the project.

B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the work. In addition, workers engaged in or near the work during sandblasting shall wear appropriate eye and face protection devices and air purifying, half mask or mouthpiece respirators with appropriate filters.

C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Ventilation shall reduce the concentration of air contaminants to the degree a hazard does not exist. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.

D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall provide and require the use of approved ear protective devices.

E. Illumination: Adequate illumination shall be provided while work is in progress, including explosion-proof lights and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination and necessary supports to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer.

F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall confirm to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and be moved by the Contractor to locations requested by the Engineer.

2.00 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Materials shall be Tnemec. Materials specified are those that have been evaluated for the specific service. Products are listed to establish a standard of quality.

1. Requests for substitution shall include manufacturer's literature for each product giving name, product number, generic type, descriptive information, solids by volume, recommended draft, and certified laboratory test reports showing results to equal the performance criteria of the products specified herein. In addition, a list of five projects shall be submitted in which each product has been used and rendered satisfactory service. The listed projects shall be in the State of Texas.

2.2 DELIVERY AND STORAGE

A. All materials shall be brought to jobsite in original sealed containers. They shall not be used until the Engineer has inspected contents and obtained data from information on containers or label. Materials exceeding storage life recommended by the manufacturer shall be rejected.

B. All coatings and paints shall be stored in enclosed structures to protect them from weather and excessive heat or cold. Flammable coatings or paint must be stored to conform to City, County, State and Federal safety codes for flammable coating or paint materials. At all times coatings and paints shall be protected from freezing.

2.3 MATERIALS

A. The number of coats called for in this schedule shall be considered minimum. If additional coats are required for complete coverage and uniform appearance, they shall be applied. Colors will be selected by the Owner. The system numbering may not be sequential or inclusive of all numbers from the first to last system or schedule numbers.

SYSTEM NO. 1

TYPE OF SURFACE:	Metal or Pre-painted Metal	
TYPE OF STRUCTURE:	Normal plant conditions such as: pipes, valves, equipment housing, ducts, pumps, motors, handrails, covers, bridges, steel sash, doors, walkways, stairways, and structural steel.	
EXPOSURE CONDITION:	Non-Submerged; inside or outside.	
SURFACE PREPARATION:	All surfaces should be clean, dry, free of oil, rust, loose and scaling paint and foreign material.	
PAINTING SYSTEM		
First Coat:	Tnemec Series 50-330 Poly-Ura-Prime	2.5 dft mils
Second Coat:	Tnemec Series 74 Endura-Shield IV (Gloss)	4.0 dft mils
		-or-
	Tnemec Series 75 Endura-Shield IV (S-G)	4.0 dft mils
	Total Thickness Tnemec Series	6.5 dft mils min.

SYSTEM NO. 2

TYPE OF SURFACE:	Metal	
TYPE OF STRUCTURE:	Severe moisture and chemical contact and fumes such as: troughs, valves, and pipes.	
EXPOSURE CONDITION:	Non-Submerged; inside or outside	
SURFACE PREPARATION:	Surface shall be sandblasted to a SSPC-SP6 commercial finish. Surface shall be dry and free of all rust and old paint.	
PAINTING SYSTEM		
First Coat:	Tnemec Series 66-1211 H.B. Epoxoline Primer	3.0 dft mils
Second Coat:	Tnemec Series 66-Color H.B. Epoxoline	5.0 dft mils
Third Coat (Interior):	Tnemec Series 66-Color H.B. Epoxoline	5.0 dft mils
		-or-
Third Coat (Exterior):	Tnemec Series 74-Color Endura-Shield IV	4.0 dft mils
	Total Thickness Tnemec Series	6.5 dft mils min.

SYSTEM NO. 3

TYPE OF SURFACE:	Metal	
TYPE OF STRUCTURE:	Piping, fittings and valves, exposed structural steel and metal trim.	
EXPOSURE CONDITION:	Non-Submerged	
SURFACE PREPARATION:	Surface must be free of moisture, oil and grease. Remove as much rust as possible by wire brushing, scraping or chipping. Color coding of piping to be as noted in Section 3.05, Paragraph B.	
PAINTING SYSTEM		
First Coat:	Tnemec Series 50-330 Poly-Ura-Prime	2.5 dft mils
Second Coat:	Tnemec Series 74 Endura-Shield IV (Gloss)	4.0 dft mils
		-or-
	Tnemec Series 75 Endura-Shield IV (S-G)	4.0 dft mils
	Total Thickness Tnemec	6.5 dft mils min.

SYSTEM NO. 4

TYPE OF LIQUID HANDLED:	Non-potable water	
TYPE OF SURFACE:	Metal	
TYPE OF STRUCTURE:	Gates, troughs, weirs, pipes, fittings, baffles, aerators, air diffusers, and pumps.	
EXPOSURE CONDITION:	Submerged or Intermittently Submerged.	
SURFACE PREPARATION:	SSPC-SP10 Near White Metal Blast Clean.	
PAINTING SYSTEM		
First Coat:	Tnemec Series 104-1255 Beige H.S. Epoxy	4.0 dft mils
Second Coat:	Tnemec Series 104-AA90 White H.S. Epoxy	5.0 dft mils
	Total Thickness Tnemec	9.0 dft mils min.

SYSTEM NO. 5

TYPE OF LIQUID HANDLED:	Potable Water	
TYPE OF SURFACE:	Metal	
TYPE OF STRUCTURE:	Gates, flumes, weirs, pipes, baffles, paddles, and pumps.	
EXPOSURE CONDITION:	Submerged or Intermittently Submerged.	
SURFACE PREPARATION:	SSPC-SP10 Near White Metal Blast Clean.	
PAINTING SYSTEM		
First Coat:	Tnemec Series 20-1211 Pota-Pox	4.0 dft mils
Second Coat:	Tnemec Series 104 Pota-Pox Plus	5.0 dft mils
	Total Thickness Tnemec	9.0 dft mils
	min.	

SYSTEM NO. 6

TYPE OF SURFACE:	Masonry	
TYPE OF STRUCTURE:	Exteriors of building	
structures. EXPOSURE CONDITION:	Non-Submerged	
SURFACE PREPARATION:	All surfaces must be clean and in sound condition. Painted surface should be wire brushed to remove any chalkiness and loose or peeling paint. Extremely rough masonry block should be given a cement wash before painting to provide a smooth uniform surface. No primer or surfacer is needed on smooth surfaces.	
PAINTING SYSTEM		
Block Filler:	Tnemec Series 130-6601	65 sf/gal
First & Second Coats:	Tnemec Series 156 Enviro-Crete	
	If rolled: 200 sq. ft. per gallon/ coat If sprayed: 100 sq. ft. per gallon/ coat	

SYSTEM NO. 7

TYPE OF SURFACE:	Concrete or Masonry	
TYPE OF STRUCTURE:	Interiors of building walls and ceilings.	
EXPOSURE CONDITION:	Non-Submerged	
SURFACE PREPARATION:	All surfaces must be clean and in sound condition. Painted surface should be wire brushed to remove any chalkiness and loose or peeling paint. Extremely rough concrete or masonry block should be given a cement wash before painting to provide a smooth uniform surface. No primer or surfacer is needed on smooth masonry.	
PAINTING SYSTEM		
Block Filler:	Tnemec Series 130-6601	65 sf/gal
First and Second Coats:	Tnemec Series 104-Color H.S. Epoxy	7.0 dft mils/coat
	Total Thickness Tnemec	14.0 dft mils min.

SYSTEM NO. 8

TYPE OF LIQUID HANDLED: Non-Potable Water TYPE OF SURFACE: Concrete

TYPE OF STRUCTURE: Influent or effluent channels and tank structures, such as aerator and clarifiers.

EXPOSURE CONDITION: Submerged

SURFACE PREPARATION: Masonry should be completely cured and brushed free of all form release compounds, laitance, loose particles and be completely dry. Previously coated surfaces must be cleaned of all loose, paint, rust, grease and dirt.

PAINTING SYSTEM

First Coat:	Tnemec Series 104-1255 H.S. Epoxy	6.0-8.0 dft mils
Second Coat:	Tnemec Series 104-Color H.S. Epoxy	6.0-8.0 dft mils
	Total Thickness Tnemec	12.0 dft mils min.

SYSTEM NO. 9

TYPE OF LIQUID HANDLED: Potable Water TYPE OF SURFACE: Concrete

TYPE OF STRUCTURE: Troughs, flumes, channels, and conduits. EXPOSURE CONDITION: Submerged

SURFACE PREPARATION: SSPC-SP7 Brush-off blast. Masonry should be completely cured and brushed free of all form release compounds, laitance, loose particles and be completely dry. Previously coated surfaces must be cleaned of all paint, rust, grease and dirt.

PAINTING SYSTEM

First Coat:	Tnemec Series 104-1255 Beige Pota-Pox Plus	6.0 - 8.0 dft mils
Second Coat:	Tnemec Series 140-AA83 Tank White Pota-Pox Plus	6.0-8.0 dft mils
	Total Thickness Tnemec	14.0 dft mils min.

SYSTEM NO. 10

TYPE OF SURFACE: Concrete

TYPE OF STRUCTURE: Exterior walls of buildings below grade EXPOSURE CONDITION: Below grade

SURFACE PREPARATION: Concrete should be completely cured and brushed free of all form release compounds, laitance, loose particles and be completely dry. Previously coated surfaces must be cleaned of all loose paint, rust, grease and dirt.

PAINTING SYSTEM

First Coat:	Tnemec Series 46H-413 H.B. Tnemec-Tar	16.0 dft mils

SYSTEM NO. 11

TYPE OF SURFACE: Concrete
TYPE OF STRUCTURE: Concrete floors, steps and walkways. Inside and outside.
EXPOSURE CONDITION: Non-Submerged
SURFACE PREPARATION: Remove grease, dirt and moisture with a mild alkali cleaner. PAINTING SYSTEM

First Coat:	Tnemec Series 66-Color H.B. Epoxoline	300 sf/gal
Second Coat:	Tnemec Series 66-Color H.B. Epoxoline*	250 sf/gal

*Broadcast with aggregate for non-skidas recommended per manufacturers instructions.

SYSTEM NO. 12

TYPE OF SURFACE: PVC Pipe
TYPE OF STRUCTURE: PVC Conduits and Pipes in Building EXPOSURE CONDITION: Normal Atmosphere
SURFACE PREPARATION: Hand sand to roughen pipe surface.
PAINTING SYSTEM

First Coat:	Tnemec Series 66 H.B. Epoxoline	4.0 dft mils
Second Coat (Interior):	Tnemec Series 66 H.B. Epoxoline	4.0 dft mils
	Total Thickness-Interior	8.0 dft mils min.
Second Coat (Exterior):	Tnemec Series 75-Color Endura-Shield IV (S-G)	3.0 dft mils
	Total Thickness-Exterior	7.0 dft mils min.

SYSTEM NO. 13

TYPE OF SURFACE: Tar Coated Pipe TYPE OF STRUCTURE: Piping
EXPOSURE CONDITION: Buried
SURFACE PREPARATION: Clean and Dry
PAINTING SYSTEM

First Coat:	Tnemec Series 66-1211 Red H.B. Epoxoline Primer	3.0 dft mils
Second Coat:	Tnemec Series 66-Color H.B.	4.0 dft mils
	Total Thickness	7.0 dft mils min.*

*Or until bleed-through of tar is stopped.

SYSTEM NO. 14

TYPE OF SURFACE: Galvanized or Non-Ferrous Metal TYPE OF STRUCTURE: Throughout plant
EXPOSURE CONDITION: Atmospheric
SURFACE PREPARATION: SSPC-SP1: Solvent wipe to remove soluble contaminants;
--or--
SSPC-SP3: Power tool clean to remove insoluble contaminants.

PAINTING SYSTEM

First Coat:	Tnemec Series 66 H.B. Epoxoline	5.0 dft mils
Second Coat:	Tnemec Series 74 Endura-Shield IV (Gloss)	3.0 dft mils
	Total Thickness Tnemec	8.0 dft mils min.

SYSTEM NO. 15

TYPE OF SURFACE: Galvanized or Non-Ferrous Metal
TYPE OF STRUCTURE: Throughout plant
EXPOSURE CONDITION: Submerged
SURFACE PREPARATION: SSPC-SP7: Brush-off Blast Clean
PAINTING SYSTEM

First Coat:	Tnemec Series 20 Pota-Pox	5.0 dft mils
Second Coat:	Tnemec Series 20 Pota-Pox	5.0 dft mils
	Total Thickness Tnemec	10.0 dft mils min

SYSTEM NO. 16

TYPE OF SURFACE: Metal
TYPE OF STRUCTURE: Buried
EXPOSURE CONDITION: Below grade
SURFACE PREPARATION: SSPC-SP10: Near White Metal Blast Clean. Surface to be clean and dry.
PAINTING SYSTEM Coating system must be pinhole free.

First Coat:	Tnemec Series 46H-413 H.B. Tnemec-Tar	16.0 dft mils min.

SYSTEM NO. 17

TYPE OF SURFACE: Galvanized Steel
TYPE OF STRUCTURE: Throughout plant, galvanized steel repair
EXPOSURE CONDITION: Atmospheric
SURFACE PREPARATION: SSPC-SP6: Commercial Blast Cleaning. Surface must be clean and dry.
PAINTING SYSTEM

First Coat:	Tnemec Series 90-97 Tnemec-Zinc	3.0 - 3.5 dft mils

3.00 EXECUTION

3.1 GENERAL

A. All surface preparation, coating and painting shall conform to applicable standards of the Steel Structures Painting Council and the manufacturer's printed instructions. Material applied to the surface prior to the approval of the Engineer shall be removed and re-applied to the satisfaction of the Engineer at the expense of the Contractor.

B. All work shall be performed by skilled craftsmen qualified to perform the required work in a manner comparable with the best standards of practice. Continuity of personnel shall be coordinated with the Engineer.

C. The Contractor shall provide a supervisor at the work site during cleaning and application operations. The supervisor shall have the authority to sign change orders, coordinate work and make decisions pertaining to the fulfillment of the contract.

D. Dust, dirt, oil, grease or any foreign matter that will affect the adhesion or durability of the finish must be removed by washing with clean rags dipped in an approved cleaning solvent and wiped dry with clean rags.

E. Coating and painting systems include surface preparation, prime coating and finish coatings. Unless otherwise approved by the Engineer, prime coating shall be field applied. Where prime coatings are shop applied, the Contractor shall instruct suppliers to provide the prime coat compatible with the finish coat specified. Any off-site work which does not conform to this specification that is damaged during transportation, construction or installation shall be thoroughly cleaned and touched-up in the field as directed by the Engineer. The Contractor shall use repair procedures which insure the complete protection of all adjacent primer. The specified repair method and equipment may include wire brushing, hand or power tool cleaning, or dry-air blast cleaning. In order to prevent injury to surrounding painted areas, blast cleaning may require use of lower air pressure, smaller nozzle and abrasive particle sizes, or shorter blast nozzle distance from surface shielding and masking. If damage is too extensive or uneconomical to touch-up, then the item shall be re-cleaned and coated as directed by the Engineer.

F. The Contractor's coating and painting equipment shall be designed for application of materials specified and shall be maintained in first class working condition. Compressors shall have suitable traps and filters to remove water and oils from the air.

G. Application of the first coat shall follow immediately after surface preparation and cleaning and before rust bloom occurs. Any cleaned areas not receiving first coat within this period shall be recleaned prior to application of first coat.

H. Prior to assembly, all surfaces made inaccessible after assembly shall be prepared as specified herein and shall receive the coating or paint system specified.

3.2 SURFACE PREPARATION

A. The latest revision of the following surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC-SP1): Removal of oil, grease, soil and other contaminants by use of solvents, emulsions, cleaning compounds, steam cleaning or similar materials and methods which involve a solvent or cleaning action.

2. Hand Tool Cleaning (SSPC-SP2): Removal of loose rust, loose mil scale and other detrimental foreign matter to degree specified by hand chipping, scraping, sanding and wire brushing.

3. Power Tool Cleaning (SSPC-SP3): Removal of loose rust, loose mil scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders.

4. White Metal Blast Cleaning (SSPC-SP5): Blast cleaning to a gray-white uniform metallic color until each element of surface area is free of all visible residues.

5. Commercial Blast Cleaning (SSPC-SP6): Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues.

6. Brush-Off Blast Cleaning (SSPC-SP7): Blast cleaning to remove loose rust, loose mil scale and other detrimental foreign matter to degree specified.

7. Near White Blast Cleaning (SSPC-SP10): The removal of all visible oil, grease, dirt, dust, mil scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other specific method. Discoloration caused by certain stains shall be limited to no more than 5% of each square inch of surface area.

8. Power Tool Cleaning to Bare Metal (SSPC-SP11): The removal of all visible oil, grease, dirt, mil scale, rust, paint, oxide, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. Differs from SSPC-SP3 in that it requires more thorough cleaning and a surface profile not less than 1 mil (25 microns). For areas where abrasive blasting is prohibited or not feasible.

B. Slag and weld metal accumulation and spatters not removed by the Fabricator, Erector or Installer shall be removed by chipping and grinding. All sharp edges shall be penned, ground or otherwise blunted as required by the Engineer.

C. Field blast cleaning for all surfaces shall be by dry method unless otherwise directed.

D. Particle size of abrasive used in blast cleaning shall be that which will produce a 1.5-2.0 mils (37.5 microns-50.0 microns) surface profile or in accordance with recommendations of the manufacturer of the specified coating or paint system to be applied.

E. Abrasive used in blast cleaning operations shall be new, washed, graded and free of contaminants that would interfere with adhesion of coating or paint and shall not be reused unless specifically approved by the Engineer.

F. During blast cleaning operations, caution shall be exercised to insure that existing coatings or paint are not exposed to abrasion from blast cleaning.

G. The Contractor shall keep the area of his work and the surrounding environment in a clean condition. He shall not permit blasting materials to accumulate as to constitute a nuisance or hazard to the accomplishment of the work, the operation of the existing facilities, or nuisance to the surrounding environment.

H. Blast cleaned surfaces shall be cleaned prior to application of specified coatings or paint. No coatings or paint shall be applied over damp or moist surfaces.

I. All welds shall be neutralized with a suitable chemical compatible with the specified coating materials.

J. Specific Surface Preparation: Surface preparation for the specific system shall be as noted in Section 2.01.

3.3 APPLICATION

A. Painting Council Paint Application Specification SSPC-PA1, latest revision, for "Shop, Field and Maintenance Painting", the American Water Works Association and the manufacturer of the coating and paint materials.

B. Thinning shall be permitted only as recommended by the manufacturer approved by the Engineer, and utilizing the thinners stated in Section 2.02 Paragraphs D and E.

C. Each application of coating or paint shall be applied evenly, free of brush marks, sags, runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping on glass or hardware. Coatings and paints shall be sharply cut to lines. Finished surfaces shall be free from defects or blemishes.

D. Protective coverings or drop cloths shall be used to protect floors, textures, and equipment. Care shall be exercised to prevent coatings or paints from being spattered onto surfaces which are not to be coated or painted. Report surfaces from which materials cannot be satisfactorily removed to the Engineer.

E. When two coats of coating or paint are specified, where possible, the first coat shall contain sufficient approved color additive to act as an indicator of coverage or the two coats must be of contrasting color.

F. Film thicknesses per coat specified in Section 2.2 are minimum required. If roller application is deemed necessary, the Contractor shall apply additional coats to achieve the specified thickness.

G. All material shall be applied as specified.

H. All welds and irregular surfaces shall receive a brush coat of the specific product prior to application of the first complete coat.

3.4 COATING SYSTEM APPLICATION

A. After completion of surface preparation as specified for the specific system, materials shall be applied at noted in Section 2.02.

3.5 COLOR SCHEME

A. The Engineer shall select colors for the project. The Contractor shall submit a current chart of the manufacturer's available colors to the Engineer thirty days prior to the start of coating and painting.

B. The identification if influent, effluent, waste backwash, and chemical feed lines shall be accomplished by use of labels or various colors of paint. Where labels are used, they shall be placed along the pipe at no greater than five foot intervals. Where colors are used they shall follow the color code prescribed below. Color coding must be by solid color or banding. If bands are used, they shall be placed along the pipe at no greater than five foot intervals. The color code is as follows:

C. PAINTING COLOR SCHEDULE

Item	Color (Tnemec)
Pumps, Rotors, Blowers, Motors, Baseplates, Misc. Equipment, and Exposed Iron or Steel	
Piping -	
Potable Water	Delft Blue
Non-Potable Water	BF82 Cloud
Air	AW42 Patina
Chlorine Gas	BW56 Bright Yellow
Chlorine Solution	Yellow w/ Red Bands
Gas	CC13 Safety Red
Caustic	Orange
Polymer	AC12 Banyon Bark
Polymer Aid	AC12 Banyon Bark
Settled Water	Green
Filter Effluent	BB42 Clear Sky
Backwash	BB42 Clear Sky
Drain	Dark Gray
Raw Water	2001 Warm Beige
Structural Steel Members, Bar Joists, Bark Support Angles, Embedded Frames	AC12 Banyon
Electrical Enclosures, Panels, and Supports	BF82 Cloud
Hollow Metal Doors, Metal Frames, Steel	AD12 Terra Cotta
Windows, Sub-frame, Gutters and Downspouts	AD12 Terra Cotta
Interior All Concrete Masonry Unit Walls	AL82 Warm Sun
Exterior Standard Concrete Masonry Unit Walls	1788 Coral Sand
Concrete	Pearl Grey

D. Irrespective of the finish coat color designations, the following shall be painted as listed:

1. OSHA Orange: Moving parts of equipment, protected by guards-shafts, couplings, pulleys, and sprockets (the guards themselves to be same color as equipment color).

2. OSHA Yellow: Caution signs and all physical hazards, outside levers, weight on check valves, lower pulley block sprockets and chains on valve operators, inside of openings adjacent to steps on ladder, platforms subject to being struck.

3. Dark Green: "Safety" and location of First-Aid equipment such as gas masks, first-aid kits, and safety deluxe showers.

4. Black and White: Areas to remain clear.

3.6 DISINFECTION

A. Disinfection may be required for interior surfaces of tanks or systems containing potable water. Coordinate painting with disinfection requirements.

3.7 VAPOR REMOVAL

A. All solvent vapors shall be completely removed by suction-type exhaust fans and blowers before placing tank or system in operating service.

3.8 CLEAN UP

A. Upon completion of the work, all staging, scaffolding and containers, waste blast abrasive, or other painting debris shall be removed from the site. Coating or paint spots or oil stains upon adjacent surfaces shall be removed and the jobsite cleaned. All damage to surfaces resulting from the work of this section shall be cleaned, repaired, or refinished to the satisfaction of the Engineer at no cost to the Owner.

3.9 SCHEDULE

A. Mechanical Equipment:

1. All indoor pumps, motors, tanks, and base plates on slabs above grade: Shop Coat - System No. 1.

2. All indoor pumps, motors, tanks, and base plates on slabs below grade: System No. 1.

3. All outdoor pumps, mixers, motors, and base plates (non-submerged): System No. 2.

4. All outdoor pumps, mixers, motors, and base plates (submerged): System No. 5.

5. Exterior submerged process steel to an imaginary plane 9" above high water level: System No. 15.

6. All exterior non-submerged process steel located above an imaginary plane 9" above high water level: System No. 14.

7. All blowers, silencers, and appurtenances: System No. 4.

B. Concrete Structures:

1. Interior submerged concrete basins/chambers: System No. 9.

2. Concrete floors, steps and walkways (non-submerged): System No. 11.

C. Miscellaneous Metals:

1. Exterior Structural Steel Members and Bar Joists: System No. 3.

2. Interior Structural Steel Members and Bar Joists: System No. 1.

E. Architectural:

1. Interior Hollow Metal Doors, Metal Frames, Steel Windows, and Subframes:

System No. 1.

2. Exterior Hollow Metal Doors, Metal Frames, Steel Windows, and Subframes: System No. 2.

3. Interior Standard and Architectural Concrete Masonry Unit Walls: System No. 7.

4. Exterior Standard Concrete Masonry Unit Walls: System No. 12.

5. Exterior Architectural Concrete Masonry Unit Walls: One (1) coat of Chemprobe Corporation Prime-A-Pell 200 or equal at 75 sq. ft./gallon.

F. Electrical: All electrical items which require painting, such as motor control panel cabinets, exposed metal junction boxes, etc. shall be shop blasted, primed, and finished. The Contractor shall be responsible for repairing any damaged areas by hand tool cleaning, priming, and painting. Repair of damaged areas shall be done in such a way that the completed electrical items are uniform in appearance.

END OF SECTION

DIVISION 10

SPECIALTIES

SECTION 10000

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY:

A. Related work specified elsewhere:
1. Gypsum board systems.
2. Painting and coating.

1.2 ACTION SUBMITTALS:

A. Shop drawings: Indicate extinguisher location, size, mounting height and method of installation. Show cabinet installation details, including fire protection enclosure where cabinet is located in fire-rated wall assembly.

B. Product data: Indicate material types, finishes, ratings, hardware, sizes, fabrication and installation details. Include sample of cabinet door sign.

1.3 QUALITY ASSURANCE:

A. Applicable standards; standards of the following as referenced herein:
1. ASTM International (ASTM).
2. Americans with Disabilities Act (ADA).
3. Factory Mutual (FM).
4. Underwriters Laboratories, Inc. (UL).

1.4 DELIVERY, STORAGE AND HANDLING:

A. Deliver and store in protective packaging to prevent soiling and physical damage.

B. Handle to prevent damage to finished surfaces and operating mechanisms.

1.5 PROJECT/SITE CONDITIONS:

A. Protection: Protect prefinished surfaces from damage or staining. Provide protective covering following installation for duration of project.

1.6 INSPECTION SERVICE:

A. Extinguishers shall have an inspection certification tag attached, indicating date of charge and service agent's name and address. Charge date shall not be earlier than sixty days prior to Date of Substantial Completion. Service agent shall be located within 50 miles of project.

B. Provide an inspection service agreement for inspection and servicing of extinguishers for one year following date of initial charge, as well as for servicing and recharging extinguishers failing to hold charge within the initial one-year period. Recharging extinguishers due to use or vandalism shall not be included in service agreement.

PART 2 - PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS:

A. Acceptable manufacturers; subject to compliance with specified requirements:
1. J. L. Industries, Inc., an Activar Construction Products Group, Inc. Company.
2. Larsen Manufacturing Co.
3. Nystrom, Inc.
4. Potter Roemer - Fire Protection Equipment, a division of Morris Group International.

B. Fire Extinguishers (F.E):
1. The extinguisher should contain a multipurpose dry chemical with 10 lbs. capacity and UL 4A-80B:C rating conforming to MP10 Series and be mounted with eye brackets for direct wall mounting to hook and for mounting in Fire Extinguisher cabinets.
2. Provide initial inspection tag for each extinguisher.

C. Container characteristics:
1. Label: UL and FM.
2. Accessories: Pressure-indicating gauge, hose and nozzle.
3. Operation: Pull-pin and squeeze grip for multiple controlled release.

2.2 FIRE EXTINGUISHER BRACKETS:

A. Description: Manufacturer's standard wall bracket designed to support extinguisher securely in vertical position on wall or centered in cabinet.

2.3 TRIMMED RECESSED CABINETS:

A. Acceptable products; subject to compliance with specified requirements:
1. Basis of design; J. L. Industries, Inc., an Activar Construction Products Group, Inc. Company, Ambassador.
2. Larsen's Manufacturing Co., Architectural Series.
3. Nystrom, Inc., Alpine Series.
4. Potter Roemer - Fire Protection Equipment, a division of Morris Group International., Alta Series.

B. Fire extinguisher cabinets (FEC):
1. Recessed fire extinguisher cabinets: J.L. Industries, Ambassador 2107S21 Series (Non-Rated) and Ambassador 2017SFX with Fire-FX fire rated tube.
a. Fire Extinguisher Cabinets (FEC) shall have a 27 inches x 12 inches x 7-3/4 inches inside tub dimension with a 22 gauge min. steel with baked acrylic enamel interior finish. The FEC should be semi-recessed with 2-1/2 inch return trim rolled edge; ADA compliant.
b. The Door and Frame shall be 18 gauge min. 304 stainless steel door and frame with vertical decal lettering "FIRE EXTINGUISHER" in red color, unless directed otherwise with no glazing.
c. Hardware consists of a continuous concealed piano hinge constructed of material which matches door and trim material, and a satin finish pull handle with cam cylinder lock with safety pull designed to release upon firm pull on handle.
d. The cabinet should have a #4 stainless steel finished exterior.
2. Provide a fire rated cabinet, as needed, for one or two hour rated conditions as indicated or required by specific location. Cabinet shall be tested and approved by Warnock Hersey to ASTM E-814, and shall bear the Warnock Hersey label.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Coordination:
1. Coordinate installation of built-in cabinets with wall construction.
2. Where extinguisher cabinets occur in fire rated walls, ensure that fire rated extinguisher cabinets match wall fire ratings.

3.2 CABINET INSTALLATION:

A. Install cabinets plumb and level, anchored to structural elements using not less than two anchors, each, top and bottom of each cabinet. Anchors shall be type and size recommended by cabinet manufacturer for substrate encountered, concealed within closed cabinet, with exposed heads finished to match cabinet interior.

B. Provide blocking built into walls at anchorage locations.

C. Where cabinet is installed in a fire-rated wall assembly, install fire-rated cabinet in accord with cabinet manufacturer's product data.

D. Conceal edges of rough opening into which cabinet is installed with cabinet assembly.

E. Mounting heights: As indicated on drawings and meeting ADA and NFPA requirements.

3.3 EXTINGUISHER INSTALLATION:

A. Install extinguishers at Date of Substantial Completion, indicating acceptable charge pressure and tagged to show charge date and service agent.

B. Install wall-hung extinguishers on wall mounting bracket. Secure bracket to wall structure with not less than two anchors.

C. Mounting heights: As indicated on the drawings and meeting ADA and NFPA requirements.

D. Install cabinet-mounted extinguishers in cabinets using wall mounting bracket attached to back wall of cabinet.

E. Install and secure extinguishers in plumb, vertical position with name and operating instructions visible on front of extinguisher.

3.4 CLEANING AND PROTECTION:

A. Protect installed equipment and finished surfaces from damage or defacement. Replace items which cannot be repaired to satisfaction of Architect.

B. Prior to date of Substantial Completion, clean and polish interior and exterior surfaces.

3.5 EXTINGUISHER SCHEDULE:

A. Provide 10 lb. ABC extinguishers in surface mounted, recessed cabinets, in locations as indicated or as directed by Architect.

B. Provide 5 lb. ABC and 10 lb. ABC extinguisher, wall bracket mounted, in locations indicated or as directed by Architect.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 22 13 29.16 SUBMERSIBLE SEWAGE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Submersible pumps, controls, and related accessories as scheduled at the end of this Section.

1.02 REFERENCES

A. Hydraulic Institute Standards

B. National Electric Code Standards

1.03 SUBMITTALS

A. Section 01300 – Shop Drawings, Product Data, and Samples

1. Product Data
2. Performance curves, pump, and motor
3. Materials of construction
4. Dimensioned pump outline drawings
5. Lift station drawing for accessories
6. Detailed electrical data
7. Control drawings and data
8. Access cover drawing
9. Wet well and valve vault dimensional drawings
10. Warranty
11. Installation instructions

B. Operation and Maintenance Manuals: Section 01700

C. Certification that installation is ready to use: Part 3 herein

1.04 PROJECT SITE CONDITIONS

A. Elevation: El Paso, TX-3,985 ft±

1.05 QUALITY ASSURANCE – PUMPS

A. Factory Tests: the pump manufacturer shall perform the following inspections and tests on one pump before shipment:

1. Verification of the pump characteristic curves by testing at 1/4, 1/2, 3/4, and full flow and recording the measured head and motor current for each flow.
2. Insulation test of the windings.
3. A test of the pump motor (run dry for 5 minutes at full load) to check electrical data measurements

4. A submerged test of the pump to establish correct rotation and mechanical integrity.

5. A motor and cable insulation test for moisture content and insulation defects.

6. A check of impeller, motor rating, and electrical connections for compliance with purchase order.

B. Manufacturer shall have a local representative located with 25 miles of the jobsite, who shall have been appointed by the manufacturer three (3) years prior to bid date, who maintains a factory- authorized service/ repair facility staffed with factory trained mechanics, stocked with a minimum of $100,000 inventory of manufacturer's repair parts and supported with service truck, fitted with lifting cranes for jobsite service.

1.06 QUALITY ASSURANCE - CONTROLS

A. General:

1. The equipment provided shall be a completely integrated control systems consisting of the required power equipment (motor starters, circuit breakers, variable frequency drives, etc.), automation and monitoring equipment in a factory wired and tested assembly.

2. All level transducers, variable frequency drives, control and monitoring equipment, and software furnished with pumps shall be standard catalogued products of the system supplier to assure single source responsibility.

3. The equipment shall be provided by an authorized manufacturer's representative who shall be responsible for the administration of the warranty. The manufacturer or his representative shall furnish a letter with submittals verifying the local representative and that the equipment is being supplied as described above.

B. U.L. Listing:

1. The equipment specified in this Section shall be constructed in a UL 508 listed controls manufacturing facility. The manufacturer shall provide certification of UL certification with submittals.

2. The equipment shall bear the appropriate UL serialized label indicating the equipment supplied for this project shall be constructed in accordance with the practices and requirements of UL.

1.07 WARRANTY

A. In printed form and apply to all similar units

B. The manufacturer shall provide a written warranty as standard covering workmanship and defects in materials for a period of Five years (5) from date of Substantial Completion. The warranty shall cover parts, labor, and return freight as follows: 1 – 18 months – 100%, 19 – 39 months – 50%, 40 – 60 months – 25%.

C. The warranty does not excuse the Owner from performing scheduled routine preventive maintenance. The Owner shall be required to maintain scheduled service maintenance records for all warranted equipment. The manufacturer shall repair or replace, at its discretion, any warranted equipment that fails within the warranty period. The manufacturer shall not be responsible for equipment damage resulting from misuse, abuse,

improper installation or storage, failure to perform or schedule routine preventative maintenance, defective power supply, improper electrical protection, tampering, or the like. The warranty does not include the cost for normal wear and maintenance items and/ or parts.

D. The manufacturer shall provide a written statement that its solids handling pumps will be free from clogging for 12 months when pumping sewage and wastewater containing solids and debris normally found in domestic wastewater, when pumps are equipped with impellers utilizing the self-cleaning Hard-Iron™ N-Technology.

1. The guarantee is extended to the original owner of the pumps for a period of 12 months from the date of start-up of the equipment by the local Flygt representative or distributor.

2. Should the Flygt N-Pump Impeller clog with typical solids and/or debris normally found in domestic wastewater during this period, the Owner will be reimbursed for reasonable cost to remove the pump, clear the obstruction and reinstall the affected pump.

E. The aluminum access frames and covers shall carry a guarantee of 10 years against defects in material and/or workmanship

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Pumps: Flygt Inc.

B. Controls: Supplied by pump manufacturer or pump supplier.

C. Accessories: Flygt Inc.

D. Access Covers:

1. Flygt

2. USF Fabrication

3. Halliday Products

E. Or Engineer approved equivalent

F. All pumps specified in this section by same manufacturer

G. Motor and pump are designed and manufactured by the same source

H. Pump manufacturer will have a minimum of 10,000 units of similar type pumps, installed and operating for no less than five (5) years in the United States.

I. Controls and variable frequency drives to be supplied by pump supplier.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

A. See Schedule.

2.03 PUMP MATERIALS

A. Volute, Motor Housing, Discharge Elbow, and Other: Gray cast iron ASTM A-48 Class 35B, with smooth surfaces devoid of blow holes or other casting irregularities.

B. Shaft:

1. Small and Mid Range pumps (1.6 – 160 hp): ASTM A479 S43100-T Stainless steel

2. Stainless steel sleeves covering shafting constructed of lesser materials are not acceptable.

C. Motor

1. Rotor bars and short circuit rings: Aluminum

2. Stator winding and lead insulation: Class H monomer free polyester resin.

D. Mechanical Seal: Tandem seals with all seal faces to be abrasion and corrosion resistant solid sintered tungsten carbide featuring a nickel binder to cement tungsten-carbide particles together during sintering.

E. Impeller:

1. Hard Iron N impeller (if listed in schedule) - ASTM A-532 25% chrome cast iron, Alloy IIIA), with the leading edges of the impeller hardened to Rc 60

2. C impeller - gray cast iron, Class 35B

F. Wear Ring: Required if C impeller scheduled

1. Case wear ring: Nitrile rubber molded with steel ring insert.

2. Impeller wear ring on 20 HP and larger pumps: ANSI 304 SS

G. Volute Insert, Replaceable: Required if N impeller scheduled

1. Hard Iron N impeller (if listed in schedule) - ASTM A-532 25% chrome cast iron, Alloy IIIA)

H. Exposed Nuts and Bolts: 304 stainless steel

I. Guide Bars and Guide Bar Brackets: 304 Stainless Steel

2.04 PUMP CONSTRUCTION

A. Water Tight Sealings: Nitrile rubber o-rings against machined surfaces

B. Cable Entry Design:

1. Seal: Torque-free mechanical compression type with strain relief (epoxies, silicones or other secondary sealing not acceptable), single grommet type flanked by washers to 11 HP, and double grommet type flanked by washers above 11 HP.

2. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top.

a. For small pumps with 1.6 – 11 hp: The cable entry junction chamber and motor are separated by a stator lead sealing gland or terminal board.

b. For mid-range pumps with 12 – 160 hp: The junction chamber is sealed off from the stator housing with a terminal board for connection of power and pilot sensor cables using threaded compression type terminals

C. Pump Motor

1. Motor shall be NEMA B design, induction type, with a squirrel cage rotor, shell type design, housed in air-filled watertight chamber.

2. Stator windings shall be insulated with moisture resistant Class H insulation rated for 180-deg C (356-deg F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free, moisture resistant, polyester resin resulting in a winding fill factor of at least 95%.

3. The stator shall be heat shrink fitted into the stator housing. Designs requiring use of bolts, pins, or other fastening devices requiring penetration of stator housing are not allowed. The use of multiple step dip and bake-type stator insulation process is not acceptable.

4. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

5. The motor shall be designed for continuous operation in up to a 40-deg C ambient and shall have a NEMA Class B maximum operating temperature rise of 80-deg C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

6. Sensors:

   a. Pumps 1.6 – 105 hp: Equipped with three (3) winding thermal switches and a float switch in the motor housing to detect the presence of moisture or oil. Also furnish a control and status monitor (MiniCAS) located in the control panel and wired to the pump to monitor the sensors and stop the motor when called for. Monitor unit shall be 24VDC powered, unless scheduled otherwise.

   b. Pumps greater than 105 hp: Equipped with three (3) winding thermal switches wired in series, stator thermal sensor, lower bearing temperature sensor (RTD), and upper and lower float leakage sensors in the motor housing. Furnish a monitoring and status unit (MAS) located in the control panel and wired to a solid state memory unit in the motor to monitor the sensors and switches, stop the motor when called for, and download stored statistical operational data. Monitor unit shall be 24VDC powered, unless scheduled otherwise. MAS unit shall include an operator panel that is dead-front panel mounted. The operator panel shall have soft-touch operator keys and provide local indication of the status of the alarms within the connected pump unit by means of a connected LCD screen read-out. Local MAS system change shall be made by use of the soft-touch keypad or local connection by means of a laptop computer. Remote indication of pump unit status shall be possible with connection to Owner's PLC or via LAN or twisted pair to Owner's plant control system. Provide cable required to connect the MAS relay to the Owner's laptop computer. Provide laptop computer interface card and software required to connect and communicate with the MAS relay. Demonstrate programming of the MAS relay using Owner's laptop computer.

D. Motor Cooling System:

1. Each unit shall be provided with an integral motor cooling system.

2. For small range pumps up to 11 HP: Provide thermal radiators integrally cast into stator housing.

3. For mid-range pumps (12 – 160 hp):

   a. Provide cooling jacket to allow circulation of propylene glycol around motor housing.

   b. A stainless steel motor cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation.

   c. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket.

   d. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer.

   e. The cooling system shall have one fill port and one drain port integral to the cooling jacket.

   f. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures of up to 104°F (40°C). Operational restrictions at temperatures below 104°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

E. Pump Shaft

1. Rotate in permanently lubricated ball bearings.

   a. For small range pumps (up to 11 hp), upper bearing to be single row deep groove ball bearing.

   b. For mid range pumps (12 hp – 160 hp), upper bearing to be single row deep groove ball bearing.

   c. For small and mid range pumps (1.6 – 160 hp), lower bearing to be a two-row angular contact ball bearing.

2. Completely isolated from pumped liquid

3. Pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings are not acceptable.

4. Lower bearing shall contain a temperature sensor for monitoring on units larger than 100 hp.

F. Minimum ABMA L10 bearing life: 50,000 hours at any point on the head-capacity curve.

G. Mechanical Seals:

1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring.

2. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber.

3. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable.

4. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable.

5. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

6. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

7. For mid-range pumps (12 – 160 hp), a separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing.

8. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

H. Impeller - See Schedule.

1. N-impeller:

a. Dynamically balanced, semi-open, multi-vane, back-swept, non-clog with vanes of screw shaped leading edges, self cleaning by shearing action from grooves in the volute. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater.

b. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw.

c. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

2. Coating: Acrylic dispersion zinc phosphate primer or Alkyd resin primer.

I. Volute - See Schedule.

1. N-impeller:

a. Volute bottom design to be of sharp, spiral shaped grooves integrally cast into the suction side of the volute to provide shearing action from the movement of the leading edges of the impeller vanes. Clearances shall be adjustable for wear.

b. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed.

J. Power Cable:

1. Each pump to be equipped with submersible pump (power) cable.
2. Pump cable sized according to NEC and ICEA Standards.
3. Pump cable meets P-MSHA Approval
4. Pump cable shall have at least 3 power leads, a ground lead, and two shielded sensor leads.
5. Pump cable to have oil-resistant, chloroprene rubber jacket.

K. Sliding guide bar bracket to be an integral part of pump unit to guide on at least two rails extending from the top of the station to the discharge connection. The pump(s) shall be automatically and firmly connected to the discharge connection. There shall be no need for personnel to enter the wet-well.

L. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable.

M. <u>Each pump shall be provided with a drilled volute bottom for attaching a flanged suction flare. Refer to construction plans.</u>

2.05 PERFORMANCE

A. Pump Motor:

1. Non-overloading throughout published pump curve
2. Capable of 30 evenly spaced starts per hour.
3. Capable of running dry indefinitely without damage.
4. Capable of continuous operation unsubmerged.
5. Motors for use in NEC/500/501, hazardous areas: FM, UL or CSA listed for use in the area specified.
6. Combined service factor of 1.15 and rated for operation at 40C AMB.
7. Inverter duty rated in accordance with NEMA MG1, Part 31.
8. Voltage tolerance of plus or minus 10%.
9. Designed for continuous duty while handling pumped media of up to 104°F.
10. Motor and cable capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater

2.06 PROTECTION COATING

A. Pump Exterior: All metal surfaces coming into contact with the pumpage, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic

dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

B. Impeller: Alkyd resin primer.

2.07 ACCESSORIES

A. Furnish the following accessories associated with pump installation. These accessories shall be furnished by the pump manufacturer:

1. 304 SS Upper and intermediate guide bar brackets.
2. 304 SS Lifting/ Safety chain with required shackles.
3. 304 SS Cable hanger rack.
4. 304 SS Cable support grips for motor cables.
5. Grip eye lifting system.
6. Wet well access covers, if specified in schedule.
7. Valve vault access covers, if specified in schedule.
8. Valve vault access ladders, if specified in schedule.

B. Grip Eye Lifting System: Each submersible pump shall be furnished with a pump lifting-chain positive recovery system consisting of the following components.

1. Minimum of 40 feet of stainless steel wire, of diameter to provide tensile strength capacity to support length of chain sling, connected to a short length (approximately ten links long) of high tensile strength proof-tested stainless steel chain sling of required capacity, connected to the lifting eye or lifting bail of the submersible pump. Contractor to verify required chain length prior to ordering.
2. A forged "grip-eye" of wrought alloy steel, provided separately to connect to the end of the lifting cable or chain of the pump lifting device.
3. Pumps are designed to automatically and firmly connect to the discharge connection, guided by two guide bars extending from the top of the station to the discharge connection with no need for personnel to enter the wet-well.
4. Acceptable manufacturer: Flygt Grip-Eye System or Engineer approved equivalent.

C. Valve Vault Ladder

1. Ladder shall be constructed entirely of aluminum.
2. The rails shall be 1/2" x 2-3/4" (13mm x 70mm) aluminum extrusion and shall be spaced 16" (406mm) apart.
3. Wall mounted standoffs shall be 3/8” x 2-1/2” (10mm x 64mm) flat bar and welded to the rails at a maximum of 60" (1.5m) on center.
4. The standoffs shall be a minimum of 7" (178mm) and manufactured to fit flush with the wall.
5. 1-3/8" (35mm) diameter type "D" rungs with flat slip resistant surface shall be spaced at 12" (305mm) on center and welded to the outside of each rail.

6. Ladder shall be supplied with a ladder extension. The extension shall retract after use so that the access cover can be closed.

7. Ladder shall be L1D with Model L1E safety extension as manufactured by Halliday Products Inc. of Orlando, Florida, or approved equal.

D. Pump Guide Rails

1. Double guide rails, with upper guide bar bracket, per each pump.

2. 3" SCH 40 guide rails of sufficient length to terminate just below wet well lid, allowing easy installation/ removal of submersible pumps.

3. Guide rails and upper guide bar brackets shall be constructed of 316 stainless steel.

E. Valve Vault Piping Expansion Joint:

1. Single sphere Style 240-AV by Proco, or Owner approved equal.

2. Quantity and size as shown on the plans.

3. Include two limit rods per unit, size as required by manufacturer.

4. All flanges and hardware shall be 316 stainless steel.

F. Combination Air Release/Vacuum Valve Assembly:

1. H-TEC 989 automatic air release/vacuum valve, short body, 316 stainless steel, quantity as shown on the plans, or Engineer approved equal.

2. 2" FNPT connection

3. Body is 316 stainless steel

4. Cup seal and diaphragm material is HNBR

5. Float material is polypropylene

6. Hex head bolts shall be 316 stainless steel

7. Outlet elbow with screen shall be polyethylene

8. Include:

a. 2" 316 stainless steel ball valve, Assured Automation Style 21, Crane Model 9431-LL, or Owner approved equal

b. 2" 316 stainless steel MNPT nipples, length and quantity as required.

c. 2" polyethylene 90° cam & groove elbow w/2"NPT outlet

d. 2" SCH 40 PVC vent piping to extend to floor

9. 4" 316 stainless steel blind flange with drilled 2" NPT connection.

10. Engineer approved substitutes are:

a. Vent-O-Mat RGX-II (stainless steel)

b. ARI D-020 (stainless steel)

11. All modifications necessary for proper installation of proposed substitute valve shall be the responsibility of the Contractor at no addition cost to Owner.

12. Valve substitutions shall incorporate all items necessary to meet general requirements shown on the plans and in this specification

13. Valve supplier shall guarantee that the substitute valve will not spit or leak under anticipated operating conditions or can be provided with a drain pipe to direct spitting and leakage to the floor drain without spilling onto associated piping.

G. Discharge Pressure Gauge with Isolation Ring

1. Ashcroft 80 Wafer Isolation Ring constructed with 360 degree flexible inner cylinder, or Owner approved equal.

2. Silicone fill fluid

3. Constructed for insertion between flanged fittings, per ASME class 150

4. Each isolation ring supplied with mounted Ashcroft Model GC51 Rangeable Pressure Transmitter, or Owner approved equal.

5. Materials of Construction:

a. Carbon Steel Center Section (Epoxy Coated)

b. Buna-N Elastomer.

c. Module Seal with Internal Pulsation Dampener.

d. Delrin Acetal End Plates.

e. Brass Stinger Fitting.

H. Valve Vault Sump Pump:

1. Tsurumi Model 50PU2.4S-62, Flygt Ready 8 MT 1~ 2p, or approved equal, with 2-inch NPT discharge.

2. Number of pumps: two (Provide for Phase 1 Valve Vault Only. Do not provide for Phase 2 Valve Vault).

3. Pumps shall activate automatically, alternate operation, and be capable of automatic duplex operation based on activation of integral or external float controls provided by pump supplier.

4. Provide number of floats, as required by manufacturer for automatic/alternating duplex operation. Floats shall allow:

a. Single pump operation:

i. Pump 1 On at designated water level.

ii. Pump 1 Off at designated water level.

iii. Alternate next pump On to Pump 2.

iv. Repeat with Pump 2 On first.

b. Duplex pump operation:

i. Pump 1 On at designated water level.

ii. Pump 2 On at designated water level.

iii. Pump 1 and 2 Off at designated water level.

iv. Alternate next pump on to Pump 2.

v. Repeat with Pump 2 On first.

5. Provide duplex control panel with disconnect for Phase 1 Valve Vault only.

6. 115 V/1ϕ/60 Hz

I. Control Floats:

1. Mechanical activated SPDT micro switch with polypropylene plastic casing.

2. The interrupting capacity of the switch shall be 250VAC 10A resistive load, 250VAC 3A inductive load, or 30VDC 5A.

3. PVC insulated 3 conductor cable of sufficient length to prevent splicing.

4. The plastic components shall be screwed or welded together. Plastic casings joined by adhesives shall not be allowed.

5. The float switch shall operate in media temperatures of 0 to +60 degrees C, and in media densities of 0.65 to 1.5 g/cm3.

6. Fygt Model ENM-10 floats

7. Quantity as shown on the plans.

J. Radar Level Sensor:

1. VEGAPULS C21, or Owner approved equal.

2. Range 15 m

3. MODBUS RTU output

4. Contractor to verify length of cable required.

5. Quantity as shown on the plans.

2.08 CONTROLS

A. Supplied by pump manufacturer or pump supplier.

B. Triplex Pump Control

1. Enclosure shall be NEMA 3R painted galvanized steel

2. Panel shall include gasketed outer door, stainless steel hardware, removable back panel, and hinged inner door fabricated from 0.080 Marine alloy aluminum.

3. Push to test Indicator Lights, oil tight

4. 3 position oil tight H-O-A switch for each pump

5. 6 digit non-resettable hour meter for each pump

6. Alarm silence push button

7. Pump overload reset push buttons shall be located on aluminum inner door.

8. The control system shall consist of a local triplex pump control panel with integrated power and automation equipment, 120VAC control circuitry, and

24VAC float circuitry, with direct acting mechanical float switches.

9. A radar sensor for continuous level measurement shall sense and transmit the wet well level signals to the remote pump control and alarm/monitoring panel.

10. Direct acting non-mercury float switches, Flygt Model ENM-10, shall sense and transmit the wet well level signals to the remote pump control and alarm/monitoring panel. Number of float switches and cable connectors (4).

11. The controller shall automatically Start/Stop/Alternate three (3) pumps in automatic operation.

12. A high water alarm (horn) with silence button and NEMA 4X flashing Lexan beacon shall be incorporated.

13. Remote digital interfaces shall consist of serial communication utilizing Modbus RTU protocol to transmit pumping system levels, fault alarms, warnings, and status conditions, including:

    a. Pump #1/#2/#3 over load

    b. Pump #1/#2/#3 over temp

    c. Pump #1/#2/#3 seal fail

    d. Pump #1/#2/#3 Running

    e. Wet well high level alarm

    f. Power fail

14. One fluorescent light fixture with integral switch shall be mounted inside the enclosure between the outer door and inner operating panel to allow work on the panel at night.

C. Station Power Loss:

1. In all cases where two or more pumps are required to run, the control system shall delay the starting of second pump to reduce the current in-rush that would be experienced by the starting of two pumps simultaneously. Hand mode of operation shall have no starting delays.

D. Incoming Feeder Lightning Protection and Surge Arrestor:

1. A three phase lightning arrestor shall be supplied in the control panel, connected to each line of the incoming side of the power input terminals.

2. A three phase surge protection device shall be supplied and connected to each line and neutral of the incoming power.

3. The surge arrestor and lightning arrestor shall protect the control system against damage as the result of transient voltage surges caused by lightning, switching loads and power abnormalities.

E. Wiring

1. All wiring shall be minimum 600 volt UL type MTW or AWM and have a current carrying capacity of not less than 125% of the full load current.

2. The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.

3. For ease of servicing and maintenance, all wiring shall be color coded. The wire color code shall be clearly indicated on all submittal and as-built drawings, with color indicated.

4. All control wiring shall be contained within wiring duct with covers as manufactured by Panduit or equal.

5. Where dimensional constraints prevent the use of wiring duct, wires shall be trained to panel components in groupings. The wire groupings shall be bundled and tied not less than every three inches with nylon self locking cable ties as manufactured by Panduit or equal. Every other cable tie shall be fastened to the enclosure door or inner device panel with a cable tie mounting plate with pressure tape.

6. Where wiring crosses hinged areas such as when trained from the inner device panel to the enclosure door, spiral wrap shall be used.

F. Phase Monitor Relay

1. The three-phase monitor relay shall be connected to the incoming side of the power input terminals.

2. The unit shall protect against loss of phase, phase reversal, under voltage, and phase imbalance.

3. The power monitor shall be interlocked into the motor starter controls – all pumps will trip OFF if the relay is activated. This shall apply to both HAND and AUTO modes.

4. The phase monitor shall be manufactured by Diversified or Macromatic.

G. Alternator Relay

1. Provision shall be made for the three main pumps in the system to be automatically alternated by an alternator on successive starts. A four position selector switch placing the three pumps in a 1-2-3 only sequence, a 2-3-1 only sequence, a 3-2-1 only sequence, or automatic alternation operation shall also be incorporated and mounted on the interior panel cover.

2. The alternator shall be manufactured by Diversified or Macromatic.

3. Sequence of Operations:

a. Phase 1 and Phase 2 Lift Stations (Phase 2 controls not in this Contract).

i. Pump 1 On at designated water level.

ii. Primary radar level sensor controls Pump 1 speed based on maintaining designated water level in wet well.

iii. Pump 2 On at designated water level based on inflow exceeding Pump 1 full speed capability.

iv. Pump 1 and 2 Off at designated water level.

v. Pump 3 On at designated water level.

vi. Primary radar sensor controls Pump 3 speed based on maintaining designated water level in wet well.

vii. Pump 1 On at designated water level based on inflow exceeding Pump 3 full speed capability.

viii. Pump 3 and 1 Off at designated water level.

ix. Pump 2 On at designated water level.

x. Primary radar sensor controls Pump 2 speed based on maintaining designated water level in wet well.

xi. Pump 3 On at designated water level based on inflow exceeding Pump 2 full speed capability..

xii. Pump 2 and 3 Off at designated water level.

xiii. Repeat from G.3.a.i. with Pump 1 On first.

b. If primary radar level sensor fails, secondary radar level sensor engages to control pump operation. Alarm notification indicating primary radar level sensor failure is initiated.

c. If primary and secondary radar level sensors fail, level control floats engage to control pump operation. Alarm notification indicating primary and secondary radar level sensor failures is initiated.

d. Refer to plans for water levels used to control pumps.

H. Condensation Protective Heater

1. Panel shall include a thermostatically controlled heating unit capable of preventing the panel and all components within the panel from freeze damage and to maintain their functionality to a temperature of –10ºF.

2. 120 VAC.

I. Circuit Breakers

1. Pump and control power electrical circuits shall be protected by molded case circuit breakers.

2. Each pole of the breaker shall provide inverse time delay overload protection and instantaneous short circuit protection by means of a thermal magnetic element.

3. The breaker shall be operated by a toggle-type handle and shall have a quick make, quick break switching mechanism that is mechanically trip free from the handle.

4. Tripping due to overload or short circuit shall be clearly indicated by the handle automatically assuming a position midway between the manual “on” and “off” position.

5. Breakers shall be completely enclosed in a molded case and shall bear the UL label.

6. Short circuit interrupting duty (14 KAIC minimum) rating for all motor protection circuit breakers shall be applicable for operating conditions. Substitution of fuses to replace circuit breakers is not acceptable.

7. Circuit breakers shall be operable through the inner door to prevent exposing the

operator to live power.

J. Relays

1. Relay Type

a. Relays shall be of the square base plug in type with integral LED indicator lights.

b. All relays shall have a transparent polycarbonate dust cover to protect the contact surfaces from airborne dust and other contaminants.

c. All relays shall have DPDT or 4PDT contacts, as required. Relays shall be rated for continuous duty operation.

2. Relay Contacts

a. Relay contacts shall be of the plug-in type with LED indicators and rated for 10 amps at 300VAC.

b. Relay sockets shall have screw terminals with self-lifting clamps and terminal identification numbers located at each connection on the relay socket.

K. Pilot Light Indicators

1. The controller output indicator lights shall be of the push to test, long life, solid-state type with a built in ballast resistor and blocking diode for use with 120VAC.

2. Pilot lights shall be equipped with 3/16" quick connect terminals for ease of field replacement. Soldered terminals shall not be acceptable.

3. Other panel lights shall be neon rated for 125 VAC and shall be high brightness lamps with appropriate built-in resistors to assure long life and desired brightness.

4. The lamps shall be self-insulated and capable of operating for a minimum of 25,000 life hours.

5. Indicator lights for the following shall be supplied:

a. Pump #1/#2/#3 over load

b. Pump #1/#2/#3 over temp

c. Pump #1/#2/#3 seal fail

d. Pump #1/#2/#3 Running

e. Wet well high level alarm

L. Transformer

1. Transformers shall be multi-tap, 480 Volt AC primary - 120/240 Volt AC and 120/24 Volt AC, dry type control power transformers and shall be designed and tested in accordance with the latest applicable standards of ANSI, IEEE and NEMA, and shall be UL listed.

M. Convenience Receptacle

1. A GFI receptacle shall be provided.

2. The unit shall have retractable ground pin and polarized blades for two (2) or three

(3) wire receptacles.

3. The unit shall require a reset after any ground fault interruption.

N. Alarms

1. On decreasing wet well level, the high alarm condition will automatically reset when the level falls below the high level alarm set point.

2. Include weatherproof flashing red beacon light on top of enclosure to indicate high level alarm status.

3. Include 120 volt alarm horn

4. Include High level Alarm horn silence push button located on inner door.

O. Hand - Off - Automatic Switch

1. Heavy-duty, three-position, oil tight hand-off-auto selector switch shall be mounted on the inner door for the operation of each pump. This selector switch shall operate the starter when it is in either the "Hand" position or the "Automatic" position and the automatic control system is calling for the operation of the equipment in the manner, as herein described.

2. The manual (Hand) mode shall override all safety devices except the thermal overload and shall engage each branch circuit until turned off.

P. Equipment Identification

1. All electrical equipment shall be identified in accordance with these specifications.

2. All identification labels, both within the enclosure and external, shall be laser-screened, laminated mylar.

3. All control wiring shall be numbered on each termination.

4. Screw-in type, engraved nameplates or laser-screened laminated mylar shall be provided to identify all individually mounted push-buttons, rocker switches, lights, meters, disconnect switches, circuit breakers, motor starters, transformers, relays, fuses, phase monitors, surge arrestors and any other equipment for which identification is required for eventual service or replacement. This includes the appropriate equipment within the cabinet. Embossed tape is not acceptable.

5. A factory ID label shall be installed inside the outer door including the following information:

   a. Factory Order Number

   b. Factory Ship Date

   c. Supply Voltage, Phase and Frequency

   d. Control Voltage

   e. Electrical Wiring Diagram Number

   f. Motor HP and Full Load Current

6. A warning label stating “DANGER - Disconnect all sources of power before opening door” shall be installed on the inner door.

7. Control switches, indicators and all back panel-mounted components shall be clearly labeled in accordance with the schematic ladder diagram.

Q. Spare Electrical Parts

1. The Contractor shall supply the owner with the following spare electrical parts:

a. Three (3) Each spare fuses for each type of fuse installed in each panel

b. Three (3) Each replacement relays for each type of relay installed in each panel

c. Two (2) Each replacement light bulbs for each light bulb installed

PART 3 EXECUTION

3.01 FIELD TESTING

A. Bump Test: Operate each pump at grade, momentarily by hand to confirm they are properly wired and rotate in the proper direction.

B. Check level controls:

i. Verify that the trip levels of float switches are set at the proper elevation.

ii. By lifting the floats by hand, verify that signals from lead, lag, alarm, and pumps OFF float switches are properly starting, stopping, and alternating the lead and lag pumps.

iii. Confirm 4-20mA signal from level transducer, verify that signals for lead, lag, alarm, and pumps OFF are properly starting, stopping, and alternating the lead and lag pumps.

C. Verify Pump Rate:

i. Fill wet well with non-potable water to the "Alarm On" level. Caution, do not over fill the wet well to avoid submerging the inlet sewer pipe and service connections.

ii. Contractor to field install temporary pressure gauge in the tap in Pump No. 1 discharge pipe located in the valve vault. Run pump #1 by hand from "Alarm ON" level down to "Pumps OFF" level. Record the time interval the pump runs, and calculate the volume of water pumped by measuring draw down in the wet well. Record pump discharge pressure and amp draw when the pump is running. Calculate measured average pump rate and plot the pump operating point on the factory pump curve. Verify that pump is operating properly on the pump curve, and at the proper amp draw. If any problems and encountered, troubleshoot, resolve, and retest until the pump is operating correctly.

iii. Fill wet well level again to "Alarm ON" level, and repeat test procedure for Pumps #2 and #3.

D. Report:

i. Submit written report to Engineer documenting results of the field testing.

ii. Results shall verify the pumps and controls are operating properly, and the system is ready for use.

E. The equipment manufacturer shall provide a service technician, properly trained in inspection and operation of the equipment, to approve the installation, test equipment operation, and instruct Owner personnel on maintenance and operation.

F. Manufacturer shall provide these services in the form of one trip to the site and one (1) eight (8) hour days of service, excluding travel time to the project site.

G. Manufacturer shall be given minimum 14 days notification prior to the need for such services.

H. Manufacturer's on-site services shall be included in the price of their equipment and shall commence within eighteen (18) months of delivery of equipment to jobsite.

I. Manufacturer shall include full instructions for proper storage of their equipment on jobsite for a period of up to eighteen (18) months from date of delivery.

3.02 REQUIRED SUPPORT BY FIELD SERVICE REPRESENTATIVE

A. See Section 01650 – Field Service Representative, for required qualifications of Field Service Representative

B. Present to check installation and operation.

C. Provide eight (8) hours training to Owners personnel on operation and maintenance per requirements of Section 01700 – Manufacturer's Instruction of Owner's Personnel

D. Provide written report to the Engineer certifying that equipment is properly installed, fully functional, ready for use, is operating correctly, and that full manufacturer warranty is in effect.

3.03 SCHEDULE

A. Project Site Conditions:

1. Site Elevation: 3,985 feet

B. Sanitary Sewer Lift Pumps, **Phase 1**:

1. Acceptable Manufacturers:

a. Flygt Model NP3202 MT 3~641

b. Or Engineer approved equivalent.

2. Design operating point: 2,752 gpm at 44.89 feet TDH

3. Shutoff head: 94.25 feet

4. Motor: 45 HP, 1,175 rpm, 480 VAC/ 3/ 60

5. Motor: FM-approved N3202.095 30-23-6AA-W, 45 hp, 1,175 rpm, 3 phase, 480 V, 60 Hz, inverter duty rated

6. Provide drilled volute bottom for each pump

7. Discharge size: 8"

8. Quantity = 3

9. Accessories:

a. Provide all accessories as listed in Section 2.07 (except portable hoist and socket)

C. Sanitary Sewer Lift Pumps**, Phase 2**:

1. Acceptable Manufacturers:

   a. Flygt Model NP3301 LT 3~624 **(Not Included In This Contract)**

   b. Or Engineer approved equivalent.

2. Design operating point: 5,414 gpm at 47.07 feet TDH

3. Shutoff head: 94 feet

4. Motor: 85 HP, 1,185 rpm, 460 VAC/ 3/ 60

5. Motor: FM-approved N3301.095 35-29-6AA-W, 85 hp, 1,185 rpm, 3 phase, 460 V, 60 Hz, inverter duty rated

6. Provide drilled volute bottom for each pump

7. Discharge size: 12" **(Included In This Contract)**

8. Quantity = 3 **(Included In This Contract)**

9. Accessories:

Provide all accessories as listed in Section 2.07 (except portable hoist and socket)

D. Spare Parts: Provide the following list of spare parts for each size pump:

1. One set of spare parts for each lift station including: Upper and lower bearings, complete set of upper and lower mechanical seals, and required o-rings.

2. Package spare parts in a separate container(s) clearly marked as "El Paso Water Utility NE Dyer St. LS-Spare Parts". Provide inventory list on exterior of each container.

END OF SECTION

DIVISION 23

MECHANICAL

SECTION 23000

DIVISION 26

ELECTRICAL

SECTION 26000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:
1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. VFD: Variable speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. COPS: Critical operations power system.
18. CU or Cu: Copper.
19. CU-AL or AL-CU: Copper-aluminum.
20. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
21. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
22. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
23. dBm: Decibel absolute power with respect to 1 mW.
24. DC or dc: Direct current.
25. DDC: Direct digital control (HVAC).
26. EGC: Equipment grounding conductor.
27. EMF: Electromotive force.
28. EMI: Electromagnetic interference.
29. EPM: Electrical preventive maintenance.
30. EPS: Emergency power supply.
31. EPSS: Emergency power supply system.
32. EVPE: Electric vehicle power export equipment.
33. EVSE: Electric vehicle supply equipment.

34. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
35. FLC: Full-load current.
36. ft: Foot.
37. GEC: Grounding electrode conductor.
38. GFCI: Ground-fault circuit interrupter.
39. GFPE: Ground-fault protection of equipment.
40. GND: Ground.
41. HACR: Heating, air conditioning, and refrigeration.
42. HDPE: High-density polyethylene.
43. HP or hp: Horsepower.
44. HVAC: Heating, ventilating, and air conditioning.
45. Hz: Hertz.
46. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
47. IP: Ingress protection rating (enclosures); Internet protocol (communications).
48. IR: Infrared.
49. IS: Intrinsically safe.
50. IT: Information technology.
51. kAIC: Kiloampere interrupting capacity.
52. kcmil: One thousand circular mils.
53. kV: Kilovolt.
54. kVA: Kilovolt-ampere.
55. kVAr or kVAR: Kilovolt-ampere reactive.
56. kW: Kilowatt.
57. kWh: Kilowatt-hour.
58. LAN: Local area network.
59. lb: Pound (weight).
60. LCD: Liquid-crystal display.
61. LED: Light-emitting diode.
62. Li-ion: Lithium-ion.
63. lm: Lumen, the SI derived unit of luminous flux.
64. LP-Gas: Liquefied petroleum gas.
65. LRC: Locked-rotor current.
66. LV: Low voltage.
67. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
68. m: Meter.
69. MCC: Motor-control center.
70. MG set: Motor-generator set.
71. MIDI: Musical instrument digital interface.
72. MLO: Main lugs only.
73. MV: Medium voltage.
74. MVA: Megavolt-ampere.
75. mW: Milliwatt.
76. MW: Megawatt.
77. MWh: Megawatt-hour.
78. NC: Normally closed.
79. Ni-Cd: Nickel-cadmium.
80. NIU: Network interface unit.
81. NO: Normally open.

82. NPT: National (American) standard pipe taper.
83. OCPD: Overcurrent protective device.
84. PC: Personal computer.
85. PCU: Power-conditioning unit.
86. PF or pf: Power factor.
87. PoE: Power over Ethernet.
88. PV: Photovoltaic.
89. PVC: Polyvinyl chloride.
90. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
91. RMS or rms: Root-mean-square.
92. RPM or rpm: Revolutions per minute.
93. SCADA: Supervisory control and data acquisition.
94. SCR: Silicon-controlled rectifier.
95. SPD: Surge protective device.
96. sq.: Square.
97. SWD: Switching duty.
98. TCP/IP: Transmission control protocol/Internet protocol.
99. TEFC: Totally enclosed fan-cooled.
100. TR: Tamper resistant.
101. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
102. UL CCN: UL Category Control Number.
103. UPS: Uninterruptible power supply.
104. USB: Universal serial bus.
105. UV: Ultraviolet.
106. V: Volt, unit of electromotive force.
107. VA: Volt-ampere, unit of complex electrical power.
108. VAR: Volt-ampere reactive, unit of reactive electrical power.
109. VFC: Variable-frequency controller.
110. VOM: Volt-ohm-multimeter.
111. VPN: Virtual private network.
112. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
113. W: Watt, unit of real electrical power.
114. Wh: Watt-hour, unit of electrical energy usage.
115. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:
1. EMT: Electrical metallic tubing.
2. EMT-S: Steel electrical metallic tubing.
3. ENT: Electrical nonmetallic tubing.
4. EPEC: Electrical HDPE underground conduit.
5. RMC: Electrical rigid metal conduit.
6. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
7. FMC: Flexible metal conduit.
8. FMC-S: Steel flexible metal conduit.
9. IMC: Intermediate metal conduit.
10. LFMC: Liquidtight flexible metal conduit.
11. LFMC-S: Steel liquidtight flexible metal conduit.
12. PVC: Rigid PVC conduit.
13. PVC-40: Schedule 40 rigid PVC conduit.
14. PVC-80: Schedule 80 rigid PVC Conduit.

15. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:
1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVR: Coaxial riser cable.
4. CL2: Class 2 cable.
5. CL2P: Class 2 plenum cable.
6. CL2R: Class 2 riser cable.
7. CL2X: Class 2 cable, limited use.
8. CL3: Class 3 cable.
9. CL3P: Class 3 plenum cable.
10. CL3R: Class 3 riser cable.
11. CL3X: Class 3 cable, limited use.
12. CM: Communications general-purpose cable.
13. CMR: Communications riser cable.
14. FPL: Power-limited fire-alarm cable.
15. MC: Metal-clad cable.
16. MC-HL: Metal-clad cable, hazardous location.
17. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
18. MV: Medium-voltage cable.
19. NM: Nonmetallic sheathed cable.
20. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
21. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
22. NPLF: Non-power-limited fire-alarm circuit cable.
23. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
24. NPLFR: Non-power-limited fire-alarm circuit riser cable.
25. NUCC: Nonmetallic underground conduit with conductors.
26. PLTC: Power-limited tray cable.
27. PLTC-ER: Power-limited tray cable, exposed run.
28. RHH: (high heat) Thermoset rubber, heat-resistant cable.
29. RHW: Thermoset rubber, moisture-resistant cable.
30. SE: Service-entrance cable.
31. TC: Tray cable.
32. THW: Thermoplastic, heat- and moisture-resistant cable.
33. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
34. THHW: Thermoplastic, heat- and moisture-resistant cable.
35. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
36. TW: Thermoplastic, moisture-resistant cable.
37. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:
1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
   a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.

2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
    a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
    b. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
    c. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
    d. Device Box: A box with provisions for mounting a wiring device directly to the box.
    e. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
    f. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
    g. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
    h. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.

i. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.

j. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Jacket: A continuous nonmetallic outer covering for conductors or cables.
12. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
13. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
14. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
15. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
16. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
17. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    d. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
18. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.
3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
   a. Exercising generators.
   b. Emergency lighting.

B. Arrange to provide temporary electrical power in accordance with requirements specified in Division 01.

1.4 PREINSTALLATION MEETINGS

A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than 10 days after notice to proceed. Agenda topics include, but are not limited to, the following:
   1. Electrical installation schedule.
   2. Status of power system studies.
   3. Value analysis proposals and requests for substitution of electrical equipment.
   4. Utility work coordination and class of service requests.
   5. Commissioning activities.
   6. Sustainability activities, including Measurement and Verification Plan.

1.5 SEQUENCING

A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.6 ACTION SUBMITTALS

A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.

B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which equipment and suspension systems will be attached.
   3. Size and location of access panels on ceilings.
   4. Elevation, size, and route of cable tray.
   5. Elevation, size, and route of conduit.
   6. Elevation and size of wall-mounted and ceiling-mounted equipment.
   7. Access panels.
   8. Sprinklers.
   9. Air inlets and outlets.
   10. Luminaires.
   11. Communications devices.

12. Security devices.
13. Fire-alarm devices.
14. Indicate clear dimensions for maintenance access in front of equipment.
15. Indicate dimensions of fully-open access doors.

C. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Elevation, size, and route of cable trays.
2. Relationships between components and adjacent structural, electrical, and mechanical elements.
3. Vertical and horizontal offsets and transitions.
4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
5. Elevation of ceilings and size of ceiling tiles.
6. Locations of access panels on ceilings.
7. Locations where cable tray crosses or parallels sprinkler piping.
8. Locations where cable tray crosses plumbing piping.
9. Locations where cable tray crosses or parallels ductwork.
10. Locations of access panels on ductwork.
11. Locations where cable tray crosses conduit.
12. Items blocking access around cable trays, including the following:
    a. Light fixtures.
    b. Speakers.
    c. Fire-alarm devices.
    d. Equipment racks.
    e. Door swings.
    f. Building features.
13. Indicate clear dimension between cable tray and walls or obstructions that are closer than 10 ft.
14. Highlight locations where cable tray is greater than 3 ft above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.

D. Coordination Drawings for Conduit Routing: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

E. Coordination Drawings for Large Equipment Indoor Installations:
1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
    a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.

b. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.

3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
   a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways, busways, and seismic bracing.
   b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
   c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.

F. Coordination Drawings for Large Equipment Outdoor Installations:
   1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
      a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
      b. Indicate clear dimensions for fence gates and wall openings.
      c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
      d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
      e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways, busways, and seismic bracing.
      f. Dimensioned working clearances and dedicated areas around electrical equipment.

G. Coordination Drawings for Duct Banks:
   1. Show duct profiles and coordination with other utilities and underground structures.
   2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.7 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:
   1. Submission of specified coordination drawings.
   2. Submission of action submittals specified in Division 26.
   3. Orders placed for major electrical equipment.
   4. Arrival of major electrical equipment on-site.
   5. Preinstallation meetings specified in Division 26.
   6. Utility service inspection and activation.
   7. System startup, testing, and commissioning activities for major electrical equipment.
   8. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
   9. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
   10. Requests for special inspections.

11. Requests for inspections by authorities having jurisdiction.

B. Certificates:
1. Welding certificates.
2. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of ASCE/SEI 7-10, ASCE/SEI 7-16 for all designated seismic-load systems identified on Drawings or in the Specifications.
   a. Include the following information:
      1) Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      2) Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
      3) Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
      4) Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
      5) Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction, or experience data as permitted by ASCE/SEI 7-16.
      6) Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in ASCE/SEI 7-16.
      7) Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.
   b. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
      1) Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
      2) Raceways, enclosures, cabinets, boxes, and their mounting provisions specified in Section 260533 "Raceway and Boxes for Electrical Systems."
      3) Seismic restraints specified in Section 260548.16 "Seismic Controls for Electrical Systems."
      4) Cable trays, accessories, and components specified in Section 260536 "Cable Trays for Electrical Systems."
      5) Equipment, accessories, and components specified in Section 261116.11 "Secondary Unit Substations with Switchgear Secondary."
      6) Equipment, accessories, and components specified in Section 261216 "Dry-Type, Medium-Voltage Transformers."
      7) Equipment, accessories, and components specified in Section 262213 "Low-Voltage Distribution Transformers."
      8) Equipment, accessories, and components specified in Section 262413 "Switchboards."
      9) Equipment, accessories, and components specified in Section 262416 "Panelboards."

10) Equipment, accessories, and components specified in Section 262416.16 "Electronically Operated Circuit-Breaker Panelboards."
11) Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
12) Equipment, accessories, and components specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
13) Equipment, accessories, and components specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
14) Equipment, accessories, and components specified in Section 263353 "Static Uninterruptible Power Supply."
15) Equipment, accessories, and components specified in Section 263600 "Transfer Switches."
16) Luminaires, accessories, and components specified in Section 265119 "LED Interior Lighting."
17) Luminaires, accessories, and components specified in Section 265213 "Emergency and Exit Lighting."
18) Poles and support components specified in Section 265613 "Lighting Poles and Standards."
19) Luminaires, accessories, and components specified in Section 265619 "LED Exterior Lighting."

3. Wind-Load Performance Certificates: Provide special certification for systems and components designated on Drawings or in the Specifications to be subject to high wind exposure and impact damage.
   a. Include the following information:
      1) Provide equipment manufacturer's written certification for each designated system and component, stating that it will remain in place and operable following the design wind event and comply with requirements of authorities having jurisdiction.
      2) Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.
   b. The following systems and components require written special certification of resistance to effects of high wind-load and impact damage by manufacturer:
      1) Pole mounted light fixtures.

C. Qualification Statements:
   1. For qualified regional manufacturer.
   2. For structural professional engineer.
   3. For electrical professional engineer.

1.8 CLOSEOUT SUBMITTALS

A. Updated Facility EPM Program Binders:
   1. Complete Set: On approved online or cloud solution and USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement.
   2. Volumes 2 and 8: Reproducible hardcopy on archival quality, 28 lb, acid-free, bond paper.

B. Operation and Maintenance Data:
   1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:

a. Generator Automatic Transfer Switch.

2. Include the following information:
   a. Manufacturer's operating specifications.
   b. User's guides for software and hardware.
   c. Schedule of maintenance material items recommended to be stored at Project site.
   d. Detailed instructions covering operation under both normal and abnormal conditions.
   e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
   f. List of load-current and overload-relay heaters with related motor nameplate data.
   g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
   h. Manufacturer's instructions for setting field-adjustable components.
   i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.

C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation in Facility EPM Program Binders, including the following:
   1. Software operating and upgrade manuals.
   2. Names, versions, and website addresses for locations of installed software.
   3. Device address list.
   4. Printout of software application and graphic screens.
   5. Testing and adjusting of panic and emergency power features.
   6. For lighting controls, include the following:
      a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
      b. Operation of adjustable zone controls.

1.9 QUALIFICATIONS

A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than eight hours.

B. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.

C. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 014000 "Quality Requirements" and NFPA 70B:
   1. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
   2. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.

D. Welder: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," with training and certification in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M.

E. ERMC-S-PVC Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by ERMC-S-PVC manufacturer prior to starting installation.

F. Medium-Voltage Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with training and manufacturer certification to install, splice, and terminate medium-voltage cable in accordance with electrical utility service provider's requirements.

G. Medium-Voltage Duct Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with installation of medium-voltage duct banks.

H. Medium-Voltage Equipment Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with hazards and safety requirements associated with installation and operation of medium-voltage equipment.

I. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.

J. Lightning Protection System Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials or unexpired LPI Master Installer credentials prior to starting installation.

K. Medium-Voltage and Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
   1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.

L. Power-Limited Electrical Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
   1. On-site power-limited testing supervisor must have BICSI Registered Communications Distribution Designer certification and documented training and experience with testing power-limited equipment in accordance with NETA testing standards.

M. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Testing Laboratory Services" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

N. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Testing Laboratory Services" with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.

O. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Testing Laboratory Services" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.

P. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Testing Laboratory Services" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

PART 2 - PRODUCTS

2.1 SUBSTITUTION LIMITATIONS FOR ELECTRICAL EQUIPMENT

A. Substitution requests for electrical equipment will be entertained under the following conditions:
   1. Substitution requests may be submitted for consideration prior to the Electrical Preconstruction Conference if accompanied by value analysis data indicating that substitution will comply with Project performance requirements while significantly increasing value for Owner throughout life of facility.
   2. Substitution requests may be submitted for consideration concurrently with submission of power system study reports when those reports indicate that substitution is necessary for safety of maintenance personnel and facility occupants.
   3. Contractor is responsible for sequencing and scheduling power system studies and electrical equipment procurement. After the Electrical Preconstruction Conference, insufficient lead time for electrical equipment delivery will not be considered a valid reason for substitution.

2.2 FACILITY ELECTRICAL PREVENTIVE MAINTENANCE (EPM) PROGRAM BINDERS

A. Description: Set of binders containing operation and maintenance data for facility's electrical equipment that was compiled during analysis of installed electrical Work for Facility EPM Program development.

B. Applicable Standards:
   1. Regulatory Requirements: Comply with recommendations in NFPA 70B.
   2. General Characteristics:
      a. Volume 1 - Introduction:
         1) Summarize how Facility EPM Program Analysis was performed, how data were collected, and how volumes are organized.
         2) Describe Facility EPM Program and provide recommended policies and procedures for implementing the program and keeping it current.
         3) Provide place for Owner to identify contact information for employees responsible for implementing and maintaining Facility EPM Program.
      b. Volume 2 - Facility Safety, Hazards Awareness, and Emergency Procedures:
         1) Include training requirements for employees and contractors.
         2) Include list of known facility hazards impacting IT&R activities.
         3) Include approval and permitting procedures for IT&R activities.
         4) Include incident emergency response procedures.
         5) Include emergency shutdown procedures.
         6) Include electrical disaster recovery procedures.
      c. Volume 3 - Operating Procedures for Electrical Equipment and Controls:
         1) Standby Generator
         2) Automatic Transfer Switch
         3) Variable Frequency Drive.
      d. Volume 4 - Facility Diagrams and Schedules:

1) Include single-line diagrams.
2) Include grounding and bonding diagrams.
3) Include system automation diagrams (SCADA, BMS, lighting, HVAC, etc.).
4) Include records of switchgear, switchboard, and panelboard schedules.
5) Include time-current curves for overcurrent protective devices.
6) Include list of load-current and overload-relay heaters with related motor nameplate data.

e. Volume 5 - Inventory of Facility Equipment Using Electrical Power:
1) Include simplified floor plans showing equipment locations.
2) Identify critical equipment (electrical or otherwise).
3) Include identifying designations and nameplate data.
4) Include warranty and maintenance contract information.

f. Volume 6 - Inventory of Facility Tools, Supplies, and Personnel Protective Equipment:
1) Include schedules of maintenance material items recommended to be stored at facility.
2) Include list of lamp types and photoelectric relays used in facility with ANSI and manufacturers' codes.
3) Include calibration and servicing data for each item.

g. Volume 7 - Inspection, Testing, and Repair (IT&R) Plan:
1) Include tables showing frequency of activities for each item.
2) Include annual schedule with activities mapped to specific days of the year.
3) Include exterior pole inspection and repair procedures.

h. Volume 10 - Spare Parts List:
1) Include list of all parts required to perform IT&R procedures.
2) Identify quantities of which parts are recommended to be stored on-site.
3) Include source contact information and budget cost for each item.

i. Volume 11 - Construction Project Closeout Record Documentation:
1) Include records of power system studies and photometric studies.
2) Include records of electrical system startup and commissioning activities.
3) Include records of baseline inspections and tests.
4) Include records of baseline infrared photographs with normal light photographs showing the location, direction, angle, and conditions necessary for reproducing each infrared photograph.
5) Include records of baseline settings for adjustable equipment and devices.

PART 3 - EXECUTION

3.1 DEVELOPMENT OF FACILITY EPM PROGRAM

A. Facility EPM Program must be developed by qualified EPM specialist.

B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.

C. Compile operation and maintenance data from Facility EPM Program analysis and submit updated Facility EPM Program Binders.

3.2 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

B. Material and installation requirements as specified in the El Paso "Design Standards Manual for Water, Wastewater and Reclaimed Water Systems."

3.3 SYSTEM STARTUP

A. Commissioning Activities:
   1. Emergency Generator Operation
   2. Pump Station Operation

3.4 FIELD QUALITY CONTROL

A. Administrant for Medium-Voltage and Low-Voltage Electrical Tests and Inspections:
   1. Owner will engage qualified medium-voltage and low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
   2. Engage qualified medium-voltage and low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
   3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

B. Administrant for Power-Limited Electrical Tests and Inspections:
   1. Owner will engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.
   2. Engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.
   3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

C. Administrant for Structural Tests and Inspections:
   1. Owner will engage qualified structural testing and inspecting agency to administer and perform tests and inspections.
   2. Engage qualified structural testing and inspecting agency to administer and perform tests and inspections.
   3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

D. Administrant for Field Tests and Inspections of Lighting Installations:
   1. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   2. Administer and perform tests and inspections with assistance of factory-authorized service representative.

3.5 CLEANING

A. Waste Management:
   1. Daily removal of trash into waste container or offsite.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration:
   1. With assistance from factory-authorized service representatives, demonstrate to Owner's maintenance and clerical personnel how to operate the following systems and equipment:
      a. Lighting control devices specified in Section 260923 "Lighting Control Devices."

B. Training:
   1. With assistance from factory-authorized service representatives, train Owner's maintenance personnel on the following topics:
      a. How to implement updated Facility EPM Program.
      b. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 260573.16 "Coordination Studies."
      c. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
      d. How to adjust, operate, and maintain systems specified in Section 260913 "Electrical Power Monitoring."
      e. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
      f. How to adjust, operate, and maintain equipment specified in Section 261216 "Dry-Type, Medium-Voltage Transformers."
      g. How to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories specified in Section 262413 "Switchboards."
      h. How to adjust, operate, and maintain equipment specified in Section 262923 "Variable-Frequency Motor Controllers."
      i. How to adjust, operate, and maintain equipment specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
      j. How to adjust, operate, and maintain equipment specified in Section 263343 "Battery Chargers."
      k. How to adjust, operate, and maintain equipment specified in Section 263353 "Static Uninterruptible Power Supply."
      l. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 263600 "Transfer Switches."

m. How to adjust, operate, and maintain devices specified in Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."

n. How to adjust, operate, and maintain luminaires[**and photoelectric controls**] specified in Section 265619 "LED Exterior Lighting."

2. Allow Owner to record training sessions.

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Copper building wire.
2. Nonmetallic underground conduit with conductors, Type NUCC.
3. Metal-clad cable, Type MC.
4. Tray cable, Type TC.
5. Fire-alarm wire and cable.
6. Connectors and splices.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.
3. Section 271313 "Communications Copper Backbone Cabling" for twisted pair cabling used for data circuits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.

6. General Cable; Prysmian Group North America.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.

C. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:
1. Type RHH and Type RHW-2: Comply with UL 44.
2. Type USE-2 and Type SE: Comply with UL 854.
3. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type UF: Comply with UL 83 and UL 493.
6. Type XHHW-2: Comply with UL 44.

2.2 NONMETALLIC UNDERGROUND CONDUIT WITH CONDUCTORS, TYPE NUCC

A. Description: A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section.

B. Applicable Standards:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
a. Reference Standards: UL 1990.

2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems; Atkore International.
2. Alpha Wire Company.
3. American Bare Conductor.
4. Belden Inc.
5. Encore Wire Corporation.
6. General Cable; Prysmian Group North America.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Comply with UL 1569.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Circuits:
   1. Single circuit and multicircuit with color-coded conductors.
   2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.

E. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

F. Ground Conductor: Insulated.

G. Conductor Insulation:
   1. Type TFN/THHN/THWN-2: Comply with UL 83.
   2. Type XHHW-2: Comply with UL 44.

H. Armor: Steel, interlocked.

I. Jacket: PVC applied over armor.

2.4 FIRE-ALARM WIRE AND CABLE

A. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
   1. Allied Wire & Cable Inc.
   2. CommScope, Inc.
   3. Comtran Corporation.
   4. Genesis Cable Products; Honeywell International, Inc.
   5. nVent (PYROTENAX).
   6. Prysmian Cables and Systems; Prysmian Group North America.
   7. Radix Wire.
   8. Rockbestos-Suprenant Cable Corp.
   9. Superior Essex Inc.
   10. West Penn Wire.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG or size as recommended by system manufacturer.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
   1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
   2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M Electrical Products.
2. ABB, Electrification Products Division.
3. AFC Cable Systems; Atkore International.
4. Gardner Bender.
5. Hubbell Incorporated, Power Systems.
6. Ideal Industries, Inc.
7. ILSCO.
8. NSi Industries LLC.
9. O-Z/Gedney; Emerson Electric Co., Automation Solutions, Appleton Group.
10. Service Wire Co.
11. TE Connectivity Ltd.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
1. Material: Copper.
2. Type: Two hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:
1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:
1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway.

D. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors larger than No. 1/0 AWG.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway Metal-clad cable, Type MC.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors in raceway.

H. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway, Type XHHW-2, single conductors larger than No. 1/0 AWG, Metal-clad cable, Type MC.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.

J. ASD Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
   1. Install plenum cable in environmental airspaces, including plenum ceilings.
   2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.
      a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
   3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70, Types MI and CI, is not permitted.
   4. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1 inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inch of slack.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
   2. Perform each of the following visual and electrical tests:
      a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
      b. Test bolted connections for high resistance using one of the following:
         1) A low-resistance ohmmeter.
         2) Calibrated torque wrench.
         3) Thermographic survey.
      c. Inspect compression-applied connectors for correct cable match and indentation.
      d. Inspect for correct identification.
      e. Inspect cable jacket and condition.
      f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
      g. Continuity test on each conductor and cable.
      h. Uniform resistance of parallel conductors.
   3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
      a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
      b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
   4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:
   1. Procedures used.
   2. Results that comply with requirements.
   3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Backboards.
2. Category 6 balanced twisted pair cable.
3. Balanced twisted pair cable hardware.
4. RS-485 cable.
5. Control cable.
6. Control-circuit conductors.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Where specific cable types are called out from control and monitoring equipment manufacturers, provide cabling complying with those requirements in addition to requirements in this section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Source quality-control reports.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
1. Flame Travel Distance: 60 inch or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inch. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."

B. Painting: Paint plywood on all sides and edges with flat gray paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M.
2. AMP NETCONNECT; a TE Connectivity Ltd. company.
3. Belden CDT Networking Division/NORDX.
4. Berk-Tek Leviton; a Nexans/Leviton alliance.
5. CommScope, Inc.
6. General Cable; Prysmian Group North America.
7. Genesis Cable Products; Honeywell International, Inc.
8. Hitachi Cable America Inc.
9. Mohawk; a division of Belden Networking, Inc.
10. Prysmian Cables and Systems; Prysmian Group North America.
11. Superior Essex Inc.
12. SYSTIMAX Solutions; a CommScope Inc. brand.

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum.

F. Jacket: White or Blue thermoplastic.

2.4 BALANCED TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. American Technology Systems Industries, Inc.
3. AMP NETCONNECT; a TE Connectivity Ltd. company.
4. Belden CDT Networking Division/NORDX.
5. Berk-Tek Leviton; a Nexans/Leviton alliance.
6. CommScope, Inc.
7. Dynacom Corporation.
8. General Cable; Prysmian Group North America.
9. Genesis Cable Products; Honeywell International, Inc.
10. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
11. KRONE Incorporated.
12. Leviton Manufacturing Co., Inc.
13. Mohawk; a division of Belden Networking, Inc.
14. Molex Premise Networks.
15. Panduit Corp.
16. Prysmian Cables and Systems; Prysmian Group North America.
17. Siemon Co. (The).
18. Superior Essex Inc.
19. SYSTIMAX Solutions; a CommScope Inc. brand.

C. General Requirements for Balanced Twisted Pair Cable Hardware:
1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables must be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.

E. Patch Cords: Factory-made, four-pair cables in 36 inch lengths; terminated with an eight-position modular plug at each end.
1. Patch cords must have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords must have latch guards to protect against snagging.
2. Patch cords must have color-coded boots for circuit identification.

F. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:
1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standards:
   a. Category 6, unshielded balanced twisted pair cable must comply with IEC 60603-7-4.

b. Category 6, shielded balanced twisted pair cable must comply with IEC 60603-7.5.
4. Marked to indicate transmission performance.

H. Faceplate:
1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
2. Eight port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
5. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
a. Flush mounting jacks, positioning the cord at a 45-degree angle.

I. Legend:
1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 RS-232 CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Wire & Cable Inc.
2. Belden Inc.
3. General Cable; Prysmian Group North America.
4. Genesis Cable Products; Honeywell International, Inc.
5. Southwire Company.

B. PVC-Jacketed, TIA 232-F:
1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. PVC jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. NFPA 70 Type: Type CM.
7. Flame Resistance: Comply with UL 1581.

C. Plenum-Type, TIA 232-F:
1. Nine, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.
4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.6 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.7 CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.
1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.8 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Encore Wire Corporation.
2. General Cable; Prysmian Group North America.
3. Service Wire Co.
4. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway or Type THW, complying with UL 83 in raceway, Type TC, complying with UL 1277 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway, power-limited cable, concealed in building finishes.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway power-limited cable, concealed in building finishes, Type TW or Type TF, complying with UL 83, in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits that Supply Critical Circuits: Circuit Integrity (CI) cable.
   1. Smoke control signaling and control circuits.

2.9 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Allied Wire & Cable Inc.
   2. CommScope, Inc.
   3. Comtran Corporation.
   4. Genesis Cable Products; Honeywell International, Inc.
   5. nVent (PYROTENAX).
   6. Prysmian Cables and Systems; Prysmian Group North America.
   7. Radix Wire.
   8. Rockbestos-Suprenant Cable Corp.
   9. Superior Essex Inc.
   10. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
   1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
   1. Control-Voltage Circuits: No. 16 AWG, minimum, in pathway.
   2. Low-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.
   1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
   1. Outlet boxes must be no smaller than 2 inch wide, 3 inch high, and 2-1/2 inch deep.
   2. Outlet boxes for cables must be no smaller than 4 inch square by 2-1/8 inch deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
   3. Flexible metal conduit must not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:
   1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
   2. Install cable trays to route cables if conduits cannot be located in these positions.
   3. Secure conduits to backboard if entering the room from overhead.
   4. Extend conduits 6 inch above finished floor.
   5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Comply with TIA-568-C Series of standards.
   2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
   3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
   4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
   5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
   6. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
   8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
   9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.

10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:
1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inch above ceilings by cable supports not more than 30 inch apart.
3. Cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch.

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:
   1. Class 1 remote-control and signal circuits; No 14 AWG.
   2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
   3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

A. Comply with TIA-569-D, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

3.9 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
   2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
   3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
      a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Grounding and bonding conductors.
2. Grounding and bonding clamps.
3. Grounding and bonding bushings.
4. Grounding and bonding hubs.
5. Grounding and bonding connectors.
6. Intersystem bonding bridge grounding connector.
7. Grounding and bonding busbars.
8. Grounding (earthing) electrodes.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of product indicated.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control" Article, including the following:
1. Test wells.
2. Rod electrodes.
3. Ring electrodes.
4. Grounding arrangements and connections for separately derived systems.

C. Field Quality-Control Submittals:
1. Field quality-control reports.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:
1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:
   a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
      1) Test wells.
      2) Rod electrodes.
      3) Ring electrodes.
      4) Grounding arrangements and connections for separately derived systems.

b. Instructions for periodic testing and inspection of grounding features at test wells based on NETA MTS .
   1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective action if values do not.
   2) Include recommended testing intervals.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment Grounding Conductor:
   1. General Characteristics: 600 V, THHN/THWN-2 or THWN-2, copper or tinned-copper wire or cable, green color, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Isolated Equipment Grounding Conductor:
   1. General Characteristics: 600 V, THHN/THWN-2 or THWN-2, copper or tinned-copper wire or cable, green color with one or more yellow stripes, in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. ASTM - Bare Copper Grounding and Bonding Conductor:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. ERICO; brand of nVent Electrical plc.
      b. Harger Lightning & Grounding; business of Harger, Inc.
   2. Referenced Standards: Complying with one or more of the following:
      a. Soft or Annealed Copper Wire: ASTM B3
      b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
      c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
      d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

D. UL KDER - Armored Grounding Wire:
   1. Description: Single corrosion-resistant copper, aluminum, or copper-clad aluminum conductor within helically formed steel armor.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. LS Cable & System USA; subsidiary of LS Corp.
      b. Southwire Company, LLC.
      c. Superior Essex Inc.; subsidiary of LS Corp.
      d. Viakon; brand of Conductores Monterrey S.A. de C.V.; a subsidiary of Xignux.
   3. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   4. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
      b. NFPA 70 – National Electrical Code C.IEEE 80

2.2 GROUNDING AND BONDING CLAMPS

A. Description: Clamps suitable for attachment of grounding and bonding conductors to grounding electrodes, pipes, tubing, and rebar. Grounding and bonding clamps specified in this article are also suitable for use with communications applications; see Section 270526 "Grounding and Bonding for Communications Systems," for selection and installation guidelines.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
      b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

D. UL KDER and KDSH - Hex-Fitting-Type Pipe and Rod Grounding and Bonding Clamp:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. America Fujikura Ltd. (AFL); Fujikura Ltd.
      c. Arlington Industries, Inc.
      d. Cooper B-line; brand of Eaton, Electrical Sector.
      e. Crouse-Hinds; brand of Eaton, Electrical Sector.
      f. ERICO; brand of nVent Electrical plc.
      g. Galvan Industries, Inc.; Electrical Products Division, LLC.
      h. Greaves Corp.; Essex Products Group, Inc.
      i. Harger Lightning & Grounding; business of Harger, Inc.
      j. ILSCO.
      k. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
      l. Panduit Corp.
      m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   2. General Characteristics:
      a. Two pieces with zinc-plated bolts.
      b. Clamp Material: Silicon bronze.
      c. Listed for outdoor use.

E. UL KDER and KDSH - U-Bolt-Type Pipe and Rod Grounding and Bonding Clamp:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. America Fujikura Ltd. (AFL); Fujikura Ltd.
      c. Arlington Industries, Inc.
      d. Cooper B-line; brand of Eaton, Electrical Sector.
      e. Crouse-Hinds; brand of Eaton, Electrical Sector.
      f. ERICO; brand of nVent Electrical plc.

g. Galvan Industries, Inc.; Electrical Products Division, LLC.
h. Greaves Corp.; Essex Products Group, Inc.
i. Harger Lightning & Grounding; business of Harger, Inc.
j. ILSCO.
k. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
l. Panduit Corp.
m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

2. General Characteristics:
   a. Clamp Material: Brass.
   b. Listed for outdoor use.

F. UL KDER and KDSH - Strap-Type Pipe and Rod Grounding and Bonding Clamp:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. ERICO; brand of nVent Electrical plc.
   d. Harger Lightning & Grounding; business of Harger, Inc.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Panduit Corp.
2. General Characteristics:
   a. Clamp Material: Copper.
   b. Listed for outdoor use.

G. UL KDER - Beam Grounding and Bonding Clamp:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Anderson; brand of Hubbell Utility Solutions; Hubbell Incorporated.
   c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. Panduit Corp.
   e. Penn-Union Corp.; subsidiary of Nesco, Inc.
2. General Characteristics: Mechanical-type, terminal, ground wire access from four directions; with dual, tin-plated or silicon bronze bolts.

H. UL KDER - Exothermically Welded Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. ALLTEC LLC.
   c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
   e. Crouse-Hinds; brand of Eaton, Electrical Sector.
   f. ERICO; brand of nVent Electrical plc.
   g. Harger Lightning & Grounding; business of Harger, Inc.

2. General Characteristics: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING AND BONDING BUSHINGS

A. Description: Bonding bushings connect conduit fittings, tubing fittings, threaded metal conduit, and unthreaded metal conduit to metal boxes and equipment enclosures, and have one or more bonding screws intended to provide electrical continuity between bushing and enclosure. Grounding bushings have provision for connection of bonding or grounding conductor and may or may not also have bonding screws.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Bonding Bushing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Harger Lightning & Grounding; business of Harger, Inc.
2. General Characteristics: Threaded bushing with insulated throat.

E. UL KDER - Grounding Bushing:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Threaded bushing with insulated throat and mechanical-type wire terminal.

2.4 GROUNDING AND BONDING HUBS

A. Description: Hubs with certified grounding or bonding locknut.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Grounding and Bonding Hub:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. Greaves Corp.; Essex Products Group, Inc.
   f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   g. Penn-Union Corp.; subsidiary of Nesco, Inc.
2. General Characteristics: Insulated, gasketed, watertight hub with mechanical-type wire terminal.

2.5 GROUNDING AND BONDING CONNECTORS

A. Source Limitations: Obtain products from single manufacturer.

B. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
   b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDER - Pressure-Type Grounding and Bonding Busbar Cable Connector:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. General Characteristics: Copper or copper alloy, for compression bonding of one or more conductor directly to copper busbar. Listed for direct burial.

D. UL KDER - Lay-In Lug Mechanical-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   c. Chatsworth Products, Inc.
   d. Greaves Corp.; Essex Products Group, Inc.
   e. ILSCO.
2. General Characteristics: Mechanical-type, copper rated for direct burial terminal with set screw.

E. UL KDER - Crimped Lug Pressure-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   c. Harger Lightning & Grounding; business of Harger, Inc.
   d. ILSCO.
2. General Characteristics: Cast silicon bronze, solderless compression-type wire terminals; with long barrel and two holes spaced on 5/8 or 1 inch centers for two-bolt connection to busbar.

F. UL KDER - Split-Bolt Service-Post Pressure-Type Grounding and Bonding Busbar Terminal:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Panduit Corp.
   b. Harger Lightning & Grounding; business of Harger, Inc.
2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened after assembly is screwed into busbar opening.

G. UL KDER - Crimped Pressure-Type Grounding and Bonding Cable Connector:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. allG Fabrication (formerly ALT).
   c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. ILSCO.
2. General Characteristics: Crimp-and-compress connectors that bond to conductor when connector is compressed around conductor.
   a. Copper, C and H shaped.

H. UL KDER - Split-Bolt Pressure-Type Grounding and Bonding Cable Connector:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. allG Fabrication (formerly ALT).

c. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
d. ERICO; brand of nVent Electrical plc.
e. Greaves Corp.; Essex Products Group, Inc.

2. General Characteristics: Bolts that surround cable and bond to cable under compression when nut is tightened.
   a. Copper.

I. UL KDER - Signal Reference Grid Grounding and Bonding Connector:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
   d. Cooper B-line; brand of Eaton, Electrical Sector.
   e. ERICO; brand of nVent Electrical plc.
   f. Harger Lightning & Grounding; business of Harger, Inc.
2. General Characteristics: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

2.6 INTERSYSTEM BONDING BRIDGE GROUNDING CONNECTORS

A. Description: Devices that provide means for connecting communications systems grounding and bonding conductors at service equipment or at disconnecting means for buildings or structures.

B. Performance Criteria:
1. Regulatory Requirements:
   a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
   a. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

C. UL KDSH - One-Piece Intersystem Bonding Bridge Grounding Connector:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Galvan Industries, Inc.; Electrical Products Division, LLC.
   b. Madison Electric Products; business of Southwire Company, LLC.
   c. Harger Lightning & Grounding; business of Harger, Inc.
2. General Characteristics: Zinc-alloy one-piece construction; six terminating points; gangable.

D. UL KDSH - Two-Piece Intersystem Bonding Bridge Grounding Connector:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

b. Crouse-Hinds; brand of Eaton, Electrical Sector.
c. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
d. Harger Lightning & Grounding; business of Harger, Inc.

2. General Characteristics: Copper body and polycarbonate cover; four terminating points.

2.7 GROUNDING AND BONDING BUSBARS

A. Description: Miscellaneous grounding and bonding device that serves as common connection for multiple grounding and bonding conductors.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
1. Regulatory Requirements:
a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
2. Listing Criteria:
a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Equipment Room Grounding and Bonding Busbar:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. allG Fabrication (formerly ALT).
b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
c. Chatsworth Products, Inc.
d. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
e. Cooper B-line; brand of Eaton, Electrical Sector.
f. ERICO; brand of nVent Electrical plc.
g. Harger Lightning & Grounding; business of Harger, Inc.
h. Hoffman; brand of nVent Electrical plc.
i. ILSCO.
j. Panduit Corp.
2. General Characteristics:
a. Bus: Rectangular bar of annealed copper.
b. Mounting Stand-Off Insulators: Lexan or PVC.
1) Comply with UL 891 for use in 600 V switchboards, impulse tested at 5000 V.
3. Options:
a. Dimensions: 1/4 by 4 inch in cross section; length as indicated on Drawings.
b. Predrilled Hole Pattern: 9/32 inch holes spaced 1-1/8 inch apart.
c. Mounting Hardware: Stand-off brackets that provide 2 inch clearance to access rear of bus. Brackets and bolts must be stainless steel.

E. UL KDER - Rack and Cabinet Bonding Busbar:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Chatsworth Products, Inc.
b. Cooper B-line; brand of Eaton, Electrical Sector.

c. Harger Lightning & Grounding; business of Harger, Inc.
d. Hoffman; brand of nVent Electrical plc.
e. Panduit Corp.

2. General Characteristics:
   a. Bus: Rectangular bar of hard-drawn solid copper.
   b. Horizontal Mounting Dimensions: Designed for mounting in 19 inch wide equipment racks or cabinets.
   c. Vertical Mounting Dimensions: Designed for mounting in 36 inch high equipment racks or cabinets.
   d. Predrilled Hole Pattern: Accepts connectors for grounding and bonding conductor sizes 14 AWG to 2/0 AWG.
   e. Mounting Hardware: Stainless steel or copper-plated, for attachment to rack.

2.8 GROUNDING (EARTHING) ELECTRODES

A. Description: Grounding electrodes include rod electrodes, ring electrodes, metal underground water pipes, metal building frames, concrete-encased electrodes, and pipe and plate electrodes.

B. Source Limitations: Obtain products from single manufacturer.

C. Performance Criteria:
   1. Regulatory Requirements:
      a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Listing Criteria:
      a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.

D. UL KDER - Rod Electrode:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. allG Fabrication (formerly ALT).
      c. Continental Industries; brand of Hubbell Utility Solutions; Hubbell Incorporated.
      d. ERICO; brand of nVent Electrical plc.
      e. Galvan Industries, Inc.; Electrical Products Division, LLC.
      f. Harger Lightning & Grounding; business of Harger, Inc.
   2. General Characteristics: Copper-clad steel; 3/4 inch by 10 ft.

E. UL KDER - Plate Electrode:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ALLTEC LLC.
      b. Galvan Industries, Inc.; Electrical Products Division, LLC.
   2. General Characteristics: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine facility's grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of electrical system.

B. Inspect test results of grounding system measured at point of electrical service equipment connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inch minimum from wall, 6 inch above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.3 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 8 AWG and smaller, and stranded conductors for 6 AWG and larger unless otherwise indicated.

B. Custom-Length Insulated Equipment Bonding Jumpers: 6 AWG, 19-strand, Type THHN.

C. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

D. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

E. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

F. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

G. Underground Grounding Conductors: Install bare copper conductor, 2/0 AWG minimum.
   1. Bury at least 30 inch below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.

3.4 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.
   4. Connections to Structural Steel: Welded connectors.

3.5 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
   1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
   2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:
   1. Conductors:
      a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
   2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
      a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
      b. Make connections with clean, bare metal at points of contact.
      c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
      d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
      e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
      f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
         1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
         2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
         3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
      g. Grounding and Bonding for Piping:
         1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to

main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.

h. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 ft apart.

3. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2) Use exothermic welds for below-grade connections.

b. For grounding electrode system, install at least three rods spaced at least 10’-0” from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.

c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least 12 inch deep, with cover.

1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

d. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around perimeter of building.

1) Install tinned-copper conductor not less than 2/0 AWG for ring electrode and for taps to building steel.

2) Bury ring electrode not less than 24 inch from building's foundation.

e. Concrete-Encased Electrode (Ufer Ground):

1) Fabricate in accordance with NFPA 70; use minimum of 20 ft of bare copper conductor not smaller than 4 AWG.

a) If concrete foundation is less than 20 ft long, coil excess conductor within base of foundation.

b) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 ft long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

5. Grounding Separately Derived Systems:

a. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.

6. Grounding Underground Distribution System Components:
   a. Duct-Bank Grounding Conductor: Bury 12 inch above duct bank when indicated as part of duct-bank installation.
   b. Comply with IEEE C2 grounding requirements.
   c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inch will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inch above to 6 inch below concrete. Seal floor opening with waterproof, nonshrink grout.
   d. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
   e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than 6 inch from foundation.
7. Equipment Grounding:
   a. Install insulated equipment grounding conductors with feeders and branch circuits.
   b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
      1) Feeders and branch circuits.
      2) Lighting circuits.
      3) Receptacle circuits.
      4) Single-phase motor and appliance branch circuits.
      5) Three-phase motor and appliance branch circuits.
      6) Flexible raceway runs.
   c. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
   d. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.

e. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
f. Metallic Fences: Comply with requirements of IEEE C2.
   1) Grounding Conductor: Bare, tinned copper, not less than 8 AWG.
   2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
   3) Barbed Wire: Strands must be bonded to grounding conductor.

8. Fence Grounding: Install at maximum intervals of 100 ft except as follows:
   a. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at maximum distance of 150 ft on each side of crossing.
   b. Grounding Method: At each grounding location, drive grounding rod vertically until top is 6 inch below finished grade. Connect rod to fence with 6 AWG conductor. Connect conductor to each fence component at grounding location.
   c. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
   d. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground fence and bond fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.6 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

B. Field tests and inspections must be witnessed by Architect.

C. Tests and Inspections:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before conductors are connected.
   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
   b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
   c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

D. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

E. Collect, assemble, and submit test and inspection reports.
   1. Report measured ground resistances that exceed the following values:
      a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω.
      b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 Ω.
      c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 Ω.
      d. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 Ω .
      e. Substations and Pad-Mounted Equipment: 5 Ω.
      f. Manhole Grounds: 10 Ω.

3.7 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Support, anchorage, and attachment components.
   2. Fabricated metal equipment support assemblies.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
   1. Hangers. Include product data for components.
   2. Slotted support systems.
   3. Equipment supports.
   4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated Design Submittal: For hangers and supports for electrical systems.
   1. Include design calculations and details of hangers.
   2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame Rating: Class 1.
   2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Products Division.
      b. Allied Tube & Conduit; Atkore International.
      c. B-line; Eaton, Electrical Sector.
      d. CADDY; nVent.
      e. Flex-Strut Inc.
      f. Gripple Inc.
      g. G-Strut.
      h. Haydon Corporation.
      i. Metal Ties Innovation.
      j. MIRO Industries.
      k. Unistrut; Atkore International.
      l. Wesanco, Inc.
   2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
   3. Material for Channel, Fittings, and Accessories: Galvanized steel.
   4. Channel Width: Selected for applicable load criteria, 1-5/8 inch, minimum
   5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
   8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: [**Steel**] [**Steel and malleable-iron**] [**Stainless steel**] [**Glass-fiber-resin**] hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as

required to suit individual conductors or cables supported. Body must be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hilti, Inc.
         2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) B-line; Eaton, Electrical Sector.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti, Inc.
         4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
   6. Toggle Bolts: All Stainless steel springhead type.
   7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 SELECTION

A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1. NECA NEIS 101
   2. NECA NEIS 102.

3. NECA NEIS 105.
4. NECA NEIS 111.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceway and Boxes for Electrical Systems."

D. Provide [**vibration**] [**and**] [**seismic**] controls with hangers and supports in accordance with requirements specified in "Section 260548.16 "Seismic Controls for Electrical Systems."

E. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERMC as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.

F. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted [**or other**]support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with two-bolt conduit clamps.

G. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, IMC and RMC may be supported by openings through structure members, in accordance with NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To New Concrete: Bolt to concrete inserts.
2. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
3. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
4. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
5. To Light Steel: Sheet metal screws.

6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:
1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup:
1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type EMT and raceways and elbows.
2. Type EMT-S raceways and elbows.
3. Type RMC raceways, elbows, couplings, and nipples.
4. Type IMC raceways.
5. Type LFMC raceways.
6. Type PVC raceways and fittings.
7. Fittings for conduit, tubing, and cable.
8. Threaded metal joint compound.
9. Solvent cements.
10. Surface metal raceways and fittings.
11. Surface nonmetallic raceways.
12. Strut-type channel raceways and fittings.
13. Wireways and auxiliary gutters.
14. Metallic outlet boxes, device boxes, rings, and covers.
15. Nonmetallic outlet boxes, device boxes, rings, and covers.
16. Termination boxes.
17. Cabinets, cutout boxes, junction boxes, pull boxes, and miscellaneous enclosures.
18. Cover plates for device boxes.
19. Hoods for outlet boxes.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).
3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
4. Section 270543 "Underground Pathways and Structures for Communication Systems" for exterior communications duct banks, manholes, and underground utility construction.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Surface nonmetallic raceways.
4. Floor boxes.
5. Cabinets, cutout boxes, and miscellaneous enclosures.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 TYPE EMT RACEWAYS AND ELBOWS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797A and UL Category Control Number FJMX.

2.2 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT) and Elbows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; Atkore International.
   b. Calconduit; Atkore International.
   c. Emerson Electric Co.
   d. Picoma; Zekelman Industries.
   e. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
   f. Topaz Lighting & Electric.
   g. Western Tube; Zekelman Industries.
   h. Wheatland Tube; Zekelman Industries.
2. Material: Steel.
3. Options:
   a. Exterior Coating: Zinc.
   b. Interior Coating: Zinc.
   c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

C. Stainless Steel Electrical Rigid Metal Conduit (ERMC-SS), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Calconduit; Atkore International.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. Patriot Aluminum Products, LLC.
2. Material: Stainless steel.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

b. Colors: As indicated on Drawings.

2.3 TYPE RMC RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 6 and UL Category Control Number DYIX.

B. Galvanized-Steel Electrical Rigid Metal Conduit (ERMC-S-G), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; Atkore International.
   b. Calconduit; Atkore International.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. Patriot Aluminum Products, LLC.
   f. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
   g. Topaz Lighting & Electric.
   h. Western Tube; Zekelman Industries.
   i. Wheatland Tube; Zekelman Industries.
2. Exterior Coating: Zinc.
3. Options:
   a. Interior Coating: Zinc.
   b. Minimum Trade Size: Metric designator 21 (trade size 3/4).

C. PVC-Coated-Steel Electrical Rigid Metal Conduit (RMC-S-PVC), Elbows, Couplings, and Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Bluesteel Services LLC.
   c. Calbond; Atkore International.
   d. KorKap; Robroy Industries.
   e. Perma-Cote; Robroy Industries.
   f. Plasti-Bond; Robroy Industries.
2. Additional Characteristics:
   a. Fittings for PVC-Coated Conduit:
      1) Minimum coating thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
      2) Conduit bodies must be Form 8 with an effective seal and a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 in. of mercury (vacuum) for 72 hours must be available. Conduit bodies must be supplied with plastic-encapsulated stainless steel cover screws.

3) Form 2 inch long or one pipe diameter long, whichever is less, PVC sleeve at openings of female fittings, except unions. Inside sleeve diameter must be matched to outside diameter of metal conduit.
4) PVC coating on the outside of conduit couplings must be protected from tool damage during installation.
5) Female threads on fittings and couplings must be protected by urethane coating.
6) Fittings must be from same manufacturer as conduit.
7) Beam clamps and U bolts must be formed and sized to fit outside diameter of coated conduit. Plastic-encapsulated nuts must cover the exposed portions of threads.

3. Options:
   a. Exterior Coating: PVC complying with NEMA RN 1.
   b. Interior Coating: Zinc.
   c. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   d. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
   e. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.4 TYPE FMC-S RACEWAYS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 1 and UL Category Control Number DXUZ.

B. Steel Flexible Metal Conduit (FMC-S):

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. Anaconda Sealtite; Anamet Electrical, Inc.
      c. Electri-Flex Company.
      d. International Metal Hose Co.
      e. Penn Aluminum Conduit & EMT.
      f. Topaz Lighting & Electric.
   2. Material: Steel.
   3. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.5 TYPE IMC RACEWAYS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 1242 and UL Category Control Number DYBY.

B. Steel Electrical Intermediate Metal Conduit (IMC):

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Business.
b. Allied Tube & Conduit; Atkore International.
c. Calconduit; Atkore International.
d. Republic Conduit; Nucor Corporation, Nucor Tubular Products.
e. Topaz Lighting & Electric.
f. Western Tube; Zekelman Industries.
g. Wheatland Tube; Zekelman Industries.

2. Options:
   a. Exterior Coating: Zinc.
   b. Interior Coating: Zinc.
   c. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.6 TYPE LFMC RACEWAYS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. Anaconda Sealtite; Anamet Electrical, Inc.
      c. Electri-Flex Company.
      d. International Metal Hose Co.
   2. Material: Steel.
   3. Options:
      a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.7 TYPE PVC RACEWAYS AND FITTINGS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 651 and UL Category Control Number DZYR.

B. Schedule 40 Rigid PVC Conduit (PVC-40) and Fittings:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. Calconduit; Atkore International.
      c. JM Eagle; J-M Manufacturing Co., Inc.
      d. NAPCO; Westlake Chemical Corp.
      e. Opti-Com Manufacturing Network, Inc (OMNI).
      f. Topaz Lighting & Electric.
   2. Dimensional Specifications: Schedule 40.
   3. Options:

a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
b. Markings: For use with maximum 90 deg C wire.

C. Schedule 80 Rigid PVC Conduit (PVC-80) and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Calconduit; Atkore International.
   c. JM Eagle; J-M Manufacturing Co., Inc.
   d. Opti-Com Manufacturing Network, Inc (OMNI).
   e. Topaz Lighting & Electric.
2. Dimensional Specifications: Schedule 80.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).
   b. Markings: For use with maximum 90 deg C wire.

D. Type A Rigid PVC Concrete-Encased Conduit (PVC-A) and Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Southern Pipe, Inc.
2. Dimensional Specifications: Type A.
3. Options:
   a. Minimum Trade Size: Metric designator 21 (trade size 3/4).

2.8 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type RMC, Type IMC, Type PVC, Type EPEC, and Type RTRC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Konkore Fittings; Atkore International.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Penn Aluminum Conduit & EMT.
   g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Southwire Company, LLC.
   i. Topaz Lighting & Electric.
2. General Characteristics: UL 514B and UL Category Control Number DWTT.
3. Options:
   a. Material: Steel.

b. Coupling Method: Compression coupling or Raintight compression coupling with distinctive color gland nut, Setscrew coupling. Setscrew couplings with only single screw per conduit are unacceptable.
c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

C. Fittings for Type EMT Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Calconduit; Atkore International.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   g. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Southwire Company, LLC.
   i. Topaz Lighting & Electric.
2. General Characteristics: UL 514B and UL Category Control Number FKAV.
3. Options:
   a. Material: Steel.
   b. Coupling Method: Compression coupling.
   c. Conduit Fittings for Hazardous (Classified) Locations: UL 1203.
   d. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

D. Fittings for Type FMC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Fittings Corp. (AMFICO).
   b. Liquid Tight Connector Co.
   c. Southwire Company, LLC.
2. General Characteristics: UL 514B and UL Category Control Number ILNR.

E. Fittings for Type LFMC and Type LFNC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Liquid Tight Connector Co.
2. General Characteristics: UL 514B and UL Category Control Number DXAS.

2.9 SOLVENT CEMENTS

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: As recommended by conduit manufacturer in accordance with UL 514B and UL Category Control Number DWTT.
3. Sustainability Characteristics:

2.10 SURFACE METAL RACEWAYS AND FITTINGS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 5 and UL Category Control Number RJBT.

B. Surface Metal Raceways and Fittings with Metal Covers:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      b. MonoSystems, Inc.
      c. Wiremold; Legrand North America, LLC.
   2. Options:
      a. Galvanized steel base with snap-on covers.
      b. Manufacturer's standard enamel finish in color selected by Architect.
      c. Wiring Channels: Single. Multiple channels must be capable of housing a standard 20 to 30 A NEMA device flush within the raceway.

2.11 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. Cooper B-line; brand of Eaton, Electrical Sector.
      c. Hoffman; brand of nVent Electrical plc.
      d. MonoSystems, Inc.
      e. Square D; Schneider Electric USA.
      f. Wiegmann; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   2. Additional Characteristics:
      a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
      b. Finish: Manufacturer's standard enamel finish.
   3. Options:
      a. Degree of Protection: Type 1 or Type 3R unless otherwise indicated.
      b. Wireway Covers: Hinged type unless otherwise indicated.

2.12 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 514A and UL Category Control Number QCIT.

B. Metallic Outlet Boxes:
1. Description: Box having pryout openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover, but without provisions for mounting wiring device directly to box.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arlington Industries, Inc.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. MonoSystems, Inc.
   i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   j. Pass & Seymour; Legrand North America, LLC.
   k. Patriot Aluminum Products, LLC.
   l. Plasti-Bond; Robroy Industries.
   m. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   n. Spring City Electrical Manufacturing Company.
   o. Topaz Lighting & Electric.
   p. Wiremold; Legrand North America, LLC.
3. Options:
   a. Material: Sheet steel.
   b. Sheet Metal Depth: Minimum 2 inch.
   c. Luminaire Outlet Boxes and Covers: Nonadjustable, listed and labeled for attachment of luminaire weighing up to 50 lb.

C. Metallic Conduit Bodies:
1. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Pass & Seymour; Legrand North America, LLC.

g. Patriot Aluminum Products, LLC.
h. Plasti-Bond; Robroy Industries.
i. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
j. Topaz Lighting & Electric.

D. Metallic Device Boxes:
1. Description: Box with provisions for mounting wiring device directly to box.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ABB, Electrification Business.
b. Arlington Industries, Inc.
c. Crouse-Hinds; brand of Eaton, Electrical Sector.
d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
g. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
h. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
i. Patriot Aluminum Products, LLC.
j. Plasti-Bond; Robroy Industries.
k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
l. Topaz Lighting & Electric.
3. Options:
a. Material: Sheet steel for interior and Cast metal for exterior applications.
b. Sheet Metal Depth: minimum 2.5 inch.
c. Cast-Metal Depth: minimum 2.4 inch.

E. Metallic Extension Rings:
1. Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ABB, Electrification Business.
b. Cooper B-line; brand of Eaton, Electrical Sector.
c. Crouse-Hinds; brand of Eaton, Electrical Sector.
d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
e. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
f. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
g. Pass & Seymour; Legrand North America, LLC.
h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
i. Topaz Lighting & Electric.

F. Metallic Concrete Boxes and Covers:
1. Description: Box intended for use in poured concrete.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   d. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   e. Topaz Lighting & Electric.
   f. Wiremold; Legrand North America, LLC.

2.13 TERMINATION BOXES

A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.

B. Performance Criteria:
   1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
   2. General Characteristics: UL 1773 and UL Category Control Number XCKT.

C. Termination Boxes and Termination Bases for Installation on Line Side of Service Equipment:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. Cooper B-line; brand of Eaton, Electrical Sector.
      c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
      d. Erickson Electrical Equipment Company.
      e. Hoffman; brand of nVent Electrical plc.
      f. Metron; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      g. Milbank Manufacturing Co.
      h. N J Sullivan Company.
      i. Square D; Schneider Electric USA.
   2. Additional Characteristics: Listed and labeled for installation on line side of service equipment.

D. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ABB, Electrification Business.
      b. Cooper B-line; brand of Eaton, Electrical Sector.
      c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
      d. Erickson Electrical Equipment Company.
      e. Hoffman; brand of nVent Electrical plc.
      f. Metron; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
      g. Milbank Manufacturing Co.
      h. N J Sullivan Company.
      i. Square D; Schneider Electric USA.

2. Additional Characteristics: Listed and labeled for installation on load side of service equipment.

2.14 CABINETS, CUTOUT BOXES, JUNCTION BOXES, PULL BOXES, AND MISCELLANEOUS ENCLOSURES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
   a. Non-Environmental Characteristics: UL 50.
   b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Cabinets:
1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Adalet.
   c. Cooper B-line; brand of Eaton, Electrical Sector.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. Erickson Electrical Equipment Company.
   f. FSR Inc.
   g. Hoffman; brand of nVent Electrical plc.
   h. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   i. Milbank Manufacturing Co.
   j. N J Sullivan Company.
   k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   l. Robroy Enclosures; Robroy Industries.
   m. Siemens Industry, Inc., Building Technologies Division.
   n. Square D; Schneider Electric USA.
3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
   a. Degree of Protection: Type 1.

C. Indoor Sheet Metal Cutout Boxes:
1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Adalet.
   c. Cooper B-line; brand of Eaton, Electrical Sector.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. Erickson Electrical Equipment Company.
   f. FSR Inc.
   g. Hoffman; brand of nVent Electrical plc.

h. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
i. Milbank Manufacturing Co.
j. N J Sullivan Company.
k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
l. Robroy Enclosures; Robroy Industries.
m. Siemens Industry, Inc., Building Technologies Division.
n. Square D; Schneider Electric USA.

3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
   a. Degree of Protection: Type 1.

D. Indoor Sheet Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Adalet.
   b. Cooper B-line; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. FSR Inc.
   e. Hoffman; brand of nVent Electrical plc.
   f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Milbank Manufacturing Co.
   i. N J Sullivan Company.
   j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   l. Spring City Electrical Manufacturing Company.
   m. Square D; Schneider Electric USA.
3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:
   a. Degree of Protection: Type 1.

E. Indoor Sheet Metal Miscellaneous Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Cooper B-line; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Erickson Electrical Equipment Company.
   e. Hoffman; brand of nVent Electrical plc.
   f. Metron; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Milbank Manufacturing Co.
   h. N J Sullivan Company.
   i. Square D; Schneider Electric USA.
2. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.

3. Options:
   a. Degree of Protection: Type 1.

F. Outdoor Sheet Metal Cabinets:
1. Description: Enclosure provided with frame, mat, or trim in which swinging door or doors are or can be hung.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Adalet.
   c. Cooper B-line; brand of Eaton, Electrical Sector.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. Erickson Electrical Equipment Company.
   f. FSR Inc.
   g. Hoffman; brand of nVent Electrical plc.
   h. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   i. Milbank Manufacturing Co.
   j. N J Sullivan Company.
   k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   l. Robroy Enclosures; Robroy Industries.
   m. Siemens Industry, Inc., Building Technologies Division.
   n. Square D; Schneider Electric USA.
3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
   a. Degree of Protection: Type 4X.

G. Outdoor Sheet Metal Cutout Boxes:
1. Description: Enclosure that has swinging doors or covers secured directly to and telescoping with walls of enclosure.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Adalet.
   c. Cooper B-line; brand of Eaton, Electrical Sector.
   d. Crouse-Hinds; brand of Eaton, Electrical Sector.
   e. Erickson Electrical Equipment Company.
   f. FSR Inc.
   g. Hoffman; brand of nVent Electrical plc.
   h. Killark; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   i. Milbank Manufacturing Co.
   j. N J Sullivan Company.
   k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   l. Robroy Enclosures; Robroy Industries.
   m. Siemens Industry, Inc., Building Technologies Division.
   n. Square D; Schneider Electric USA.
3. Additional Characteristics: UL Category Control Number CYIV.
4. Options:
   a. Degree of Protection: Type 4X.

H. Outdoor Sheet Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Adalet.
   b. Cooper B-line; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. FSR Inc.
   e. Hoffman; brand of nVent Electrical plc.
   f. Hubbell Industrial Controls; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   h. Milbank Manufacturing Co.
   i. N J Sullivan Company.
   j. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   k. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   l. Spring City Electrical Manufacturing Company.
   m. Square D; Schneider Electric USA.
3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:
   a. Degree of Protection: Type 4X.

I. Outdoor Cast-Metal Junction and Pull Boxes:
1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Adalet.
   b. Crouse-Hinds; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:
   a. Degree of Protection: Type 3R or Type 4X.

J. Outdoor Sheet Metal Miscellaneous Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Cooper B-line; brand of Eaton, Electrical Sector.
   c. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   d. Erickson Electrical Equipment Company.
   e. Hoffman; brand of nVent Electrical plc.
   f. Metron; brand of Hubbell Electrical Solutions; Hubbell Incorporated.

g. Milbank Manufacturing Co.
h. N J Sullivan Company.
i. Square D; Schneider Electric USA.

2. Additional Characteristics: UL 1773 and UL Category Control Number XCKT.
3. Options:
   a. Degree of Protection: Type 4X.

2.15 COVER PLATES FOR DEVICES BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
   a. Reference Standards: UL 514D and UL Category Control Numbers QCIT and QCMZ.
   b. Wallplate-Securing Screws: Metal with head color to match wallplate finish.

B. Metallic Cover Plates for Device Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   c. Crouse-Hinds; brand of Eaton, Electrical Sector.
   d. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   e. Hubbell Premise Wiring; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   f. Hubbell Wiring Device-Kellems; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   g. Intermatic, Inc.
   h. Leviton Manufacturing Co., Inc.
   i. O-Z/Gedney; brand of Emerson Electric Co., Automation Solutions, Appleton Group.
   j. Panduit Corp.
   k. Pass & Seymour; Legrand North America, LLC.
   l. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
   m. Topaz Lighting & Electric.
   n. Wiremold; Legrand North America, LLC.
2. Options:
   a. Damp and Wet Locations: Listed, labeled, and marked for location and use. Provide gaskets and accessories necessary for compliance with listing.
   b. Wallplate Material: 0.032 inch thick Type 302/304 non-magnetic stainless steel with brushed finish.

2.16 HOODS FOR OUTLET BOXES

A. Performance Criteria:
1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

a. Reference Standards:
   1) UL 514D and UL Category Control Numbers QCIT and QCMZ.
   2) Receptacle, hood, cover plate, gaskets, and seals comply with UL 498 Supplement SA when mated with box or enclosure complying with UL 514A, UL 514C, or UL 50E.
b. Mounts to box using fasteners different from wiring device.

B. Extra-Duty, While-in-Use Hoods for Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ABB, Electrification Business.
   b. Allied Tube & Conduit; Atkore International.
   c. Arlington Industries, Inc.
   d. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   e. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
   f. Intermatic, Inc.
   g. Leviton Manufacturing Co., Inc.
   h. Raco Taymac Bell; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
2. Additional Characteristics: Marked "Extra-Duty" in accordance with UL 514D.
3. Options:
   a. Provides clear, weatherproof, "while-in-use" cover.
   b. Manufacturer may combine nonmetallic device box with hood as extra-duty rated assembly.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:
1. Exposed and Subject to Severe Physical Damage: RMC or IMC.
2. Exposed and Subject to Physical Damage: RMC.
   a. Locations less than 2.5 m (8 ft) above finished floor.
3. Exposed and Not Subject to Physical Damage: RMC or IMC.
4. Concealed Aboveground: EMT.
5. Direct Buried: PVC-80.
6. Concrete Encased Not in Trench: PVC-40.
7. Concrete Encased in Trench: PVC-40.
8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

C. Indoors:
1. Hazardous Classified Locations: RMC or IMC.
2. Exposed and Subject to Severe Physical Damage: RMC or IMC. Subject to severe physical damage includes the following locations:
   a. Loading docks.

b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
c. Mechanical rooms.
d. Gymnasiums.

3. Exposed and Subject to Physical Damage: RMC or IMC. Subject to physical damage includes the following locations:
   a. Locations less than 2.5 m (8 ft) above finished floor.
   b. Stub-ups to above suspended ceilings.
4. Exposed and Not Subject to Physical Damage: EMT.
5. Concealed in Ceilings and Interior Walls and Partitions: EMT.
6. Damp or Wet Locations: RMC or IMC.
7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or FMC.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
   1. RMC and IMC: Provide threaded type fittings unless otherwise indicated.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:
   1. Outdoors:
      a. Type 3R unless otherwise indicated.
      b. Locations Exposed to Hosedown: Type 4.
      c. Locations Subject to Potential Flooding: Type 6P.
      d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
      e. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.
      f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
   2. Indoors:
      a. Type 1 unless otherwise indicated.
      b. Damp or Dusty Locations: Type 2.
      c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
      d. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: Type 4.
      e. Locations Exposed to Hosedown: Type 4.
      f. Locations Exposed to Brief Submersion: Type 6.
      g. Locations Exposed to Prolonged Submersion: Type 6P.
      h. Locations Exposed to Corrosive Agents: Type 4X.
      i. Locations Exposed to Spraying Oil or Coolants: Type 13.

C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
   1. Boxes with knockouts or unprotected openings are prohibited.
   2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:
   1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
   2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
   3. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
   4. Comply with NECA NEIS 101 for installation of steel raceways.
   5. Comply with NECA NEIS 102 for installation of aluminum raceways.
   6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
   7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
   8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
   9. Raceway Terminations at Locations Subject to Moisture or Vibration:
      a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG. Install insulated throat metal grounding bushings on service conduits.

B. General Requirements for Installation of Raceways:
   1. Complete raceway installation before starting conductor installation.
   2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
   3. Install no more than equivalent of three 90-degree bends in conduit run except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted. Support within 12 inch of changes in direction.
   4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
   5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
   6. Support conduit within 12 inch of enclosures to which attached.
   7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
   8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:
      a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
      b. Where an underground service raceway enters a building or structure.
      c. Conduit extending from interior to exterior of building.

d. Where otherwise required by NFPA 70.

9. Do not install raceways or electrical items on "explosion-relief" walls or rotating equipment.
10. Do not install conduits within 2 inch of the bottom side of a metal deck roof.
11. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
12. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
13. Install pull wires in empty raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb tensile strength. Leave at least 12 inch of slack at both ends of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

C. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. RMC-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
2. EMT: Provide compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.

D. Expansion-Joint Fittings:

1. Install in runs of aboveground PVC that are located where environmental temperature change may exceed 30 deg F and that have straight-run length that exceeds 25 ft. Install in runs of aboveground ERMC conduit that are located where environmental temperature change may exceed 100 deg F and that have straight-run length that exceeds 100 ft.
2. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at locations where conduits cross building or structure expansion joints.
5. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

3.4 INSTALLATION OF SURFACE RACEWAYS

A. Install surface raceways only where indicated on Drawings.

B. Install surface raceway with a minimum 2 inch radius control at bend points.

C. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inch and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's written instructions. Tape and glue are unacceptable support methods.

3.5 INSTALLATION OF BOXES AND ENCLOSURES

A. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.

B. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

C. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.

D. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

E. Locate boxes so that cover or plate will not span different building finishes.

F. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.

G. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.

H. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.8 CLEANING

A. Boxes: Remove construction dust and debris from device boxes, outlet boxes, and floor-mounted enclosures before installing wallplates, covers, and hoods.

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Round sleeves.
2. Rectangular sleeves.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Pourable sealants.
7. Foam sealants.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Steel Wall Sleeves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, LLC.
   b. CCI Piping Systems.
   c. Flexicraft Industries.
   d. GPT; an EnPro Industries company.
2. General Characteristics: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

B. Cast-Iron Wall Sleeves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Ductile Iron Pipe.
   b. Flexicraft Industries.
   c. McWane Ductile.

2. General Characteristics: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Round, Galvanized-Steel, Sheet Metal Sleeves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Benefast.
   b. Specified Technologies, Inc.
2. General Characteristics: Galvanized-steel sheet; thickness not less than 0.0239 inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Rectangular, Galvanized-Steel, Sheet Metal Sleeves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Abesco Fire LLC.
   b. Specified Technologies, Inc.
   c. Wiremold; Legrand North America, LLC.
2. General Characteristics:
   a. Material: Galvanized sheet steel.
   b. Minimum Metal Thickness:
      1) For sleeve cross-section rectangle perimeter less than 50 inch and with no side larger than 16 inch, thickness must be 0.052 inch.
      2) For sleeve cross-section rectangle perimeter not less than 50 inch or with one or more sides larger than 16 inch, thickness must be 0.138 inch.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advance Products & Systems, LLC.
   2. BWM Company.
   3. CALPICO, Inc.
   4. Flexicraft Industries.
   5. GPT; a division of EnPRO Industries.
   6. Metraflex Company (The).
   7. Proco Products, Inc.

B. General Characteristics: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

C. Options:
   1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. HoldRite; Reliance Worldwide Company.

B. General Characteristics: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit must have plastic or rubber waterstop collar with center opening to match piping OD.

2.5 POURABLE SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Carlisle SynTec Incorporated; Carlisle Construction Materials.
   2. GAF.
   3. Johns Manville; a Berkshire Hathaway company.

B. Performance Criteria:
   1. General Characteristics: Single-component, neutral-curing elastomeric sealants of grade indicated below.
      a. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2.6 FOAM SEALANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dow Chemical Company (The).
   2. Innovative Chemical Products (Building Solutions Group).

B. Performance Criteria:
   1. General Characteristics: Multicomponent, liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam. Foam expansion must not damage cables or crack penetrated structure.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inch above finished floor level. Install sleeves during erection of floors.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel or pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:
1. Install steel or cast-iron pipe sleeves with integral waterstops. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1 inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.

B. Install conduits and cable with no crossings within the sleeve.

C. Fill opening around conduits and cables with expanding foam without leaving voids.

D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE-SEAL SYSTEMS

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 260544

SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Restraints - rigid type.
2. Restraints - cable type.
3. Restraint accessories.
4. Post-installed concrete anchors.
5. Concrete inserts.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.2 COORDINATION

A. Tests and Inspections:
1. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and provide notice at least seven days in advance.
2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated load capacity for each seismic- and wind-load-restraint device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic- and wind-load-restraint component used.
3. Annotate types and sizes of seismic restraints and accessories, complete with listing markings or report numbers and load rating in tension and compression as evaluated by UL product listing, FM Approvals, OSHPD or an agency acceptable to authorities having jurisdiction.
4. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated Design Submittal, signed and sealed by qualified structural professional engineer, for Each Seismic-Restraint Device:
1. For each seismic-restraint device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:

a. Seismic Restraints: Select seismic restraints complying with performance requirements, design criteria, and analysis data.
b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated seismic loads. Include certification that device is approved by an NRTL for seismic reinforcement use.
c. Seismic Design Calculations: Submit input data and loading calculations prepared under Section 260011 "Facility Performance Requirements for Electrical."

C. Delegated Design Submittal: Signed and sealed by qualified structural professional engineer, for each wind-load protection device.
1. For each wind-load protection device, including restraint - rigid and cable type, restraint accessory, and concrete anchor and insert that is required by this Section or is indicated on Drawings, submit the following:
a. Wind-Load Restraint: Select wind-load restraints complying with performance requirements, design criteria, and analysis data.
b. Post-Installed Concrete Anchors and Inserts: Include calculations showing anticipated wind loads. Include certification that device is approved by an NRTL for reinforcement use.
c. Wind-Load Design Calculations: Submit static and dynamic loading calculations prepared under Section 260011 "Facility Performance Requirements for Electrical."
2. Seismic- and Wind-Load-Restraint Detail Drawings prepared by qualified structural professional engineer:
a. Design Analysis: To support selection and arrangement of seismic and wind-load restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Coordinate seismic-restraint details with wind-load details required for equipment mounted outdoors.
3. Product Listing, Preapproval and Evaluation Documentation: By UL FM Approvals or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic and wind-load bracing for components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Welding certificates.

C. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer to design seismic and wind-load control system in accordance with criteria specified in Section 260010 "Supplemental Requirements for Electrical" and Section 260011 "Facility Performance Requirements for Electrical."

B. Seismic- and Wind-Load-Restraint Device Load Ratings: Devices to be tested and rated in accordance with applicable code requirements and authorities having jurisdiction. Devices to be listed by a nationally recognized third party that requires periodic follow-up inspections and has a listing directory available to the public. Provide third-party listing by one or more of the following: UL product listing, FM Approvals or an agency acceptable to authorities having jurisdiction.

C. Consequential Damage: Provide additional seismic and wind-load restraints for suspended components or anchorage of floor-, roof-, or wall-mounted components so that failure of a non-essential or essential component does not cause failure of any other essential building component.

D. Fire/Smoke Resistance: Seismic- and wind-load-restraint devices that are not constructed of ferrous metals must have a maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested and labeled by an NRTL in accordance with ASTM E84 or UL 723.

E. Component Supports:
   1. Load ratings, features, and applications of all reinforcement components must be based on testing standards of an NRTL.

2.2 RESTRAINTS - RIGID TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CADDY; brand of nVent Electrical plc.
   2. California Dynamics Corporation.
   3. Cooper B-line; brand of Eaton, Electrical Sector.
   4. Hilti, Inc.
   5. Isolation Technology, Inc.
   6. TOLCO.
   7. Unistrut; Atkore International.
   8. Vibration Mountings & Controls, Inc.

B. Description: Shop- or field-fabricated bracing assembly made of ANSI/AISI S110-07-S1 slotted steel channels, ANSI/ASTM A53/A53M steel pipe, or other rigid steel brace member. Includes accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINTS - CABLE TYPE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CADDY; brand of nVent Electrical plc.
   2. Cooper B-line; brand of Eaton, Electrical Sector.
   3. Gripple Inc.
   4. Loos & Co.
   5. Vibration Mountings & Controls, Inc.

B. Seismic- and Wind-Load-Restraint Cables: ASTM A492 stainless steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for seismic-restraining cable service; with fittings attached by means of poured socket, swaged socket or mechanical (Flemish eye) loop.

C. Restraint cable assembly and cable fittings must comply with ASCE/SEI 19. Cable fittings and complete cable assembly must maintain the minimum cable breaking force. U-shaped cable clips and wedge-type end fittings do not comply and are unacceptable.

2.4 RESTRAINT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CADDY; brand of nVent Electrical plc.
   2. Cooper B-line; brand of Eaton, Electrical Sector.
   3. Hilti, Inc.
   4. Loos & Co.
   5. Mason Industries, Inc.
   6. TOLCO.
   7. Unistrut; Atkore International.

B. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or Reinforcing steel angle clamped to hanger rod. Non-metallic stiffeners are unacceptable.

C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 POST-INSTALLED CONCRETE ANCHORS

A. Mechanical Anchor Bolts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Cooper B-line; brand of Eaton, Electrical Sector.
   b. Hilti, Inc.
   c. Mason Industries, Inc.
   d. Powers Fasteners.
   e. Simpson Strong-Tie Co., Inc.
   f. Unistrut; Atkore International.
2. Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength for anchor and as tested according to ASTM E488/E488M.

B. Provide post-installed concrete anchors that have been prequalified for use in seismic and wind-load applications.
   1. Prequalify post-installed anchors in concrete in accordance with ACI 355.2 or other approved qualification testing procedures.
   2. Prequalify post-installed anchors in masonry in accordance with approved qualification procedures.

2.6 CONCRETE INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hilti, Inc.
   2. Mason Industries, Inc.
   3. Powers Fasteners.
   4. Simpson Strong-Tie Co., Inc.
   5. Unistrut; Atkore International.

B. Provide preset concrete inserts that are seismically prequalified in accordance with ICC-ES AC446 testing.

C. Comply with MSS SP-58.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive seismic and wind-load control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by OSHPD or an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry static, wind-load, and seismic loads within specified loading limits.

3.3 INSTALLATION OF SEISMIC-RESTRAINT AND WIND-LOAD CONTROL DEVICES

A. Provide seismic-restraint and wind-load control devices for systems and equipment where indicated in Equipment Schedules or Seismic and Wind-Load Controls Schedule, where indicated on Drawings, where the Specifications indicate they are to be installed on specific equipment and systems, and where required by applicable codes.
   1. Install equipment and devices to withstand the effects of earthquake motions and high wind events.

B. Installation of seismic and wind-load restraints must not cause any stresses, misalignment, or change of position of equipment or conduits.

C. Equipment Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint and wind-load-restraint devices using methods approved by OSHPD, or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

D. Raceway, Cable, Wireway, Cable Tray, and Busway Support and Hanger Restraints:
   1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by OSHPD, or an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Equipment and Hanger Restraints:
   1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
   2. Install seismic-restraint devices using methods approved by OSHPD, or an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install cables so they do not bend across edges of adjacent equipment or building structure.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Post-Installed Concrete Anchors:
   1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
   2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
   3. Mechanical-Type Anchor Bolts: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors must be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
   4. Set anchors to manufacturer's recommended torque using a torque wrench.
   5. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Field tests must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Test no fewer than four of each type and size of installed anchors and fasteners selected by Architect.
   3. Test to 90 percent of rated proof load of device.

C. Seismic controls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260548.16

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
1. Fire-protection and fire-alarm equipment, including raceways, must be finished, painted, or suitably marked safety red.
2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:
1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.

4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 1000 V or Less:
1. Black letters on white field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
1. Color must be factory applied or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit.
2. Colors for 208Y/120 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 240 V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
4. Colors for 480Y/277 V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
5. Color for Neutral: White or gray.
6. Color for Equipment Grounds: Bare copper or Green if insulated.
7. Colors for Isolated Grounds: Green with two or more yellow stripes.

C. Raceways and Cables Carrying Circuits at More Than 1000 V:
1. Black letters on white field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:
1. Identify system voltage with black letters on orange background.

E. Warning labels and signs must include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."

F. Equipment Identification Labels:
   1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. Champion America.
      c. emedco.
      d. Grafoplast Wire Markers.
      e. HellermannTyton.
      f. LEM Products Inc.
      g. Marking Services, Inc.
      h. Panduit Corp.
      i. Seton Identification Products; a Brady Corporation company.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Brady Corporation.
      b. HellermannTyton.
      c. Marking Services, Inc.
      d. Panduit Corp.
      e. Seton Identification Products; a Brady Corporation company.

C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. A'n D Cable Products.
      b. Brady Corporation.
      c. Brother International Corporation.
      d. emedco.
      e. Grafoplast Wire Markers.
      f. Ideal Industries, Inc.
      g. LEM Products Inc.
      h. Marking Services, Inc.
      i. Panduit Corp.
      j. Seton Identification Products; a Brady Corporation company.
   2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
   3. Marker for Labels:
      a. Permanent, waterproof, black ink marker recommended by tag manufacturer.

b. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. A'n D Cable Products.
   b. Brady Corporation.
   c. Brother International Corporation.
   d. emedco.
   e. Grafoplast Wire Markers.
   f. HellermannTyton.
   g. Ideal Industries, Inc.
   h. LEM Products Inc.
   i. Marking Services, Inc.
   j. Panduit Corp.
   k. Seton Identification Products; a Brady Corporation company.
2. Minimum Nominal Size:
   a. 1-1/2 by 6 inch for raceway and conductors.
   b. 3-1/2 by 5 inch for equipment.
   c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Panduit Corp.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlton Industries, LP.
   b. Champion America.
   c. HellermannTyton.
   d. Ideal Industries, Inc.
   e. Marking Services, Inc.
   f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.

C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brimar Industries, Inc.
   b. HellermannTyton.
   c. LEM Products Inc.
   d. Marking Services, Inc.
   e. Seton Identification Products; a Brady Corporation company.

D. Underground-Line Warning Tape:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Brimar Industries, Inc.
   c. Ideal Industries, Inc.
   d. LEM Products Inc.
   e. Marking Services, Inc.
   f. Reef Industries, Inc.
   g. Seton Identification Products; a Brady Corporation company.
2. Tape:
   a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
   b. Printing on tape must be permanent and may not be damaged by burial operations.
   c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
3. Color and Printing:
   a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
   b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
   c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
4. Tape Type ID:
   a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
   b. Width: 3 inch.
   c. Overall Thickness: 5 mil.
   d. Foil Core Thickness: 0.35 mil.
   e. Weight: 28 lb/1000 sq. ft.

f. Tensile in accordance with ASTM D882: 70 lbf and 4600 psi.

5. Tape Type IID:
   a. Reinforced, detectable three-layer laminate, consisting of printed pigmented woven scrim, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright-colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
   b. Width: 3 inch.
   c. Overall Thickness: 8 mil.
   d. Foil Core Thickness: 0.35 mil.
   e. Weight: 34 lb/1000 sq. ft.
   f. Tensile in accordance with ASTM D882: 300 lbf and 12,500 psi.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.6 TAGS

A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.
   e. Seton Identification Products; a Brady Corporation company.

B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Grafoplast Wire Markers.
   e. LEM Products Inc.
   f. Marking Services, Inc.
   g. Panduit Corp.
   h. Seton Identification Products; a Brady Corporation company.

C. Write-on Tags:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brimar Industries, Inc.
   b. Carlton Industries, LP.
   c. LEM Products Inc.
   d. Seton Identification Products; a Brady Corporation company.

2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
3. Marker for Tags:
   a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
   b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Carlton Industries, LP.
   b. Champion America.
   c. emedco.
   d. Marking Services, Inc.
2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inch.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Champion America.
   c. emedco.
   d. Marking Services, Inc.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4 inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inch.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. emedco.
   d. Marking Services, Inc.
   e. Seton Identification Products; a Brady Corporation company.
2. Engraved legend.
3. Thickness:
   a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
   b. For signs larger than 20 sq. inch, 1/8 inch thick.
   c. Engraved legend with black letters on white face.

d. Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for power transfer.

K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.

L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
   1. "EMERGENCY POWER."
   2. "POWER."
   3. "UPS."

M. Vinyl Wraparound Labels:
   1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.

O. Self-Adhesive Labels:
   1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.

P. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.

Q. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.

R. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

S. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

T. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
   2. Limit use of underground-line warning tape to direct-buried cables.
   3. Install underground-line warning tape for direct-buried cables and cables in raceways.

U. Metal Tags:
   1. Place in location with high visibility and accessibility.
   2. Secure using UV-stabilized cable ties.

V. Nonmetallic Preprinted Tags:
   1. Place in location with high visibility and accessibility.
   2. Secure using general-purpose cable ties.

W. Write-on Tags:
   1. Place in location with high visibility and accessibility.
   2. Secure using general-purpose cable ties.

X. Baked-Enamel Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
   2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inch high.

Y. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

Z. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

AA. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Concealed Raceways, Duct Banks, More Than 1000 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3 inch high, black letters on 20 inch centers.
1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10 ft maximum intervals.

D. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

E. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
1. "EMERGENCY POWER."
2. "POWER."
3. "UPS."

F. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape to identify phase.
1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.

G. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

H. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with conductor designation.

I. Conductors to Be Extended in Future: Attach write-on tags to conductors and list source.

J. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

K. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

L. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

M. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.

N. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
   1. Apply to exterior of door, cover, or other access.
   2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
      a. Power-transfer switches.
      b. Controls with external control power connections.

O. Arc Flash Warning Labeling: Self-adhesive labels.

P. Operating Instruction Signs: Self-adhesive labels.

Q. Equipment Identification Labels:
   1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Computer-based, fault-current study to determine minimum interrupting capacity of circuit protective devices.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
   2. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.
   3. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items must remain functional throughout construction period.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

F. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For power system analysis software to be used for studies.

B. Short-Circuit Study Report:
   1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form.
      a. Short-circuit study input data, including completed computer program input data sheets.

b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
c. Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. EasyPower, LLC (formerly ESA Inc.).
2. ESA Inc.
3. ETAP - Digital Twin Platform.
4. Power Analytics, Corporation.
5. SKM Systems Analysis, Inc.

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of power systems analysis software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output.

E. Computer program must be designed to perform short-circuit studies or have function, component, or add-on module designed to perform short-circuit studies.

F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kVA and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
   6. Derating factors and environmental conditions.
   7. Any revisions to electrical equipment required by study.

D. Comments and recommendations for system improvements or revisions in written document, separate from one-line diagram.

E. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
   2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
   3. For 600 V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
   4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
   5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data:
   1. One-line diagram of system being studied.
   2. Power sources available.
   3. Manufacturer, model, and interrupting rating of protective devices.
   4. Conductors.
   5. Transformer data.

G. Short-Circuit Study Output Reports:
   1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. Equivalent impedance.
   2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.
2) Based on calculated symmetrical value multiplied by 1.6.
3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
a. Voltage.
b. Calculated symmetrical fault-current magnitude and angle.
c. Fault-point X/R ratio.
d. No AC Decrement (NACD) ratio.
e. Equivalent impedance.
f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain data necessary for conduct of study.
1. Verify completeness of data supplied on one-line diagram. Call discrepancies to Architect's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate required input data to support short-circuit study. Record data on Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to amount of detail that is required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance at service.
3. Power sources and ties.
4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
5. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
6. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
7. Motor horsepower and NEMA MG 1 code letter designation.
8. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
9. Derating factors.

3.2 SHORT-CIRCUIT STUDY

A. Perform study following general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin short-circuit current analysis at service, extending down to system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 5 kA or less.
   2. Exclude equipment supplied by single transformer smaller than 75 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement to address asymmetrical requirements of interrupting equipment.

H. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
   1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

I. Include in report identification of protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 - COORDINATION STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
   2. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
   3. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash studies.

1.2 DEFINITIONS

A. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when abnormal current flow exists and then removes the affected portion of the circuit from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

E. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For power system analysis software to be used for studies.

B. Coordination Study Report:
   1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form.
      a. Coordination-study input data, including completed computer program input data sheets.
      b. Study and equipment evaluation reports.
      c. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary

submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

d. Revised one-line diagram, reflecting field investigation results and results of coordination study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.5 QUALITY ASSURANCE

A. Studies must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.6 REGULATORY AGENCY APPROVALS

A. Submittals for coordination study requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation. Submit for action by Engineer prior to submitting for approval by authorities having jurisdiction.

B. Submittals for coordination study require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. ESA Inc.
5. ETAP - Digital Twin Platform.
6. Power Analytics, Corporation.
7. SKM Systems Analysis, Inc.

B. Comply with IEEE 242 and IEEE 399.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program must be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program must report device settings and ratings of overcurrent protective devices and must demonstrate selective coordination by computer-generated, time-current coordination plots.
   1. Optional Features:
      a. Arcing faults.
      b. Simultaneous faults.
      c. Explicit negative sequence.
      d. Mutual coupling in zero sequence.

E. Computer program must be designed to perform coordination studies or have function, component, or add-on module designed to perform coordination studies.

F. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 COORDINATION STUDY REPORT CONTENTS

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram of modeled power system, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kVA and voltage ratings.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, and panelboard designations.
   6. Revisions to electrical equipment required by study.
   7. Study Input Data: As described in "Power System Data" Article.
      a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

D. Protective Device Coordination Study:
   1. Report recommended settings of protective devices, ready to be applied in field. Use manufacturer's data sheets for recording recommended setting of overcurrent protective devices when available.
      a. Phase and Ground Relays:
         1) Device tag.
         2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
         3) Recommendations on improved relaying systems, if applicable.
      b. Circuit Breakers:
         1) Adjustable pickups and time delays (long time, short time, and ground).
         2) Adjustable time-current characteristic.
         3) Adjustable instantaneous pickup.
         4) Recommendations on improved trip systems, if applicable.
      c. Fuses: Show current rating, voltage, and class.

E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for switching schemes and for emergency periods where power source is local generation. Show the following information:
   1. Device tag and title, one-line diagram with legend identifying portion of system covered.
   2. Terminate device characteristic curves at point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
   3. Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
   4. Plot the following listed characteristic curves, as applicable:
      a. Power utility's overcurrent protective device.
      b. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
      c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
      d. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
      e. Cables and conductors damage curves.
      f. Ground-fault protective devices.
      g. Motor-starting characteristics and motor damage points.
      h. Generator short-circuit decrement curve and generator damage point.
      i. Largest feeder circuit breaker in each motor-control center and panelboard.
   5. Maintain selectivity for tripping currents caused by overloads.
   6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
   7. Provide adequate time margins between device characteristics such that selective operation is achieved.
   8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.
   1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

A. Obtain data necessary for conduct of overcurrent protective device study.
   1. Verify completeness of data supplied in one-line diagram on Drawings. Call discrepancies to Architect's attention.
   2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.

B. Gather and tabulate required input data to support coordination study. List below is guide. Comply with recommendations in IEEE 551 for amount of detail required to be acquired in field. Field data gathering must be by, or under supervision of, qualified electrical professional engineer. Data include, but are not limited to, the following:
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
   2. Electrical power utility impedance at service.
   3. Power sources and ties.
   4. Short-circuit current at each system bus (three phase and line to ground).
   5. Full-load current of loads.
   6. Voltage level at each bus.
   7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
   8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
   9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
   10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
   11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
   12. Motor horsepower and NEMA MG 1 code letter designation.
   13. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
   14. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
      a. Special load considerations, including starting inrush currents and frequent starting and stopping.
      b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
      c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
      d. Generator thermal-damage curve.
      e. Ratings, types, and settings of utility company's overcurrent protective devices.
      f. Special overcurrent protective device settings or types stipulated by utility company.
      g. Time-current-characteristic curves of devices indicated to be coordinated.
      h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
      i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
      j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.

3.3 COORDINATION STUDY

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. Base study on device characteristics supplied by device manufacturer.

D. Extent of electrical power system to be studied is indicated on Drawings.

E. Begin analysis at service, extending down to system overcurrent protective devices as follows:
   1. To normal system low-voltage load buses where fault current is 5 kA or less.
   2. Exclude equipment supplied by single transformer smaller than 75 kVA.

F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

G. Transformer Primary Overcurrent Protective Devices:
   1. Device must not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings must protect transformers according to IEEE C57.12.00, for fault currents.

H. Motor Protection:
   1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
   2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands maximum short-circuit current for time equivalent to tripping time of primary relay protection or total clearing time of fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Generator Protection: Select protection according to manufacturer's instructions and to IEEE 242.

K. Include ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.

L. Calculate short-circuit momentary and interrupting duties for three-phase bolted fault and single line-to-ground fault at each equipment indicated on one-line diagram.
   1. For grounded systems, provide bolted line-to-ground fault-current study for areas as defined for three-phase bolted fault short-circuit study.

M. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
   3. Include in report identification of protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

A. Perform load-flow and voltage-drop study to determine steady-state loading profile of system. Analyze power system performance two times as follows:
   1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
   2. Determine load flow and voltage drop based on 80 percent of design capacity of load buses.
   3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by NFPA 70.

3.5 MOTOR-STARTING STUDY

A. Perform motor-starting study to analyze transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze effects of motor starting on power system stability.

B. Prepare motor-starting study report, noting light flicker for limits proposed by IEEE 141 and voltage sags so as not to affect operation of other utilization equipment on system supplying motor.

3.6 FIELD ADJUSTING

A. Adjust relay and protective device settings according to recommended settings provided by coordination study. Field adjustments must be completed by engineering service division of equipment manufacturer under "Startup and Acceptance Testing" contract portion.

B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.

C. Testing and adjusting must be by qualified low-voltage electrical testing and inspecting agency.
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for adjustable overcurrent protective devices.

END OF SECTION 260573.16

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Computer-based, arc-flash study to determine arc-flash hazard distance and incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
   2. Section 260573.13 "Short-Circuit Studies" for fault-current studies.
   3. Section 260573.16 "Coordination Studies" for overcurrent protective device coordination studies.

1.2 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. p.u.: Per unit. The reference unit, established as a calculating convenience, for expressing all power system electrical parameters on a common reference base.

E. SCCR: Short-circuit current rating.

F. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

G. Single-Line Diagram: See "One-Line Diagram."

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For power system analysis software to be used for studies.

B. Study Submittals:
   1. Submit the following after approval of system protective devices submittals. Submittals may be in digital form:

a. Arc-flash study input data, including completed computer program input data sheets.
b. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
c. Revised one-line diagram, reflecting field investigation results and results of arc-flash study.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.5 QUALITY ASSURANCE

A. Study must be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms must comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

1.6 REGULATORY AGENCY APPROVALS

A. Submittals for arc-flash hazard analysis requiring approval by authorities having jurisdiction must be signed and sealed by qualified electrical professional engineer responsible for their preparation. Submit for action by Engineer prior to submitting for approval by authorities having jurisdiction.

B. Submittals for arc-flash hazard analysis require action by Architect prior to submitting for approval by authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CGI CYME.
2. EasyPower, LLC (formerly ESA Inc.).
3. EDSA Micro Corporation.
4. ESA Inc.
5. ETAP - Digital Twin Platform.
6. Power Analytics, Corporation.
7. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program must have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer program must be designed to perform arc-flash analysis or have function, component, or add-on module designed to perform arc-flash analysis.

E. Computer program must be developed under supervision of licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:
   1. Protective device designations and ampere ratings.
   2. Conductor types, sizes, and lengths.
   3. Transformer kVA and voltage ratings, including derating factors and environmental conditions.
   4. Motor and generator designations and kVA ratings.
   5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in report:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude and angle.
      c. Fault-point X/R ratio.
      d. No AC Decrement (NACD) ratio.
      e. Equivalent impedance.
      f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on symmetrical basis.
      g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on total basis.

H. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.

3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.

I. Fault study input data, case descriptions, and fault-current calculations including definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce 3.5 by 5 inch self-adhesive equipment label for each work location included in analysis.

B. Label must have orange header with wording, "WARNING, ARC-FLASH HAZARD," and must include the following information taken directly from arc-flash hazard analysis:
1. Location designation.
2. Nominal voltage.
3. Protection boundaries.
   a. Arc-flash boundary.
   b. Restricted approach boundary.
   c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels must be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform Short-Circuit and Protective Device Coordination studies prior to starting Arc-Flash Hazard Analysis.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.
1. Maximum calculation must assume maximum contribution from utility and must assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current in accordance with IEEE 1584 recommendations.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current in accordance with NFPA 70E recommendations.
4. Calculate arc-flash energy with utility contribution at minimum and assume no motor contribution.

D. Calculate arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment fed from transformers smaller than 75 kVA.

F. Calculate limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations must consider accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations must take into account changing current contributions, as sources are interrupted or decremented with time. Fault contribution from motors and generators must be decremented as follows:
1. Fault contribution from induction motors must not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators must be decayed to match actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 p.u. to 3 p.u. after 10 cycles).

H. Arc-flash energy must generally be reported for maximum of line or load side of circuit breaker. However, arc-flash computation must be performed and reported for both line and load side of circuit breaker as follows:
1. When circuit breaker is in separate enclosure.
2. When line terminals of circuit breaker are separate from work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain data necessary for conduct of arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.

3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

3.4 LABELING

A. Apply one arc-flash label on front cover of each section of equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below not fed by single transformer smaller than 75 kVA must have arc-flash label applied to it:
   1. Low-voltage switchgear.
   2. Switchboards.
   3. Panelboards.
   4. Motor-control centers.
   5. Low voltage transformers.
   6. Safety switches.
   7. Control panels.

C. Note on record Drawings location of equipment where personnel could be exposed to arc-flash hazard during their work.
   1. Indicate arc-flash energy.
   2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under direct supervision and control of qualified electrical professional engineer.

END OF SECTION 260573.19

SECTION 260913 - ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Multifunction energy meters.
2. Power meters.
3. Power monitoring and control software.
4. Monitoring and control of power distribution equipment.
5. System operator interfaces.
6. Portable workstations.
7. Raceways and boxes.
8. Wires and cables.
9. Surge protection devices.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. Active Power: The average power consumed by a unit. Also known as "real power."

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. Apparent (Phasor) Power: "S = VI" where "S" is the apparent power, "V" is the RMS value of the voltage, and "I" is the RMS value of the current.

D. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.

E. L-G: Line to ground.

F. L-L: Line to line.

G. L-N: Line to neutral.

H. MODBUS TCP/IP: An open protocol for exchange of process data.

I. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

J. N-G: Neutral to ground.

K. Power Factor: The ratio of active power to apparent power, sometimes expressed in percentage.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for power monitoring and control.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For power monitoring and control equipment.
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.
      a. Attach copies of approved Product Data submittals for products (such as switchboards, switchgear, and motor-control centers) that describe the following:
         1) Location of the meters and gateways, and routing of the connecting wiring.
         2) Details of power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
   3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
   4. Include diagrams for power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
   5. Specifications for workstations.
   6. UPS sizing calculations for workstation.
   7. Surge Suppressors: Data for each device used and where applied.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Design Data:
   1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.
      a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format on compact disk or portable storage device with a USB interface.
      b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
      c. As-built versions of submittal Product Data.
      d. Names, addresses, e-mail addresses, and 24-hour telephone numbers of Installer and service representatives for the system and products.
      e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.

f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to do the following:
   1) Design and install new points, panels, and other hardware.
   2) Perform preventive maintenance and calibration.
   3) Debug hardware problems.
   4) Repair or replace hardware.
h. Documentation of programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on compact disk or portable storage device with a USB interface.
j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
k. Complete original-issue copies of furnished software, including operating systems, custom programming language, workstation software, and graphics software on compact disk or portable storage device with a USB interface.
l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
m. Owner training materials.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Addressable Relays: One for every 10 installed. Furnish at least one of each type.
   2. Data Line Surge Suppressors: One for every 10 of each type installed. Furnish at least one of each type.

1.6 COORDINATION

A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
   1. Match components and interconnections for optimum performance of specified functions.

B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Microprocessor-based monitoring of electrical power distribution system(s) that includes the following:
   1. Electrical meters that monitor, control, and connect to the data transmission network.
   2. LAN: High-speed, multi-access, open, nonproprietary, industry-standard communication protocols.

3. Include PC-based workstation with web access, with its operating system and application software, connected to data transmission network.

B. The electrical power monitoring and control system must be Internet based.
1. System software must be based on server thin-client architecture, designed around open standards of internet technology.
2. Intent of thin-client architecture is to provide operators complete access to power monitoring and control system via an Internet browser. No special software other than an Internet browser must be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
3. Internet access must be password protected.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with UL 61010-1 and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
1. Minimum Protection for Power Lines 120 V and More: SPDs complying with UL 1449, listed and labeled for intended use by an NRTL acceptable to authorities having jurisdiction.
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.

B. Addressable Devices: Transmitters and receivers must communicate unique device identification and status reports to monitoring and control clients.
1. Hardwired Monitoring Points: Electrical power demand (kilowatts), electrical power consumption (kilowatt-hours), power factor.

C. Backup Power Source:
1. Electrical power distribution equipment served by a backup power source for controls must have associated power monitoring and control system products that monitor and control such systems and equipment also served from a backup power source.

2.3 MULTIFUNCTION ENERGY METERS

A. Manufacturers: Subject to compliance with requirements, provide Seimens #9410 Power Meter (No exceptions).

B. Multifunction Energy Meter: Separately mounted, modular, permanently installed, solid-state, digital I/O instrument for power and energy metering and monitoring; complying with UL 61010-1.
1. Capable of metering four-wire wye, three-wire wye, three-wire delta, and single-phase power systems.
2. Equipped with security lock to protect revenue related metering from unauthorized and accidental changes.

C. Comply with IEC 60529 degree of protection code of IP65 for the front of the meter, and code of IP30 for the body.

D. Overvoltage: Comply with UL 61010-1 overvoltage withstand rating for CAT III.

E. Accuracy (Minimum):
1. Comply with ANSI C12.20, Class 0.5.
2. Neutral Current Measurement: Not more than 0.65 percent.
3. Power Factor: 1.0 percent.
4. Frequency: 0.1 percent.
5. THD: 1.0 percent.
6. Waveform Sampling: 64 per cycle.

F. Data Link:
1. Ethernet with RS485 connection.

G. Meter Physical Characteristics:
1. Display: Backlit LCD with antiglare and scratch-resistant lens.
2. Display of Metered Values:
a. One screen to show at least three user-selected values displayed at the same time. Selections available to display must include the following:
1) Meters.
2) Measurements.
3) THD.
4) Energy.
5) Demand.
6) Minimum and maximum values.
7) Power demand.

H. Sampling Rate: Continuously sample and record voltage and current at a rate not less than 64 samples per cycle, simultaneously on voltage and current channels of the meter.

I. Meters:
1. Instantaneous, RMS:
a. Current: Each phase, neutral and three-phase average.
b. Voltage: L-L each phase, L-L three-phase average, L-N each phase, and L-N three-phase average.
c. Active Power (kW): three-phase total.
d. Reactive Power (kVAR): three-phase total.
e. Apparent Power (kVA): three-phase total.
f. Power Factor: three-phase total.
2. Energy:
a. Active Energy (kWh): Three-phase total.
3. Demand, Derived from Instantaneous RMS Meters:
a. Current: Present and maximum.
b. Active: Present and maximum.
c. Reactive: Present and maximum.
d. Apparent: Present and maximum.
4. Power Quality Measurements:
a. THD: Current and voltage from measurements simultaneously from the same cycle, as can be calculated from the specified sampling rate.

J. Capacities and Characteristics:
   1. Power Supply: 120 V(ac), 60 Hz or 480 volts, 60 Hz
   2. Circuit Connections:
      a. Voltage: Measurement autoranging, 60 to 400 V(ac) L-N. Connect directly to low-voltage (600 V and less) without using voltage transformers. Meter impedance must be 2 megohm L-L or greater. Overload Tolerance: 1500 V(ac), RMS, continuously.
      b. Current: Connect to instrument grade current transformer with a metering range of 5 mA to 6 A. Overcurrent tolerance of the instrument must be 10 A continuous, 50 A for 10 seconds once per hour, and 120 A for one second per hour.
      c. Frequency: 45 to 65 Hz.
      d. Time: Input from a GPS receiver to synchronize the internal clock of the instrument and to time-synchronize this instrument with the network to a deviation of not greater than 1 ms.

2.4 PC OPERATING SYSTEM SOFTWARE

A. Description: System software must monitor, analyze, display, control, and save the parameters and features available at the connected meter.

B. Software: Configured to run on a portable laptop computer, a single PC, or a tablet computer, with capability for accessing a single meter at a time, at the location of the meter. System is not connected to LAN.

C. Minimum Requirements:
   1. Real-time multitasking and multiuser 64-bit operating system that allows execution of multiple real-time programs and custom program development.
   2. Operating system must be capable of operating Microsoft Windows applications.
   3. Scheduling software must schedule centrally based time and event, temporary, and exception day programs.

2.5 NETWORKED PC OPERATING SYSTEM SOFTWARE

A. Description: System software must monitor, analyze, display, control, and save parameters and features available at each of the connected meters.

B. Software: Configured to run on a single PC, with capability for accessing multiple devices simultaneously. Software must include interactive graphics client and must be web enabled.

C. System Software Minimum Requirements:
   1. Real-time multitasking and multiuser 64-bit operating system that allows concurrent multiple workstations operating and concurrent execution of multiple real-time programs and custom program development.
   2. Operating system must be capable of operating Microsoft Windows applications.
   3. Database management software must manage data on an integrated and non-redundant basis. Additions and deletions to database must be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
   4. Scheduling software must schedule centrally based time and event, temporary, and exception day programs.

D. Operator Interface Software:
   1. Minimize operator training through use of English language prorating and English language point identification.
   2. Minimize use of a typewriter-style keyboard through use of a pointing device, touchscreen, or mouse.
   3. Operator sign-off must be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
   4. Automatic sign-off period must be programmable from 1 to 60 minutes in 1-minute increments on a per operator basis.
   5. Record operator sign-on and sign-off activity.
   6. Security Access:
      a. Operator access to electrical monitoring and control system must be under password control.
      b. An alphanumeric password must be user assignable to each operator.
      c. Software must have at least five access levels.
         1) View - View information. No change privileges allowed.
         2) User - Same as View, but is able to initiate control functions.
         3) Controller - Same as User, but is able to initiate communications.
         4) Operator - Same as Controller, but is able to modify configurations.
         5) Supervisor - Same as Operator, but is able to administer security privileges.
      d. Each menu item must be assigned an access level so that a one-for-one correspondence between operator-assigned access level(s) and menu-item access level(s) is required to gain access to menu item.
      e. Display menu items to operator with those menu items capable of access highlighted. Menu and operator access level assignments must be online programmable and under password control.

E. Graphic Interface Software:
   1. Include a full interactive graphical selection means of accessing and displaying system data to operator.
   2. Descriptors for graphics, points, alarms, and such must be modified through workstation under password control.
   3. Display operator accessed data on the monitor.
   4. Help Features: On-line context-sensitive help utility to facilitate operator training and understanding.

2.6 POWER MONITORING AND CONTROL SOFTWARE

A. Data Storage and Data Sharing:
   1. Query and download logs of interval data stored on metering devices.
   2. Query and download logs of alarm and event data stored on metering devices.
   3. Query and download logs of waveform capture data stored on metering devices.
   4. Query and download logs of interval data generated by the software and calculated by the meters.
   5. Query and download logs of alarm and event data generated by the software and calculated by the meters.
   6. Automatically re-arm the waveform recorders, on upload of information.
   7. Provide a facility to archive, trim, and back up the database on demand, or on a schedule.
   8. Provide a facility to view historical data from archived databases.
   9. Support user changes to the database.

a. Support on-line changes while the data storage/retrieval application is running.
b. Suffer no interruption to its operation while changes are being made.
c. Require no restart once the configuration has been performed.

B. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:
1. Site plan showing each building, and additional site elements, which are being controlled or monitored by the electrical power monitoring and control system.
2. Plan for each building floor, showing the following:
a. Locations and identification of monitored and controlled electrical equipment.

2.7 NETWORK CONFIGURATION SOFTWARE

A. Network Management Graphical Interface Features:
1. Add and remove devices in the power monitoring and control network.
2. Application for naming devices based on a user-defined naming scheme.
3. Add and remove I/O servers in the power monitoring and control network.
4. Edit communication properties for devices including timeouts and delays.
5. Display mandatory fields when adding a new device.
6. Allow to manually connect and disconnect serial, Ethernet, modem, and Ethernet gateway sites.
7. Enable and disable devices and sites in the power monitoring and control network without interruption to other devices or sites.
8. Pool modem resources so that the software uses any available modem.
9. Monitor the following diagnostics:
a. Communication request/response and error rates, and timeouts.
b. Log acquisition services.

B. Database Maintenance Features:
1. Backup, archive, and trim data, event, and waveform logs.
a. Record start and end date for operation.
b. Allow copying data to another database.
c. Be capable of selecting logs specified for the meters that are Work of this Section.
1) Data logs.
2) Event logs.
3) Waveform logs.

2.8 SYSTEM OPERATOR INTERFACES

A. Operator means of system access must be through the following:
1. Desktop workstation with hardwired connection through LAN port.
2. Portable terminal with hardwired connection through LAN port at each meter.
3. Remote connection using outside of system PC, tablet, or local PLC.

2.9 PORTABLE WORKSTATIONS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Dell Inc.

B. Performance Requirements:

1. Performance requirements may dictate equipment exceeding minimum requirements indicated.
2. ENERGY STAR compliant.
3. Hardware and software must support local downloading to DDC controllers.
4. Data transfer rate to DDC controller must be at network speed.

C. Processor:
1. Minimum Processor Speed: 4.5 gigahertz.
2. RAM:
   a. Capacity: 8.0 GB.
   b. Speed and Type: 3.2 MHz, DDR4.
3. Hard Drive:
   a. Media: Hybrid solid-state and rotating disc.
   b. Number of Hard Drives: Two.
   c. Capacity: 2.0 Terahertz, each.
   d. Up to 500 MB/s read time and up to 450 MBytes/s write time.
4. Video Card: 8 gigabytes of RAM.

D. Input and Output Ports:
1. Serial port.
2. Shared port for external keyboard or mouse.
3. Four USB 3.0 ports.
4. Ethernet port.
5. HDMI port.
6. IEEE 1394 port.

E. Battery:
1. Capable of supporting operation of portable workstation for a minimum of 8 hours.
2. Battery life of at least three years.
3. Battery charge time of less than three hours.

F. Keyboard:
1. 85-key backlit keyboard.
2. Full upper- and lowercase ASCII keyset.

G. Integral Pointing Device: Touchpad with two buttons. Gesture enabled.

H. Display:
1. 17” diagonal or larger high-definition WLED color display.
2. Antiglare screen.
3. 1920 by 1080 pixel resolution.
4. Brightness: 300 nits.

I. Network Interfaces:
1. Network Interface Card: Include card with connection, as application.
   a. 10-100-1000 base TX Ethernet with 8PSJ connector port.
   b. 100 base FX Ethernet with SC or ST port.
2. Wireless:
   a. Internal with integrated antenna, capable of supporting 802.11 a/b/g/n.

J. Digital Video Disc Rewrite Recorder (DVD+/-RW):

1. Compatible with DVD disks and data, audio, recordable and rewritable compact disks.
2. Nominal Data Transfer Rates:
   a. Reading: 8X.
   b. Writing: 8X.
3. 160 ms access time.

K. Accessories:
1. Nylon carrying case.
2. Docking station.
3. Mobile broadband card.
4. Wireless optical mouse.
5. 2.0 TB portable hard drive.
6. Light-sensitive web cam and noise-cancelling digital array microphone.
7. Category 6a patch cable. Minimum cable length must be 6’.
8. HDMI cable. Minimum cable length must be 6’.

2.10 RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceway and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.

B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for control wiring, TIA-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.

2.11 WIRES AND CABLES

A. Electrical Power Wiring: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Copper conductors are Type THHN/THWN-2.

B. Control Wiring: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
1. Balanced Twisted Pair Cable: 100 ohm, four-pair Category 6.
2. TIA-485 Cable: Paired, two pairs, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
3. Control-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
   a. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
   b. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
   c. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.

C. TIA-232 Cable:
1. PVC-Jacketed, TIA-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
   a. Type CM.
   b. Flame Resistance: UL 1581, vertical tray.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER MONITORING AND CONTROL SYSTEMS

A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

C. Wiring and Cabling Installation:
1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
2. Comply with Section 260523 "Control-Voltage Electrical Power Cables" for control wiring.

D. Raceways Installation:
1. Comply with Section 260533 "Raceway and Boxes for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.
2. Comply with Section 270528 "Pathways for Communications Systems" for control wiring, TIA-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.

E. Identification Installation:
1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
2. Comply with Section 271513 "Communications Copper Horizontal Cabling" for identification products and cable management system requirements for twisted pair cable, TIA-485 cable, control-voltage cable, and TIA-232 cable.

3.3 INSTALLATION OF WORKSTATIONS

A. Portable Workstations Installation:
1. Turn over portable workstations to Owner at Substantial Completion.
2. Install software on workstation(s) and verify that software functions properly.

B. Graphics Application:
1. Use system schematics indicated as starting point to create graphics.
2. Develop Project-specific library of symbols for representing system equipment and products.
3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.

4. Submit sketch of graphic layout with description of text for each graphic for Owner's and Engineer's review before creating graphic using graphics software.
5. Seek Owner input in graphics development once using graphics software.
6. Final editing must be done on-site with Owner's review and feedback.
7. Refine graphics as necessary for Owner acceptance.
8. On receiving Owner acceptance, print a hard copy to include in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of the system operation and maintenance manual.

3.4 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

3.5 GROUNDING

A. For data communication wiring, comply with BICSI N1.

B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Owner.

B. Tests and Inspections:
1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Visually inspect balanced twisted pair cabling and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of components.
4. Test balanced twisted pair cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
   a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
   b. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
5. Power Monitoring and Control System Tests.
   a. Test Analog Signals:
      1) Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.

2) Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3) Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

b. Test Digital Signals:
1) Check digital signals using a jumper wire.
2) Check digital signals using an ohmmeter to test for contact making or breaking.

c. I/O Control Loop Tests:
1) Test every I/O point to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
2) Test every I/O point throughout its full operating range.
3) Test every control loop to verify that operation is stable and accurate.
4) Adjust control loop proportional, integral, and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
5) Test and adjust every control loop for proper operation according to sequence of operation.
6) Test software and hardware interlocks for proper operation.
7) Operate each analog point at the following:

a) Upper quarter of range.
b) Lower quarter of range.
c) At midpoint of range.

8) Exercise each binary point.
9) For every I/O point in the system, read and record each value at workstation, at controller, and at field instrument simultaneously. Value displayed at workstation and at field instrument must match.
10) Prepare and submit a report documenting results for each I/O point in the system, and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

C. Nonconforming Work:
1. Wiring and cabling will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 FINAL REVIEW

A. Submit written request to Engineer and Construction Manager when the power monitoring and control system is ready for final review. Written request must state the following:
1. The system has been thoroughly inspected for compliance with Contract Documents and found to be in full compliance.
2. The system has been calibrated, adjusted, and tested and found to comply with requirements of operational stability, accuracy, speed, and other performance requirements indicated.
3. The system monitoring and control of electrical distribution systems results in operation according to sequences of operation indicated.
4. The system is complete and ready for final review.

B. Review by Engineer and Construction Manager will be made after receipt of written request. A field report must be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Final review must include a demonstration to parties participating in final review.

3.8 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, maintenance service must include three months' full maintenance by manufacturer's authorized service representative. Include quarterly preventive maintenance, repair or replacement of defective components, cleaning, and adjusting as required for proper system operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

3.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
   1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.10 TRAINING

A. Attendee Training Manuals:
   1. Provide each attendee with a color hard copy of training materials and visual presentations.
   2. Hard-copy materials must be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
   3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of hard-copy materials.

B. On-Site Training:
   1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power, and data connectivity for instructor and each attendee.
   2. Instructor must provide training materials, projector, and other audiovisual equipment used in training.
   3. Provide as much of training located on-site as deemed feasible and practical by Owner.
   4. On-site training must include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration, and service requirements.

5. The workstation provided with the system must be used in training. If workstation is not indicated, provide a temporary workstation to convey training content.

C. Off-Site Training:
1. Provide conditioned training rooms and workspace with ample tables, chairs, power, and data connectivity for each attendee.
2. Provide capability to remotely access to Project monitoring and control system for use in training.
3. Provide a workstation for use by each attendee.

D. At Completion of Training: Staff familiar with the system installed are capable of demonstrating operation of the system during final review.

E. Demonstration must include, but not be limited to, the following:
1. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
2. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and workstations.
3. Trends, summaries, logs, and reports set-up for Project.
4. Software's ability to communicate with controllers, workstations, and uploading and downloading of control programs.
5. Software's ability to edit control programs off-line.
6. Data entry to show Project-specific customizing capability including parameter changes.
7. Step through penetration tree, display graphics, demonstrate dynamic update, and direct access to graphics.
8. Execution of digital and analog commands in graphic mode.
9. Spreadsheet and curve plot software and its integration with database.
10. Online user guide and help functions.
11. For Each Meter:
    a. Memory: Programmed data, parameters, trend, and alarm history collected during normal operation is not lost during power failure.
    b. Operator Interface: Ability to connect directly to each meter with a portable workstation.
    c. Wiring Labels: Match control drawings.
    d. Network Communication: Ability to locate a meter on the network. Communication architecture matches Shop Drawings.
    e. Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators, and devices.

END OF SECTION 260913

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Electronic time switches.
2. Outdoor photoelectric switches, solid state, flexible mounting.
3. Digital timer light switch.
4. Lighting contactors.
5. Conductors and cables.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of product.

B. Shop Drawings:
1. Show installation details for the following:
   a. Occupancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.
2. Extended Warranty Period: Three year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Cooper Industries, Inc.
   2. Intermatic, Inc.
   3. Invensys Controls.
   4. Leviton Manufacturing Co., Inc.
   5. NSi Industries LLC.
   6. TE Connectivity Ltd.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
   1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Contact Configuration: SPST.
   3. Contact Rating: 30 A inductive or resistive, 240 V(ac).
   4. Programs:
      a. Three channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
   5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
   6. Astronomic Time: All channels.
   7. Automatic daylight savings time changeover.
   8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cooper Industries, Inc.
   2. Intermatic, Inc.
   3. Leviton Manufacturing Co., Inc.
   4. NSi Industries LLC.
   5. TE Connectivity Ltd.

B. Description: Solid state, with DPST dry contacts rated for 1200 VA for LED lighting , to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
   1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
   2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
   3. Time Delay: Fifteen-second minimum, to prevent false operation.
   4. Surge Protection: Metal-oxide varistor.

5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.3 OUTDOOR MOTION SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Bryant Electric.
   2. Cooper Industries, Inc.
   3. Hubbell Control Solutions; Hubbell Incorporated, Lighting.
   4. Leviton Manufacturing Co., Inc.
   5. Lithonia Lighting; Acuity Brands Lighting, Inc.
   6. NSi Industries LLC.
   7. RAB Lighting.
   8. Sensor Switch, Inc.
   9. WattStopper; Legrand North America, LLC.

B. Description: Solid-state outdoor motion sensors.
   1. Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application[**, and must comply with California Title 24**].
   2. Dual-technology (PIR and ultrasonic) type, weatherproof. Detect occurrences of 6 inch minimum movement of any portion of a human body that presents a target of not less than 36 sq. inch. Comply with UL 773A.
   3. Switch Rating:
      a. Luminaire-Mounted Sensor: 1000 VA LED.
      b. Separately Mounted Sensor: Dry contacts rated for 20 A LED load at 120 and 277 V(ac), for 13 A tungsten at 120 V(ac), and for 1 hp at 120 V(ac). Sensor has 24 V(dc), 150 mA, Class 2 power source.
   4. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off." With bypass switch to override the "on" function in case of sensor failure.
   5. Voltage: Match the circuit voltage type.
   6. Detector Coverage:
      a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
      b. Long Range: 180-degree field of view and 110 ft. detection range.
   7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
   8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
   9. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.
   10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
   11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" in accordance with UL 773A.

2.4 LIGHTING CONTACTORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. ABB, Electrification Products Division.
   2. Allen-Bradley/Rockwell Automation.
   3. ASCO Power Technologies.
   4. Eaton.
   5. Leviton Manufacturing Co., Inc.
   6. Square D; Schneider Electric USA.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
   1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
   2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
   3. Enclosure: Comply with NEMA 250.
   4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.5 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 16 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF CONTACTORS

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.

C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems.
   1. Identify controlled circuits in lighting contactors.
   2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:
   1. Lighting control devices will be considered defective if they do not pass tests and inspections.

2. Remove and replace defective units and retest.

C. Prepare test and inspection reports.

D. Manufacturer Services:
1. Engage factory-authorized service representative to [**support**] [**supervise**] field tests and inspections.

END OF SECTION 260923

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Distribution, dry-type transformers with nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

B. Related Requirements:
   1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
      a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
      b. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.

B. Shop Drawings:
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connections.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
   3. Include diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:
   1. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
   1. Transformer temporary heating, working clearances, anchoring, torque values, and insulation-resistance testing.

B. Source quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note shipping damage to packaging and transformer.

1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat in accordance with manufacturer's published instructions within enclosure of ventilated-type units, throughout periods during which equipment is not energized and when transformer is not in space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
2. Acme Electric; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
3. Cutler Hammer
4. Dongan Electric Manufacturing Company.
5. Eaton.
6. General Electric Company
7. Powersmiths International Corp.; Socomec Group.
8. Siemens Industry, Inc., Energy Management Division.
9. SolaHD; Emerson Electric Co., Automation Solutions.
10. Square D; Schneider Electric USA.

B. Source Limitations: Obtain each type of transformer from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60 Hz service.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

C. Transformers Rated 15 kVA and Larger:
1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.
3. CSL-1 (NEMA TP-1)

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: Grade M6, non-aging silicon steel with high permeability and low hysteresis losses.
   1. One leg per phase.
   2. Core volume must allow efficient transformer operation at 10 percent above nominal tap voltage.
   3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.
   1. Coil Material: Aluminum.
   2. Internal Coil Connections: Brazed or pressure type.
   3. Terminal Connections: Bolted.

D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.

E. Enclosure: Ventilated.
   1. Core and coil must be encapsulated within resin compound using vacuum-pressure impregnation process to seal out moisture and air.
   2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
   3. Wiring Compartment: Sized for conduit entry and wiring installation.
   4. Environmental Protection:
      a. Indoor: UL 50E, Type 2.
      b. Outdoor: UL 50E, Type 4X.
   5. Finish Color: ANSI 61 gray weather-resistant enamel.

F. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.

I. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.

J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 80 deg C rise above 40 deg C ambient temperature.

K. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.

L. K-Factor Rating: Transformers indicated to be K-factor rated must comply with UL 1561 requirements for nonsinusoidal load current-handling capability to degree defined by designated K-factor.

1. Unit may not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding indicated insulation class in 40 deg C maximum ambient and 24-hour average ambient of 30 deg C.
2. Indicate value of K-factor on transformer nameplate.
3. Unit must comply with requirements of DOE 2016 efficiency levels when tested in accordance with NEMA TP 2 with K-factor equal to one.

M. Electrostatic Shielding: Windings must have independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding shield.

N. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.

O. Wall Brackets: Manufacturer's standard brackets.

P. Low-Sound-Level Requirements: Maximum sound levels when factory tested in accordance with IEEE C57.12.91, as follows:
1. 9.01 to 30.00 kVA: [**45 dB(A-weighted)**] <**Insert dB(A-weighted)**>.
2. 30.01 to 50.00 kVA: 45 dB(A-weighted) for K-factors of 1, 4, and 9.
3. 50.01 to 150.00 kVA: 50 dB(A-weighted) for K-factors of 1, 4, and 9.
4. 150.01 to 300.00 kVA: 55 dB(A-weighted) for K-factors of 1, 4, and 9.

2.4 IDENTIFICATION

A. Nameplates:
1. Engraved, laminated-acrylic or melamine plastic signs for distribution transformers, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."
2. Self-adhesive label for distribution transformers. Self-adhesive labels are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections: Test and inspect assembled system, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with IEEE C57.12.01 and IEEE C57.12.91 before delivering to site. Affix label with name and date of manufacturer's qualified electrical testing laboratory's certification of system compliance on control units.
1. Resistance measurements of windings at rated voltage connections and at tap connections.
2. Ratio tests at rated voltage connections and at tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:

a. Line-side to ground.
b. Load-side to ground.
c. Line-side to load-side.

9. Temperature tests.

B. Nonconforming Work:
1. System equipment that does not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for transformers.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's published instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance must be 5 Ω at location of transformer.

E. Environment: Enclosures must be rated for environment in which they are located. Covers for UL 50E, Type 4X enclosures may not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer or from design drawings signed and sealed by qualified structural professional engineer.
1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.
2. Brace wall-mounted transformers as specified in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Install transformers level and plumb on concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases and anchor floor-mounted transformers in accordance with manufacturer's published instructions, seismic requirements applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base in accordance with manufacturer's published instructions.

E. Secure covers to enclosure and tighten bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

D. Provide flexible connections at conduit and conductor terminations and supports to eliminate sound and vibration transmission to building structure.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

B. Tests and Inspections:
1. Small (Up to 167 kVA Single-Phase or 500 kVA Three-Phase) Dry-Type Transformer Field Tests:
   a. Visual and Mechanical Inspection.
      1) Inspect physical and mechanical condition.
      2) Inspect anchorage, alignment, and grounding.
      3) Verify that resilient mounts are free and that shipping brackets have been removed.
      4) Verify that unit is clean.
      5) Perform specific inspections and mechanical tests recommended by manufacturer.
      6) Verify that as-left tap connections are as specified.
   b. Electrical Tests:
      1) Measure resistance at windings, taps, and bolted connections.
      2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.

3) Perform turns-ratio tests at tap positions. Test results may not deviate by more than one-half percent from either adjacent coils or calculated ratio. If test fails, replace transformer.
4) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

2. Large (Larger Than 167 kVA Single Phase or 500 kVA Three Phase) Dry-Type Transformer Field Tests:
   a. Visual and Mechanical Inspection:
      1) Inspect physical and mechanical condition.
      2) Inspect anchorage, alignment, and grounding.
      3) Verify that resilient mounts are free and that shipping brackets have been removed.
      4) Verify that unit is clean.
      5) Perform specific inspections and mechanical tests recommended by manufacturer.
      6) Verify that as-left tap connections are as specified.
   b. Electrical Tests:
      1) Measure resistance at windings, taps, and bolted connections.
      2) Perform insulation-resistance tests winding-to-winding and windings-to-ground. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: value of index may not be less than 1.0.
      3) Perform excitation-current test on each phase.
      4) Perform applied voltage test on line- and load-side windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.
      5) Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

C. Test Labeling: On completion of satisfactory testing of units, attach dated and signed "Satisfactory Test" label to tested components.

D. Nonconforming Work:
   1. Transformer will be considered defective if it does not pass tests and inspections.
   2. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Assemble and submit test and inspection reports.

F. Manufacturer Services:
   1. Engage factory-authorized service representative to supervise field tests and inspections.

3.5 ADJUSTING

A. Record transformer secondary voltage at unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.7 MAINTENANCE

A. Infrared Scanning: Two months after Substantial Completion, perform infrared scan of transformer connections.
   1. Use infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   2. Perform two follow-up infrared scans of transformers, one at four months and another at 11 months after Substantial Completion.
   3. Prepare certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Switchboards.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.

B. Related Requirements
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.2 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Switchboards.
2. Overcurrent protective devices.
3. Surge protection devices.
4. Groud-fault protection devices.
5. Accessories.
6. Other components.
7. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than UL 50E, Type 1.

3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:
1. Field Quality-Control Reports:
   a. Test procedures used.
   b. Test results that comply with requirements.
   c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions: Record copy of official installation and testing instructions issued to Installer by manufacturer for the following:
1. Handling, storing, and providing temporary heat.
2. Mounting accessories and anchoring devices.
3. Testing and adjusting overcurrent protective devices.

B. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing switchboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.

5. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to switchboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
2. Portable Test Set: For testing functions of solid-state trip devices without removing from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.

C. Handle and prepare switchboards for installation in accordance with NEMA PB 2.1.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:
   1. Main Devices: Panel mounted.
   2. Branch Devices: Panel mounted.
   3. Sections front and rear aligned.

I. Nominal System Voltage: 480Y/277 V.

J. Main-Bus Continuous: As indicated on drawings.

K. Indoor Enclosures: Steel, UL 50E, Type 1.

L. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over rust-inhibiting primer on treated metal surface.

M. Barriers: Between adjacent switchboard sections.

N. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

O. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
   1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
   2. Space-Heater Power Source: Transformer, factory installed in switchboard.

P. Service Entrance Rating: Switchboards intended for use as service entrance equipment may contain from one to six service disconnecting means with overcurrent protection, neutral bus with disconnecting link, grounding electrode conductor terminal, and main bonding jumper.

Q. Customer Metering Compartment: Separate customer metering compartment and section with front hinged door, and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring must be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

R. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

S. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

T. Pull Box on Top of Switchboard:
   1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
   2. Set back from front to clear circuit-breaker removal mechanism.
   3. Removable covers may form top, front, and sides. Top covers at rear must be easily removable for drilling and cutting.
   4. Bottom must be insulating, fire-resistive material with separate holes for cable drops into switchboard.
   5. Cable supports must be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

U. Buses and Connections: Three phase, four wire unless otherwise indicated.
   1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from front of switchboard.
   2. Phase- and Neutral-Bus Material:
      a. Hard-drawn copper of 98 percent conductivity, silver-plated.
      b. Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
   3. Copper feeder circuit-breaker line connections.
   4. Tin-plated aluminum feeder circuit-breaker line connections.
   5. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with [**mechanical**] [**compression**] connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
   6. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
   7. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
   8. Disconnect Links:
      a. Isolate neutral bus from incoming neutral conductors.
      b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
   9. Neutral Buses: 50 percent of ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
   10. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

V. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

W. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

X. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Business.
   2. Eaton.
   3. Siemens Industry, Inc., Energy Management Division.
   4. Square D; Schneider Electric USA.

B. SPDs: Listed and labeled in accordance with UL 1449, Type 1.

C. Features and Accessories:
   1. Integral disconnect switch.

2. Internal thermal protection that disconnects SPD before damaging internal suppressor components.
3. Indicator light display for protection status.
4. Form-C contacts rated at 5 A and 250 V(ac), one normally open and one normally closed, for remote monitoring of protection status. Contacts must reverse on failure of surge diversion module or on opening of current-limiting device. Coordinate with building power monitoring and control system.
5. Surge counter.

D. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase may not be less than 250 kA. Peak surge current rating must be arithmetic sum of ratings of individual MOVs in each mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits may not exceed the following:
1. Line to Neutral: 1200 V for 480Y/277 V.
2. Line to Ground: 1200 V for 480Y/277 V.
3. Line to Line: 2000 V for 480Y/277 V.

F. SCCR: Equal or exceed 200 kA.

G. Nominal Rating: 20 kA.

2.3 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, and the following:
1. Potential Transformers: NEMA EI 21.1; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy must be consistent with connected metering and relay devices.
2. Current Transformers: NEMA EI 21.1; 5 A, 60 Hz, secondary; bar or window type; single secondary winding and secondary shorting device. Burden and accuracy must be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
d. Megawatts: Plus or minus 1 percent.
e. Megavars: Plus or minus 1 percent.
f. Power Factor: Plus or minus 1 percent.
g. Frequency: Plus or minus 0.1 percent.

h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.4 CONTROL POWER

A. Control Circuits:
1. 120 V(ac), supplied through secondary disconnecting devices from control-power transformer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards in accordance with NEMA PB 2.1.
1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's published instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage in accordance with manufacturer's published instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect performance of equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
1. Switchboards and Accessories: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 2.1.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:
1. Equipment Mounting: Install switchboards on concrete base, 4 inch nominal thickness. Comply with requirements for concrete base specified in Section 260529 "Hangers and Supports for Electrical Systems."

a. Install conduits entering underneath switchboard, entering under vertical section where conductors will terminate. Install with couplings flush with concrete base. Extend 2 inch above concrete base after switchboard is anchored in place.
b. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around full perimeter of concrete base.
c. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
d. Place and secure anchorage devices. Use setting drawings, templates, diagrams, published instructions, and directions furnished with items to be embedded.
e. Install anchor bolts to elevations required for proper attachment to switchboards.
f. Anchor switchboard to building structure at top of switchboard if required or recommended by manufacturer.

2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.
3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
4. Operating Instructions: Frame and mount printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
5. Install filler plates in unused spaces of panel-mounted sections.
6. Install overcurrent protective devices, surge protection devices, and instrumentation.
   a. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Bond conduits entering underneath switchboard to equipment ground bus with bonding conductor sized in accordance with NFPA 70.

C. Support and secure conductors within switchboard in accordance with NFPA 70.

D. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Acceptance Testing:
      a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
      b. Test continuity of each circuit.
   2. Test ground-fault protection of equipment for service equipment in accordance with NFPA 70.
   3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   5. Perform the following infrared scan tests and inspections, and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

B. Nonconforming Work:
   1. Switchboard will be considered defective if it does not pass tests and inspections.
   2. Remove and replace defective units and retest.

C. Collect, assemble, and submit test and inspection reports, including certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Manufacturer Services:
   1. Engage factory-authorized service representative to supervise field tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature in accordance with manufacturer's published instructions, until switchboard is ready to be energized and placed into service.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Disconnecting and overcurrent protective devices.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. GFEP: Ground-fault equipment protection.

B. MCCB: Molded-case circuit breaker.

C. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Power panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
4. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.
1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for series rating of installed devices.
7. Include evidence of listing, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

9. Include wiring diagrams for power, signal, and control wiring.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include Internet link for electronic access to downloadable PDF of coordination curves.

C. Field Quality-Control Submittals:
1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

B. Manufacturers' Published Instructions: Record copy of official installation[**and testing**] instructions issued to Installer by manufacturer for the following:
1. Recommended procedures for installing panelboards.
2. Recommended torque settings for bolted connections on panelboards.
3. Recommended temperature range for energizing panelboards.

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish to Owner spare parts, for repairing panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Keys: Two spares for each type of panelboard cabinet lock.

B. Special Tools: Furnish to Owner proprietary equipment, keys, and software required to operate, maintain, repair, adjust, or implement future changes to panelboards, that are packaged with protective covering for storage on-site and identified with labels describing contents. Include the following:
1. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
2. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation in accordance with NEMA PB 1.

1.8 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
   1. Follow-On Extended-Warranty Period: Five years from date of Substantial Completion; full coverage for materials that failed because of transient voltage surges only, free on board destination, freight prepaid.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards in accordance with IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing agency recognized by authorities having jurisdiction, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Surface-mounted, dead-front cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: UL 50E, Type 1.
      b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.
   2. Height: 7 ft maximum.
   3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims must cover live parts and may have no exposed hardware.
   4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims must cover live parts and may have no exposed hardware.
   5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
   6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
   7. Finishes:
      a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Galvanized steel.
      c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:
   1. Location: Top or Bottom.
   2. Main Breaker: Main lug interiors up to 400 A must be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:
   1. Material: Hard-drawn copper, 98 percent conductivity.
      a. Plating must run entire length of bus.
      b. Bus must be fully rated for entire length.
   2. Interiors must be factory assembled into unit. Replacing switching and protective devices may not disturb adjacent units or require removing main bus connectors.
   3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
   4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
   5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure.
   6. Do not mount neutral bus in gutter.

I. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Hard-drawn copper, 98 percent conductivity.
   2. Terminations must allow use of 75 deg C rated conductors without derating.
   3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
   4. Main and Neutral Lugs: Mechanical type, with lug on neutral bar for each pole in panelboard.
   5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with lug on bar for each pole in panelboard.

J. Quality-Control Label: Panelboards or load centers must be labeled, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers must have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers must have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
   1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating:
   1. Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed, by qualified electrical testing laboratory recognized by authorities having jurisdiction, for 100 percent interrupting capacity.
      a. Panelboards and overcurrent protective devices rated 240 V or less must have short-circuit ratings as shown on Drawings, but not less than 10 000 A(rms) symmetrical.
      b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V must have short-circuit ratings as shown on Drawings, but not less than 14 000 A(rms) symmetrical.

M. Surge Suppression: Factory installed as integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton/Cutler-Hammer
   2. General Electric
   3. Siemens Industry, Inc., Energy Management Division.
   4. Square D; Schneider Electric USA.

B. Listing Criteria: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
   1. For doors more than 36 inch high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only as indicated on drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Business.
   2. Bender Inc.; Bender GmbH & Co. KG.
   3. Eaton.
   4. Siemens Industry, Inc., Energy Management Division.
   5. Square D; Schneider Electric USA.

B. Listing Criteria: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with flush latch with tumbler lock; keyed alike. Outer door must permit full access to panel interior. Inner door must permit access to breaker operating handles and labeling, but current carrying terminals and bus must remain concealed.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton/Cutler-Hammer

2. General Electric
3. Square D; Schneider Electric USA.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
   a. Inverse time-current element for low-level overloads.
   b. Instantaneous magnetic trip element for short circuits.
   c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event must be recorded with type, phase, and magnitude of fault that caused trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:
      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.
4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6 mA trip).
5. GFEP Circuit Breakers: Class B ground-fault protection (30 mA trip).
6. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   f. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
   g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
   h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
   i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 A must have interchangeable rating plugs or electronic adjustable trip units.
   j. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
   k. Multipole units enclosed in single housing with single handle.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards in accordance with NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:
1. Panelboards: Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA PB 1.1.
2. Consult Architect for resolution of conflicting requirements.

C. Special Techniques:
1. Equipment Mounting:
   a. Attach panelboard to vertical finished or structural surface behind panelboard.
   b. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.
   c. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
2. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
4. Mount top of trim 7.5 ft above finished floor unless otherwise indicated.
5. Mount panelboard cabinet plumb and rigid without distortion of box.
6. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
7. Install overcurrent protective devices and controllers not already factory installed.
   a. Set field-adjustable, circuit-breaker trip ranges.
   b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver in accordance with manufacturer's published instructions.
8. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

9. Install filler plates in unused spaces.
10. Stub four 1 inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in future. Stub four 1 inch empty conduits into raised floor space or below slab not on grade.
11. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
12. Mount spare fuse cabinet in accessible location.

D. Interfaces with Other Work:
1. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Panelboard Nameplates: Label each panelboard with nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

D. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles must be located on interior of panelboard door.

E. Breaker Labels: Faceplate must list current rating, UL and IEC certification standards, and AIC rating.

F. Circuit Directory:
1. Provide directory card inside panelboard door, mounted in metal frame with transparent protective cover.
   a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
2. Provide computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
   a. Circuit directory must identify specific purpose with detail sufficient to distinguish it from other circuits.
3. Create directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:
1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Nonconforming Work:
1. Panelboards will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports, including certified report that identifies panelboards included and that describes scanning results, with comparisons of two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:
1. Engage factory-authorized service representative to supervise field tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within panelboard, may not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature in accordance with manufacturer's published instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Standard-grade receptacles, 125 V, 20 A.
   2. USB receptacles.
   3. GFCI receptacles, 125 V, 20 A.
   4. SPD receptacles, 125 V, 20 A.
   5. Toggle switches, 120/277 V, 20 A.
   6. Wall plates.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

E. RFI: Radio-frequency interference.

F. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:
1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
2. SPD Devices: Blue.
3. Isolated-Ground Receptacles: Orange.

F. Wall Plate Color: For plastic covers, match device color.

G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Isolated-Ground Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Pass & Seymour; Legrand North America, LLC.
   b. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-15R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498 and UL 943 Class A.
6. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 SPD RECEPTACLES, 125 V, 20 A

A. Isolated-Ground Duplex SPD Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light.
3. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

4. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
5. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
6. Configuration: NEMA WD 6, Configuration 5-20R.
7. Standards: Comply with UL 498, UL 1449, and FS W-C-596.

2.5 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Configuration: NEMA WD 6, Configuration L5-20R.
3. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour; Legrand North America, LLC.
2. Configuration: NEMA WD 6, Configuration L6-20R.
3. Standards: Comply with UL 498.

2.6 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
   b. Leviton Manufacturing Co., Inc.
   c. Pass & Seymour; Legrand North America, LLC.
   d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
2. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Leviton Manufacturing Co., Inc.
      c. Pass & Seymour; Legrand North America, LLC.
      d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
   2. Comply with UL 20 and FS W-S-896.

D. Four-Way Switches, 120/277 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Leviton Manufacturing Co., Inc.
      c. Pass & Seymour; Legrand North America, LLC.
      d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
   2. Standards: Comply with UL 20 and FS W-S-896.

E. Lighted Single-Pole Switches, 120/277 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Hubbell Premise Wiring; Hubbell Incorporated, Commercial and Industrial.
      c. Leviton Manufacturing Co., Inc.
      d. Pass & Seymour; Legrand North America, LLC.
   2. Description: Handle illuminated when switch is [**on**] [**off**].
   3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

F. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Arrow Hart, Wiring Devices; Eaton, Electrical Sector.
      b. Leviton Manufacturing Co., Inc.
      c. Pass & Seymour; Legrand North America, LLC.
      d. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.
   2. Description: For use with mechanically held lighting contactors and interior vacancy sensors.
   3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.7 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
   3. Material for Unfinished Spaces: Galvanized steel.
   4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:
1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on bottom. Group adjacent switches under single, multigang wall plates.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:
   1. Test Instruments: Use instruments that comply with UL 1436.
   2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.
   6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers (MCCBs).
4. Enclosures.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. GFEP: Ground-fault circuit-interrupter for equipment protection.

B. GFLS: Ground-fault circuit-interrupter for life safety.

C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data:
1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
2. Enclosure types and details for types other than UL 50E, Type 1.
3. Current and voltage ratings.
4. Short-circuit current ratings (interrupting and withstand, as appropriate).
5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
7. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.
1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Warranty documentation.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain products from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Business.
2. Eaton.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty:
1. Single throw.
2. Three pole.
3. 600 V(ac).
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Business.
   2. Eaton.
   3. Siemens Industry, Inc., Energy Management Division.
   4. Square D; Schneider Electric USA.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Business.
   2. Eaton.
   3. NOARK Electric North America.
   4. Siemens Industry, Inc., Energy Management Division.
   5. Square D; Schneider Electric USA.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker. Circuit breakers must be 100 percent rated.

E. MCCBs must be equipped with device for locking in isolated position.

F. Lugs must be suitable for 75 deg C rated wire.

G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

2.5 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Business.
   2. Eaton.
   3. NOARK Electric North America.
   4. Siemens Industry, Inc., Energy Management Division.
   5. Square D; Schneider Electric USA.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:
   1. Standard frame sizes and number of poles.
   2. Lugs:
      a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
      b. Lugs must be suitable for 75 deg C rated wire.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: Enclosure must be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1).

C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: Circuit-breaker operating handle must be externally operable with operating mechanism being integral part of box, not cover. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism,

which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.

F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R or Type 4X as indicated.

C. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Special Techniques:
   1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
   2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
   3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
   4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
   5. Install fuses in fusible devices.

3.4 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the following methods:
         1) Use low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify correct phase barrier installation.
      i. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
   2. Electrical Tests:
      a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
      b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
      c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
      d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

B. Tests and Inspections for Molded-Case Circuit Breakers:
   1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify that unit is clean.
e. Operate circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance using one of the following methods:
   1) Use low-resistance ohmmeter.
      a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
   2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
      a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
g. Inspect operating mechanism, contacts, and chutes in unsealed units.
h. Perform adjustments for final protective device settings in accordance with coordination study.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

C. Nonconforming Work:
   1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
   2. Remove and replace defective units and retest.

D. Collect, assemble, and submit test and inspection reports.
   1. Test procedures used.
   2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
   3. List deficiencies detected, remedial action taken, and observations after remedial action.

E. Manufacturer Services:
   1. Engage factory-authorized service representative to supervise field tests and inspections.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.7 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.8 MAINTENANCE

A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
   1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
   3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
   4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

SECTION 16 42 50 VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish and install variable frequency drives (VFD), complete and operational with controls and accessories as shown on the Drawings and as specified. Type 316 stainless steel anchor bolts shall be included and shall be furnished in this Section.

B. Related Sections: CONTRACTOR shall coordinate the requirements of the Work in this Section along with the requirements of the Sections listed below which includes, but is not necessarily limited to, Work that is directly related to this Section.

1. Section 22 13 29.16 Submersible Sewage Pumps.

C. Coordination: CONTRACTOR shall coordinate speed control, starting and acceleration torque requirements with the driven equipment. CONTRACTOR shall submit an acceptance letter from the driven equipment and motor manufacturers stating that each VFD will fully meet all starting and operating requirements of the respective driven equipment/motor combination. CONTRACTOR shall be responsible for coordinating all VFD units with the driven equipment to obtain successful operation throughout the driven equipment speed range.

1.02 QUALITY ASSURANCE

A. Manufacturers Qualifications:

1. Manufacturer shall have a minimum of five years of experience producing substantially similar equipment, and shall be able to show evidence of at least five installations in satisfactory operation for at least five years. Prototypes or newly introduced drive unit models will not be acceptable.

B. The manufacturer shall demonstrate, in writing, the Quality Assurance Program in use to certify key components. In-house manufacture of key components is desirable, and will be considered in evaluating acceptance.

C. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.

1. National Electrical Code.

2. Standards of National Electrical Manufacturers Association.

3. Institute of Electrical and Electronic Engineers.

4. American Gear Manufacturers Association.

5. Applicable local Electrical Code.

6. National Fire Protection Association 79, Electrical Standard for Industrial Machinery.

D. For the equipment specified herein, the manufacturer shall be ISO 9000, 9001, or 9002 certified.

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Manufacturer's literature, illustrations, specifications and engineering data which indicate performance, dimensions, materials, size and weight.

2. Fabrication, assembly and installation drawings, and wiring diagrams.

3. Complete list of components and catalogue identification.

4. List of in-house manufactured key components.

5. Quality Assurance Program description.

6. Complete description of schematic and wiring diagrams and functional operation.

7. Recommended spare parts list.

B. Operation and Maintenance Manuals:

1. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation and spare parts information.

2. Furnish Operation and Maintenance Manuals in conformance with the requirements of Section 01781, Operation and Maintenance Data.

3. Furnish list of final parameters and function selections programmed into each drive control module.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices which are to be embedded in cast-in-place concrete in ample time to prevent delay of the Work.

B. All boxes, crates and packages shall be inspected by CONTRACTOR upon delivery to the site. CONTRACTOR shall notify ENGINEER of any loss or damage exists to equipment or components. Replace loss and repair damage to new condition in accordance with manufacturer's instructions.

C. Store materials to permit easy access for inspection and identification. Keep all materials off the ground, using pallets, platforms or other supports. Protect steel members and packaged materials from corrosion and deterioration.

D. Store all electrical and electronic equipment, control panels, and like equipment and materials in heated buildings which have a concrete or wooden floor, a roof, and fully closed walls on all sides. Protect electrical and electronic equipment from contamination by dust, dirt and moisture. Maintain humidity at levels recommended by manufacturer for electric and electronic equipment.

E. Energize space heaters during storage.

1.05 SHOP TESTS

A. Each variable frequency drive (VFD) shall be tested at the manufacturer's facility.

B. In addition to the manufacturer's standard tests, each VFD, including all instruments, controls, solid state components, systems, and internal and external equipment which are a part of the VFDs shall be assembled, tested and thoroughly checked for proper operation of all functions and features. Simulated signals and loads shall be employed

that shall simulate actual signals and loads, if they are a part of the final installation and are not included in this Section.

C. If the test results indicate that any VFD unit does not conform to specified and/or guaranteed performance, the unit shall be modified and retested, at no additional cost to OWNER, until full compliance with specified and guaranteed performance can be demonstrated. OWNER and/or ENGINEER shall be permitted to witness the retest.

D. No equipment shall be shipped until the ENGINEER has approved all test reports.

PART 2 PRODUCTS

2.01 GENERAL

A. CONTRACTOR shall furnish and install variable frequency drive units, AC PWM inverter type, 480 volts, sine coded with carrier frequency adjustment, 3-phase, 60 hertz input with output suitable for and coordinated with the driven equipment furnished under the appropriate Sections in Division 11, Equipment. Drives shall be equipped with input harmonic filters as indicated on the Drawings.

B. VFD supplier shall coordinate with pump supplier to ensure VFD compatibility with pumps.

C. The drives shall have the following characteristics:

1. Output voltage (Maximum): 460 volts.

2. Frequency accuracy: ±0.5 percent (at 25°C ±l0°C).

3. Frequency range: 3 to 67 hertz, selectable by switch to 120 hertz (Except where otherwise indicated).

4. Volts per hertz ratio (V/HZ) adjustable for 3 to 60 hertz.

5. Overload capacity shall be one minute at 125 percent of continuous constant torque rated nameplate current. The inverter shall be designed to not be internally shutdown within the 125 percent overload operating range.

6. Constant torque rated for motor nameplate horsepower without revision of inverter unit manufacturer's nameplated published constant torque rating.

D. VFD's shall meet all requirements as outlined in the latest edition of IEEE 519 for total harmonic voltage and current distortion and as indicated in this Section. Individual or simultaneous operation of the VFDs shall not add more than three percent total harmonic voltage distortion while operating. Maximum allowable total harmonic current distortion limits for each VFD and its filter shall not exceed five percent as calculated and measured at the point of common coupling. The point of common coupling for all harmonic calculations and field measurements for both voltage and current distortion shall be the utility service entrance section. A preliminary harmonic analysis must be submitted by the VFD manufacturer with Shop Drawings which includes all voltage and current harmonics up to the 99th harmonic; for this purpose, cable lengths can be estimated on a conservative basis by CONTRACTOR. Compliance shall be verified with onsite field measurements of both the voltage and current harmonic distortion at the defined point of common coupling with and without the VFD's operating.

E. Product and Manufacturer: Provide one of the following:

1. Danfoss, VLT Aqua Drive FC 202 Series

2. No Equal

2.02 DETAILS OF CONSTRUCTION

A. All individually mounted VFD's shall be housed in NEMA 1 wall or floor mounted cabinets configured as shown on the Drawings. VFD units shall be individually fed from circuit breakers located in distribution equipment as shown on the Drawings. Conduit and cable entrances shall be from either top or bottom. VFD's shall be located as shown on the Drawings. Space shall be verified for future units.

B. The VFD units shall require front access only and shall be suitable for against-the-wall installation. Bypass contactors, where required, shall be integral to VFD enclosure along with the overload relay.

C. VFD shall be furnished with a back-channel cooling kit. The back-channel cooling kit shall duct air from outside of the electric room through each VFD and back outside.

2.03 OPERATIONAL DESCRIPTION

A. Operational sequences shall be as shown on the Drawings and described in the applicable Sections of these Specifications.

2.04 OPTIONAL VFD COMPONENTS

A. All VFD units shall be furnished with no less than the following:

1. Input circuit breaker interlocked with the unit door. Switch shall be pad lockable in the "OPEN" position.
2. Fused control power transformer.
3. Motor contactor where required by the Drawings.
4. By-pass contactor with overload relay with external or programmable reset where required by the Drawings.
5. Speed control to be integral on the programmable control module.
6. Process follower to accept 4 to 20 mA DC signal input.
7. Output signal of 4 to 20 mA DC proportional to speed.
8. Discrete IO as indicated on the drawings.
9. Ethernet/IP communications module.
10. All additional devices as shown on the Drawings and specified herein.

2.05 MANUFACTURER

A. The VFD's listed in this Division and in other Divisions shall be the product of one manufacturer. The VFD assembler shall be the manufacturer of the power inverter.

2.06 HARMONIC FILTER

A. The bus from which the VFDs are supplied shall be equipped with an active harmonic filter. Active harmonic filter shall be rated for 480VAC, 60Hz, in a free-standing Type NEMA 2 enclosure.

B. Product and Manufacturer: Provide the following:

1. Eaton, HCU2 Harmonic Correction Unit, Model number: HCU2300D5
2. Or approved equal

2.07 LINE REACTOR

A. Each VFD shall be supplied by a 3% series line reactor fully rated for service or equivalent, provided separately or incorporated into drive

2.08 MOTOR PROTECTION RELAY

A. The bus from which the VFDs are supplied shall be equipped with an active harmonic filter. Active harmonic filter shall be rated for 480VAC, 60Hz, in a free-standing Type NEMA 2 enclosure.

B. Operation

1. Current sensing Environment: -20 to 65°C (-4 to 149°F)

2. Supply Voltage: 120 VAC 50-60 Hz ±10%

3. Relay Contact Rating: 10 Amps@ 120 VAC Voltage to Sensor: 12 VDC ±10% Values of Operation: 3.0 mA<I< 3.0 mA = High temp. ±5% (or interrupt). I > 22.0 mA = Leakage ±5% (or short circuit). (I= current measured by the MiniCAS II/FUS).

C. Indication

1. Green LED On= Supply Voltage present

2. Green LED Off= No Supply Voltage present

D. Product and Manufacturer: Provide the following:

1. Flygt , MiniCAS II

2. No equal

2.09 TRANSIENT CONDITIONS

A. The drives shall be capable of accepting a supply variation of 460 volts plus five percent or minus ten percent at 60 hertz plus or minus two hertz as a standard design feature.

B. The drives shall be of the diode bridge rectifier front-end type to minimize electrical noise generation and to operate at not less than 95 percent power factor over the full operating range.

C. For sustained or momentary power outages the drives shall have a safe shutdown design with automatic ramp-up return to normal operation, upon restoration of power.

D. For momentary voltage dips which shut down the drive, means shall be provided for automatic ramp-up return to full, controlled operation upon restoration of full line voltage

2.10 ENVIRONMENT

A. The drive shall be capable of operating under any combination of the following conditions without mechanical or electrical damage:

1. Ambient temperature: 0 to 50°C.

2. Relative humidity: 0 to 95 percent non-condensing.

3. Vibration: 0 to 0.5G.

2.11 CONTROL REQUIREMENTS

A. Current limit circuitry shall automatically phase back voltage and frequency to decrease current to 125 percent of the drive rated capacity.

B. The drive and inverter shall be UL listed and labeled by a nationally recognized testing laboratory.

C. The variable speed drive system shall include a diode bridge converter, filter network and a transistorized inverter section. Base driver signals used to control firing of the power transistors shall be designed with optically coupled isolators.

2.12 PROTECTIVE AND OPERATIONAL CHARACTERISTICS

A. The drives shall have the following protective and operational characteristics in addition to those previously described:

1. Adjustable current limit.
2. Overcurrent trip (125 percent).
3. Short circuit trip (hall-effect current transformer).
4. DC bus overvoltage trip.
5. DC bus fuses.
6. Line undervoltage trip (-30 percent) with automatic restart on voltage recovery.
7. Momentary power failure trip (greater than ten milliseconds) with automatic restart.
8. Line input 3-pole circuit breaker with current limiting fuses or current limiting circuit breaker and door interlock.
9. 4 to 20 mA DC output signal proportional to speed.
10. LED display of the following:
    a. Overcurrent trip at 125 percent.
    b. Internal component short circuit.
    c. Output short circuit.
    d. Overload (when soft stall not selected).
    e. Overvoltage on DC bus.
    f. Overvoltage on input.
    g. Undervoltage.
    h. Overheat.
    i. Ground Fault.
    J. Initial parameter mismatch.
11. Electronic motor overload relay.
12. An internal microprocessor shall monitor the load on the drive and in the event of an overload it shall, based on the microprocessor's calculation of the true inverse time overload characteristic, either trip out or phase back the voltage

and speed as selected by an internal jumper.

13. Acceleration time: 1 to 20 seconds adjustable.

14. Dynamic braking: 12 percent standard.

15. Ramp to stop: 1 to 20 seconds adjustable.

16. Speed control integral to the programmable control module.

17. Frequency meter integral to the programmable control module.

18. Local/Computer operation solid-state selector switch to be integral to the programmable control module.

19. General fault, run, and stop indication pilot lights mounted on door or integral to the programmable control module. The display must indicate the type of alarm, not part of a general alarm. If programmable control module is not capable of providing indication, provide fault indication pilot lights mounted on the door for each alarm/shutdown condition.

20. Motor and bypass contactors and power unit isolation circuit breaker or contactor as shown on the Drawings or described in the Specifications. Contactors shall be NEMA integral size. Half sizes and IEC rated contactors shall not be acceptable. NEMA dual rated contactors shall not be acceptable. Disconnects to have locking provisions.

21. Isolated contacts for remote indication of "RUNNING", “Computer Mode Selection", VFD Fault and all other alarm conditions, as required by the Drawings.

22. Normal/bypass selector switch (for units with by-pass contactors) if feature is not available from the programmable control module.

23. Fault reset button on door if fault reset feature is not available from the programmable control module.

24. VFD shall be equipped with a de-ragging reversal function.

B. The drive units shall be able to withstand phase-to-phase and phase-to-ground shorts without damage to the drive unit.

C. The drive shall include the solid-state features described above on plug-in circuit boards with microprocessor and on-board diagnostic circuitry with LED readouts as listed above.

D. The drive shall have integral transformers to supply all required control voltages including space heaters, where required. The control transformer and entire drive unit shall be de-energized when the line disconnect switch or circuit breaker is opened.

E. Fault trip conditions, except short time or momentary line voltage loss or line voltage momentary dip, shall lock out the control. Resetting of control after fault trip you shall be manual by a door-mounted pushbutton.

F. Auto restart shall be a standard feature of the drive as follows:

1. Auto restart shall be enabled or disabled by programming or jumper selection.

2. On auto restart selection, the microprocessor shall determine, in the event of a fault, if a restart should be attempted. A restart shall be attempted under the following conditions:

a. Undervoltage (UP): Every time as soon as voltage returns to a safe level. Fault relay shall not be activated.

b. Input Overvoltage (OPS): Every time as soon as voltage returns to a safe level. Fault relay shall be activated for the duration of the high voltage condition.

c. Overcurrent (OC): Five attempts in 30 seconds. After the fifth OC, the drive shall trip out and latch the fault relay.

G. A restart shall not be attempted for any other type of fault and the drive shall trip out immediately, activate the fault relay, and make the information available on the programmable control module display until the drive is manually reset.

H. An undervoltage condition of less than 30 ms duration shall not affect drive operation. If main power falls below 85 percent of rated voltage for longer than 30 ms while control power is retained, the drive shall forcibly decelerate the load in an attempt to force a higher bus voltage through regeneration to allow the drive to "ride through" the undervoltage condition for up to 70 additional milliseconds for a total "ride through" of up to 100 ms for very high inertia loads. The manufacturer shall provide an option that allows control power to be maintained for 100 ms in the event of a power failure. If the drive drops out, it shall automatically restart upon restoration of full rated voltage, as previously described.

2.13 FACTORY TESTS

A. The testing procedure shall be the manufacturer's standard procedure to assure maintenance free service. The OWNER shall be given 14 days notice prior to start of factory testing so that the OWNER, at his option, may witness the testing.

1. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The VFD shall trip electronically without device failure.

2. After all tests have been performed; each VFD shall undergo a 40- hour bum-in test. The VFD's shall be burned in at 100 percent inductive or motor load for 40 hours without an unscheduled shutdown.

3. After the bum-in cycle is complete, each VFD shall be put through a 30-minute cycling motor load test before inspection and shipping.

4. Certification that all of the testing above has been performed shall be provided by the VFD manufacture, upon request.

B. All equipment, devices, instrumentation, and personnel required to perform the tests shall be supplied by the manufacturer. Upon satisfactory completion of the test, the manufacturer shall submit two certified copies of the test report to the ENGINEER. Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.

2.14 PAINTING

A. Units shall receive manufacturer's standard finish paint system prior to shipment.

B. Machined, polished, and non-ferrous surfaces shall be coated with corrosion prevention compound.

C. Painting shall conform to the requirements of Section 0 990 00, Painting.

D. All internally electronic components, devices terminations and other items shall be coated with an epoxy based conformal coating system.

PART 3 EXECUTION

3.01 INSTALLATION

A. VFD shall be installed such that heat generated by the VFD shall be vented outside of the electrical building.

3.02 START-UP AND TEST

A. Make adjustments required to place system in proper operating condition.

B. A manufacturer's representative shall check and approve the installation before operation. He shall test operate the system in the presence of the ENGINEER and verify that the units conform to requirements. He shall revisit the jobsite as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

3.03 MANUFACTURER'S SERVICES

A. A factory trained representative shall be provided for installation supervision, start-up and test services and operation and maintenance personnel training services. The representative shall make a minimum of 2 visits, minimum 8 hours on-site for each visit, to the site. The first visit shall be for assistance in the installation of equipment. The second visit shall be for checking the completed installation and start-up of the system. The third visit shall be as described under Section 01821, Instruction of Operations and Maintenance Personnel. Manufacturer's representative shall test operate the system in the presence of the ENGINEER and verify that the variable frequency drives conform to requirements. Representative shall revisit the job site as often as necessary until all trouble is corrected and the installation is entirely satisfactory.

B. All costs, including travel, lodging, meals and incidentals, shall be considered as included in CONTRACTORS bid price.

END OF SECTION

SECTION 263213.13 - DIESEL-ENGINE-DRIVEN GENERATOR SETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Diesel engine.
2. Diesel fuel-oil system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor engine generator enclosure.
7. Vibration isolation devices.

B. Related Requirements:
1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.
4. Include fuel consumption in gallons per hour at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide drawings indicating requirements and limitations for location of air intake and exhausts.

7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:
1. Include plans and elevations for engine generator and other components specified. Indicate access requirements affected by height of subbase fuel tank.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for engine generators and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, including full fuel tank, supplied enclosure, external silencer, subbase-mounted fuel tank, and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source Quality-Control Reports: Including, but not limited to, the following:
1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in other specification sections, include the following:
      a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
      b. Operating instructions laminated and mounted adjacent to generator location.
      c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
   4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar, Inc.; Electric Power Division.
   2. Cummins Power Generation.
   3. Generac Power Systems, Inc.
   4. Kohler Power Systems.

B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine generator housing, subbase fuel tank, engine generator, batteries, battery racks, silencers, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Component Importance Factor: 1.0.

B. B11 Compliance: Comply with B11.19.

C. NFPA Compliance:
   1. Comply with NFPA 37.
   2. Comply with NFPA 70.
   3. Comply with NFPA 110 requirements for Level 2 EPSS.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with EPA Tier 3 requirements and applicable state and local government requirements.

F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

G. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient Temperature: 5 to 104 deg F.
   2. Relative Humidity: Zero to 95 percent.
   3. Altitude: Sea level to 1000 feet.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Power Rating: 650 KVA - **Standby**.

D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.

E. EPSS Class: Engine generator shall be classified as a Class 6 according to NFPA 110.

F. Service Load: As indicated on drawings.

G. Power Factor: 0.8, lagging.

H. Frequency: 60 Hz.

I. Voltage: 480-Volts ac.

J. Phase: Three-phase, four wire, wye.

K. Induction Method: Naturally aspirated.

L. Governor: Adjustable isochronous, with speed sensing.

M. Mounting Frame: Structural steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

N. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries.
   2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

O. Engine Generator Performance:
   1. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
   2. Transient Voltage Performance: Not more than 15 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
   3. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
   4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   5. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
   6. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   7. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
   8. Start Time:
      a. Comply with NFPA 110, **Type 10** system requirements.

2.4 DIESEL ENGINE

A. Fuel: ASTM D975, diesel fuel oil, Grade 2-D S15.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid-mounted.
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.

E. Integral Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator set mounting frame and integral engine-driven coolant pump.
   1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
   4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.
      a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer:
   1. Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
      a. Minimum sound attenuation of 25 dB at 500 Hz.
      b. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 78 dBA or less.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24-V electric, with negative ground.
   1. Components: Sized so they are not damaged during a full engine-cranking cycle with ambient temperature at maximum specified in "Performance Requirements" Article.
   2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
   3. Cranking Cycle: 60 seconds.
   4. Battery: Lead acid, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
9. Battery Charger: Current-limiting, automatic-equalizing, and float-charging type designed for lead-acid batteries. Unit shall comply with UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 DIESEL FUEL-OIL SYSTEM

A. Comply with NFPA 37.

B. Piping: Fuel-oil piping shall be Schedule 40 black steel, complying with requirements in Section 231113 "Facility Fuel-Oil Piping." Cast iron, aluminum, copper, and galvanized steel shall not be used in the fuel-oil system.

C. Main Fuel Pump: Mounted on engine to provide primary fuel flow under starting and load conditions.

D. Fuel Filtering: Remove water and contaminants larger than 1 micron.

E. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Subbase-Mounted, Double-Wall, Fuel-Oil Tank: Factory installed and piped, complying with UL 142 fuel-oil tank. Features include the following:

1. Tank level indicator.
2. Fuel-Tank Capacity: Minimum 133 percent of total fuel required for planned operation plus fuel for periodic maintenance operations between fuel refills.
3. Leak detection in interstitial space.
4. Vandal-resistant fill cap.
5. Containment Provisions: Comply with requirements of authorities having jurisdiction.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Provide minimum run time control set for 15 minutes with override only by operation of a remote emergency-stop switch.

C. Comply with UL 508A.

D. Configuration:
1. Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

E. Control and Monitoring Panel:
1. Digital engine generator controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Instruments: Located on the control and monitoring panel and viewable during operation.
   a. Engine lubricating-oil pressure gage.
   b. Engine-coolant temperature gage.
   c. DC voltmeter (alternator battery charging).
   d. Running-time meter.
   e. AC voltmeter, for each phase.
   f. AC ammeter, for each phase.
   g. AC frequency meter.
   h. Generator-voltage adjusting rheostat.
3. Controls and Protective Devices: Controls, shutdown devices, and common alarm indication, including the following:
   a. Cranking control equipment.
   b. Run-Off-Auto switch.
   c. Control switch not in automatic position alarm.
   d. Overcrank alarm.
   e. Overcrank shutdown device.
   f. Low-water temperature alarm.
   g. High engine temperature prealarm.
   h. High engine temperature.

i. High engine temperature shutdown device.
j. Overspeed alarm.
k. Overspeed shutdown device.
l. Low fuel main tank.
   1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for duration required in "Fuel Tank Capacity" Subparagraph in "Diesel Fuel-Oil System" Article.
m. Coolant low-level alarm.
n. Coolant low-level shutdown device.
o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant high-temperature shutdown device.
r. EPS load indicator.
s. Battery high-voltage alarm.
t. Low cranking voltage alarm.
u. Battery-charger malfunction alarm.
v. Battery low-voltage alarm.
w. Lamp test.
x. Contacts for local and remote common alarm.
y. Low-starting air pressure alarm.
z. Low-starting hydraulic pressure alarm.
aa. Remote manual stop shutdown device.
bb. Air shutdown damper alarm when used.
cc. Air shutdown damper shutdown device when used.
dd. Generator overcurrent-protective-device not-closed alarm.
ee. Hours of operation.
ff. Engine generator metering, including voltage, current, hertz, kilowatt, kilovolt ampere, and power factor.

F. Engine Generator Metering: Comply with Section 260913 "Electrical Power Monitoring and Control."

G. Connection to Datalink:
   1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
   2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet. Data system connections to site control panel are covered in Section 260913 "Electrical Power Monitoring and Control."

H. Common Remote Panel with Common Audible Alarm: Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

I. Remote Alarm Annunciator: An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.
   1. Overcrank alarm.
   2. Low water-temperature alarm.

3. High engine temperature prealarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low fuel main tank alarm.
8. Low coolant level alarm.
9. Low cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low-cranking voltage alarm.
19. Generator overcurrent-protective-device not-closed alarm.

J. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

K. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices shall be coordinated to optimize selective tripping when a short circuit occurs.
   1. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.
   2. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Overcurrent Protective Device:
   1. Molded-case circuit breaker, electronic-trip type; 100 percent rated; complying with UL 489:
      a. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
      b. Trip Settings: Selected to coordinate with generator thermal damage curve.
      c. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
      d. Mounting: Adjacent to, or integrated with, control and monitoring panel.

C. Generator Protector: Microprocessor-based unit shall continuously monitor current level in each phase of generator output, integrate generator heating effect over time, and predict when thermal damage of alternator will occur. When signaled by generator protector or other engine generator protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from load circuits. Protector performs the following functions:

1. Initiates a generator overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other engine generator malfunction alarms. Contacts shall be available for load shed functions.
2. Under single- or three-phase fault conditions, regulates generator to 300 percent of rated full-load current for up to 10 seconds.
3. As overcurrent heating effect on the generator approaches the thermal damage point of the unit, protector switches the excitation system off, opens the generator disconnect device, and shuts down the engine generator.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground fault.
1. Trip generator protective device on ground fault.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.

E. Range: Provide limited range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.
1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 15 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within 5 seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description:
   1. Vandal-resistant, sound-attenuating, weatherproof steel housing; wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.
      a. Sound Attenuation Level: 80 dB(A).
   2. Prefabricated or pre-engineered, galvanized-steel-clad, integral structural-steel-framed, walk-in enclosure; erected on concrete foundation.

B. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 100 mph.

C. Seismic Design: Comply with seismic requirements in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Hinged Doors: With padlocking provisions.

E. Space Heater: Thermostatically controlled and sized to prevent condensation.

F. Lighting: Provide weather-resistant LED lighting with 30 fc average maintained.

G. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

H. Muffler Location: Within enclosure.

I. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.
   2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.
   3. Ventilation: Provide temperature-controlled exhaust fan interlocked to prevent operation when engine is running.

J. Interior Lights with Switch: Factory-wired, vapor-proof luminaires within housing; arranged to illuminate controls and accessible interior. Arrange for external electrical connection.
   1. AC lighting system and connection point for operation when remote source is available.

K. Convenience Outlets: Factory-wired, GFCI. Arrange for external electrical connection.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Bridge-bearing neoprene, complying with AASHTO M 251 separated by steel shims.
2. Shore A Scale Durometer Rating: 50.
3. Number of Layers: Three.
4. Minimum Deflection: 1 inch.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment-mounting and -leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Minimum Deflection: 1 inch.

C. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
1. Tests: Comply with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections. Verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Equipment Mounting:
   1. Install packaged engine generators on cast-in-place concrete equipment bases. See construction drawings for details.
   2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
   3. Install packaged engine generator with restrained spring isolators having a minimum deflection of 1 inch on 4-inch- high concrete base. Secure enclosure to anchor bolts installed in concrete bases. Concrete base construction is specified in Section 260548.16 "Seismic Controls for Electrical Systems."

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Exhaust System: Install Schedule 40 black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet.
   1. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."
   2. Install isolating thimbles where exhaust piping penetrates combustible surfaces with a minimum of 9 inches of clearance from combustibles.

F. Drain Piping: Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40 black steel pipe with welded joints.
   1. Piping materials and installation requirements are specified in Section 232113 "Hydronic Piping."

G. Fuel Piping:
   1. Copper and galvanized steel shall not be used in the fuel-oil piping system.

H. Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow space for service and maintenance.

B. Connect engine exhaust pipe to engine with flexible connector.

C. Connect fuel piping to engines with a gate valve and union and flexible connector.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

F. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.4 IDENTIFICATION

A. Identify system components according to Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.5 FIELD QUALITY CONTROL

A. Testing Agency:
   1. Perform tests and inspections with the assistance of a factory-authorized service representative.

B. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.
      a. Visual and Mechanical Inspection:
         1) Compare equipment nameplate data with Drawings and the Specifications.
         2) Inspect physical and mechanical condition.
         3) Inspect anchorage, alignment, and grounding.
         4) Verify that the unit is clean.
      b. Electrical and Mechanical Tests:
         1) Perform insulation-resistance tests according to IEEE 43.
            a) Machines Larger Than 200 hp: Test duration shall be 10 minutes. Calculate polarization index.
         2) Test protective relay devices.

3) Verify phase rotation, phasing, and synchronized operation as required by the application.
4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
5) Perform vibration test for each main bearing cap.
6) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here, including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
   b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
   c. Verify acceptance of charge for each element of the battery after discharge.
   d. Verify that measurements are within manufacturer's specifications.
4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust Emissions Test: Comply with applicable government test criteria.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
8. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure or at the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels so terminations and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.13

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. UPS systems.
2. Surge suppression.
3. Rectifier-charger.
4. Inverter.
5. Controls and indications.
6. Static bypass transfer switch.
7. Output distribution section.
8. Output isolation transformer.
9. Remote status and alarm panel.
10. Remote monitoring.
11. Battery.
12. Basic battery monitoring.
13. Battery-cycle warranty monitoring.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GTO: Gate turn-off thyristor.

C. IGBT: Isolated gate bipolar transistor.

D. LCD: Liquid-crystal display.

E. LED: Light-emitting diode.

F. NiCd: Nickel cadmium.

G. PC: Personal computer.

H. SPD: Surge protection device.

I. THD: Total harmonic distortion.

J. UPS: Uninterruptible power supply.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of UPS.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for UPS.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For UPS.
   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.
   4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Seismic Qualification Certificates: For UPS equipment, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each product, from manufacturer.

D. Factory Test Reports: Comply with specified requirements.

E. Product Test Reports: Indicate test results compared with specified performance requirements, and provide justification and resolution of differences if values do not agree.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For UPS units to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than [**one**] [**one set**] <**Insert number**> of each.
2. Cabinet Ventilation Filters: One complete set.

1.8 QUALITY ASSURANCE

A. Power Quality Specialist Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET Level 4, minimum, experienced in performance testing UPS installations and in performing power quality surveys similar to that required in "Performance Testing" Article.

B. Testing Agency Qualifications: Certified by NETA.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Special Battery Warranties: Manufacturer and Installer agree to repair or replace UPS system storage batteries that fail in materials or workmanship within specified warranty period.
   1. Warranted Cycle Life for Valve-Regulated, Lead-Calcium Batteries: Equal to or greater than that represented in manufacturer's published table, but not less than the following, based on annual average battery temperature of 77 deg F:

B. Special UPS Warranties: Specified form in which manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within special warranty period.
   1. Special Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPERATIONAL REQUIREMENTS

A. Automatic operation includes the following:
   1. Double Conversion, Standard Efficiency:
      a. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output.
      b. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to maintain constant, regulated inverter power output to the load without switching or disturbance.
      c. Power Failure: If normal power fails, energy supplied by the battery through the inverter continues supply-regulated power to the load without switching or disturbance.
   2. Double Conversion, IGBT:
      a. Normal Conditions: Load is supplied with power flowing from the normal power input terminals, through the rectifier-charger and inverter, with the battery connected in parallel with the rectifier-charger output. High-efficiency carrier stored trench IGBT, in both rectifier-charger and inverter circuits, provides a

minimum of 97 percent efficiency for the UPS system at full load and a minimum of 94 percent efficiency at 50 percent load.

b. Abnormal Supply Conditions: If normal supply deviates from specified and adjustable voltage, voltage waveform, or frequency limits, the battery supplies energy to provide constant, regulated inverter power output to the load.

c. Power Failure: If normal power fails, the rectifier-charger and inverter use energy from the battery to supply constant, regulated power output to the load without switching or disturbance.

3. When power is restored at the normal supply terminals of the system, controls shall automatically synchronize the inverter with the external source before transferring the load. The rectifier-charger shall supply power to the load through the inverter and simultaneously recharge the battery.
4. If the battery becomes discharged and normal supply is available, the rectifier-charger shall charge the battery. The rectifier-charger shall automatically shift to float-charge mode on reaching full charge.
5. If any element of the UPS system fails and power is available at the normal supply terminals of the system, the static bypass transfer switch shall switch the load to the normal ac supply circuit without disturbance or interruption.
6. The output power converters shall produce up to 300 percent of rated full-load current for short-circuit clearing. The inverter shall sustain steady-state overload conditions of up to 200 percent of rated full-load current for 60 seconds in normal operation.
7. The inverter shall be capable of sustaining 150 percent of system capacity for 30 seconds while powered from the battery.
8. Should overloads persist past the time limitations, the automatic static transfer switch shall switch the load to the bypass output of the UPS. When the fault has cleared, the static bypass transfer switch shall return the load to the UPS system.
9. If the battery is disconnected, the UPS shall supply power to the load from the normal supply with no degradation of its regulation of voltage and frequency of the output bus.

B. Manual operation includes the following:
1. Turning the inverter off causes the static bypass transfer switch to transfer the load directly to the normal ac supply circuit without disturbance or interruption.
2. Turning the inverter on causes the static bypass transfer switch to transfer the load to the inverter.

C. Environmental Conditions: The UPS shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability, except battery performance:
1. Ambient Temperature for Electronic Components: 32 to 104 deg F.
2. Ambient Temperature for Battery: 41 to 95 deg F.
3. Relative Humidity: Zero to 95 percent, noncondensing.
4. Altitude: Sea level to 4000 feet.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: UPS shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

B. UL Compliance: Listed and labeled by an NRTL to comply with UL 1778.

C. NFPA Compliance: UPS components shall be listed and labeled by an NRTL as suitable for installation in computer rooms according to NFPA 75.

D. The UPS shall perform as specified in this article while supplying rated full-load current, composed of any combination of linear and nonlinear load, up to 100 percent nonlinear load with a maximum load crest factor of 3.0, under the following conditions or combinations of the following conditions:
   1. Inverter is switched to battery source.
   2. Steady-state ac input voltage deviates up to plus or minus 10 percent from nominal voltage.
   3. Steady-state input frequency deviates up to plus or minus 5 percent from nominal frequency.
   4. THD of input voltage is 15 percent or more with a minimum crest factor of 3.0, and the largest single harmonic component is a minimum of 5 percent of the fundamental value.
   5. Load is 30 percent unbalanced continuously.

E. Minimum Duration of Supply: If battery is sole energy source supplying rated full-load UPS current at 80 percent power factor, duration of supply is 60 minutes.

F. Input Voltage Tolerance: System steady-state and transient output performance remains within specified tolerances when steady-state ac input voltage varies plus 15 percent and minus 30 percent from nominal voltage.

G. Overall UPS Efficiency: Equal to or greater than 94 percent at 100 percent load, 95 percent at 75 percent load, and 91 percent at 25 percent load.

H. Maximum Acoustical Noise: 61dB, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 1 meter from nearest surface of component enclosure.

I. Maximum Energizing Inrush Current: Six times the full-load current.

J. AC Output-Voltage Regulation for Loads 100 Percent Unbalanced: Maximum of plus or minus 2 percent over the full range of battery voltage.

K. AC Output-Voltage Regulation for Loads 100 Percent Balanced: Maximum of plus or minus 1 percent over the full range of battery voltage.

L. Output Frequency: 60 Hz, plus or minus 0.1 percent over the full range of input voltage, load, and battery voltage.

M. Limitation of harmonic distortion of input current to the UPS shall be as follows:
   1. Description:
      a. Rectifier-charger circuits shall limit THD to 5 percent, maximum, at rated full-load UPS current, for power sources with X/R ratio between 2 and 30. Provide tuned harmonic filter if required to meet harmonic distortion limit.
      b. THD is limited to a maximum of 32 percent, at rated full-load UPS current, for power sources with X/R ratio between 2 and 30.

N. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for 100 percent rated nonlinear load current rated full load with THD up to 50 percent, with a load crest factor of 3.0.

O. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, 200 percent for 60 seconds in normal operation, and 150 percent for 30 seconds in battery operating mode.

P. Maximum Output-Voltage Transient Excursions from Rated Value: For the following instantaneous load changes, stated as percentages of rated full UPS load, voltage shall remain within stated percentages of rated value and recover to, and remain within, plus or minus 2 percent of that value within 50 ms:
   1. 50 Percent: Plus or minus 3 percent.
   2. 100 Percent: Plus or minus 5 percent.
   3. Loss of AC Input Power: Plus or minus 1 percent.
   4. Restoration of AC Input Power: Plus or minus 1 percent.

Q. Input Power Factor: A minimum of 0.95 lagging when supply voltage and current are at nominal rated values and the UPS is supplying rated full-load current without additional filters.

R. EMI Emissions: Comply with FCC rules and regulations and with 47 CFR 15 for Class A equipment.

2.3 UPS SYSTEMS

A. Description: Self-contained, battery backup device and accessories that provides three-phase electrical power in the event of failure or sag in the normal power system.

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. APC by Schneider Electric.
   2. Eaton.
   3. Liebert; Vertiv Holdings Co.
   4. Mitsubishi Electric Automation, Inc.
   5. Toshiba International Corporation.

C. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, inverter, static bypass transfer switch, and system controls.

D. Enclosures: Comply with NEMA 250, Type 1, unless otherwise indicated.

E. Configuration: Field-assembled, multicabinet modular style units.

F. Control Assemblies: Mount on modular plug-ins, readily accessible for maintenance.

G. Maintainability Features: Mount rectifier-charger and inverter sections and the static bypass transfer switch on modular plug-ins, readily accessible for maintenance.

H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Seismic-Restraint Design: UPS assemblies, subassemblies, and components (and fastenings and supports, mounting, and anchorage devices for them) shall be designed and fabricated to withstand static and seismic forces.

J. UPS Cabinet Ventilation: Redundant fans or blowers draw in ambient air near the bottom of cabinet and discharge it near the top rear.

K. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.

2.4 SURGE SUPPRESSION

A. Protect internal UPS components from surges that enter at each ac power input connection including main disconnect switch, static bypass transfer switch. Protect rectifier-charger, inverter, controls, and output components.
   1. Use factory-installed surge suppressors tested according to IEEE C62.41.1 and IEEE C62.41.2, Category B.
   2. Additional Surge Protection: Protect internal UPS components from low-frequency, high-energy voltage surges described in IEEE C62.41.1 and IEEE C62.41.2. Design the circuits connecting with external power sources and select circuit elements, conductors, conventional surge suppressors, and rectifier components and controls so input assemblies will have adequate mechanical strength and thermal and current-carrying capacity to withstand stresses imposed by 400-Hz, 180 percent voltage surges described in IEEE C62.41.1 and IEEE C62.41.2.

2.5 RECTIFIER-CHARGER

A. Description: Voltage source converter, six-pulse IGBT rectifier.

B. Capacity: Adequate to supply the inverter during rated full output load conditions and simultaneously recharge the battery from fully discharged condition to 95 percent of full charge within 10 times the rated discharge time for duration of supply under battery power at full load.

C. Output Ripple: Limited by output filtration to less than 0.5 percent of rated current, peak to peak.

D. Control Circuits: Immune to frequency variations within rated frequency ranges of normal and emergency power sources.
   1. Response Time: Field adjustable for maximum compatibility with local generator-set power source.

E. Battery Float-Charging Conditions: Comply with battery manufacturer's written instructions for battery terminal voltage and charging current required for maximum battery life. The battery charger shall be matched to the battery type supplied.

F. NiCd Battery Charger: Sense full charge by measuring the rate of temperature increase. Battery charging shall be terminated when the rate of temperature rise reaches 1.8 deg F per minute. If the battery reaches 140 deg F prior to reaching this rate of temperature rise, charging shall terminate. Chargers that determine full charge by voltage measurement to sense a 10-mV drop per cell when reaching full charge are also acceptable.

2.6 INVERTER

A. Description:
   1. Pulse-width modulated, IGBT with sinusoidal output.
   2. Include a bypass phase synchronization window adjustment to optimize compatibility with local engine-generator-set power source.

2.7 CONTROLS AND INDICATIONS

A. Description: Group displays, indications, and basic system controls on a common control panel on front of UPS enclosure.

B. Minimum displays, indicating devices, and controls include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms include audible signals and visual displays.

C. Indications: Labeled LED or Plain-language messages on a digital LCD.
   1. Quantitative indications shall include the following:
      a. Input voltage, each phase, line to line.
      b. Input current, each phase, line to line.
      c. Bypass input voltage, each phase, line to line.
      d. Bypass input frequency.
      e. System output voltage, each phase, line to line.
      f. System output current, each phase.
      g. System output frequency.
      h. DC bus voltage.
      i. Battery current and direction (charge/discharge).
      j. Elapsed time discharging battery.
   2. Basic status condition indications shall include the following:
      a. Normal operation.
      b. Load-on bypass.
      c. Load-on battery.
      d. Inverter off.
      e. Alarm condition.
   3. Alarm indications shall include the following:
      a. Bypass ac input overvoltage or undervoltage.
      b. Bypass ac input overfrequency or underfrequency.
      c. Bypass ac input and inverter out of synchronization.
      d. Bypass ac input wrong-phase rotation.
      e. Bypass ac input single-phase condition.
      f. Bypass ac input filter fuse blown.
      g. Internal frequency standard in use.
      h. Battery system alarm.
      i. Control power failure.
      j. Fan failure.
      k. UPS overload.
      l. Battery-charging control faulty.
      m. Input overvoltage or undervoltage.
      n. Input transformer overtemperature.
      o. Input circuit breaker tripped.
      p. Input wrong-phase rotation.

q. Input single-phase condition.
r. Approaching end of battery operation.
s. Battery undervoltage shutdown.
t. Maximum battery voltage.
u. Inverter fuse blown.
v. Inverter transformer overtemperature.
w. Inverter overtemperature.
x. Static bypass transfer switch overtemperature.
y. Inverter power supply fault.
z. Inverter transistors out of saturation.
aa. Identification of faulty inverter section/leg.
bb. Inverter output overvoltage or undervoltage.
cc. UPS overload shutdown.
dd. Inverter current sensor fault.
ee. Inverter output contactor open.
ff. Inverter current limit.

4. Controls shall include the following:
   a. Inverter on-off.
   b. UPS start.
   c. Battery test.
   d. Alarm silence/reset.
   e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:
   1. UPS on battery.
   2. UPS on-line.
   3. UPS load-on bypass.
   4. UPS in alarm condition.
   5. UPS off (maintenance bypass closed).

E. Emergency Power off Switch: Capable of local operation and operation by means of activation by external dry contacts.

2.8 STATIC BYPASS TRANSFER SWITCH

A. Description: Solid-state switching device providing uninterrupted transfer with a contactor or electrically operated circuit breaker to automatically provide electrical isolation for the switch.

B. Switch Rating: Continuous duty at the rated full-load UPS current, minimum.

C. Input SPD: [**80**] [**160**] kA.

2.9 MAINTENANCE BYPASS/ISOLATION SWITCH

A. Description: Manually operated switch or arrangement of switching devices with mechanically actuated contact mechanism arranged to route the flow of power to the load around the rectifier-charger, inverter, and static bypass transfer switch.
   1. Switch shall be electrically and mechanically interlocked to prevent interrupting power to the load when switching to bypass mode.
   2. Switch shall electrically isolate other UPS components to permit safe servicing.

3. Switch shall electrically isolate the rectifier-charger, inverter, and static bypass transfer switch from the load, but shall allow primary power to the UPS for testing.

B. Comply with NEMA PB 2 and UL 891.

C. Switch Rating: Continuous duty at rated full-load UPS current.

D. Mounting Provisions: Internal to system cabinet.

2.10 REMOTE STATUS AND ALARM PANEL

A. Description: Labeled LEDs on panel faceplate indicating basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.
   1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

2.11 REMOTE MONITORING

A. Description: Communication module in unit control panel provides capability for remote monitoring of status, parameters, and alarms specified in "Controls and Indications" Article. The remote computer and the connecting signal wiring are not included in this Section. Include the following features:
   1. Connectors and network interface units for data transmission via RS-485, Ethernet, or web-based link.
   2. Software designed for control and monitoring of UPS functions and to provide on-screen explanations, interpretations, diagnosis, action guidance, and instructions for use of monitoring indications and development of meaningful reports. Permit storage and analysis of power-line transient records. Designs for Windows applications, software, and computer are not included in this Section.
   3. Software and Hardware: Compatible with that specified in Section 260913 "Electrical Power Monitoring and Control."

2.12 BATTERY

A. Description:
   1. Valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.
      a. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

B. Description:
   1. Valve-regulated, recombinant, lead-calcium units, factory assembled in an isolated compartment of UPS cabinet, complete with battery disconnect switch.
      a. Arrange for drawout removal of battery assembly from cabinet for testing and inspecting.

C. Seismic-Restraint Design: Battery racks, cabinets, assemblies, subassemblies, and components (and fastenings and supports, mounting, and anchorage devices for them) shall be designed and fabricated to withstand static and seismic forces.

2.13 BASIC BATTERY MONITORING

A. Description: Continuous, real-time capture of battery performance data.

B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

C. Battery compartment high-temperature detector initiates an alarm when smoke or a temperature greater than 167 deg F occurs within the compartment.

D. Battery compartment smoke/high-temperature detector initiates an alarm when smoke or a temperature greater than 167 deg F occurs within the compartment.

E. Annunciation of Alarms: At UPS control panel and remotely.

2.14 BATTERY-CYCLE WARRANTY MONITORING

A. Description: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring of charge-discharge cycle history of batteries covered by cycle-life warranties.

B. Performance: Automatically measure and record each discharge event, classify it according to duration category and total discharges according to warranty criteria, and display remaining warranted battery life on front panel display.

C. Additional monitoring functions and features shall include the following:
   1. Measuring and Recording: Total voltage at battery terminal. Initiate an alarm for excursions outside the proper float-voltage level.
   2. Monitoring: Ambient temperature at battery; initiate an alarm if temperature deviates from normally acceptable range.
   3. Keypad on Device Front Panel: Provide access to monitored data using front panel display.
   4. Alarm Contacts: Arrange to initiate local and remote alarm for battery discharge events, abnormal battery voltage or temperature.
   5. Memory: Store recorded data in nonvolatile electronic memory.
   6. Ethernet Port: Permits downloading of data to a PC.

2.15 SOURCE QUALITY CONTROL

A. Factory test complete UPS system before shipment. Use actual batteries that are part of final installation. Include the following:
   1. Test and demonstration of all functions, controls, indicators, sensors, and protective devices.
   2. Full-load test.
   3. Transient-load response test.
   4. Overload test.
   5. Power failure test.

B. Observation of Test: Give 14 days' advance notice of tests and provide opportunity for Owner's representative to observe tests at Owner's choice.

C. Report test results. Include the following data:
   1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
   2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
   3. List of instruments and equipment used in factory tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the UPS.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify installation conditions are representative of the conditions used in the coordination studies for the electrical system. Provide fuse protection according to Section 262813 "Fuses" if required for coordination with UPS overcurrent protective device requirements.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
   1. Install plenum cable in environmental air spaces, including plenum ceilings.
   2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
   3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
   4. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Equipment Mounting: Install UPS on concrete base.
   1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

E. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

F. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated. Apply oxide inhibitor on battery terminals.

3.3 GROUNDING

A. Separately Derived Systems:
   1. If part of a listed power supply for a data-processing room, comply with manufacturer's written instructions that include grounding requirements in excess of NFPA 70 requirements for connecting to grounding electrodes and for bonding to metallic piping near isolation transformer. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
   1. Identify each battery cell individually.

3.5 BATTERY EQUALIZATION

A. Equalize charging of battery cells according to manufacturer's written instructions. Record individual-cell voltages.

3.6 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:
   1. Owner will engage qualified testing agency to administer and perform tests and inspections.
   2. Engage qualified testing agency to administer and perform tests and inspections.
   3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
   4. Administer and perform tests and inspections with assistance of factory-authorized service representative.

B. Tests and Inspections:
   1. Inspect interiors of enclosures, including the following:
      a. Inspect anchorage, alignment, grounding, and required clearances.
      b. Component type and labeling verification.
      c. Ratings of installed components.
   2. Test electrical and mechanical interlock systems for correct operation and sequencing.
   3. Inspect bolted electrical connections for high resistance using one or more of the following methods:
      a. Use of low-resistance ohmmeter according to Section 7.22.2.2 of NETA ATS.
      b. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or Table 100.12 of NETA ATS.
      c. Perform thermographic survey according to Section 9 of NETA ATS.
   4. Test static transfer from inverter to bypass and back. Use normal load, if possible.
   5. Test dc undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.
   6. Verify synchronizing indicators for static switch and bypass switches.
   7. Test insulated-case and molded-case breakers.

a. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 of NETA ATS.
b. Perform insulation-resistance tests on all control wiring for ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation.
c. Use primary current injection to determine long time and short time, ground fault, and instantaneous pickup, Use secondary current injection to test trip functions.
d. Perform minimum pickup voltage tests on shunt trip and close coils according to manufacturer's published data.
e. Verify operation of charging mechanism.
f. Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, antipump function, and trip unit battery condition. Reset all trip logs and indicators.

8. Test direct current system's batteries.
   a. Verify adequacy of battery support racks, mounting, anchorage, alignment, grounding, and clearances.
   b. Inspect spill containment installation. Measure charger float and equalizing voltage levels. Adjust to battery manufacturer's recommended settings.
   c. Verify all charger functions and alarms.
   d. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.
   e. Perform a load test according to manufacturer's published data or IEEE 450.
   f. Measure charger float and equalizing voltage levels. Adjust to battery manufacturer's recommended settings.
   g. Test values.
      1) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      2) Charger float and equalize voltage levels shall be according to battery manufacturer's published data.
      3) The results of charger functions and alarms shall be according to manufacturer's published data.
      4) Cell voltages shall be within 0.05 V of each other or according to manufacturer's published data.
      5) Cell internal ohmic values (resistance, impedance, or conductance) shall not vary by more than 25 percent between identical cells that are in a fully charged state.
      6) Results of load tests shall be according to manufacturer's published data or IEEE 450.
9. Test communication of status and alarms to remote monitoring equipment.

C. Seismic-restraint tests and inspections shall include the following:
   1. Inspect type, size, quantity, arrangement, and proper installation of mounting or anchorage devices.
   2. Test mounting and anchorage devices according to requirements in Section 260548.16 "Seismic Controls for Electrical Systems."

D. The UPS system will be considered defective if it does not pass tests and inspections.

E. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

F. Prepare test and inspection reports.

3.7 PERFORMANCE TESTING

A. Engage the services of a qualified power quality specialist to perform tests and activities indicated.

B. Monitoring and Testing Schedule: Perform monitoring and testing in a single 10-day period.
   1. Schedule monitoring and testing activity with Owner, through Architect, with at least 14 days' advance notice.
   2. Schedule monitoring and testing after Substantial Completion, when the UPS is supplying power to its intended load.

C. Monitoring and Testing Instruments: Three-phase, recording, power monitors. Instruments shall provide continuous simultaneous monitoring of electrical parameters at UPS input terminals and at input terminals of loads served by the UPS. Instruments shall monitor, measure, and graph voltage current and frequency simultaneously and provide full-graphic recordings of the values of those parameters before and during power-line disturbances that cause the values to deviate from normal beyond the adjustable threshold values. Instruments shall be capable of recording either on paper or on magnetic media and have a minimum accuracy of plus or minus 2 percent for electrical parameters. Parameters to be monitored include the following:
   1. Current: Each phase and neutral and grounding conductors.
   2. Voltage: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
   3. Frequency transients.
   4. Voltage swells and sags.
   5. Voltage Impulses: Phase to phase, phase to neutral, phase to ground, and neutral to ground.
   6. High-frequency noise.
   7. Radio-frequency interference.
   8. THD of the above currents and voltages.
   9. Harmonic content of currents and voltages above.
   10. Battery cell temperature during charging.
   11. Ambient temperature.

D. Monitoring and Testing Procedures:
   1. Exploratory Period: For the first two days of the first scheduled monitoring and testing period, make recordings at various circuit locations and with various parameter-threshold and sampling-interval settings. Make these measurements with the objective of identifying optimum UPS, power system, load, and instrumentation setup conditions for subsequent test and monitoring operations.
   2. Remainder of Test Period: Perform continuous monitoring of at least two circuit locations selected on the basis of data obtained during exploratory period.
      a. Set thresholds and sampling intervals for recording data at values selected to optimize data on performance of the UPS for values indicated, and to highlight the need to adjust, repair, or modify the UPS, distribution system, or load component that may influence its performance or that may require better power quality.

b. Perform load and UPS power source switching and operate the UPS on generator power during portions of test period according to directions of Owner's power quality specialist.
c. Operate the UPS and its loads in each mode of operation permitted by UPS controls and by the power distribution system design.
d. Using loads and devices available as part of the facility's installed systems and equipment, create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients. Maintain normal operating loads in operation on system to maximum extent possible during tests.
e. Using temporarily connected resistive/inductive load banks, create and simulate unusual operating conditions, including outages, voltage swells and sags, and voltage, current, and frequency transients. Maintain normal operating loads in operation on system to maximum extent possible during tests.
f. Make adjustments and repairs to UPS, distribution, and load equipment to correct deficiencies disclosed by monitoring and testing; repeat appropriate monitoring and testing to verify success of corrective action.

E. Monitoring and Testing Assistance by Contractor:
1. Open UPS and electrical distribution and load equipment and wiring enclosures to make monitoring and testing points accessible for temporary monitoring probe and sensor placement and removal as requested.
2. Observe monitoring and testing operations; ensure that UPS and distribution and load equipment warranties are not compromised.
3. Perform switching and control of various UPS units, electrical distribution systems, and load components as directed by power quality specialist. Specialist shall design this portion of monitoring and testing operations to expose the UPS to various operating environments, conditions, and events while response is observed, electrical parameters are monitored, and system and equipment deficiencies are identified.
4. Make repairs and adjustments to the UPS and to electrical distribution system and load components, and retest and repeat monitoring as needed to verify validity of results and correction of deficiencies.
5. Engage the services of the UPS manufacturer's factory-authorized service representative periodically during performance testing operations for repairs, adjustments, and consultations.

F. Analysis of Recorded Data and Report: Review and analyze test observations and recorded data and submit a detailed written report. Include the following in [**each**]report:
1. Descriptions of corrective actions performed during monitoring and survey work and their results.
2. Recommendations for further action to provide optimum performance by the UPS and appropriate power quality for non-UPS loads. Include a statement of priority ranking and a cost estimate for each recommendation that involves system or equipment revisions.
3. Copies of monitoring summary graphics and graphics illustrating harmonic content of significant voltages and currents.
4. Copies of graphics of power disturbance recordings that illustrate findings, conclusions, and recommendations.
5. Recommendations for operating, adjusting, or revising UPS controls.
6. Recommendations for alterations to the UPS installation.
7. Recommendations for adjusting or revising generator-set or automatic transfer switch installations or their controls.

8. Recommendations for power distribution system revisions.
9. Recommendations for adjusting or revising electrical loads, their connections, or controls.

G. Interim and Final Reports: Provide an interim report at the end of each test period and a final comprehensive report at the end of final test and analysis period.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the UPS.

END OF SECTION 263353

SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Contactor-type automatic transfer switches.
   2. Transfer switch accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
   2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
   2. Include material lists for each switch specified.
   3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
   4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer-authorized service representative.

B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
      a. Features and operating sequences, both automatic and manual.
      b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:
   1. Member company of NETA.
      a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 12 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 110.

D. Comply with UL 1008 unless requirements of these Specifications are stricter.

E. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

F. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.
   1. Short-time withstand capability for [**three**] [**30**] <**Insert number**> cycles.

G. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

H. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

I. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

J. Service-Rated Transfer Switch:
   1. Comply with UL 869A and UL 489.
   2. Provide terminals for bonding the grounding electrode conductor to the grounded service conductor.
   3. In systems with a neutral, the bonding connection shall be on the neutral bus.
   4. Provide removable link for temporary separation of the service and load grounded conductors.
   5. Surge Protective Device: Service rated.
   6. Ground-Fault Protection: Comply with UL 1008 for normal and alternative buses.
   7. Service Disconnecting Means: Externally operated, manual mechanically actuated.

K. Neutral Switching: Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

L. Neutral Terminal: Solid and fully rated unless otherwise indicated.

M. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable shrinkable sleeve markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."
   1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
   2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
   3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
   4. Accessible via front access.

O. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Products Division.
   2. Caterpillar, Inc.; Electric Power Division.
   3. Cummins Power Generation.
   4. Eaton.

5. Emerson.
6. Generac Power Systems, Inc.
7. Kohler Power Systems.
8. Russelectric, Inc.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Mechanical type.
7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. Automatic Transfer-Switch Controller Features:
1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal and Alternate Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
    a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

G. Large-Motor-Load Power Transfer:
1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.
2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.

2.3 MOLDED-CASE-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Products Division.
2. Caterpillar, Inc.; Electric Power Division.
3. Cummins Power Generation.
4. Eaton.
5. Emerson Electric Co.
6. Generac Power Systems, Inc.
7. Kohler Power Systems.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Limitation: Switches using contactor-based components are unacceptable.
   2. Switch Action: Double throw; mechanically held in both directions.
   3. Contacts: Silver composition or silver alloy for load-current switching.
   4. Conductor Connectors: Suitable for use with conductor material and sizes.
   5. Material: Hard-drawn copper, 98 percent conductivity.
   6. Main and Neutral Lugs: Mechanical type.
   7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
   8. Ground bar.
   9. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Open-Transition Transfer Switches: Interlocked to prevent the load from being closed on both sources at the same time.
   1. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.

E. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.
   1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
   2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
   3. Fully automatic break-before-make operation with center off position.
   4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. Automatic Transfer-Switch Controller Features:
   1. Controller operates through a period of loss of control power.
   2. Undervoltage Sensing for Each Phase of Normal and Alternative Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
   3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
   4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
   5. Test Switch: Simulate normal-source failure.
   6. Switch-Position Pilot Lights: Indicate source to which load is connected.
   7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts:
    a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

2.4 TRANSFER SWITCH ACCESSORIES

A. Remote Annunciator System:
1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches.
3. Annunciation panel display shall include the following indicators:
    a. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
    b. Switch position.
    c. Switch in test mode.
    d. Failure of communication link.
4. Annunciator Panel: LED-lamp type with audible signal and silencing switch.
    a. Indicating Lights: Grouped for each transfer switch monitored.
    b. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.
    c. Mounting: Flush, modular, steel cabinet unless otherwise indicated.
    d. Lamp Test: Push-to-test or lamp-test switch on front panel.

B. Remote Annunciator and Control System:
1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Include the following functions for indicated transfer switches:

a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
b. Indication of switch position.
c. Indication of switch in test mode.
d. Indication of failure of digital communication link.
e. Key-switch or user-code access to control functions of panel.
f. Control of switch-test initiation.

3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:
   a. Controls and indicating lights grouped together for each transfer switch.
   b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
   c. Digital Communication Capability: Matched to that of transfer switches supervised.
   d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.
   1. Install transfer switches on cast-in-place concrete equipment base(s).
   2. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
   3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
   4. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.
   1. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."

G. Route and brace conductors according to manufacturer's written instructions. Do not obscure manufacturer's markings and labels.

H. Brace and support equipment according to Section 260548.16 "Seismic Controls for Electrical Systems."

I. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Administrant for Tests and Inspections:
   1. Administer and perform tests and inspections with assistance of factory-authorized service representative.

B. Tests and Inspections:
   1. After installing equipment, test for compliance with requirements according to NETA ATS.
   2. Visual and Mechanical Inspection:
      a. Compare equipment nameplate data with Drawings and Specifications.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage, alignment, grounding, and required clearances.
      d. Verify that the unit is clean.
      e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
      f. Verify that manual transfer warnings are attached and visible.
      g. Verify tightness of all control connections.

h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:
   1) Use of low-resistance ohmmeter.
   2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.
i. Perform manual transfer operation.
j. Verify positive mechanical interlocking between normal and alternate sources.
k. Perform visual and mechanical inspection of surge arresters.
l. Inspect control power transformers.
   1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
   2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
   3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:
   a. Perform insulation-resistance tests on all control wiring with respect to ground.
   b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
   c. Verify settings and operation of control devices.
   d. Calibrate and set all relays and timers.
   e. Verify phase rotation, phasing, and synchronized operation.
   f. Perform automatic transfer tests.
   g. Verify correct operation and timing of the following functions:
      1) Normal source voltage-sensing and frequency-sensing relays.
      2) Engine start sequence.
      3) Time delay on transfer.
      4) Alternative source voltage-sensing and frequency-sensing relays.
      5) Automatic transfer operation.
      6) Interlocks and limit switch function.
      7) Time delay and retransfer on normal power restoration.
      8) Engine cool-down and shutdown feature.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.
5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.
   a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
   b. Verify time-delay settings.
   c. Verify pickup and dropout voltages by data readout or inspection of control settings.

d. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
e. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Transfer switches will be considered defective if they do not pass tests and inspections.

F. Remove and replace malfunctioning units and retest as specified above.

G. Prepare test and inspection reports.

H. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
   1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
   3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes lightning protection system for ordinary structures.

B. Section includes lightning protection system for the following:
   1. Ordinary structures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
   1. Include layouts of the lightning protection system, with details of the components to be used in the installation.
   2. Include raceway locations needed for the installation of conductors.
   3. Details of air terminals, ground rods, ground rings, conductor supports, splices, and terminations, including concealment requirements.
   4. Include roof attachment details, coordinated with roof installation.
   5. Calculations required by NFPA 780 for bonding of metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Lightning protection system Shop Drawings, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Lightning protection cabling attachments to roofing systems and accessories.
   2. Lightning protection strike termination device attachment to roofing systems, coordinated with the roofing system manufacturer.
   3. Lightning protection system components penetrating roofing and moisture protection systems and system components, coordinated with the roofing system manufacturer.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of roof adhesive for attaching the roof-mounted air terminal assemblies, approved by the roofing-material manufacturer.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For lightning protection system to include in maintenance manuals.
   1. Include the following:
      a. Dimensioned site plan showing dimensioned route of the ground loop conductor and the ground rod locations.
      b. A system testing and inspection record, listing the results of inspections and ground resistance tests, as recommended by NFPA 780, Annex D.

B. Completion Certificate:
   1. UL Master Label Certificate.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: UL-listed installer, category OWAY.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Lightning Technology, Ltd.
   2. East Coast Lightning Equipment Inc.
   3. Harger Lightning & Grounding.
   4. National Lightning Protection.
   5. Thompson Lightning Protection, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. NFPA Lightning Protection Standard: Comply with NFPA 780 requirements for Class I buildings.

B. UL Lightning Protection Standard: Comply with UL 96A requirements for Class I buildings.

C. Lightning Protection Components, Devices, and Accessories: Listed and labeled by a qualified testing agency as complying with UL 96, and marked for intended location and application.

2.3 MATERIALS

A. Air Terminals:
   1. Aluminum unless otherwise indicated.
   2. 1/2-inch diameter by 10 inches long.
   3. Pointed tip.
   4. Threaded base support.

B. Class 1 Main Conductors:
   1. Aluminum: 98,600 circular mils in diameter.

C. Secondary Conductors:
   1. Aluminum: 41,400 circular mils in diameter.

D. Ground Loop Conductor: Stranded copper**.**

E. Ground Rods:
   1. Material: Copper-clad steel.
   2. Diameter: 3/4 inch.
   3. Rods shall be not less than 120 inches long.

F. Conductor Splices and Connectors: Compression fittings that are installed with hydraulically operated tools, or exothermic welds, approved for use with the class type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid bends less than 90 degrees and 8 inches in radius and narrow loops.

C. Conceal conductors within normal view from exterior locations at grade within 200 feet of building. Comply with requirements for concealed systems in NFPA 780.
   1. Roof penetrations required for down conductors and connections to structural-steel framework shall be made using listed through-roof fitting and connector assemblies with solid rods and appropriate roof flashings. Use materials approved by the roofing manufacturer for the purpose. Conform to the methods and materials required at roofing penetrations of the lightning protection components to ensure compatibility with the roofing specifications and warranty.
   2. Install conduit where necessary to comply with conductor concealment requirements.
   3. Air Terminals on Single-Ply Membrane Roofing: Comply with adhesive manufacturer's written instructions.

D. Ground Ring Electrode: The conductor shall be not less than the main-size lightning conductor.

3.2 CONNECTIONS

A. Aboveground concealed connections, and connections in earth or concrete, shall be done by exothermic welds or by high-compression fittings listed for the purpose.

B. Aboveground exposed connections shall be done using the following types of connectors, listed and labeled for the purpose: high compression crimp.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions would cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Perform inspections as required to obtain a UL Master Label for system.
   2. Perform inspections to obtain an LPI certification.

B. Prepare test and inspection reports and certificates.

END OF SECTION 264113

SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Type 1 surge protective devices.
2. Type 2 surge protective devices.
3. Enclosures.
4. Conductors and cables.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
3. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
4. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.2 DEFINITIONS

A. I_n: Nominal discharge current.

B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.

C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.

D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient over-voltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).

E. SCCR: Short-circuit current rating.

F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.

G. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.

H. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. For each type of product.
      a. Include electrical characteristics, specialties, and accessories for SPDs.
      b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:
         1) Tested values for VPRs.
         2) I_n ratings.
         3) MCOV, type designations.
         4) OCPD requirements.
         5) Manufacturer's model number.
         6) System voltage.
         7) Modes of protection.

B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.
   1. Initial Extended Warranty Period: Five year(s) from date of Substantial Completion, for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ABB, Electrification Products Division.
   2. Eaton.
   3. Leviton Manufacturing Co., Inc.
   4. Liebert; a brand of Vertiv.
   5. Schneider Electric USA, Inc.
   6. Siemens Industry, Inc., Energy Management Division.
   7. SSI, an ILSCO Company.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. General Characteristics:
   1. Reference Standards: UL 1449, Type 1.

2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 320 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits must not exceed the following:
   a. Line to Neutral: 1200 V for 480Y/277 V.
   b. Line to Line: 2000 V for 480Y/277 V.
5. SCCR: Not less than 200 kA.
6. I_n Rating: 20 kA.

D. Options:
1. Include integral disconnect switch.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include indicator light display for protection status.
4. Include audible alarm.
5. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
6. Include surge counter.

2.2 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ABB, Electrification Products Division.
2. Advanced Protection Technologies Inc. (APT).
3. ALLTEC.
4. Citel, Inc.
5. Eaton.
6. Leviton Manufacturing Co., Inc.
7. Liebert; a brand of Vertiv.
8. Mersen USA.
9. Schneider Electric USA, Inc.
10. Siemens Industry, Inc., Energy Management Division.
11. SSI, an ILSCO Company.

B. Source Limitations: Obtain devices from single source from single manufacturer.

C. General Characteristics:
1. Reference Standards: UL 1449, Type 2; UL 1283.
2. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
3. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 150 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
4. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits must not exceed the following:

a. Line to Neutral: 700 V for 208Y/120 V.
b. Line to Ground: 700 V for 208Y/120 V.
c. Neutral to Ground: 700 V for 208Y/120 V.
d. Line to Line: 1200 V for 208Y/120 V.

5. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits must not exceed the following:
   a. Line to Neutral: 700 V.
   b. Line to Ground: 700 V.
   c. Neutral to Ground: 700 V.
   d. Line to Line: 1200 V.
6. SCCR: Equal or exceed 100 kA.
7. I_n Rating: 10 kA.

D. Options:
1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V(ac) for remote monitoring of protection status.
4. Include surge counter.

2.3 ENCLOSURES

A. Indoor Enclosures: Type 1.

2.4 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.

B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
2. Do not exceed manufacturer's recommended lead length.
3. Do not bond neutral and ground.

C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by Owner or Owner's representative.

B. Tests and Inspections:
   1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's installation requirements.

C. Nonconforming Work:
   1. SPDs that do not pass tests and inspections will be considered defective.
   2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

E. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Emergency lighting.
2. Exit signs.
3. Materials.
4. Luminaire support components.

B. Related Requirements:
1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 DEFINITIONS

A. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.

B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.

C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

A. Product Data:
1. For each type of emergency lighting unit, exit sign, and emergency lighting support.
   a. Include data on features, accessories, and finishes.
   b. Include physical description of unit and dimensions.
   c. Battery and charger for light units.
   d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
   e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.

B. Shop Drawings:
1. For nonstandard or custom luminaires.
   a. Include plans, elevations, sections, and mounting and attachment details.

b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
c. Include diagrams for power, signal, and control wiring.

C. Samples: For each product and for each color and texture specified.

D. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.

E. Samples for Verification: For each type of luminaire.
1. Include Samples of luminaires and accessories to verify finish selection.

F. Product Schedule:
1. For emergency lighting units. Use same designations indicated on Drawings.
2. For exit signs. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of luminaire.

B. Product Test Reports: For each luminaire for tests performed by, or under supervision of, qualified luminaire photometric testing laboratory.

C. Sample Warranty: For manufacturer's warranty.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.

1.6 QUALITY ASSURANCE

A. FM Global Compliance: Luminaires for hazardous locations must be listed and labeled for indicated class and division of hazard by FM Global.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, including batteries, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.

1. Extended Warranty Period: Two year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

B. Special Manufacturer Extended Warranty for Batteries for Emergency and Exit Lighting: Manufacturer warrants that batteries for emergency luminaires and exit signs perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended warranty period.
   1. Extended Warranty Period: Five year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Comply with NFPA 101.

C. Comply with NEMA LE 4 for recessed luminaires.

D. Lamp Base: Comply with ANSI C81.61.

E. Bulb Shape: Complying with ANSI C79.1.

F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast.
   1. Emergency Connection: Operate one lamp(s) continuously at an output of 1100 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
   2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
   3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
      a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
      b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
   4. Battery: Sealed, maintenance-free, nickel-cadmium type.
   5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
   6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.2 EMERGENCY LIGHTING

A. General Characteristics: Self-contained units.

B. Emergency Luminaire:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Architectural Lighting Works.
      b. Cooper Lighting Solutions; Signify North America Corp.
      c. Current Lighting Solutions, LLC (Current, powered by GE).
      d. Dual-Lite.
      e. Juno Lighting Group by Schneider Electric.
      f. Lithonia Lighting; Acuity Brands Lighting, Inc.
   2. Options:
      a. Operating at nominal voltage of 120 V-277 V(ac).
      b. Internal emergency power unit.
      c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
      d. UL 94 V-1 flame rating.

2.3 EXIT SIGNS

A. General Characteristics: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Sign:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cooper Lighting Solutions; Signify North America Corp.
      b. Hubbell Incorporated, Lighting.
      c. Lithonia Lighting; Acuity Brands Lighting, Inc.
   2. Options:
      a. Operating at nominal voltage of 120 V-277 V(ac).
      b. Lamps for AC Operation:
         1) LEDs; 50,000 hours minimum rated lamp life.
      c. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.4 MATERIALS

A. Metal Parts:
   1. Free of burrs and sharp corners and edges.
   2. Sheet metal components must be steel unless otherwise indicated.
   3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:
   1. Smooth operating, free of light leakage under operating conditions.
   2. Designed to permit relamping without use of tools.
   3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
   1. Clear, UV-stabilized acrylic.
   2. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
   1. Die-cast aluminum, brushed finish .

2.5 METAL FINISHES

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

B. Install lamps in each luminaire.

C. Supports:
   1. Sized and rated for luminaire and emergency power unit weight.
   2. Able to maintain luminaire position when testing emergency power unit.
   3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
   4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.

E. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inch, brace to limit swinging.
   2. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
   3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Luminaires:
   1. Secure to outlet box, if provided.
   2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
   3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Field tests and inspections must be witnessed by authorities having jurisdiction.

B. Tests and Inspections:
   1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

C. Nonconforming Work:
   1. Luminaire will be considered defective if it does not pass operation tests and inspections.
   2. Remove and replace defective units and retest.

D. Prepare test and inspection reports.

E. Manufacturer Services:
   1. Engage factory-authorized service representative to support field tests and inspections.

3.5 SYSTEM STARTUP

A. Perform startup service:
   1. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect luminaires. Replace lamps, emergency power units , batteries, exit signs, and luminaires that are defective.
   a. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

3.7 PROTECTION

A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

SECTION 265613 - LIGHTING POLES AND STANDARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Poles and accessories for support of luminaires.
   2. Luminaire-lowering devices.

1.3 DEFINITIONS

A. EPA: Equivalent projected area.

B. Luminaire: Complete luminaire.

C. Pole: Luminaire-supporting structure, including tower used for large-area illumination.

D. Standard: See "Pole."

1.4 ACTION SUBMITTALS

A. Product Data: For each pole, accessory, and luminaire-supporting and -lowering device, arranged as indicated.
   1. Include data on construction details, profiles, EPA, cable entrances, materials, dimensions, weight, rated design load, and ultimate strength of individual components.
   2. Include finishes for lighting poles and luminaire-supporting devices.
   3. Anchor bolts.
   4. Manufactured pole foundations.

B. Shop Drawings:
   1. Include plans, elevations, sections, and mounting and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Detail fabrication and assembly of poles and pole accessories.
   4. Foundation construction details, including material descriptions, dimensions, anchor bolts, support devices, and calculations, signed and sealed by a professional engineer licensed in the state of installation.
   5. Anchor bolt templates keyed to specific poles and certified by manufacturer.
   6. Method and procedure of pole installation. Include manufacturer's written installations.

C. Samples: For each exposed lighting pole, standard, and luminaire-supporting device and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements according to AASHTO LTS-6-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations signed and sealed by a professional engineer.

B. Qualification Data: For Installer.

C. Seismic Qualification Data: For accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Material Test Reports:
   1. For each pole, by a qualified testing agency.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: Manufacturer's standard warranty.

H. Soil test reports

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For poles to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Pole repair materials.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for foundation testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B660.

B. Store poles on decay-resistant skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. Handle poles with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of pole(s) and luminaire-lowering device(s) that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within a specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs from special warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.
   2. Warranty Period for Corrosion Resistance: Five years from date of Substantial Completion.
   3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design pole foundation and pole power system.

B. Seismic Performance: Foundation and pole shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified and the system will be fully operational after the seismic event."
   2. Component Importance Factor: 1.0.

C. Structural Characteristics: Comply with AASHTO LTS-6-M.

D. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied according to AASHTO LTS-6-M.

E. Live Load: Single load of 500 lbf distributed according to AASHTO LTS-6-M.

F. Ice Load: Load of 3 lbf/sq. ft., applied according to AASHTO LTS-6-M for applicable areas on the Ice Load Map.

G. Wind Load: Pressure of wind on pole and luminaire, calculated and applied according to AASHTO LTS-6-M.
   1. Basic wind speed for calculating wind load for poles 50 feet high or less is 100 mph.
      a. Wind Importance Factor: 1.0.
      b. Minimum Design Life: 25 years.
      c. Velocity Conversion Factor: 1.0.

H. Strength Analysis: For each pole, multiply the actual EPA of luminaires and brackets by a factor of 1.1 to obtain the EPA to be used in pole selection strength analysis.

I. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

2.2 STEEL POLES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. American LitePole.
   2. Bridgewell Resources.
   3. Cooper Lighting Solutions; Signify North America Corp.
   4. H.E. Williams.
   5. Hubbell Incorporated.
   6. Kim Lighting; Hubbell Incorporated, Lighting.
   7. Lithonia Lighting; Acuity Brands Lighting, Inc.
   8. LSI Industries.
   9. Millerbernd Manufacturing Company.

B. Source Limitations: Obtain poles from single manufacturer or producer.

C. Source Limitations: For poles, obtain each color, grade, finish, type, and variety of pole from single source with resources to provide products of consistent quality in appearance and physical properties.

D. Poles: Comply with ASTM A500/A500M, Grade B carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.
   1. Shape: Square, straight.
   2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

E. Steel Mast Arms: Single-arm type, continuously welded to pole attachment plate. Material and finish same as plate.

F. Brackets for Luminaires: Detachable, cantilever, without underbrace.
   1. Adaptor fitting welded to pole, allowing the bracket to be bolted to the pole-mounted adapter, then bolted together with galvanized-steel bolts.
   2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire. Match pole material and finish.

G. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

H. Fasteners: Galvanized steel, size and type as determined by manufacturer. Corrosion-resistant items compatible with support components.
   1. Materials: Compatible with poles and standards as well as the substrates to which poles and standards are fastened and shall not cause galvanic action at contact points.
   2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

I. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 260526 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size indicated, and accessible through handhole.

J. Handhole: Oval shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

K. Powder-Coat Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces according to SSPC-SP 1 to remove dirt, oil, grease, and other contaminants that could impair powder coat bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, according to SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Powder Coat: Comply with AAMA 2604.
      a. Electrostatic-applied powder coating; single application and cured to a minimum 2.5- to 3.5-mils dry film thickness. Coat interior and exterior of pole for equal corrosion protection.
      b. Color: As indicated on drawings.

2.3 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, finished same as pole, and arranged to cover pole's mounting bolts and nuts.

2.4 MOUNTING HARDWARE

A. Anchor Bolts: Manufactured to ASTM F1554, Grade 55, with a minimum yield strength of 55,000 psi.
   1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
   2. Bent rods 3/4" in diameter.
   3. Threading: Uniform National Coarse, Class 2A.

B. Nuts: ASTM A563, Grade A, Heavy-Hex.
   1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
   2. Four nuts provided per anchor bolt, shipped with nuts pre-assembled to the anchor bolts.

C. Washers: ASTM F436, Type 1.
   1. Galvanizing: Hot dip galvanized according to ASTM A153, Class C.
   2. Two washer(s) provided per anchor bolt.

2.5 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine poles, luminaire-mounting devices, lowering devices, and pole accessories before installation. Components that are scratched, dented, marred, wet, moisture damaged, or visibly damaged are considered defective.

C. Examine roughing-in for foundation and conduit to verify actual locations of installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 POLE FOUNDATION

A. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Structural steel complying with ASTM A36/A36M and hot-dip galvanized according to ASTM A123/A123M; and with top-plate and mounting bolts to match pole-base flange and strength required to support pole, luminaire, and accessories.

B. Direct-Buried Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than [**one-sixth of pole height**] [**as indicated**]. To ensure a plumb installation, continuously check pole orientation with plumb bob while tamping.
   1. Make holes 6 inches in diameter larger than pole diameter.
   2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days and finish in a dome above finished grade.
   3. Use a short piece of 1/2-inch diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
   4. Cure concrete a minimum of 72 hours before performing work on pole.

C. Anchor Bolts: Install plumb using manufacturer-supplied template, uniformly spaced.

3.3 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on drawing.
   1. Fire Hydrants and Water Piping: 60 inches.
   2. Water, Gas, Electric, Communications, and Sewer Lines: 10 feet.
   3. Trees: 15 feet from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer.

D. Poles and Pole Foundations Set in Concrete-Paved Areas: Install poles with a minimum 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of the adjacent concrete

slab. Fill unpaved ring with pea gravel. Insert material to a level 1 inch below top of concrete slab.

E. Raise and set pole using web fabric slings (not chain or cable) at locations indicated by manufacturer.

3.4 CORROSION PREVENTION

A. Steel Conduits: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50-percent overlap.

3.5 GROUNDING

A. Ground Metal Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole unless otherwise indicated.
   2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

B. Ground Nonmetallic Poles and Support Structures: Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
   1. Install grounding electrode for each pole.
   2. Install grounding conductor and conductor protector.
   3. Ground metallic components of pole accessories and foundation.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Inspect poles for nicks, mars, dents, scratches, and other damage.
   2. System function tests.

END OF SECTION 265613

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Luminaire-mounted photoelectric relays.
2. Luminaire types.
3. Materials.
4. Finishes.
5. Luminaire support components.

B. Related Requirements:
1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 265613 "Lighting Poles and Standards" for poles and standards used to support exterior lighting equipment.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The

adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project, IES LM-79, IES LM-80.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
9. Hazardous ratings for luminaires installed in classified hazardous locations.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
2. Structural members to which luminaires will be attached.
3. Underground utilities and structures.
4. Above-grade utilities and structures.
5. Existing above-grade utilities and structures.
6. Building features.
7. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:
1. Luminaire.
2. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency.

F. Source quality-control reports.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires [and photoelectric relays] to include in operation and maintenance manuals.
   1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
   2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications:
   1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
   2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance:
1. Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
2. Luminaires and lamps shall be labeled vibration and shock resistant.
3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598[and listed for wet location].

E. Lamp base complying with ANSI C81.61 or IEC 60061-1.

F. Bulb shape complying with ANSI C79.1.

G. CRI of [**minimum**] 80. CCT of 4100 K.

H. L70 lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 120 V-277 V ac.

L. In-line Fusing: Separate in-line fuse for each luminaire.

M. Lamp Rating: Lamp marked for outdoor use.

N. Source Limitations:

1. Obtain luminaires from single source from a single manufacturer.
2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Manufacturers: Same as light manufacturer or as indicated on drawings.

B. Comply with UL 773 or UL 773A.

C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
   1. Relay with locking-type receptacle shall comply with ANSI C136.10.
   2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

A. Area and Site:
   1. Manufacturers: Subject to compliance with requirements, provide products specified on drawings by one of the following:
      a. Architectural Area Lighting.
      b. Atlas Lighting Products.
      c. Cooper Lighting Solutions; Signify North America Corp.
      d. H.E. Williams.
      e. Juno Lighting Group by Schneider Electric.
      f. Kim Lighting; Hubbell Incorporated, Lighting.
      g. Lithonia Lighting; Acuity Brands Lighting, Inc.
      h. OSRAM SYLVANIA.
      i. Signify North America Corporation (formerly Philips Lighting).
   2. Luminaire Shape: Square.
   3. Mounting: Pole and building with rectangular arm, 11 inches in length.
   4. Luminaire-Mounting Height: As specified on drawings.
   5. Distribution: As specified on drawings.
   6. Diffusers and Globes: Clear, UV-stabilized acrylic .
   7. Housings:
      a. Extruded-aluminum housing and heat sink.
      b. Anodized powder-coat finish.

2.5 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum or as indicated on drawings. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to

prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
   1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

G. Housings:
   1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
   2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage and coating.
      c. CCT and CRI for all luminaires.

2.6 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
   3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
   a. Color: Dark bronze.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Support luminaires without causing deflection of finished surface.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
      a. IES LM-5.
      b. IES LM-50.
      c. IES LM-52.
      d. IES LM-64.
      e. IES LM-72.
   2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 32000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

This section specifies paving consisting of aggregate base, emulsified asphalt, asphaltic concrete, and associated materials.

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt overlay.
3. Cold milling of existing asphalt pavement.
4. Hot-mix asphalt patching.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

B. Related Requirements:

1. Section 02223 "Excavation Backfill and Compaction for Pavement" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.

1.3 QUALITY ASSURANCE

A. References:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where

document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM D1557	Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.5-kg) Rammer and 18-in (457-mm) Drop
Texas Department of Transportation	Standard Specifications for Construction of Highways, Streets, and Bridges – 1993
TxDOT	Manual of Testing Procedures, Volume 1, 2, and 3 – Current Updates and Revisions

B. Testing:

Testing will be conducted by the Engineer to determine compliance with the specified degree of compaction and moisture content.

PART 2 - PRODUCTS

2.1 AGGREGATE BASE:

Aggregate base shall be Type A, Grade 3. Placed at a 6-inch layer conforming to Item 247 of TxDOT specifications.

A. 247 of TxDOT specifications.Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

2.2 EMULSIFIED ASPHALT:

Emulsified asphalt slow setting, diluted in water, of suitable grade and consistency for application. for tack coats and treatment of aggregate base shall be CSS-1H and shall comply with Item 300 of the TxDOT specifications. Emulsified Asphalt shall be applied at a rate of 0.15 GAL. per square yard (minimum coverage).

2.3 ASPHALT CONCRETE:

Aggregate shall be Type C, SAC A PG70-22, conforming to Item 340 of the TxDOT specifications. Asphalt concrete mixing and proportioning shall comply with Item 340 of the TxDOT specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Engineer, and replace with compacted backfill or fill as directed.

3.3 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Herbicide Treatment: Apply herbicide in accordance with manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.

1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 gal./sq. yd. (0.7 to 2.3 L/sq. m). Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

3.4 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Place hot-mix asphalt surface course in single lift.
3. Spread mix at a minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with [**ASTM D6927**] [**or**] [**AASHTO T 245**], but not less than 94 percent or greater than 100 percent.
2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

END OF SECTION 321216

SECTION 32 3120 - METAL GATES

PART 1 - GENERAL

1.1 ACTION SUBMITTALS:

A. Shop drawings: Submit shop drawings indicating sizes and locations of components, materials, finishes, relationship to adjacent construction, controls and operators.

B. Product data: Indicate material types, gauges, sizes and finishes, construction and erection details, including posts and details.

1.2 QUALITY ASSURANCE:

A. Applicable standards: ASTM International (ASTM), standards as referenced herein.

1.3 WARRANTY:

A. Manufacturer's warranty: Manufacturer's ten (10) year warranty for factory finished metal gate components.

B. Warranty to begin at Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL SLIDING GATES:

A. Characteristics:
1. Materials:
a. Steel: Hot-rolled steel tube or bar stock, hot-dipped galvanized in accord with requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/ft^2, Coating Designation G-60.
b. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water reducing and plasticizing additives.
2. Sliding/rolling parking exit gate: Steel gate system consisting of welded steel tube framing with open grille steel panels. Pickets, posts, rails and stringers: Size shall be as indicated on the drawings and approved shop drawings.
a. Gate posts: Minimum 4" x 12 gauge unless otherwise required by manufacturer for size and height indicated on drawings.
3. Hardware: Provide anchors, fasteners and other hardware required for a secure, complete installation.
a. Equip gates with manufacturer's standard stainless steel hardware required for functional operation.
b. Sliding/rolling vehicular exit gatest: Padlock hardware set.

B. Gate finish:
1. Galvanized to ASTM A123-07.
2. Manufacturer's standard powder polyester coated finish system. Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
a. Minimum hardness measured in accordance with ASTM D3363: 2H.
b. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
c. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than 3/16" undercutting.
d. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.

2.2 FABRICATION:

A. General: Fabricate gates in accord with approved shop drawings and manufacturer's product data with pickets and posts spacing meeting the 4" sphere rule.

B. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

C. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by manufacturer's proprietary fusion welding process, thus completing the rigid panel assembly.

D. Manufactured system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Gates shall be fabricated using fusion welded ornamental panel material and 1-3/4" sq. x 14ga. gate ends. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install gate in accordance with manufacturer's installation instructions and approved shop drawings.

B. Install posts plumb and level.

C. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.

D. Installation of gate panels to posts:
1. Secure gate panels to posts by welding as recommended by manufacturer.
2. Secure to posts at spacing indicated on approved shop drawings.

E. Install gates and adjust hardware for smooth operation.

F. Attach plastic caps to steel posts.

G. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

H Protect completed installations until Date of Substantial Completion; replace any damaged units.

END OF SECTION

DIVISION 33

UTILITIES

SECTION 33000

SECTON 31 41 33 TRENCH SAFETY REQUIREMENTS

1.00 GENERAL

1.01 SUMMARY

A. Section Includes

1. Furnish all labor, materials, and equipment and perform all operations to plan, design, construct, install, maintain, monitor, modify as necessary, and remove upon completion, a Trench Safety System as specified herein.

2. The requirements of this Section apply to all trenches that equal or exceed a depth of five (5) feet, measured from the ground surface at the highest side of the trench to the trench bottom.

B. Related Specification Sections include but are not necessarily limited to

1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.

2. Division 1 - General Requirements.

3. Section 02221 - Excavation Backfill and Compaction for Structures

4. Section 02222 - Excavation Backfill and Compaction for Utilities

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement for this item shall be per linear foot of trench.

B. The price bid shall include all work, labor, equipment, and materials necessary to design and provide a trench safety system in accordance with this Section.

1.03 REFERENCES

A. Reference Standards

1. Reference standards cited in this specification refer to the current reference standard published at the time of the latest revision date logged at the end of this specification, unless a date is specifically cited.

2. Texas Statute

a. HB 1569, 71st Regular Legislative Session.

3. Occupational Safety and Health Administration (OSHA)

a. 29 CFR 1926, Subpart P – Excavations, latest revision at time of construction Agreement execution.

1.04 ACTION SUBMITTALS/INFORMATION SUBMITTALS

A. Shop Drawings

1. The Contractor shall be responsible for providing to the Owner an acceptable trench safety plan signed and sealed by a Professional Engineer qualified to do such work and registered in Texas.

1.05 QUALITY ASSURANCE

A. The Contractor shall be responsible for complying with state laws and federal regulations relating to trench safety, including those that may be enacted during the performance under this contract.

2.00 PRODUCTS

2.01 GENERAL

A. All materials and products incorporated into the Trench Safety System shall be suitable for their intended uses; shall meet all design criteria and parameters used by the Trench Safety System designer; and shall meet all applicable requirements of OSHA Standards.

3.00 EXECUTION

3.01 PROCEDURES

A. At least ten (10) Calendar Days prior to execution or any excavation operations, and not more than thirty (30) Calendar Days following the execution date of the Construction Agreement, Contractor shall submit a site specific Trench Safety System Conformance Affidavit stating that operations will be conducted in full conformance with the OSHA Standards.

1. The Conformance Letter shall also describe the Trench Safety System techniques proposed to be used on the project.

2. Specific references to the applicable OSHA Standards sections shall be included for each technique to be used.

B. The Trench Safety System Plan shall be in writing, site specific and sufficiently detailed and clear to be understandable and usable by all personnel who will be executing, supervising and witnessing the trenching operations. A copy of the Trench Safety System Plan shall be available at the site of trenching operations at all times. A second copy shall be provided to the Owner for the Owner's records.

C. If borings and/or detailed geotechnical analyses are required to develop the Trench Safety System Plan, they shall be executed by the Contractor at his cost.

D. For trenches having depths greater than the various limits given in the OSHA Standards (8, 12 or 20 feet, depending on the techniques used), a site specific protective system shall be designed by a Licensed Professional Engineer experienced in soil mechanics and structural design. The design shall be signed, sealed and dated by the Professional Engineer, and it shall identify those specific locations where the design is applicable.

3.02 METHODS OF PROVIDING TRENCH SAFETY

A. Protective systems referenced in this Section shall be as defined and described in 29 CFR 1962.652, "Requirements for Protective Systems."

B. It is the duty, responsibility and prerogative of the Contractor to determine the specific applicability of a proposed Trench Safety System for each field condition encountered on the project. Contractor specifically holds the Owner, Engineer, and any of their designated representatives harmless in any actions resulting from the failure or inadequacy of the Trench Safety System used to complete the project.

C. Unless otherwise noted on the drawings or excluded below, Sloping/Benching, Trench Shielding with trench boxes, and/or Sheeting/Shoring/Bracing protective systems may be used on this project.

D. Restrictions on the use of the various protective systems for this project are as follows:

1. Sloping or Benching No Restrictions, except as noted on plans.

2. Trench Shields/Boxes No Restrictions.

3. Sheeting/Shoring/Bracing No Restrictions.

3.03 INSPECTION DUTIES OF CONTRACTOR

A. Provide a Competent Person, as defined in the OSHA Standards, to make frequent inspections of the trenching operations and the Trench Safety System in full conformance with the OSHA Standards.

B. If evidence of a possible cave-in or landslide is apparent, all work in the trench shall immediately cease and not be resumed until all necessary precautions have been taken to safeguard personnel entering the trench.

C. In an emergency that may threaten or affect the safety or welfare of any persons or properties, the Contractor shall act at his discretion to prevent possible damage, injury or loss. Any additional compensation or time extension claimed for such actions shall be considered in view of the cause of the emergency and in accordance with the Agreement.

END OF SECTION

SECTION 33 01 30.02 MANHOLE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This section describes manhole testing to effectively confirm the watertight integrity of existing manholes following infiltration related repairs and inflow related repairs. Vacuum testing is also applicable to complete manhole replacements.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 – General Requirements
3. Division 33 – Utilities

1.2 PRICE AND PAYMENT PROCEDURES

Will be in accordance with Section 01025.

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 – Submittals and Substitutions.

B. All submittals shall be approved by Owner prior to construction.

1.4 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Test Conformance

1. Submit data to show conformance with the specification for all testing methods.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Visual

1. The Engineer, Owner, or Owners Representative shall make a final visual inspection. Any deficiencies in the finished rehabilitation work completed shall be marked and repaired according to the manufacturer's recommendations.

B. Vacuum Testing

1. All manholes that are replaced by the contractor shall be vacuum tested by the Contractor in the presence of the Engineer for sources of infiltration. Testing will be made during high groundwater conditions, wherever possible. Prior to testing Contractor shall set up and test bypass pumping or utilize flow through plugs as necessary (no additional pay item).

2. Manholes shall be tested after installation with all connections (existing and/or proposed) in place. Drop-connections and gas sealing connections shall be installed prior to testing. The lines entering the manhole shall be temporarily plugged with the plugs braced to prevent them from being drawn into the manhole. The plugs shall be installed in the lines beyond drop-connections, gas sealing connections, etc. The test head shall be placed inside the frame at the top of the manhole and inflated in accordance with the manufacturer's recommendations. A vacuum of 10 inches of mercury shall be drawn, and the vacuum pump will be turned off. With the valve closed, the level of vacuum shall be read after the required test time. If the drop in the level is less than 1-inch of mercury (final vacuum greater than 9 inches of mercury), the manhole will have passed the vacuum test. After a successful test, the temporary plugs will be removed. The required test time is determined from Table I.

Table I

MINIMUM TIME REQUIRED FOR A VACUUM DROP OF 1" H_g (10"H_g - 9"H_g) (MIN:SEC)

DEPTH OF M.H. (DEPTH IN FT.)	48" M.H.	60" M.H.	72" M.H.
0 - 20'	:40	:50	1:00
22'	:44	:55	1:06
24'	:48	1:00	1:12
26'	:52	1:05	1:18
28'	:56	1:10	1:24
30'	1:00	1:15	1:30
ADDITIONAL 2' DEPTHS-ADD FOR EACH 2'	:04	:05	:06

3. Manhole vacuum levels observed to drop greater than 1-inch of mercury (Final vacuum less than 9 inches of mercury) will have failed the test and will require additional rehabilitation. The Contractor shall make the necessary repairs at no additional compensation for only those work items completed by the Contractor. The manhole shall then be retested as described above until a successful test is made.

C. Infiltration / Inflow Testing

1. All frame seal and pipe seal repairs shall be dyed water tested. Manholes shall be dye water tested in the presence of the Engineer. The dye test shall consist of applying a concentrated dye solution around the manhole frame, prior to backfilling and restoration. Dyed water shall be applied for at least ten (10) minutes.

2. Manholes observed to be actively leaking will have failed the test and will not be acceptable. Manholes failing the test will require additional rehabilitation by the Contractor at no additional compensation. The Contractor shall be responsible for only those work items listed in the Manhole Rehabilitation Schedule. The manhole shall then be retested as described above until a successful test is made.

D. Spark Testing (Holiday Test)

1. After the coating or lining product(s) have set in accordance with manufacturer instructions, all coated or lined structures shall be inspected for holidays with high-voltage holiday detection equipment. Reference NACE RPO 188-99 for performing holiday detection. All detected holidays as indicated by the audible or visual signal of the test apparatus shall be marked and repaired by abrading the coating or lining surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional coating or lining can be hand applied to the repair area. All touch-up/repair procedures shall follow the coating or lining manufacturer's recommendations. All surfaces shall be retested after the repairs at no additional cost to the Owner. Documentation on areas tested, results and repairs made shall be provided to Owner by Contractor.

2. Spark testing shall not be performed in any explosive environment. Prior to conducting testing in an enclosure, an inspection shall be conducted to indicate weather the enclosure is safe for entry, including testing for explosive gas.

E. Thickness Testing

1. Thickness testing of the Protective Coating Material shall be done during the application by the use of a wet film thickness gauge. During application of epoxy coatings, Contractor shall regularly perform and record thickness readings with a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, to ensure a monolithic coating and uniform thickness during application. A minimum of two readings every four vertical feet, two (2) readings on the Bench (one on each side of the invert) area and one (1) reading in the chimney area shall be recorded. Contractor will submit all documentation on thickness readings to Inspector on a daily basis when coating application occurs.

2. Due to the rapid cure of the approved polyurethane Protective Coating Material, the use of a wet film thickness gage is not practical. Therefore, thickness testing for the polyurethane Protective Coating Material will be done by cutting coupons at random locations on a minimum of (10 %), one out of every ten of the total structures coated with the PCM in each basin and or subdivision, as directed by the Owner or Engineer. Using test samples from the adhesion testing (dolly's) is acceptable. All repairs shall be made by Contractor in strict accordance with manufacturer's recommendations using the manufacturer's approved patching material to repair the structure where test coupons were taken.

F. Adhesion Testing

1. Adhesion testing shall be performed on ten percent (10%) of the coated or lined manholes and structures, at random locations for one out of every ten of the total structures coated in each basin and/or subdivision, as directed by the Owner or Engineer. Testing shall be conducted in accordance with ASTM D7234 as modified herein.

a. For each test manhole a minimum of three 20 mm dollies shall be affixed to the coated surface; One test dolly shall be affixed within 2 ft of the bench area /bottom of structure, one test dolly shall be affixed in the middle of the structures wall area and the final test dolly shall be affixed within two foot of the top of the chimney area /top of the structure.

b. For larger structures a minimum of three 20 mm dollies shall be affixed to the coated surface at random locations within each 1000 square foot area or as otherwise agreed upon.

c. The adhesive used to attach the dollies to the coating shall be rapid setting with tensile strengths in excess of at least twice the anticipated failure point (generally at least 1000 psi) and permitted to cure in accordance with manufacturer recommendations. The coating and dollies shall be adequately cleaned and prepared to receive the adhesive. Failure of the dolly adhesive shall be deemed a non-test and require retesting.

d. Prior to performing the pull test, the coating shall be scored to the substrate, or within 10 mils of the substrate surface, by mechanical means without disturbing the dolly or coating system bond within the test area.

e. Two of the three adhesion pulls in each test area shall exceed 200 psi and shall include substrate adhered to the back of the dolly or no visual signs of the coating product in the test hole. Pulls tests with results between 150 and 200 psi may be acceptable if more than 50 percent of the substrate in the test area is adhered to the dolly.

f. Should a structure, or area, fail to achieve two successful pulls as described above, additional testing shall be performed at the discretion of the Owner or Project Engineer. Any areas detected to have inadequate bond strength shall be evaluated by the Project Engineer. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by Contractor.

g. All adhesion testing shall be performed by qualified personnel using calibrated equipment as specified by the applicable ASTM standard(s).

h. All adhesion testing shall be documented and submitted in a consistent format detailing location, test values, description of the failure point/mode, scoring method employed, adhesive used, cure time of coating and adhesive and other data as deemed necessary by the Owner/Engineer.

2.2 FIELD QUALITY CONTROL

A. The testing required shall be performed by the Contractor at all rehabilitated manholes and documented to the satisfaction of the Engineer.

B. Any rehabilitated manholes that are observed to be leaking by the Engineer shall be subject to additional repairs and retested by the Contractor at no additional cost to the Owner.

END OF SECTION

33 01 30.13 ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Acceptance testing criteria and procedures for sanitary sewers below are mandatory:

1. Visual inspection of sewer pipes.
2. Mandrel testing for flexible sewer pipes.
3. Leakage testing of sewer pipes.

B. Tests listed in this Section are required on this Project. Required test is named in other Sections which refer to this Section for testing criteria and procedures.

1.2 UNIT PRICES

A. No payment will be made for Acceptance Testing for Sanitary Sewers under this section. Payment for work performed as described under this section shall be included in the unit price bid for applicable work items.

1.3 PERFORMANCE REQUIREMENTS

A. Gravity flow sanitary sewers are required to have a straight alignment and uniform grade between manholes.

B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of a line segment but prior to final acceptance using a standard mandrel to verify that installed pipe is within specified deflection tolerances.

C. Maximum allowable leakage for infiltration or exfiltration.

1. The total exfiltration, as determined by a hydrostatic head test, shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of 2 feet above the crown of the pipe at the upstream manhole or 2 feet above the groundwater elevation, whichever is greater.
2. When pipes are installed more than 2 feet below the groundwater level, an infiltration test shall be used in lieu of the exfiltration test. The total infiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above the crown of the pipe at the upstream manhole.
3. Refer to **Table 1**, Water Test Allowable Leakage, at the end of this Section, for measuring leakage in sewers. Perform leakage testing to verify that leakage criteria are met.

D. Perform air testing in accordance with requirements of this Section and the Texas Commission on Environmental Quality requirements. Refer to Table 02732-2, Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig, Table 02732-3, Minimum testing Times for Low Pressure Air Test, and Table 02732-4, Vacuum Test Time Table, at the end of this Section.

1.4 SUBMITTALS

A. Submittals shall conform to all provisions and sections of these specifications.

B. Test Plan: Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for approval by Owner's Representative Include testing procedures, methods, equipment, and tentative schedule. Obtain advance written approval for deviations form the Drawings and Specifications.

C. Test Reports: Submit test reports for each test on each segment of sanitary sewer within 7 days after testing on that segment as performed.

1.5 GRAVITY SANITARY SEWER QUALITY ASSURANCE

A. Remove and replace, and retest manholes or sections of pipe which fail to meet specified requirements when tested.

B. Provide testing reports within 7 days after completion.

1.6 SEQUENCING AND SCHEDULING

A. Perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at any one time.

B. Coordinate testing schedules with The Owner's Representative. Perform testing under observation of the Owner's Representative.

PART 2 PRODUCTS

2.1 DEFLECTION MANDREL

A. Mandrel Sizing. The rigid mandrel shall have an outside diameter (O.D.) equal to 95 percent of the inside diameter (I.D.) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for O.D. controlled pipe and the average inside diameter for I.D. controlled pipe. Dimensions shall be per appropriate standard. Statistical or other "tolerance package" shall not be considered in mandrel sizing.

B. Mandrel Design. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 200 psi without being deformed. The mandrel shall have nine or more "runners" or "legs" as long as the total number of legs is an odd number. The barrel section of the mandrel shall have a length of at least 75 percent of the inside diameter of the pipe. The rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. A proving ring shall be provided and used for verifying each size mandrel.

C. Proving Ring. Furnish a "proving ring" with each mandrel. Fabricate the ring of 2-inch-thick, 3-inch-wide bar steel to a diameter 0.02-inches larger than approved mandrel diameter.

D. Mandrel Dimensions (5% allowance). Mandrels for higher strength, thicker wall pipe or other pipe not listed in the table may be used when approved by the Owner's Representative.

2.2 EXFILTRATION TEST

A. Test Equipment:

1. Pipe plugs.

2. Pipe risers where the manhole cone is less than 2 feet above highest point in pipe or service lead.

2.3 INFILTRATION TEST

A. Test Equipment:

1. Calibrated 90° V-notch weir.

2. Pipe plugs.

2.4 LOW PRESSURE AIR TEST

A. Minimum Requirement for Equipment:

1. Control panel.

2. Low-pressure air supply connected to control panel.

3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.

4. Air hoses from control panel to:

a. Air supply

b. Pneumatic plugs

c. Sealed line for pressuring

d. Sealed line for monitoring internal pressure

B. Testing Pneumatic Plugs: Place a pneumatic plug in each end of a length of pipe on the ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable if they remain in place against the test pressure without external aids.

2.5 GROUND WATER DETERMINATION

A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

PART 3 EXECUTION

3.1 PREPARATION

A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

B. The selection of test methods and pressures for gravity sanitary sewers shall be determined based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Section 01563-Control of Ground Water and Surface Water.

3.2 VISUAL INSPECTION OF GRAVITY SANITARY SEWERS

A. Check pipe alignment visually by flashing a light between structures. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

3.3 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of the line segment.

B. Pull the approved mandrel by hand through sewer sections. Replace any section of sewer not passing the mandrel. Mandrel testing is not required for stubs.

C. Retest repaired or replaced sewer sections.

3.4 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

A. Test Options:

1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.

2. Test new or rehabilitated sanitary sewer manholes with water or low-pressure air. Manholes tested with low-pressure air shall undergo a physical inspection prior to testing.

3. Leakage testing shall be performed after backfilling of a line segment, and prior to tie-in of service connections.

4. If no installed piezometer is within 500 feet of the sewer segment, Contractor shall provide a temporary piezometer for this purpose.

B. Compensating for Ground Water Pressure:

1. Where ground water exists, install a pipe nipple at the same time sewer line is placed. Use a ½ - inch capped pipe nipple approximately 10 inches long. Make the installation through manhole wall on top of the sewer line where line enters manhole.

2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect a clear plastic tube to nipple. Support tube vertically and allow water to rise in the tube. After water stops rising, measure height in feet of water over invert of the pipe. Divide this height by 2.3 feet/psi to determine the ground water pressure to be used in line testing.

C. Exfiltration test:

1. Determine ground water elevation.

2. Plug sewer in downstream manhole.

3. Plug incoming pipes in upstream manhole.

4. Install riser pipe in outgoing pipe of upstream manhole if highest point in

service lead (house service) is less than 2 feet below bottom of manhole cone.

5. Fill sewer pipe and manhole or pipe riser, if used, with water to a point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.

6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over a one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure the quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 02732-1 at the end of this section.

D. Infiltration test: Ground water elevation must be not less than 2.0 feet above highest point of sewer pipe or service lead (house service).

1. Determine ground water elevation.

2. Plug incoming pipes in upstream manhole.

3. Insert calibrated 90° V-notch weir in pipe on downstream manhole.

4. Allow water to rise and flow over weir until it stabilizes.

5. Take five readings of accumulated volume over a period of 2 hours and use average for infiltration. The average must not exceed that calculated for 2 hours from allowable leakage according to the **Table 1** at the end of this Section.

E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F 1417, as applicable, with holding time not less than that listed in **Table 2**.

1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.

2. Lines 36-inch average inside diameter and larger shall be "joint" tested at each joint. The minimum time allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during a joint test shall be 10 seconds, regardless of pipe size. "Joint Test" shall be conducted as follows:

a. Each joint shall be tested successfully.

b. Joint Tester shall be set over joint to be tested so that the two inflation tubes straddle the joint.

c. Inflate "inflation tubes" to 25 psig to seal off joint to be tested.

d. Apply air pressure into void between inflation tubes until pressure reaches 4 psig.

e. After pressure has stabilized, bleed air pressure back to 3.5 psig.

f. Record time required for pressure to drop from 3.5 psig to 2.5 psig.

g. If the time in seconds for the air pressure to decrease from 3.5 psig to2.5 psig is greater than 10 seconds, the joint shall be presumed to be free from defect. When the time is less than 10 seconds pipe breakage, joint leakage or leaking tester seals are indicated and an inspection must be made to determine the cause. The contractor shall effect such repairs as may be required to accomplish a successful air joint test.

h. The joint shall be air tested before the pipe has been backfilled. Air testing shall be performed as pipe installation progresses.

3. For pipe sections less than 36-inch average inside diameter:

a. Determine ground water level.

b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.

c. After a manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.

d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in the system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See **Table 2** at the end of this Section.

e. To determine air loss, measure the time interval for pressure to drop to 2.5 psig. The time must exceed that listed in the Table 02732-2 at the end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.

F. Retest: Any section of pipe which fails to meet requirements shall be repaired and retested.

3.5 TEST CRITERIA TABLES

A. Exfiltration and Infiltration Water Tests: Refer to **Table 1**, Water Test Allowable Leakage, at the end of this Section.

B. Low Pressure Air Test:

1. Times in **Table 2**, Time Allowed for Pressure Loss From 3.5 psig to 2.5 psig, at the end of this Section, are based on the equation from Texas Commission on Environmental Quality (TCEQ) Design Criteria 317.2(a)(4)(B).

$T = 0.0850 (D) (K)/ (Q)$

where:

T	=time for pressure to drop 1.0 pounds per square inch gauge in seconds
K	=0.000419 DL, but not less than 1.0
D	=average inside diameter in inches
L	=length of line of same pipe size in feet
Q	=rate of loss, 0.0015 ft^3/min./sq. ft. internal surface

2. Since a K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in **Table 3**, Minimum Testing Times for Low Pressure Air Test.

3. Notes:

   (a). When two sizes of pipe are involved, the time shall be computed by the ratio of lengths involved.

   (b). Lines with 27-inch average inside diameter and larger may be air tested at each joint.

   (c). Line with an average inside diameter greater than 36 inches must be air tested for leakage at each joint.

   (d). If the joint test is used, a visual inspection of the joint shall be performed immediately after testing.

   (e). For joint test, the pipe is to be pressurized to 3.5 psi greater than the pressure exerted by groundwater above the pipe. Once the pressure has stabilized, the minimum times allowable for the pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch gauge shall be 10 seconds.

TABLE 1
WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	Inch	Gallons	Pipe Size in Inches	Gallon/Minute per 100 Ft.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	10	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value for 1" diameter.			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours.	

- Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within the 25-year flood plain

TABLE 2
TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG

Pipe Diamete	Minimum Time	Length for Minimum	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min. sec)										
				[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.8565	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

TABLE 3
MINIMUM TESTING TIMES FOR LOW PRESSURE AIR TEST

PIPE DIAMETER (inches)	MINIMUM TIME (seconds)	LENGTH FOR MINIMUM TIME (feet)	TIME FOR LONGER LENGTH (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676 (L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

END OF SECTION

33 03 10 BYPASS PUMPING OF EXISTING SEWER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Bypass pumping of the existing sewer system, required on all sewer lines that are open-cut point repairs or new connections unless otherwise specified in the Contract Documents.
2. Pumping flow requirements to be provided by Owner.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Bidding Requirements, Contract Forms, and Conditions of the Contract
2. Division 01 – General Requirements

1.02 PRICE AND PAYMENT PROCEDURES

Will be in accordance with Section 01025 Payment Procedures.

1.03 REFERENCES

A. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. Occupational Safety and Health Organization (OSHA).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Schedule meeting with Owner to review sewer shutdown prior to replacing or rehabilitating any facilities.
2. Owner reserves the right to delay schedule due to weather conditions, or other unexpected emergency within the sewer system.
3. Review bypass pumping arrangement or layout in the field with Owner prior to beginning operations. Facilitate preliminary bypass pumping run with Owner staff present to affirm the operation is satisfactory to the Owner.
4. After replacement or rehabilitation of facilities, coordinate the reestablishment of sewer flow with Owner staff.
5. Provide onsite continuous monitoring during all bypass pumping operations using one of the following methods:
   a. Personnel on site
   b. Portable SCADA equipment

1.05 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 – Submittals and Substitutions.

B. All submittals shall be approved by the Engineer or the Owner prior to delivery.

1.06 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Submit a detailed plan and description outlining all provisions and precautions that will be taken with regard to the handling of sewer flows. Submit the plan to the Owner for approval a minimum of 14 days prior to commencing work. Include the following details:

1. Schedule for installation and maintenance of the bypass pumping system
2. Staging areas for pumps
3. Pump sizes, capacity, number of each size, and power requirements
4. Calculations for static lift, friction losses, and velocity
5. Pump curves showing operating range and system head curves
6. Sewer plugging methods
7. Size, length, material, joint type, and method for installation of suction and discharge piping
8. Method of noise control for each pump and/or generator, if required
9. Standby power generator size and location
10. Suction and discharge piping plan
11. Emergency action plan identifying the measures taken in the event of a pump failure or sewer spill
12. Staffing plan for responding to alarm conditions identifying multiple contacts by name and phone numbers (office, mobile)
13. A contingency plan to implement in the event the replacement or rehabilitation has unexpected delays or problems

PART 2 - PRODUCTS

2.01 EQUIPMENT

A. Pumping

1. Provide equipment that shall meet or exceed the projected peak wet-weather flow for the project.
2. Provide fully automatic self-priming pumps. Foot-valves or vacuum pumps are not permitted for priming the system.
3. Pumps must be constructed to allow dry running for periods of time to account for the cyclical nature of sewer flow.
4. Provide 1 stand-by pump for each size to be maintained on site. Place backup pumps on line, isolated from the primary system by valve.
5. If multiple pumps are required to meet the flow requirements, provide the necessary fittings and connections to incorporate multiple discharges.
6. Noise levels of the pumping system must follow the requirements per the City's noise ordinance.

B. Piping

1. Install pipes with joints which prevent the incident of flow spillage.

C. Plugs or Stop Logs

1. Plugs

a. Select a plug that is made for the size and potential pressure head that will be experienced.
b. Provide an additional anchor, support or bracing to secure plug when back pressure is present.
c. Use accurately calibrated air pressure gauges for monitoring the inflation pressure.
d. Place inflation gauge at location outside of confined space area. Keep the inflation gauge and valve a safe distance from the plugs.
e. Never over inflate the plug beyond its pressure rating.

2. Stop Logs
   a. Use stop log devices designed for the manhole or sewer vault structure in use.
   b. If applicable, obtain stop logs from Owner that may be used on specific structures.

PART 3 - EXECUTION

3.01 PREPARATION

A. Locate the bypass pipelines in area to minimize disturbance to existing utilities and obtain approval of those locations from the Owner.

B. Make preparations to comply with OSHA requirements when working in the presence of sewer gases, oxygen-deficient atmospheres and confined spaces.

C. Do not begin bypass preparation and operation until Owner approval of the submittals requested per this Specification.

3.02 INSTALLATION

A. Install and operate pumping and piping equipment in accordance to the submittals provided per this Specification.

B. Sewer flow stoppage
   1. Plugging
      a. Use confined space procedures and equipment during installation when necessary.
      b. Thoroughly clean the pipe before insertion of the plug.
      c. Insert the plug seal surface completely so it is fully supported by the pipe.
      d. Position the plug where there are not sharp edges or protrusions that may damage the plug.
      e. Use pressure gauges for measuring inflation pressures.
      f. Minimize upstream pressure head before deflating and removing.

C. Sewer flow control and monitoring
   1. Take sufficient precautions to ensure sewer flow operations do not cause flooding or damage to public or private property. The Contractor is responsible for any damage resulting from bypass pumping operations.
   2. Begin continual monitoring of the sewer system as soon as the sewer is plugged or blocked. Be prepared to immediately start bypass pumping if needed due to surcharge conditions.

3. Sewer discharge may be into another sewer manhole or appropriate vehicle or container only. Do not discharge sewer into an open environment such as an open channel or earthen holding facility.

4. Do not construct bypass facilities where vehicular traffic may travel over the piping.

   a. Provide details in the suction and discharge piping plan that accommodate both the bypass facilities and traffic without disrupting either service.

3.03 FIELD [OR] SITE QUALITY CONTROL

A. Field [OR] Site Tests and Inspections

1. Perform leakage and pressure tests of the bypass pumping pipe and equipment before actual operation begins. Have Owner staff on site during tests.

3.04 CLOSEOUT ACTIVITIES

A. Once plugging or blocking is no longer necessary, remove in such a way that permits the sewer flow to slowly return to normal – preventing surge, surcharging and major downstream disturbance.

END OF SECTION

SECTION 33 04 50 CLEANING OF SEWER MAINS

1.00 GENERAL

1.01 SUMMARY

A. General

1. Before any television inspection, any sewer main shall be cleaned to remove all debris, solids, sand, grease, grit, etc. from the sewer and manholes.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 0 – Contracts
2. Division 1 – General Requirements

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment

1. Measurement

a. Measurement for this item will be by the linear foot of line cleaned.

2. Payment

a. The work performed conforming to this section is subsidiary to sanitary sewer pipe installation and no separate measurement or payment will be made.

2.00 PRODUCTS

2.01 PRODUCT TYPES

A. Use only the type of cleaning material which will not create hazards to health or property or affect treatment plant processes.

3.00 EXECUTION

3.01 CLEANING

A. General

1. All materials, equipment, and personnel necessary to complete the cleaning of the sanitary sewer main and manholes must be present on the jobsite prior to isolating the sewer manhole or line segment and beginning the cleaning process.

2. Maintain clean work and surrounding premises within the work limits so as to comply with Federal, State, and local environmental and anti-pollution laws, ordinances, codes, and regulations when cleaning and disposing of waste materials, debris, and rubbish.

3. Keep the work and surrounding premises within work limits free of accumulations of dirt, dust, waste materials, debris, and rubbish.

4. Suitable containers for storage of waste materials, debris, and rubbish shall be provided until time of disposal.

a. It is the sole responsibility of the Contractor to secure a licensed legal dump site for the disposal of this material.

b. Under no circumstances shall sewage or solids removed from the main or manhole be dumped onto streets or into ditches, catch basins, storm drains, or sanitary sewers.

5. The cleaning process shall remove all grease, sand, silts, solids, rags, debris, etc. from each sewer segment, including the manhole(s).
6. Selection of cleaning equipment and the method for cleaning shall be based on the condition of the sanitary sewer mains at the time work commences and will be subject to approval by the Owner.
7. All cleaning equipment and devices shall be operated by experienced personnel.
8. Satisfactory precautions shall be taken to protect the sanitary sewer mains and manholes from damage that might be inflicted by the improper use of the cleaning process or equipment.
9. Any damages done to a sewer main and/or structure by the Contractor shall be repaired by the Contractor at no additional cost and to the satisfaction of the Owner.
10. Cleaning shall also include the manhole wall washing by high pressure water jet.
11. The Contractor may be required to demonstrate the performance capabilities of the cleaning equipment proposed for use on the project.
    a. If the results obtained by the proposed sanitary sewer cleaning equipment are not satisfactory, the Contractor shall use different equipment and/or attachments, as required, to meet Owner satisfaction.
    b. More than 1 type of equipment/attachments may be required at a location.
12. When hydraulic or high velocity cleaning equipment is used, a suitable sand trap, weir, dam, or suction shall be constructed in the downstream manhole in such a manner that all the solids and debris are trapped for removal.
13. Whenever hydraulically-propelled cleaning tools which depend upon water pressure to provide their cleaning force, or any tool which retard the flow of water in the sanitary sewer lines are used, precautions shall be taken to insure that the water pressure created does not cause any damage or flooding to public or private property being served by the manhole section involved.
14. Any damage of property, as a result of flooding, shall be the liability and responsibility of the Contractor.
15. The flow of wastewater present in the sanitary sewer main shall be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible.
16. When additional quantities of water from fire hydrants are necessary to avoid delay in normal working procedures, the water shall be conserved and not used unnecessarily.
    a. No fire hydrant shall be obstructed or used when there is a fire in the area.
    b. It is the responsibility of the Contractor to obtain the fire hydrant, water meter and all related charges for the set-up, including the water usage bills from respective water purveyor agency.
    c. All expenses shall be considered incidental to the cleaning of the existing sanitary sewer mains.

B. Methods

1. Hydraulic Cleaning

   a. Hydraulic-propelled devices which require a head of water to operate must utilize a collapsible dam.

   b. The dam must be easily collapsible to prevent damage to the sewer main, property, etc.

   c. When using hydraulically-propelled devices, precautions shall be taken to insure that the water pressure created does not cause damage or flood public or private property.

   d. Do not increase the hydraulic gradient of the sanitary sewers beyond the elevation that could cause overflow of sewage into area waterways or laterals.

   e. The flow of wastewater present in the sanitary sewer main shall be utilized to provide necessary fluid for hydraulic cleaning devices whenever possible.

2. High-Velocity Cleaning

   a. Cleaning equipment that uses a high velocity water jet for removing debris shall be capable of producing a minimum volume of 50 gpm, with a pressure of 1,500 psi, for the sanitary sewer line and 3,500 psi for the (manhole) structure at the pump.

      i. Any variations to this pumping rate must be approved, in advance, by the Owner.

      ii. To prevent damage to older sewer mains and property, a pressure less than 1500 psi can be used.

      iii. A working pressure gauge shall be used on the discharge of all high pressure water pumps.

      iv. For sewers 18 inches and larger in diameter, in addition to conventional nozzles, use a nozzle which directs the cleaning force to the bottom of the pipe.

      v. Operate the equipment so that the pressurized nozzle continues to move at all times.

      vi. The pressurized nozzle shall be turned off or reduced anytime the hose is on hold or delayed in order to prevent damage to the line.

3. Mechanical Cleaning

   a. Mechanical cleaning, in addition to normal cleaning when required, shall be with approved equipment and accessories driven by power winching devices.

   b. Submit the equipment manufacturer's operational manual and guidelines to the Owner, which shall be followed strictly unless modified by the Owner.

   c. All equipment and devices shall be operated by experienced operators so that they do not damage the pipe in the process of cleaning.

   d. Buckets, scrapers, scooters, porcupines, kites, heavy duty brushes, and other debris

removing equipment/accessories shall be used as appropriate and necessary in the field, in conjunction with the approved power machines.

e. The use of cleaning devices such as rods, metal pigs, porcupines, root saws, snakes, scooters, sewer balls, kites, and other approved equipment, in conjunction with hand winching device, and/or gas, electric rod propelled devices, shall be considered normal cleaning equipment.

END OF SECTION

33 05 13 FRAMES, COVERS AND GRADE RINGS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Frame, cover and grade rings used as access ports into water, sanitary sewer and storm drain structures such as manholes or vaults

1.02 REFERENCES

A. Reference Standards
   1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
   2. ASTM International (ASTM)
      a. ASTM A48 – Standard Specification for Gray Iron Castings
      b. ASTM A536 - Standard Specification for Ductile Iron Castings
      c. ASTM C478 - Specification for Precast Reinforced Concrete Manhole Sections
   3. American Association of State Highways and Transportation Officials (AASHTO)
      a. AASHTO M306 – Standard Specification for Drainage, Sewer, Utility and Related Castings

1.03 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data
   1. All castings shall be cast with:
      a. Approved foundry's name
      b. Part number
      c. Country of origin
   2. Provide manufacturer's:
      a. Specifications
      b. Load tables
      c. Dimension diagrams
      d. Anchor details
      e. Installation instructions

B. Certificates
   1. Manufacturer shall certify that all castings conform to the ASTM and AASHTO designations.

PART 2 - PRODUCTS

2.01 EQUIPMENT, PRODUCT TYPES, MATERIALS

A. Castings
   1. Use castings for frames that conform to ASTM A48, Class 35B or better.
   2. Use castings for covers that conform to ASTM A536, Grade 65-45-12 or better.
   3. Use clean casting capable of withstanding application of AASHTO HS-20 vehicle

loading with permanent deformation.

4. Covers
   a. Size to set flush with the frame with no larger than a 1/8 inch gap between the frame and cover
   b. Provide with 2-inch wide pick slots in lieu of pick holes.
   c. Provide gasket in frame and cover.
   d. Standard Dimensions
      1) Sanitary Sewer
         a) Provide a clear opening of 30 inches for all sanitary sewer frames and cover assemblies unless otherwise specified in the Contract Documents.
      2) Storm Drain
         a) Provide a clear opening of 22 1/2 inches for all storm drain frames, inlets and cover assemblies unless otherwise specified in the Contract Documents.
         b) Provide a minimum clear opening of 30 inches for all storm sewer manholes and junction structures.
   e. Standard Labels
      1) Water
         a) Cast lid with the word "WATER" in 2-inch letters across the lid.
      2) Sanitary Sewer
         a) Cast lid with the word "SANITARY SEWER" in 2-inch letters across the lid.
      3) Storm Drain
         a) Cast lid with the word "STORM DRAIN" in 2-inch letters across the lid.
   f. Hinge Covers
      1) Provide watertight gasket on all hinged covers.
      2) Water
         a) Provide hinged covers for all water structures.
      3) Sanitary Sewer
         a) Provide hinged covers for all manholes or structures constructed over 24-inch sewer lines and larger and for manholes where rim elevations are greater than 12 inches above the surface.

B. Grade Rings
   1. Provide grade rings in sizes from 2-inch up to 8-inch.
   2. Use HDPE in traffic loading areas.
   3. In non-traffic areas, HDPE can be used.

C. Joint Sealant
   1. Provide a pre-formed or trowelable bitumastic sealant in an extrudable or flat tape form.
   2. Provide sealant that is not dependent on a chemical action for its adhesive properties or cohesive strength.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Grade Rings
   1. Place as shown in the water and sanitary sewer Drawings.
   2. Clean surfaces of dirt, sand, mud or other foreign matter before placing sealant.
   3. Seal each grade ring with sealant specified in this Specification and as shown on the Drawings.

B. Frame and Cover
   1. Water
      a. For water structures install frame, cover and grade rings in accordance with applicable Drawings.
   2. Sanitary Sewer
      a. For sanitary sewer structures install frame, cover and grade rings in accordance with applicable Drawings.
   3. Storm Drain
      a. For storm drain structures install frame, cover and grade rings in accordance with applicable Drawings.
   4. Hinge Cover
      a. Provide hinge cover on elevated manholes, junction boxes, in the flood plain and where specified on the Drawings.

C. Joint Sealing
   1. Seal frame, grade rings and structure with specified sealant.

D. Concrete Collar
   1. Provide concrete collar around all frame and cover assemblies.

END OF SECTION

SECTION 33 05 30 LOCATION OF EXISTING UTILITIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Locating and verifying the location and elevation of the existing underground utilities that may conflict with a facility proposed for construction by use of:

a. Exploratory Excavation

b. Vacuum Excavation

B. Work is subsidiary to the work and shall be included in the cost to install the pipeline.

1.02 REFERENCES

A. Definitions

1. Exploratory Excavation: A method used to locate existing underground utility as shown on the plans through the use of standard excavation equipment.

2. Vacuum Excavation: Method used to locate existing underground utility as shown on the plans through the use of geophysical prospecting equipment such as vacuum excavation.

B. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.

2. American Society of Civil Engineers (ASCE)

a. ASCE Publication CI/ASCE 38 (Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data)

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate with OWNER at least 48 hours prior to commencing on site for Exploratory Excavation of Existing Utilities.

2. Coordinate location of all other existing utilities within vicinity of excavation prior to commencing Exploratory Excavation.

3. Coordinate staking of Exploratory Excavations with OWNER at least 1 week prior to commencement.

B. Sequencing

1. Exploratory Excavations shall be conducted prior to the construction of the entire project.

C. Scheduling

1. For critical utility locations, the OWNER may choose to be present during excavation.

2. Alter schedule for Exploratory Excavation of Existing Utilities to

accommodate OWNER personnel.

1.04 SUBMITTALS

A. Report of Utility Location

1. Horizontal location of utility as surveyed

2. Vertical elevation of utility as surveyed

a. Top of utility

b. Spring line of utility

c. Existing ground

3. Material type, diameter and description of the condition of existing utility

PART 2 - EXECUTION

2.01 EXAMINATION

A. Verification of Conditions

1. Verify location of existing utilities in accordance with the General Requirements, the General Notes and the Drawings.

2.02 INSTALLATION

A. Exploratory Excavation

1. Verify location of existing utility at location denoted on the Drawings, or as directed by the OWNER.

a. Expose utility to spring line, as necessary.

B. Vacuum Excavation

1. Verify location of existing utility at location denoted on the Drawings, or as directed by the OWNER.

2. Designate the horizontal position of the existing underground utilities that are to be located using geophysical prospecting equipment.

a. Acquire record documentation from and coordinate with utility companies, as necessary to locate utility.

3. Perform excavation in general accordance with the recommended practices and procedures described in ASCE Publication CI/ASCE 38.

C. Upon completion of the utility locating, submit a report of the findings.

D. If location of utility is in conflict with the Drawings, notify the Owner for appropriate design modifications.

E. Place embedment and backfill in accordance with Section 02222.

F. Once necessary data is obtained, immediately restore surface to existing conditions to:

1. Obtain a safe and proper driving surface, if applicable

2. Ensure the safety of the general public

3. The satisfaction of the OWNER

END OF SECTION

SECTION 33 05 36.13 FIBERGLASS DUCTWORK FOR FOUL AIR

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This specification covers requirements for fiberglass ductwork as indicated on the plans and schedules. The duct system shall be furnished and installed complete with all fittings, transitions, jointing materials, expansion joints, dampers and all other necessary appurtenances.

B. Duct and appurtenances will be continuously exposed to a humid environment containing hydrogen sulfide and will be used in interior and exterior location as well as above and below grade.

1.2 REFERENCES

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Reference Standards

1. ASTM D1599 Standard test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing and Fittings.
2. ASTM D2105 Standard test Method for Longitudinal Tensile Properties of 'Fiberglass' (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube.
3. ASTM D2412 Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
4. ASTM D2992 Standard Practice of Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings.
5. ASTM D2996 Standard Specification for Filament Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
6. ASTM D2997 Standard Specification for Centrifugal Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
7. ASTM D3567 Standard Practice for Determining Dimensions of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
8. AWWA C-950American Water Works Association Standard for Fiberglass Pressure Pipe.

1.3 QUALITY ASSURANCE

A. Duct manufacturer shall provide the services of a trained factory representative to oversee and coordinate duct installation. This factory representative shall make a minimum of one trip to the project site, and shall spend a minimum of one 8-hour day at the project site, not including travel time. The factory representative shall have at least 5 years of experience with installation of fiberglass duct systems similar to those required for this project. The factory representative shall certify that the ductwork, supports, joints, and fittings have been installed in accordance with manufacturer's instructions, specifications, and other applicable standards.

B. Minimum Duct Wall Stiffness: The minimum duct wall stiffness, at 5 percent deflection, determined in accordance with ASTM D2412 and Section 3 of AWWA C950, shall not be less than the following:

Nominal Duct Diameter (inches)	Duct Stiffness (psi)
1-8	36
10	18
12-16	9
18 and larger, buried	10
18 and larger, other locations	5

C. Buried duct and fittings shall be designed in accordance with Appendix A of AWWA C950 to withstand the simultaneous application of either the following external loading and internal pressure or the following external loading and internal vacuum, whichever produces a stiffer pipe:

Field External			
Duct Size (inches)	**Load (lb per lf)**	**Internal Pressure (psig)**	**Internal Vacuum (in. water column)**
6	1450	25	20
8	1150	25	20
12	1600	25	20
14	1900	25	20
16	1850	25	20
18	2400	25	20
24	2750	25	20
30	1875	25	20
36	6500	25	20

D. Temperature and Pressure: All duct, fittings, and appurtenances shall be suitable for the following conditions:

	Design Temperature, ^{o}F
Minimum	0
Maximum	115
Internal Pressure, psig	25
Internal Vacuum, inches water column	20

E. Coefficient of Thermal Expansion: All ductwork, fittings and appurtenances shall have a coefficient of thermal expansion not exceeding:

9.6×10^{-6} in/in ^{o}F for centrifugally cast pipe,
10.5×10^{-6} in/in ^{o}F filament wound pipe.

F. Expansion Joint Performance: Expansion joints shall be furnished in sufficient number to accommodate the coefficient of thermal expansion. The minimum and maximum air temperatures shall be $0^{o}F$ and $115^{o}F$, respectively. Duct shall be protected from excessive solar heating during storage and installation in accordance with manufacturer's recommendations. All thermal expansion and contraction throughout the duct system shall be accommodated in expansion joints to be provided by the duct manufacturer.

1.4 SUBMITTALS

A. Shop Drawings: Submit scaled layout drawings of fiberglass ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling as recommended by the manufacturer. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping as recommended by the manufacturer.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Vinyl Ester Duct

1. Centrifugally Cast, 14-inch and smaller - ASTM D2997, RTRP-21B, centrifugally cast, reinforced vinyl ester resin duct with 30 mil liner,
   a. Smith/Fibercast "Centricast CL 1520"
2. Filament-Wound, 16-inch and smaller - ASTM D2996, RTRP-12ED-101, -12EF-311, and -12EQ-311, or -12EU-311, with at least a 20 mil reinforced liner
   a. Ameron "Bondstrand Series 5000"
   b. Smith/Fibercast "F-Chem-V"
   c. Beetle “Series 5000”.
   d. Belco Manufacturing Co. Inc.
   e. Daniel Company
3. Filament-Wound, 18-inch and larger - ASTM D2310, RTRP-12ED, -11EQ, or -12EU, with at least a 20 mil reinforced liner
   a. Ameron "Bondstrand Series 5000"
   b. Smith/Fibercast "F-Chem-V”
   c. Beetle “Series 5000”.
   d. Belco Manufacturing Co. Inc.
   e. Daniel Company

B. Fittings and Flanges

1. Manufacturer's standard, glass fiber reinforced, compatible with the duct provided and with chemical resistance equal to or greater than the duct. Flanges shall comply with PS-1569, Table 5, at a design pressure of 25 psi, and shall have a minimum of ANSI/ASME B16.1, Class 25 diameter and drilling. All bends and elbows shall have

a centerline radius of at least 1.5 times the inside diameter of the duct. An eccentric reducer shall be installed on the main or primary duct immediately upstream of the wye fitting to increase the main duct size prior to the intersection with the lateral duct in locations where size changes occur at intersections. Alternate bend and fitting configurations may be considered by ENGINEER on a case-by-case basis where existing site constraints prohibit installation of fittings shown on plans.

C. Flange Bolts or Studs and Nuts
   1. Type 316 stainless steel, sized such that, after installation, bolts will project 1/8- to 3/8-inch beyond the outer face of the nut.

D. Flat Washers - Type 316 stainless steel.

E. Flange Gaskets
   1. Full face, ASTM D2240, Type A durometer 50-70, 1/8-inch minimum thickness, EPDM.

F. Bell-and-Spigot Joints
   1. Matched tapered bell-and-spigot ends bonded with adhesive.

G. Butt Joints
   1. Butt and wrap, resin bonded, PS-15, with pressure rating equal to the duct.

H. Expansion Joints - As specified herein.

I. Adhesive - Duct manufacturer's standard.

J. Straight Socket – Straight socket bonded with adhesive

K. All duct, fittings, and appurtenances shall contain ultraviolet (UV) inhibitors. All duct, fittings, supports and appurtenances shall be painted to match the color of existing ductwork. Painting shall be done in accordance with specification Division 9 Section 09 91 00 “Painting”.

L. Caulking – Polyurethane-based, 1 part elastomeric sealant, Vulkem 921 by Maneco International or equal. Use with compressible polyethene foam backer rod.

2.2 FABRICATION

A. Joint Method: Unless otherwise specified, duct shall have straight socket, match tapered bell and spigot or butt joints. Shop fabricated assemblies should be provided to the maximum extent possible, to minimize the number of field joints.
   1. Flanged joints shall be provided at each damper and item of equipment to facilitate disassembly, at each change in material, at road crossings and where indicated on the drawings.
   2. Field butt joints, when needed, shall be made at locations at least 12 inches from any increasing or decreasing cross-section of duct where the duct to be jointed has the same diameter. All bolts, nuts, washers, and gaskets required for all connections of the ductwork system, including connections to equipment, shall be provided.

B. Transitions: Fiberglass reinforced plastic transition sections shall be furnished for connecting round duct to rectangular openings on equipment. Transitions shall have a pressure rating and wall stiffness equal to that of the duct. Internal lining shall be of the same type of material and thickness as specified for the duct. Transitions shall have flanged end connections compatible with the connecting duct and equipment. Transitions will be constructed to provide for draining condensate in the direction of the airflow.

C. Expansion Joints: Expansion joints shall be furnished and installed at locations required for proper duct installation. Expansion joints shall be resistant to ultraviolet light and shall be suitable for the service conditions. All expansion joint materials in contact with the foul air shall be manufactured of EPDM or other materials suitable for sustained contact in wet hydrogen sulfide concentrations of up to 200 parts per million and dilute sulfuric acid. The duct manufacturer shall be responsible for selecting locations and quantities of expansion joints based on the longitudinal and lateral movement capability of the specific expansion

joint product selected.

D. Expansion joints shall be flanged type, as manufactured by Red Valve Co., Inc., Mercer Rubber or approved equivalent. Hardware shall be type 316 stainless steel.

2.3 PIPE SUPPORTS

A. Details of construction of pipe support anchors and guides shall be as shown on the plans. Manufacturer's pipe shall be suitable for the support spacing shown on the plans. Duct support spacings greater than 20 feet may be considered by ENGINEER if modifications are made to anchor bolts and to concrete support pads at no additional cost to OWNER. Duct support spacings shall be as shown on the plans. All ductwork, guides, and anchors supplied by manufacturer shall be capable of withstanding a 100-mile per hour lateral wind load, and shall be capable of withstanding a 200 pound concentrated vertical load (applied over a 1 square foot bearing area) at mid-span between any two supports.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which fiberglass ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor or as recommended by manufacturer.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs as indicated in the plans.

D. Coordination: Coordinate duct installations with installation of accessories, dampers, equipment, controls, weir area covers, and other associated work of ductwork system.

E. Ductwork runs shall slope to the blower with the lowest point of the suction duct at the entrance to the blower.

F. A condensate drain shall be provided at the low point in the suction ductwork and at locations shown on the plans and shall be connected to the plant drain system.

3.3 FIELD QUALITY CONTROL

A. Any ductwork found to be improperly installed shall be removed and replaced with ductwork, liner or fittings meeting these specifications. Improper installation shall include, but not be limited to, the following:

1. Fiberglass duct smaller than specified.
2. Construction joints not properly sealed.

3.4 EQUIPMENT CONNECTIONS

A. General: Connect ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.5 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of fiberglass or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

END OF SECTION

SECTION 33 11 13 PUBLIC WATER UTILTY DISTRIBUTION AND FORCE MAIN PIPING

1.00 GENERAL

1.01 SECTION INCLUDES:

A. Pipe and fittings for water lines including, supply lines, and potable water distribution lines.

B. Fire hydrants, fittings, and appurtenances.

1.02 RELATED SECTIONS:

A. Section 01300 – Submittals and Substitutions.

1.03 REFERENCES:

A. American Society for Testing and Materials (ASTM):

1. ASTM A-126 - Gray Iron Castings for Valves, Flanges and Pipe Fittings.
2. ASTM A-307 - Specification for Carbon Steel Bolts and Studs 60,000 psi Tensile.
3. ASTM A-536 - Ductile Iron Castings.
4. ASTM B88 - Seamless Copper Water Tube.
5. ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures.
6. ASTM D-1784 - Standard Specification for Rigid PVC Compounds and Chlorinated PVE Compounds.
7. ASTM D-1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
8. ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
9. ASTM D-2464 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
10. ASTM D-2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
11. ASTM D-2467 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
12. ASTM D-2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
13. ASTM D-2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
14. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
15. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
16. ASTM D-3139 - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
17. ASTM F-477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA):

1. AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3 inches through 48 inches, for Water and Other Liquids.

2. AWWA C153 - Ductile Iron Compact Fittings, 3 inches through 12 inches, for Water and Other Liquids.

3. AWWA C200 - Steel Water Pipe, 6 In. and Larger

4. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied.

5. AWWA C301 - Prestressed Concrete Pressure Pipe, Steel-Cylinder Type

6. AWWA C303 -Concrete Pressure Pipe, Bar-Wrapped, Steel Cylinder Type

7. AWWA C502 - Dry-Barrel Fire Hydrants

8. AWWA C600 - Installation of ductile Iron Water Mains and Their Appurtenances

9. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches, for Water.

10. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, ½ inch through 3 inches for Water.

C. National Sanitation Foundation (NSF)

1. NSF14 - Plastic Piping System Components and Related Materials

2. NSF61 - Drinking Water System Components - Health Effects

D. ANSI B16.9 - Fittings

E. ANSI B36.19 - Wall Thickness

F. ANSI A21.11/AWWA C111 - Mechanical Joints

G. ANSI B16.1 - Flanges and Flanged Fittings.

H. 30 TAC 290, Texas Administrative Code, Volume 30, Chapter 290, Water Hygiene.

1.04 SUBMITTALS:

A. Procedures for Submittals: Section 01300 – Submittals and Substitutions.

B. Product Data: Manufacturer's product data sheets on all materials incorporated into work.

C. Quality Control Submittals: For information only.

1. Certificates: Manufacturer's certificates attesting compliance with applicable specifications for grades, types, classes, and other properties.

2. Test Reports: Results of field quality control tests including hydrostatic tests and bacteriological tests.

D. Contract Closeout Submittals: Refer to Section 01 70 00, EXECUTION AND CLOSEOUT REQUIREMENTS.

1. Protect Record Documents: Submit documents in accordance with Section 01 70 00. Accurately record installed location of valves, hydrants, piping and service connections, and accessories.

2. Contractor to submit GPS coordinates for all bends, fittings, grade change locations and appurtenances to be included in record drawings.

1.2 QUALITY ASSURANCE:

A. Pipeline installation shall be in accordance with manufacturer's recommendations and as supplemented by these specifications.

B. Pipe shall be kept clean of all foreign matter.

C. Jointing shall be by trained employees.

1.3 DELIVERY, STORAGE, AND HANDLING:

A. Deliver, store, and handle products under provisions of Section 01 31 00, PROJECT MANAGMENT AND COORDINATION.

B. Each load of pipe delivered to the job site shall be inspected by the Engineer.

1. Pipe transported without adequate protection shall be rejected and removed immediately from the job site.

2. Inadequate wall thickness or tolerances greater than specified: Randomly selected samples of the pipe shall be forwarded immediately to an approved testing laboratory with instructions to check the pipe for compliance with applicable product standards, ASTM Specifications, and other applicable specifications.

3. If the testing laboratory reports concur that the pipe does not meet specifications, the defective pipe shall be removed immediately from the job site by the Contractor.

4. If defective, all costs for shipping of samples, laboratory testing, removal of defective pipe, and replacement pipe shall be the sole responsibility of the Contractor.

5. Pipes with excessive “pitting”, cracks, mold scares and/or other surface defects may be rejected by the Engineer at his discretion. The Contractor and supplier shall remove the pipe from the project site and shall replace the material at no additional cost to the Owner.

6. Pipe stored on the project site shall be covered with a tarp/sheeting in such a manner to prevent weather damage to the pipe.

2.00 PRODUCTS

2.01 PIPE:

A. Ductile Iron Water Pipe - Pressure Class: ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51. All pipe shall be ductile iron unless otherwise noted.

1. Pipe shall be PC350 or Thickness Class 53.

2. All pipes shall bear NSF Seal of Approval.
3. Interior shall be ceramic epoxy lined with Protecto 401 or owner approved equal.
4. Exterior shall be coated with bituminous coating per AWWA C110 or as required by Section 09 97 16.
5. Pipe shall be free from excessive pits, scars, or other surface defects.
7. Joints shall be integral bell with flexible elastomeric seal per AWWA C111.
8. Install pipe as specified and as detailed in AWWA C600.
9. Pre-approved Acceptable Manufacturers
    a. U.S. Pipe
    b. Griffin
    c. American Cast Iron Pipe Co.

B. PVC Water Pipe - Pressure Class: AWWA C900:
1. DR 18 - Pressure Class 235.
2. All pipe shall bear NSF Seal of Approval.
3. Joints shall be integral bell with flexible elastomeric seal.
4. Pre-approved Acceptable Manufacturers:
    a. Northern Pipe Products
    b. JM Eagle
    c. Diamond Plastics Co.

C. PVC Water Pipe - Pressure Class: AWWA C905
1. DR 18 - Pressure Class 235.
2. All pipe shall bear NSF Seal of Approval.
3. Joints shall be integral bell with flexible elastomeric seal.
4. Pre-approved Acceptable Manufacturers:
    a. JM Eagle

D. PVC Water Pipe -Pressure Class: AWWA C909
1. Cast iron outside diameter (C.1.O.D.).
2. DR 18 - Pressure Class 235.
3. All pipe shall bear NSF Seal of Approval.

4. Joints shall be groove and coupling with flexible elastomeric seal.
5. Pre-approved Acceptable Manufacturers:
    a. PW Eagle

E. PVC Water Pipe - Pressure Class: ASTM D2241/RJ
1. Restrained joint PVC pipe.
2. SDR 21 - Pressure Class 200.
3. All pipe shall bear NSF Seal of Approval.
4. Joints shall be integral bell with flexible elastomeric seal.
5. Pre-approved Acceptable Manufacturers:
    a. Certainteed

F. PVC Water Pipe -Pressure Class: AWWA C900/RJ
1. Restrained joint PVC pipe
2. DR 18 - Pressure Class 150.
3. All pipe shall bear NSF Seal of Approval.
4. Joints shall be groove and coupling with flexible elastomeric seal.
5. Pre-approved Acceptable Manufacturers:
    a. Certainteed

G. PVC Water Pipe -Pressure Class: AWWA C905/RJ
1. Restrained joint PVC pipe
2. DR 18 - Pressure Class 235.
3. All pipe shall bear NSF Seal of Approval.
4. Joints shall be groove and coupling with flexible elastomeric seal.
5. Pre-approved Acceptable Manufacturers:
    a. Certainteed

H. HDPE Water Pipe -Pressure Class: AWWA C901
1. Polyethylene Pipe
2. DR 9 - Pressure Class 200.
3. All pipe shall bear NSF Seal of Approval.
4. Pre-approved Acceptable Manufacturers:

a. JM-Eagle

2.02 FITTINGS:

A. Buried Fittings (size 3-inch through 48-inch):

1. Ductile iron, AWWA C110 (non-compact) or AWWA C153 (compact).

2. Cement lined interior, AWWA C104.

3. Exterior shall be bituminous coated, AWWA C110.

4. Fittings shall be push-on, mechanical joint or flanged as shown.

5. Working pressure rated to 350 psi.

2.03 COUPLINGS:

A. Pipe couplings by Dresser Industries, Smith-Blair or Engineer approved equal.

1. Supply couplings with a steel center band, steel gland rings, gaskets and bolts.

2. Couplings shall be rated for 1.25 times the maximum operating pressure of line connected.

3. All couplings near bends, fittings, or valves shall be restrained with Engineer approved mechanical restraint system.

2.04 BOLTS AND GASKETS:

A. Gaskets shall be 1/16-inch cloth insert, red rubber, full face.

B. Bolts shall be in accordance with the following:

1. Non-Pressure Applications: ASTM A307A.

2. Pressure Applications: ASTM A307B.

3. Submerged/Splashed: 316 stainless steel.

2.05 PIPE SUPPORTS:

A. Install Standon, Anvil, Houston Pipe Support, or approved equal, adjustable pipe supports as shown on the plans.

2.06 TAPPING SLEEVES:

A. Sleeves shall be Mueller Model H 615/616 or Engineer approved equal and designed for a working pressure of at least 200 psi, and furnished with a test plug through the body for hydrostatic pressure testing.

B. Only mechanical joint sleeves are acceptable

C. The outlet shall conform to ANSI B16.1, Class 125 flanges designed to accept tapping valves.

D. Sleeves shall be designed to properly fit the type and class of pipe specified. Sleeves may be cast iron or ductile iron.

E. All bolts shall be corrosion resistant alloy.

F. Sleeves which are designed in such a manner that the watertight seal around the outlet is achieved by a gasket placed between the sleeve body and the pipe barrel shall be provided with a recess in the sleeve body to accommodate the gasket.

G. Pre-approved Acceptable Manufacturers

1. Smith Blair

2. JCM

3. Ford

2.07 TRACER WIRE FOR PVC PIPE:

A. A continuous THHN 12 gauge solid insulated copper wire shall be installed along with all PVC water pipe to assist in locating the line following installation. Tracer wire splices shall utilize a DBY-6 direct bury splice kit as manufactured by 3M. Wires should be tied together at splices to prevent pulling the splices apart. The tracer wire should stubup near valves, but should not be installed in the valve box. The distance between stubups should not exceed 2,000 feet. Color shall be in accordance with the American Public Works Association color code.

3.00 EXECUTION

3.01 PIPE INSTALLATION:

A. Preparation:

1. Inspect, unload, handle, and store materials as set forth in AWWA C600 and as specified.

2. Do not lay pipe in water, or when trench or weather are unsuitable for work. Keep water out of trench until jointing is complete and bedding is placed to top of pipe. When work is not in progress, close ends of pipe and fittings securely so that no trench water, earth or other substances will enter pipes or fittings.

3. Keep inside of pipe free from foreign matter during operations by plugging or other approved method.

4. Place pipe so that full length of each section rests solidly upon pipe bed, with recesses excavated to accommodate bells and joints. Take up and re-lay pipe when grade or joint is disturbed after laying.

5. Handle pipe and accessories so that pipe placed in trench is sound and undamaged. Take particular care not to injure pipe coating when applicable.

6. Cut neatly, using approved type mechanical cutter without damaging pipe. Use wheel cutters when practicable.

7. Install in locations sited with hangers, brackets, supports, etc., at spacings as recommended by pipe manufacturer.

8. Field cutting of stainless steel pipe will not be allowed.

B. Pipe Bedding and Backfill:

1. Bedding shall be in accordance with Section 31 23 33, TRENCHING & BACKFILL.

C. Placing and Laying:

1. Bury water lines as shown.

2. Intersecting lines shall be joined by an appropriate fitting.

3. Install pipe sleeves where seamless steel piping passes through concrete walls.

D. Joints:

1. Install mechanical joints in accordance with manufacturer's recommendations.

2. Make push-on joints in accordance with manufacturer's recommendations.

3. Install solvent weld joints in accordance with ASTM D 2855.

4. Joint lubricant shall be as recommended by the pipe manufacturer.

5. Install joints in the field by cleaning all joint surfaces and gaskets with soapy water, tighten bolts alternately, evenly and to the specified torques. Extension wrenches shall not be used to secure greater leverage. Install electrical bonding or insulation during manufacture of joints.

6. Complete installation of pipe and appurtenances as set forth in AWWA C600 and as specified.

F. Anchorage of Fittings

1. Joint Restraint for bends requiring multiple fittings:

a. Where bends with multiple fittings are specified and where thrust rod anchors are shown or specified the Star Joint Restraint System as manufactured by Star National Products of Columbus, Ohio shall be utilized.

b. Where thrust rod anchors are shown or specified the Star Joint Restraint System as manufactured by Star National Products of Columbus, Ohio shall be utilized.

c. This system consists of the use of 304 stainless steel Super Star tie bolts, tie nuts, tie rods (¾") and tie couplings.

d. The number of tie rods required is listed as follows:

Pipe Size (in.)	Number of ¾" Rods Required
6	2
8	2
10	2
12	4
14	4
16	6
18	6
20	8
24	10

e. Where restrained joint fittings are required, Contractor shall restrain pipe joints on either side of the fitting in accordance with Manufacturer's recommendations.

G. Hydrostatic Testing

1. Complete hydrostatic testing as set forth in AWWA C600 and as specified.

2. Testing shall be completed for each subsection, or plugged section of pipeline between main line valves. The test pressure and allowable leakage shall be calculated based on each subsection, or plugged section of the pipeline between the main line valves.

3. Once the subsections have passed the hydrostatic testing, the entire pipeline shall be hydrostatically tested. The test pressure and allowable leakage shall be calculated based on the entire pipeline.

4. Refer to Section 01 45 16.16, HYDROSTATIC TESTING for additional testing procedures and allowable leakage calculations.

END OF SECTION

33 12 16.19 ECCENTRIC PLUG VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install eccentric plug valves and appurtenances, including valve boxes, operators, bolts, nuts and gaskets.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. DeZurik.
2. Pratt.

1.03 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

1. Shop drawings
2. Equipment Installation Reports
3. Operation and Maintenance Manuals.

1.04 STANDARDS

A. The applicable provisions of the following standards shall apply as if written here in their entirety:

1. American Water Works Association (AAWA) Standards:

ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings
AWWA C110	Ductile-Iron and Grey-Iron Fittings
AWWA C111	Standard for Rubber Gasket Joints for Ductile Iron Pipe and Fittings
AWWA C517	Resilient Seated Cast-Iron Eccentric Plug Valves
ASTM A-126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A-536	Standard Specification for Ductile Iron Castings

2.00 PRODUCTS

2.01 MATERIALS

A. Valve Bodies: Constructed of cast iron, ASTM A126, Class B, in accordance with AWWA C504.

B. Flanges: Class 125 conforming to ANSI standard for cast-iron flanges.

C. Mechanical Joint Ends: For buried service shall be to AWWA Standard C111.

D. Nuts, Bolts, Springs, Washers, etc.: Type 316 Stainless Steel.

E. Resilient Plug Facings: Neoprene, nitrile rubber, BUNA-N, or approved equal.

F. Mating Surface: Overlaid with thick, welded and machined nickel alloy.

G. Valve Boxes: Three piece cast iron extension type, Mueller No. 10380 or Clow F2450, with No. 6 round base. The three pieces shall consist of the top section, center section, and base plus the cover.

2.02 ECCENTRIC PLUG VALVES

A. Eccentric valves shall be non-lubricated quarter-turn type with resilient faced plugs. Unless otherwise indicated, buried valves shall be furnished with mechanical joint ends and exposed valves shall be furnished with flanged ends. Valves shall have a minimum nominal port area of 100 percent of the pipe for valve sizes up to 20 inches. Port area for valves 24 inches and larger shall be at least 70 percent of full pipe area. All valves shall have a minimum pressure rating of 150 psi.

B. Valves 6 inches and smaller shall be wrench operated unless otherwise shown or scheduled. Supply a wrench operator for each wrench operated valve. Larger valves shall be supplied with a handwheel. Valves shall have seals on shafts and gaskets on the valve operator covers to prevent the entry of water.

C. Valves larger than 6 inches shall be side-mounted and come complete with a totally enclosed worm gear operator. Valves shall have seals on all shafts and gasketed valve operator covers to prevent the entry of water.

D. Valves for buried service shall be supplied with cast iron valve boxes. The valve box shall be firmly supported, maintained, centered, and plumb over the wrench nut of the plug valve, with box cover flush with the surface of the ground.

E. The Manufacturer shall supply valve box, floor stand and extension stem and necessary appurtenances for complete installation of the buried valves irrespective of the electric or manual operator on the valve.

3.00 EXECUTION

3.01 INSTALLATION

A. Carefully handle and lower valves into position in such a manner as to prevent damage to any part of the valves. Place the valve in the proper position with stem truly vertical or horizontal as the case may be. Furnish bolts and gaskets for flange connections. Adjust the valve boxes to the proper length to conform with the ground surface.

3.02 PAINTING

A. Valves to be exposed shall be cleaned to a bright metal and given a shop coat of rust inhibitive primer. Primer shall be coordinated with field painting to ensure compatibility. Final painting shall be in accordance with Section 09 96 00.01 “High- Performance Coatings.”

B. The interior of the valve shall be epoxy lined by the manufacturer.

3.03 SCHEDULES

A. The required valves and certain pertinent data are given below.

Service & Location	Total No. of Valves	Size (Inches)	Flange ANSI Class*	Maximum Differential Pressure (psi)	Operation
Phase 1 Valve Vault	3	14	125	100	Manual - Handwheel
Phase 1 On-Site Force Main	2	16	125	100	Manual – Buried with Bevel Gear and Nut
Phase 1 On-Site Force Main	1	18	125	100	Manual – Buried with Bevel Gear and Nut
Phase 2 On-Site Force Main	3	24	125	100	Manual – Buried with Bevel Gear and Nut

END OF SECTION

33 12 16.33 SWING CHECK VALVES

1.00 GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary to install swing check valves (external weight and lever) at the locations and size as indicated. Valves shall be designed, manufactured and tested in accordance with American Water Works Association Standards ANSI/AWWA C508.

1.02 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. DeZurik/APCO
2. Pratt
3. Mueller

A. Experience Requirements: The Manufacturer shall have had successful experience in manufacturing valves for this type service in the sizes indicated. The Manufacturer shall have at least 10 years' experience in the manufacture of the valves.

B. Manufacturer's Representative for Startup and Training: The Manufacturer shall provide the services of a competent manufacturer's representative for an indefinite period of time as required to insure proper adjustment, installation and operation of the valve.

C. All valves shall be hydrostatically tested and seat tested to demonstrate zero leakage. When requested, the Manufacturer shall provide test certification and required documentation.

1.01 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00 "Submittal Procedures" and shall include:

1. Record Data
2. Operation and Maintenance Manuals.

1.02 STANDARDS

A. The following standards shall apply as if they are included in these documents:

1. American Society for Testing and Materials (ASTM) Standards:

ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A276	Standard Specifications for Stainless Steel Bars
ASTM A582 T303	Standard Specification for Free-Machining Stainless Steel Bars

2. American Water Works Association (AWWA) Standards:

AWWA C508	Swing-Check Valves for Waterworks Service, 2- through 24-inch NPS

2.00 PRODUCTS

2.01 SWING CHECK VALVES

A. The check valves used shall be swing check valves unless otherwise specified and shall be constructed with a heavy cast iron body and bronze seat ring, non-corrosive shaft for attachment of weight and lever, and complete bronze air cushion chamber, ductile iron body and stainless steel body seat ring, single continuous stainless steel shaft for attachment of weight and lever, and complete aluminum alloy air cylinder. The air cushion cylinder shall be totally enclosed, and externally attached to the side of the valve body with the cylinder piston rod connected to the external lever arm in a manner to lift the piston upwards when flow starts and downwards when flow stops to compress the trapped air in the cylinder for cushion closing. The air cushion cylinder shall be fitted with an adjustable valve to increase or decrease air compression in the cylinder.

B. The valve disc shall absolutely prevent the return of water or sewage back through the valve when the inlet pressure decreases below the delivery pressure, on pump shutoff or power failure. The valve shall be tight-seating. The seat ring shall be renewable and shall be securely held in place by stainless steel screws. The valve disc shall be of ductile iron and shall be suspended from a stainless steel (non- corrosive) shaft which passes through bushings and shall be connected to the weight and lever on the outside of the valve. The shaft shall be keyed into the disc and lever arm. Set screws shall not be acceptable.

C. Swing check valves shall be furnished with ANSI 125/150 pound flat faced flanges. Valve exterior and interior to be painted with Fusion Epoxy Paint per AWWA C550.

D. The closing and opening rate of the valve shall be field adjustable.

3.00 EXECUTION

3.01 INSTALLATION

A. Carefully handle and lower the valves into position so to prevent damage to any part of the valves.

3.02 CLEAN AND ADJUST

A. Adjust weight position and air cushion operation in accordance with manufacturer recommendations.

3.03 SCHEDULES

A. The required valves and certain pertinent data are given below.

Service & Location	**Total No. of Valves**	**Size (Inches)**	**Flange ANSI Class***
Phase 1 Valve Vault	3	14	125

END OF SECTION

SECTION 33 13 00 DISINFECTION OF WATER DISTRIBUTION SYSTEM

1.00 GENERAL

1.01 SECTION INCLUDES

A. Disinfection of potable water distribution and transmission lines.

B. Dechlorination of water used for disinfection of water distribution and transmission lines.

C. Testing and reporting results.

1.02 RELATED SECTIONS

A. Section 01300 - Submittals.

B. Section 33 11 13 - Public Water Utility Distribution Piping.

1.03 REFERENCES

A. AWWA B300 - Standard for Hypochlorites.

B. AWWA C651 - Standards for Disinfecting Water Mains.

1.04 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 – Submittals and Substitutions.

B. Test Reports: Submit all test reports and indicate results comparative tospecified requirements

C. Certificate: Certify that cleanliness of water distribution system meets or exceeds Texas Department of Health requirements.

1.05 PROJECT RECORD DOCUMENTS

A. Protect Record Documents: Submit documents in accordance with Section 01700 -Contract Closeout. Accurately record installed location of valves, hydrants, piping and service connections, and accessories.

B. Disinfection report:

1. Type and form of disinfectant used.

2. Date and time of disinfectant injection start and time of completion.

3. Test locations (minimum of one sample per 1,000 feet).

4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.

5. Date and time of flushing start and completion.

6. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations (minimum of one sample per 1,000 feet).
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of Texas Department of Health.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AWWA C651.

B. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three (3) years documented experience.

C. Testing Firm: Company specializing in testing potable water systems, certified by the State of Texas.

D. Submit bacteriologist's signature and authority associated with testing.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of AWWA C651 for performing the work of this Section.

B. The Contractor shall comply with all regulatory requirements of the TCEQ regarding release of chlorine contaminated water. The Contractor shall notify the TCEQ if chlorinated water is released.

C. Provide certificate of compliance from Texas Department of Health indicating approval of water system.

2.00 PRODUCTS

2.01 DISINFECTION CHEMICALS

A. Chemicals: AWWA B300, Hypochlorite.

3.00 EXECUTION

3.01 EXAMINATION

A. Verify that piping system has been cleaned, inspected, and pressure tested.

B. Perform scheduling and disinfecting activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

3.02 DISINFECTION

A. Prior to sterilization, each valved section of the new pipeline shall be pressure tested and flushed with clean water from the existing system to remove all apparent evidence of dust, soil and fine debris which may have entered the line during construction and testing.

B. Disinfection of water line shall be accomplished by the Contractor in accordance with the requirements of AWWA C651 using the tablet, continuous feed or slug methods as described therein.

C. If used, the continuous feed and slug methods shall be as described in AWWA C651.

3.03 REPAIRS OR CONNECTIONS TO EXISTING LINES

A. Clean and sterilize the interior surfaces of new pipe, fittings, equipment, and appurtenances to be connected to an existing potable system.

B. Clean and sterilize the existing pipe or facilities for a minimum distance of three pipe diameters back from the ends of the pipe. Plug the ends of the line when work is not being performed on the pipe.

C. Perform sterilization by swabbing each item with a concentrated chlorine solution.

1. Each piece is to be disinfected prior to being assembled for connection to the existing pipe.

2. Disinfect each piece just prior to assembly to help prevent re-contamination.

3. Plug the ends of the assembly until a new item is to be added to the assembly.

4. Store disinfected materials on blocks to prevent contact with the ground.

3.04 EXECUTION

A. Provide and attach required equipment to perform the work of this Section.

B. Introduce treatment into piping system.

C. Maintain disinfectant in system for 24 hours.

D. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.

E. Dechlorinate all water used for flushing/disinfection prior to discharge.

F. Replace permanent system devices removed for disinfection.

3.05 FIELD QUALITY CONTROL

A. Test samples in accordance with AWWA C651.

END OF SECTION

SECTION 33 13 10 HYDROSTATIC TESTING

1.00 GENERAL

1.01 WORK INCLUDED

A. Perform a hydrostatic pressure test on each valved or plugged section of newly laid pipe after the pipe has been backfilled. Perform hydrostatic pressure test by raising the pressure in the pipe section to the required test pressure for the duration defined in Paragraph 3.02.

B. Plugs may be installed in concrete cylinder or steel pipe at intermediate locations for the purpose of testing shorter lengths of pipe at the Contractor's option. No additional compensation will be paid to the Contractor for testing at intermediate locations if Contractor uses this option.

C. Obtain water from the Owner for filling the pipeline for the hydrostatic test. Provide the necessary piping, connection, pressure reducing and backflow prevention equipment required to conduct the test. Fill the new pipeline through a backflow prevention device. Leave the pipeline full of water upon completion of the hydrostatic test, unless internal test plugs must be removed to allow construction to continue or where pipe will gravity drain.

D. Purchase water required for re-testing of the pipeline from the Owner. Water will be sold to the Contractor at published rates.

1.02 SUBMTTALS

A. Submit Hydrostatic Pipe Test Reports per Section 01300 – Submittals and Substitutions.

1.03 STANDARDS

A. American Water Works Association

AWWA M23	PVC Pipe Design and Installation
AWWA C605	Standard for Underground Installation of PVC Pressure Pipe and Fittings.
AWWA C900	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inches to 12 Inches.
AWWA C905	Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In.

2.00 PRODUCTS (NOT USED)

3.00 EXECUTION

3.01 GENERAL

A. Perform hydrostatic pressure and leakage tests using methods, and per performance requirements of AWWA C605, in accordance with these specifications, and the pipe Supplier's recommendations.

3.02 TEST CONDITIONS

A. Test pipe at the test pressure for the duration as indicated below for the various pipe materials:

Pipe Type	Duration (hours)	Test Pressure (psi)
Concrete Pipe	4 hours	120
Steel Pipe	4 hours	150
Ductile Iron Pipe	4 hours	150
PVC Pipe	4 hours	150

3.03 PROCEDURE

A. Pressure Pipe

1. Provide temporary plugs and blocking necessary to maintain the required test pressure. Where piping is cast in the walls for a structure, brace the walls prior to testing as required to prevent load of test pressure from being imposed upon the structure.
2. Provide corporation cocks at least 3/4" in diameter, pipe riser, and angle globe valves at each pipe dead-end in order to bleed air from the line.
3. Repair any visible leaks regardless of the total leakage shown by the test.
4. Repair pipelines which fail to meet the test and retest as necessary until the results conform to the test requirements.
5. Remove and replace defective materials, pipes, valves, and accessories.
6. Test the pipelines in sections by shutting valves or installing temporary plugs as necessary.
7. Fill the pipeline with water and remove the air.
8. Maintain the test pressure in the pipe for the entire test period by means of a force pump.
9. Accurately measure the water required to maintain the pressure. The amount of water required is a measure of the leakage.
10. The maximum allowable leakage is determined by the following formula:

$$L = \frac{SD(P)^{1/2}}{F}$$

Equation Term	Represents	Measure
L	Maximum allowable leakage	gallons per hour
S	Length of pipe tested	feet
D	Nominal diameter of the pipe	inches
P	Test pressure	pounds per square inch gauge
	Pipe factor	

	Use 148,000 Ductile Iron Pipe and PVC Pipe.
F	Use 133,200 for all other pipe types.

Leakage is defined as the volume of water provided to maintain the test pressure after the pipe has been filled with water, the air expelled and the pipe brought to test pressure.

B. Pipe with visible leaks or leakage exceeding the maximum allowable leakage is considered defective and must be corrected.

3.4 EXAMINATION UNDER PRESSURE

A. Inspect the pipe during the test to locate any leaks or breaks, defective joints, cracked or defective pipe, fittings, or valves. Correct defective Work identified during the pressure test.

3.05 PERMISSIBLE MAKEUP WATER

A. Measure make up water required for the section of pipe being tested. Makeup water is the volume of water pumped into the test section of pipe necessary to maintain the specified test pressure after the pipe has been filled with water and the air expelled.

B. The maximum acceptable volume of makeup water for steel or bar-wrapped pipe installations is 10 gallons per inch of pipe diameter per mile of pipe tested per 24 hours. Calculate the maximum acceptable volume of makeup water using the following equation:

$V_m = 10\ D\ L / 5280$ where

V_m is the maximum acceptable volume of makeup water in gallons for 24 hours

D is the nominal pipe diameter in inches

L is the length of the pipe test section in feet

As an example the allowable amount of makeup water for a test section of 2,500 feet of 60 inch diameter pipe would be:

10 x 60 x 2500 / 5280= 284 gallons

3.06 LEAK REPAIR DETECTION

A. If any pipe section fails hydrostatic pressure testing, it is the responsibility of the Contractor to perform leak detection testing to accurately locate and repair the leak.

B. Work performed will not be accepted by the Owner until satisfactory hydrostatic test results are obtained.

END OF SECTION

33 19 23 ELECTROMAGNETIC FLOWMETERS

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

Contractor shall furnish and install electromagnetic flowmeters and all appurtenant materials and equipment. Electromagnetic flowmeters shall be suitable for the services listed, complete and operable in accordance with requirements of the Contract Documents and in conformance with the manufacturer's recommendations.

1.02 PROJECT SPECIFIC REQUIREMENTS

Contractor shall furnish and install electromagnetic flowmeter(s) as shown on the Drawings and as specified herein.

1.03 RELATED SECTIONS

A. The Contract Documents are a single integrated document, and as such all Specification Sections apply. It is the responsibility of the Contractor and its subcontractors to review all sections and ensure a complete and coordinated project.

B. Related Specification Sections include, but are not limited to, the following:

1. Division 11 – Equipment
2. Division 13 – Special Construction
3. Division 15 – Mechanical
4. Division 16 – Electrical
5. Division 17 – Instrumentation and Controls

1.04 SUBMITTALS

All submittals shall be in accordance with the General Conditions and requirements specified herein.

A. Shop Drawings

Contractor shall prepare and submit complete and organized information, drawings, and technical data for all equipment and components. All drawings shall be legible and reduced to a maximum size of 11” x 17” for inclusion within the submittal. Shop drawings shall include, but not be limited to, the following:

1. Detailed Bill of Materials for all equipment and components, listing: manufacturer's name, quantity, size, description, and catalog/part number.
2. Manufacturer's product literature, specifications, performance capabilities, features and accessories, materials of construction, illustrations, and data in

sufficient detail to demonstrate compliance with Specification requirements. Manufacturer's literature and data shall be marked to clearly delineate all applicable information and crossing out all inapplicable information.

3. Dimensional drawings for each meter size.

4. Electrical wiring schematics for flow sensor and signal converter/transmitter. Interconnection wiring diagrams between signal converters/transmitters and related equipment and materials.

5. Diagrams showing meter grounding recommendations and grounding conductor/connection requirements (conductor size and connection type), including: connection from meter terminal box or signal converter (if integrally mounted) to grounding ring(s), connection between grounding rings, and connection from grounding rings to ground rod.

6. Meter cable product data sheets.

7. Manufacturer's application performance guarantee for each meter location, and recommendations for installation at each location.

B. Operation and Maintenance Manual

Contractor shall submit a detailed Operation and Maintenance Manual for all equipment and components specified herein and incorporated into the Work. The Operation and Maintenance Manual shall be provided in accordance with the requirements of the Owner's General Conditions, and Section 01430.

Operation and maintenance manuals shall include, but not be limited to, the following:

1. Equipment Performance Data and Drawings

   a. Detailed Bill of Materials for all equipment and components, listing: manufacturer's name, quantity, size, description, and catalog/part number.

   b. Manufacturer's product literature, specifications, performance capabilities, features and accessories, materials of construction, and illustrations.

   c. Dimensional drawings for each meter size.

   d. Electrical wiring schematics for flow sensor and signal converter/transmitter. Interconnection wiring diagrams between signal converters/transmitters and related equipment and materials.

2. Equipment Installation Requirements

   a. Complete, detailed installation instructions for all equipment and components.

3. Equipment Operation Data

   a. Complete and detailed operating instructions, including operator interface menus, programming, and setup parameters.

   b. Printed list of all final setup parameters for each flowmeter, including factory settings and any field modifications to factory settings.

4. Equipment Service and Maintenance Data

   a. Maintenance data shall include all information and instructions required by Owner's personnel to keep equipment properly cleaned and adjusted so that it functions economically throughout its full design life.

   b. Unloading, handling, and long term storage requirements.

   c. Explanation with illustrations as necessary for each maintenance task.

   d. Recommended schedule of maintenance tasks.

   e. Troubleshooting instructions.
   f. List of maintenance tools and equipment.

   g. Recommended spare parts list.

   h. Name, address and phone number of manufacturer and manufacturer's local service representative.

5. Manufacturer's Warranty

6. Provide a signed written certification report with the Final Operation and Maintenance Manuals, certifying that the electromagnetic flowmeters have been properly installed, calibrated and adjusted, and are suitable for satisfactory continuous operation under varying operating conditions, and meet all requirements specified in the Contract Documents.

1.05 COORDINATION

Flowmeters and control systems shall be designed and coordinated for proper operation with related equipment and materials furnished by other suppliers and manufacturers under other sections of these Specifications and where applicable, with related existing equipment. All flowmeter and control devices shall be applied in full conformity with the Construction Drawings and Specifications, and with the instructions and recommendations of the flowmeter manufacturer and the related equipment manufacturer.

Related equipment and materials may include, but not be limited to: valve actuators, chemical feed equipment, analytical measuring devices, supervisory control equipment (SCADA), telemetry, conduit, cable, and piping, as described in other Sections associated with the project and shown on the Drawings.

Interconnection wiring diagrams shall be prepared between the related equipment and the equipment furnished under this Section. Interconnection wiring shall provide all functions specified herein and/or shown on the Drawings.

PART 2 - PRODUCTS

2.01 GENERAL

The electromagnetic flowmeter shall consist of a flow sensor and a signal converter/transmitter. The flow sensor shall utilize Faraday's Law of Electromagnetic Induction, to produce an electrical voltage that is proportional to the velocity of the flow of liquid through the sensor. The signal converter/transmitter shall be micro-processor based. Unless specified otherwise, the signal converter/transmitter shall be remote mounted.

2.02 FLOW SENSOR

A. Each flow sensor shall be provided with a flanged end flow tube and a non-conductive liner suitable for the liquid being metered. Unless specified otherwise, the flow tube shall be constructed of Type 304 stainless steel with stainless steel or carbon steel flanged ends. Flanges shall be ANSI Class 150 for meter sizes up to 24", and AWWA Class D for meter sizes larger than 24". Unless specified otherwise, liner material shall be hard rubber or polyurethane. Flow sensors exposed to water with a chlorine concentration of 10 ppm or greater, such as recycled water, shall be provided with Teflon liner material

B. The field coils of the flow sensor shall be supplied with a precisely adjusted bi-polar direct current. Coil drive power shall be supplied by the signal converter/transmitter. The output signal from the flow sensor shall be fed through cable to the signal converter/transmitter. There shall be no electronic components in the flow sensor.

C. The flow sensor coil enclosure and cable connection housing shall be epoxy coated steel or epoxy coated aluminum. Plastic housings will not be acceptable.

D. Flow sensors shall be weatherproof NEMA 4X at a minimum. Meters installed underground or in a below grade vault shall be manufactured to NEMA 6P standards to enable the meter to be submerged up to 30 feet for 48 hours and up to 10 feet with continuous submersion. Meters rated NEMA 6P shall have remote transmitters in separate NEMA 4X enclosures. The interconnecting cables shall be installed at the factory and the termination box filled with a non-setting, transparent potting material.

E. When installed in metallic piping, the flow sensor shall be provided with integral grounding electrodes. When installed in lined or non-metallic piping, the flow sensor shall be provided with Type 304 stainless steel grounding rings (grounding electrodes will not be acceptable).

F. When installed in piping conveying raw sewage or sludge, the flow sensor shall be certified for use in Class I, Division 2 hazardous locations.

G. Flow sensor grounding electrode and sensing electrode material shall be compatible with the process fluid. Unless specified otherwise, electrodes shall be constructed of Type 316 stainless steel or Hastelloy C.

H. Unless specified otherwise, the flow sensor lining material shall be hard rubber or polyurethane. The flow sensor, including liner material, shall be certified in accordance with National Sanitation Foundation Standard 61 for use with potable water. Accuracy shall not be affected by cuts or scratches in the flow sensor liner.

I. The flow sensor shall be provided with multiple sensing electrodes to accurately measure mean velocity. The flow sensor shall be capable of accurately measuring slurries and water with entrained air. Accuracy of the flowmeter system shall be ±0.2% of rate. Accuracy shall be traceable to the US National Institute of Standards and Technology (NIST), and shall be guaranteed on-site for applications such as drinking water, raw sewage, and similar media, even with a permanent coating of raw sewage or similar on the electrodes. A NIST traceable calibration certificate shall be provided with each flowmeter.

J. The flow senor shall incorporate an empty pipe detection feature, which shall cause the meter to register zero flow when the sensor is not full.

K. Unless specified otherwise, the flow sensor shall be rated for a minimum working pressure of 150 psig.

L. The flow sensor shall be suitable for operating temperatures ranging from -4°F to +122°F (minimum).

2.03 SIGNAL CONVERTER/TRANSMITTER

A. Unless specified otherwise, the signal converter/transmitter shall be remote mounted from the flow sensor. Where special signal cable is required and recommended by the manufacturer, the cable shall be supplied by the meter manufacturer. Supplier shall confirm the length and installation requirements. Where signal converter/transmitter location is not shown on the Drawings, each flowmeter shall be furnished with a minimum of 200 feet of signal cable.

B. The signal converter/transmitter shall be suitable for outdoor exposure and shall be rated NEMA 4X.

C. The signal converter/transmitter shall be provided with an alphanumeric, 3-line, 16-character (minimum), backlit display to indicate flow rate, totalized values, settings, and faults. Unless specified otherwise, the display shall indicate flow in gallons per minute and total flow in acre feet. All programming shall be accomplished through an integral keypad or touch screen operation and all programming shall be protected by a user-defined password. The signal converter/transmitter shall be provided with a fault and status log.

D. The signal converter shall be coordinated with the flow sensor selection for accurately measuring potable water, raw sewage, slurries, and water with entrained air.

E. The signal converter/transmitter shall be capable of measuring bi-directional flow and shall have three separate totalizers.

F. The signal converter/transmitter shall operate on 120V, 60 Hz supply power.

G. The signal converter/transmitter shall produce a 4-20 mA DC output signal into a minimum load of 800 ohms, linear to flow. Output shall be selectable as unidirectional or bi-directional. In addition, the signal converter/transmitter shall provide a digital scaled pulse output for external display/recording of flow rate or total flow.

H. Where indicated on the Drawings or in Section 33 19 23.1, the signal converter/transmitter shall be provided with a positive zero circuit to register zero flow when pumping units are not operating. A closed external dry contact (generated by pump "off" or other similar equipment control signal) input to the signal converter/transmitter shall drive the meter output to zero.

I. The signal converter/transmitter shall be suitable for operation in ambient temperatures ranging from -4°F to +140°F (minimum).

J. Where located indoors, the signal converter/transmitter shall be wall mounted or flush panel door mounted as indicated on the Drawings.

K. Where located outdoors, signal converter/transmitter shall be suitable for mounting inside a NEMA 4X stainless steel enclosure, Hoffman, or equal. The stainless steel enclosure shall be provided with a swing-out door panel and back panel. The signal converter/transmitter shall be flush mounted on the swing-out door panel or back panel mounted with a cut-out in the swing-out door panel for the display. The enclosure shall be provided with side mounted air supply fan, side mounted louvered and filtered air supply and exhaust openings, 120V supply power circuit breaker for the signal converter and air supply fan, and fuses for each.

L. The signal converter/transmitter shall be capable of verifying the performance of the measuring system in the field without removing the meter tube from the process. The field verification feature shall be integral to the signal converter/transmitter and shall be capable of continuously monitoring electronic parameters within the flowmeter and signal converter/transmitter. If any value deviates from an acceptable range, the signal converter/transmitter shall acknowledge the event and a relay shall be activated. A summary report of the verification shall be downloadable directly through the service port of the signal converter/transmitter or while logged onto the manufacturer's webserver for an Ethernet/IP capable signal converter/transmitter. The integral verification system shall be Endress+Hauser Heartbeat Technology, or equal.

M. Where specified, local service communication with the meter shall be capable via a RJ-45 port and an Ethernet cable regardless of the output. The signal converter/transmitter shall have integral webserver capabilities with an unique IP address.

2.04 MANUFACTURERS

Electromagnetic flow meters and manufacturers shall be as follows (no substitutes):

A. Promag W 500 Electromagnetic Flowmeter, as manufactured by Endress+Hauser. Unless specified otherwise, the signal converter/transmitter shall be provided with the following input/output signal capabilities: HART/4-20 mA; frequency, relay, and status input (flexible module); and Ethernet/IP. Promag W 500 must incorporate the 0 x DN full-bore unrestricted installation feature.

B. Owner will consider substitutions for acceptability.

Model numbers supplied herein are provided for information purposes only, to assist Contractor in selecting equipment that conforms to the Specification and Drawing requirements. In case of any conflict between model numbers provided and the descriptive requirements specified herein, the descriptive requirements shall govern.

Manufacturers shall modify or supplement standard equipment to provide all features and capabilities specified herein.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of electromagnetic flowmeters and signal converters/transmitters shall be in accordance with manufacturer's written instructions.

B. Wiring between flow sensors and remote mounted signal converters shall be supplied by the meter manufacturer.

C. All electromagnetic flowmeters shall be grounded per manufacturer's requirements. Contractor shall coordinate grounding between signal converter, flow sensor, grounding rings, and ground rod to ensure compliance with the manufacturer's recommended grounding procedures. Prior to start up, manufacturer shall provide written certification that the meter installation is in accordance with their requirements, including grounding.

D. Unless specified or shown otherwise, outdoor signal converters/transmitters shall be remote mounted within NEMA 4X stainless steel enclosures. The enclosures shall be mounted on stanchions adjacent to the respective meters.

3.02 MANUFACTURER'S WARRANTY

Manufacturer shall guarantee all equipment against defects in material and workmanship for a period of two years from date of project acceptance. During the warranty period, manufacturer shall provide all labor and material required to repair or replace defective equipment at no cost to the Owner.

END OF SECTION

SECTION 33 31 20 POLYVINYL CHLORIDE (PVC) GRAVITY SANITARY SEWER PIPE

PART 1 GENERAL

1.01 SCOPE

A. This specification section includes all materials, equipment, labor, and incidentals required for the supply and installation of polyvinyl chloride (PVC) pipe and fittings, 4-inch diameter to 60-in diameter for use in storm sewer, sanitary sewer, or other non-pressure sewer applications.

1.02 RELATED SECTIONS

A. Section 01300 Submittals and Substitutions

1.03 REFERENCES

The Contractor and/or Pipe Manufacturer shall follow the standards listed below, except as otherwise specified herein. The latest revision or edition in effect at the time of bid opening shall be utilized.

A. American Society for Testing and Materials (ASTM)
   1. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
   2. D2321 – Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications
   3. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
   4. D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
   5. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
   6. F679 – Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
   7. F1417 – Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

B. American Water Works Association (AWWA)
   1. M23 – PVC Pipe – Design and Installation

C. Uni-Bell PVC Pipe Association
   1. UNI-B-6 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
   2. UNI-PUB-6 – Installation Guide for PVC Solid-Wall Sewer Pipe (4 - 48 in.)
   3. UNI-TR-3 – Maintenance of PVC Sewer Pipe
   4. Handbook of PVC Pipe Design and Construction

1.04 QUALIFICATIONS

A. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.

B. The pipe and fittings shall be designed, manufactured, and installed in accordance with industry standards and shall comply with the specification requirements herein.

1.05 SUBMITTALS

A. Conform to the requirements of Section 01300 - Submittals

B. Submit product data on pipe, fittings, gaskets and appurtenances as required to ensure products meet the requirements of this specification.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Pipe shall be shipped so as to not bend, dent, or otherwise damage the pipe during transport.
B. Contractor shall take all necessary precautions to prevent damage to pipe and fittings during delivery and unloading.
C. Owner shall observe and inspect unloading of pipe to ensure proper unloading procedures are followed.
D. Under no circumstances will pipe or fittings be allowed to be rolled, pushed, or dropped off from any height for delivery, storage, or installation. Any pipe found to have been damaged due to improper handling procedures will be immediately marked for identification and removed from the jobsite at Contractor's expense.
E. Material storage shall be performed in accordance with Pipe Manufacturer's recommendations.
F. Stacking of pipe shall be performed in accordance with Pipe Manufacturer's recommendations.
G. Once pipe has been unloaded, it shall be stored as near to its point of installation as possible. Contractor shall limit moving or restacking of pipe prior to installation.
H. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.
I. Pipe shall not be stored close to heat sources or hot objects such as heaters, boilers, steam lines, and engine exhaust.
J. If pipe is to be exposed to direct sunlight for extended periods (in excess of two years from the date of manufacture), then Contractor shall cover/shade pipe utilizing canvas or other opaque materials. Black plastic will not be acceptable as a shading material.
K. Gaskets shall be protected from exposure to excessive heat, prolonged direct sunlight, and oil and grease.

PART 2 PRODUCTS

2.01 PIPE

A. Pipe shall be manufactured and supplied in accordance with ASTM D3034 (4-Inch to 15-Inch) or F679 (18-Inch to 60-Inch).
B. Pipe shall have lay lengths between 14 and 22 feet unless otherwise specified by the Owner.
C. The pipe shall be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.
D. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.
E. Pipe shall have markings at intervals of 5ft or less including:
   1. Manufacturer's name or trademark and code
   2. Nominal pipe size
   3. PVC cell classification
   4. Legend (e.g. " SDR-41 PVC Sewer Pipe" or "PS 46 PVC Sewer Pipe")
   5. ASTM Designation
   6. Gasketed pipe shall be marked with an insertion depth mark on the spigot end
F. Pipe for non-potable water shall be white in color.
G. Pipe for wastewater uses shall be green color.
H. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified by the Owner.

2.02 PIPE DESIGN

A. Pipe shall be supplied to meet the external loading requirements of the project as follows:
   1. Maximum calculated deflection of 7.5%
   2. Live loads as calculated per AWWA M23 based on the profile shown on the plans
   3. Depth of cover as shown on the plans
   4. Trench width as shown on the plans
   5. Modulus of soil reaction (E'), bedding constant (K), and soil density (γ) shall be based on design and site conditions.

2.03 FITTINGS

A. Fittings shall be manufactured and supplied in accordance with ASTM D3034 (4-Inch to 15-Inch) or ASTM F679 (18-Inch to 60-Inch). Molded and fabricated fittings may be supplied in accordance with ASTM F1336.
B. Fittings shall be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.
C. Pipe used in fabricated fittings shall have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting (or that part of the fitting) will be joined.
D. Molded and fabricated fittings shall have markings including:
   1. Manufacturer's name or trademark
   2. Nominal size
   3. Material designation (e.g. "PVC")
   4. ASTM Designation
E. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153.

2.04 PIPE JOINTS

A. Joints shall be gasketed push-on type conforming to ASTM D3212.
B. Gasket materials shall meet requirements of ASTM F477.
C. Joint lubricant shall be approved by the Pipe Manufacturer and shall have no detrimental effect on the gasket or pipe.

PART 3 EXECUTION

3.01 GENERAL

A. Install pipe, fittings, specials, and appurtenances in accordance with ASTM D2321, UNI-PUB-6 and/or in accordance with the Pipe Manufacturer's recommendations.
B. Lay pipe to the lines and grades as indicated on the Plans.

3.02 PIPE HANDLING

A. Handle pipe and piping materials with care to avoid damage.
B. Prior to installation, each pipe length shall be carefully inspected for damage.
C. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has completed.
D. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.
E. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.
F. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

3.03 PIPE INSTALLATION

A. Do not drag pipe over gravel or rock. Avoid striking rocks or hard objects when lowering pipe into the trench.
B. Placement of pipe and fittings into the trench should be done with ropes and skids, slings on a backhoe bucket, or by hand.
C. Pipe or fittings shall not be thrown into the trench and no part of the pipe shall be allowed to take an unrestrained fall onto the trench bottom.
D. Joint sockets shall be carefully cleaned before pipes are lowered into trenches.
E. Pipe trenches and excavation shall be kept free of water during pipe laying operations and other related work. If high groundwater levels are expected or encountered, Contractor is to ensure that a minimum depth of cover of 1.5 times the pipe diameter will be maintained over the pipe once it has been installed or provide other methods approved by the Owner and Pipe Manufacturer of preventing flotation of the pipe.

3.04 JOINT MAKING

A. Install push-on joints in accordance with Pipe and Fittings Manufacturer's recommendations.
B. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. In cases when gaskets are supplied separately from pipe, Contractor is to ensure that gaskets supplied are designed for the pipe in use.
C. Clean the gasket of all extraneous matter.
D. Apply a thin film of joint lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Lubricated spigots ends shall not come in contact with soil or backfill material.
E. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell. If two reference marks are present, the mark closest to the spigot end shall be considered the minimum insertion mark, and the second mark shall be considered the maximum insertion mark. Under no circumstances will the spigot be inserted into the bell past the reference mark or maximum insertion mark.
F. For small diameter pipe, use the bar-and-block method for joint assembly or other method approved for use by the Owner and Pipe Manufacturer.
G. For large diameter pipe, use mechanical assistance such as hydraulic pipe pullers, jacks, pulleys, come-alongs, or a backhoe bucket. Observation by a spotter will be required when assembling joints for large diameter pipe to prevent over-insertion.
H. When using a field cut plain end piece of pipe, bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.
I. Angular changes in pipe alignment shall be achieved by either fittings, joint deflection, or longitudinal bending of the pipe.
J. Joint deflection shall not exceed the Pipe Manufacturer's recommendation.
K. Field assembly of pipe fittings shall follow the Pipe Fittings Manufacturer's recommendations.
L. Mechanical joints shall be assembled per the Pipe and/or Fittings Manufacturer's recommendations as well as the recommendations of the mechanical joint supplier.

3.05 LONGITUDINAL PIPE BENDING

A. Controlled changes in direction may be accomplished by longitudinal bending of the pipe barrel.
B. Pipe Manufacturer shall be consulted prior to start of construction for recommendations on longitudinal bending.

C. When longitudinal bending of pipe is utilized, Contractor shall use manual force alone to achieve prescribed bending. Mechanical means shall not be utilized to achieve longitudinal bending of the pipe.

D. When the desired change of direction in the pipeline exceeds the maximum allowable deflection specified, the longitudinal bending shall be made throughout a number of pipe lengths.

E. Contractor will ensure that pipe joints will not be over-pulled or over-inserted during longitudinal bending operations.

3.06 FIELD TESTING

A. After pipe has been installed and backfilled, deflection testing shall be performed in accordance with ASTM D3034 and/or F679, PVC Pipe Handbook, and the specifications herein. Deflection testing shall utilize a "go/no-go" mandrel for measurement of pipe deflection. Where practical, Contractor should allow for stabilization of the pipe/soil system (up to 30 days) prior to testing.

1. The maximum allowable deflection of pipe measured as the reduction in vertical inside diameter is 5.0% unless specified otherwise.
2. Conduct test after the final backfill has been in place a minimum of 30 days; if deflection is tested between 30 and 60 days after backfill has been placed, the maximum allowable vertical deflection shall be 4% to help keep the long-term deflection at 5%. Deflection testing to be completed prior to final acceptance testing of line segment.
3. Thoroughly clear the lines before testing.

B. All finished installations for non-pressure applications shall be tested via low-pressure air testing in accordance with ASTM F1417, UNI-B-6, and the specifications herein.

C. Isolate the section of non-pressure sewer line to be air tested by inflatable stoppers or other suitable test plugs/caps.

D. Ends of all branches, laterals, tees, wyes, and/or stubs in the test section shall be plugged or capped to prevent air leakage. One of the plugs/caps shall have an inlet tap or other method for connecting the air hose to an air control source.

E. Test ends should be restrained and/or braced during air testing.

F. Add air slowly to the test section until the pressure reaches 4.0 psi. After the test pressure is obtained, regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psi for at least 2 minutes until the air temperature stabilizes and is in equilibrium with the temperature of the pipe walls.

G. After equilibrium is achieved, determine the rate of air pressure loss by either the constant pressure method or the time-pressure drop method as outlined in ASTM F1417.

H. Upon completion of the test, open the bleeder valve and allow all air to escape. Caps/plugs shall not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

END OF SECTION

SECTION 33 39 60 EPOXY & POLYMER LINERS FOR SANITARY SEWER STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Application of a high-build epoxy and or polymer coating system to concrete utility structures such as manholes, lift station wet wells, junction boxes or other concrete facilities that may need protection from corrosive materials. Manholes designated for interior coating shall be first coated with a cementitious coating as detailed in Section 33 39 61.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 – General Requirements
3. Section 33 01 30.02 –Manhole Testing
4. Section 33 39 61 – Cementitious Manhole Coating

1.2 PRICE AND PAYMENT PROCEDURES

Will be in accordance with Section 01025.

1.3 REFERENCES

A. Reference Standards

1. Reference standards cited in this Specification refer to the current reference standard published at the time of the latest revision date logged at the end of this Specification, unless a date is specifically cited.
2. ASTM International (ASTM).
3. Environmental Protection Agency (EPA).
4. NACE International (NACE).
5. Occupational Safety and Health Administration (OSHA).
6. Resource Conservation and Recovery Act, (RCRA).
7. The Society for Protective Coatings/NACE International (SSPC/NACE):
   a. sp 13/NACE No. 6, Surface Preparation of Concrete.

1.4 SUBMITTALS

A. Submittals shall be in accordance with Section 01 33 00.

B. All submittals shall be approved by Owner prior to delivery.

1.5 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data

1. Technical data sheet on each product used

2. Material Safety Data Sheet (MSDS) for each product used

3. Copies of independent testing performed on the coating product indicating the product meets the requirements as specified herein

4. Technical data sheet and project specific data for repair materials to be top-coated with the coating product including application, cure time and surface preparation procedures

B. Contractor Data

1. Current documentation from coating product manufacturer certifying Contractor's training and equipment complies with the Quality Assurance requirements specified herein

2. 5 recent references of Contractor indicating successful application of coating product(s) of the same material type as specified herein, applied by spray application within the municipal wastewater environment

1.6 QUALITY ASSURANCE

A. Obtain all materials from a single manufacturer.

B. At a minimum, products and installers must meet all of the following criteria to be deemed commercially acceptable:

1. For a Product to be considered commercially acceptable, the product must have a minimum of eighty thousand (80,000) vertical feet and five (5) year history of successful wastewater collection system installations on manholes in the United Stated. In addition, products must provide Third Party test Results supporting the long-term performance and structural strength of the product and such data shall be satisfactory to the Owner. No product will be allowed without Independent Third Party Testing verification.

2. For an installing contractor to be considered commercially acceptable, the installer must satisfy all insurance, financial and bonding requirements for the Owner. The Contractor must have a certification from the manufacturer as a licensed and fully installer of the product. The installer must also have a minimum of eighty thousand (80,000) vertical feet of successful wastewater collection system installations and five (5) year of rehabilitation experience on manholes.

C. Personnel shall have confined space entry certification.

D. Field verification shall be completed by the contractor prior to commencement of work.

E. Contractor shall verify the finished thickness of each rehabilitation method prior to starting the next layer and upon completion of the work. The Engineer my obtain core samples at his discretion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Keep materials dry, protected from weather and stored under cover.

B. Store coating materials between 50 degrees F and 90 degrees F.

C. Do not store near flame, heat or strong oxidants.

D. Handle coating materials according to their material safety data sheets.

1.8 FIELD [SITE] CONDITIONS

A. Provide confined space entry, flow diversion and/or bypass plans as necessary to perform the specified work.

1.9 WARRANTY

A. Contractor Warranty

1. Contractor's Warranty shall be 5 years for labor and materials.

PART 2 - PRODUCTS

2.1 EQUIPMENT, PRODUCT TYPES, MATERIALS

A. Repair and Resurfacing Products

1. Compatible with the specified coating product(s) in order to bond effectively, thus forming a composite system

2. Used and applied in accordance with the manufacturer's recommendations

3. The repair and resurfacing products must meet the following:

a. 100 percent solids, solvent-free epoxy grout specifically formulated for epoxy top-coating compatibility

b. Factory blended, rapid setting, high early strength, fiber reinforced, non-shrink repair mortar that can be toweled or pneumatically spray applied and specifically formulated to be suitable for top-coating with the specified coating product used

B. Coating Product

1. Manufacturers: Only the following manufacturers will be considered for lining:

   a. Sauereisen Sewergard-Spay Applied No. 210S

   b. Raven Lining Systems (Primer-Raven 405 & Top Coat-Raven 405 Trowel)

   c. CCI Spectrum, Inc (Spectrashield Total Lining System)

   d. Warren Epoxy (Primer-S301-14 & Top Coat-301-18)

2. Capable of being installed and curing properly within a wet manhole or concrete utility environment

3. Resistant to all forms of chemical or bacteriological attack found in municipal sanitary sewer systems; and, capable of adhering to typical manhole structure substrates

4. 100 percent solids system, specially compounded to protect concrete surfaces from corrosion:

   a. Application Temperature – 50 degrees F, minimum

   b. Thickness – 125 mils **minimum** (Epoxy) - CCI Spectrum should be applied per manufactures guidelines for thickness.

   c. Color – Per manufacturer

   d. Compressive Strength (per ASTM C579) – 9,000 psi minimum

   e. Bond Strength: Min 400psi

   f. Cured Density: 117lb/cf

   g. Tensile Strength (per ASTM C307) – 2,500 psi minimum

   h. Abrasion Resistance (per ASTM D4060): Less than 148 mg loss (H18;250 gm load)

   i. Modulus of Elasticity (ASTM C580): 1x86x106 PSI

   j. Flexural Strength (per ASTM C580) – 5,000 psi minimum

   k. Adhesion to Concrete, mode of failure (ASTM D4541): Substrate (concrete) failure

   l. Thermal Coeff of Linear Expansion: 1.5x10-5 in/in/deg F (ASTM D531)

   m. Chemical Resistance (ASTM D543/G20) all types of service for:

      1) Municipal sanitary sewer environment

      2) Sulfuric acid, 30 percent

      3) Sodium hydroxide, 5 percent

C. Coating Application Equipment

1. Manufacturer approved equipment

2. Hard to reach areas, primer application and touch-up may be performed using hand tools.

2.2 SOURCE QUALITY CONTROL

1. Testing

   a. Take wet film thickness gauge per ASTM D4414 at 3 locations within the manhole, 2 spaced equally apart along the wall and 1 on the bench.

      1) Document and attest measurements and provide to the Owner.

   b. After coating has set, repair all visible pinholes by lightly abrading the surface and brushing the lining material over the area.

   c. Repair all blisters and evidence of uneven cover according to the manufacturer's recommendations.

   d. Test manhole for final acceptance according to Section 33 01 30.02.

PART 3 - EXECUTION

3.1 INSTALLERS

A. All installers shall be certified applicators approved by the manufacturers.

3.2 PREPARATION

A. Manhole Preparation

   1. Stop I/I prior to coating.

   2. Stop active flows via damming, plugging or diverting as required to ensure all liquids are maintained below or away from the surfaces to be coated.

   3. Maintain temperature of the surface to be coated between 50 and 120 degrees F.

   4. Shield specified surfaces to avoid exposure of direct sunlight or other intense heat source.

      a. Where varying surface temperatures do exist, coating installation should be scheduled when the temperature is falling versus rising.

B. Surface Preparation

   1. Remove oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts or other contaminants, which may affect the performance and adhesion of the coating to the substrate.

   2. Remove concrete and/or mortar damaged by corrosion, chemical attack or other means of degradation so that only sound substrate remains.

3. Surface preparation method, or combination of methods, that may be used include high pressure water cleaning, high pressure water jetting, abrasive blasting, shot blasting, grinding, scarifying, detergent water cleaning, hot water blasting and others as described in SSPC SP 13/NACE No. 6.

4. All methods used shall be performed in a manner that provides a uniform, sound, clean, neutralized, surface suitable for the specified coating product.

5. Install cementitious coating as detailed in Section 33 39 61 and cure prior to the application of epoxy coating.

3.3 BYPASS PUMPING

A. Utilize flow through plugs to maintain sewage flow as needed and to prevent backup or overflow as specified.

B. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify the Engineer so that required reporting can be made to the Texas Commission on Environmental Quality and U. S. Environmental Protection Agency.

3.4 INSTALLATION

A. General

1. Perform coating after the sewer line replacement/repairs, grade adjustments and grouting are complete (See 33 39 61 Cementitious Manhole Coating Specification).

2. Perform application procedures per recommendations of the coating product manufacturer, including environmental controls, product handling, mixing and application.

B. Temperature

1. Only perform application if surface temperature is between 50 and 120 degrees F.

2. Make no application if freezing is expected to occur inside the manhole within 24 hours after application.

C. Coating

1. Apply per manufacturer's recommendation at a minimum film thickness per manufacture.

2. Approved manufactures are as follow:

a. Sauereisen Sewergard-Spay Applied No. 210S

b. CCI Spectrum (Spectrashield),

c. Raven Lining Systems

d. Warren Environmental

3. Coating shall begin at the bottom of grade adjustment rings and extend below the normal depth of water in the manhole channel. Contractor shall cut 1/ 4" wide and 1/ 4" deep coating termination groove into concrete channel at least 4" below normal water depth as termination point of manhole coating. Coating shall be completed during dry-weather, low-flow periods.

4. Apply any topcoat or additional coats within the product's recoat window.

   a. Additional surface preparation is required if the recoat window is exceeded.

5. Allow a minimum of 3 hours of cure time or be set hard to touch before reactivating flow.

3.5 FIELD [OR] SITE QUALITY CONTROL

A. Each structure will be visually inspected by the Owner the same day following the application.

B. The inspector will check for deficiencies, pinholes and thin spots.

C. If leaks are detected, they will be chipped back, plugged and coated immediately with protective epoxy resin coating.

   1. Make repair 24 hours after leak detection.

D. Any and all defects in coating observed by the Owner or Owner's Representative during Final Walkthrough will be remedied by Contractor prior to Owner's acceptance.

3.6 CLOSEOUT ACTIVITIES

A. Upon final completion of the work, the manufacturer will provide a written certification of proper application to the District.

B. The certification will confirm that the deficient areas were repaired in accordance with the procedure set forth in this Specification.

END OF SECTION

33 39 12 PRECAST CONCRETE MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Precast concrete manholes or manhole sections for sanitary sewers.

B. Precast concrete sanitary sewer manholes with manhole coating where corrosion-resistant manholes are used.

C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.02 REFERENCES

A. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. ASTM A 307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.

C. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

D. ASTM C 270- Standard Specification for Mortar for Unit Masonry.

E. ASTM C 443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

F. ASTM C 478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.

G. ASTM C 923 - Standard Specifications for Resilient Connectors between Reinforced Concrete Manhole Structures and Pipes.

H. ASTM C 1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).

I. ASTM D 698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3).

J. ASTM D 2665 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.

K. ASTM D 2996 - Standard Specification for Filament-Wound Fiberglass@(Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.

L. ASTM D 2997 - Standard Specification for Centrifugally Cast Fiberglass@(Glass-Fiber-Reinforced Thermosetting Resin) Pipe.

M. AWWA C 213 - Standard for Fusion Bonded Epoxy Coating for Interior and Exterior of Steel Water Pipelines.

N. American Association of State Highway and Transportation Officials (AASHTO).

1.03 SUBMITTALS

A. Submit manufacturer's data and details of following items for approval:

1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.

2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.

3. Frames, grates, rings, and covers.

4. Materials to be used in fabricating drop connections.

5. Materials to be used for pipe connections at manhole walls.

6. Materials to be used for stubs and stub plugs, if required.

7. Materials and procedures for corrosion-resistant liner and coatings, if required.

8. Plugs to be used for bypassing flows and sanitary sewer hydrostatic testing.

9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

B. Seal submittal drawings by Professional Engineer registered in State of Texas.

PART 2 - PRODUCTS

2.01 PRECAST CONCRETE MANHOLES

A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings that are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.

B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints. Design wall sections for depth and loading conditions in Paragraph 2.01E, with minimum thickness of 5 inches. Base section shall have minimum thickness of 12 inches under invert.

C. Provide tops to support HS-20 vehicle loading, and receive cast iron frame covers, as indicated on Drawings.

D. Where manholes larger than 48-inch diameter are indicated on Drawings, provide precast base sections with precast sections used to transition to lid. Transition can be concentric or eccentric unless otherwise shown on Drawings.

E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed, by manufacturer, to requirements of ASTM C 478 for depth as shown on Drawings and to resist following loads.

1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs.

2. Unit soil weight of 130 pcf located above portions of manhole, including base slab projections.

3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 pcf.

4. Internal liquid pressure based on unit weight of 63 pcf.

5. Dead load of manhole sections fully supported by transition and base slabs.

F. Design: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed according to requirements of ASTM C 478 and following:

1. Design additional reinforcing steel to transfer stresses at openings.

2. Wall Loading Conditions:

a. Saturated soil pressure acting on empty manhole.

b. Manhole filled with liquid to a halfway depth as measured from invert to cover, with no balancing external soil pressure.

3. Minimum clear distance between two wall penetrations shall be 12 inches or half diameter of smaller penetration, whichever is greater.

G. Provide joints between sections with O-ring gaskets conforming to ASTM C 443.

H. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.

I. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: for water line manhole, no less than 6 inches above inside surface of floor of base.

2.02 CONCRETE

A. Conform to requirements of Section 03 01 30.05 - Concrete for Utility Construction.

B. Channel Inverts: Use 5 sack premix (bag) concrete or Class A concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.

C. Cement Stabilized Sand Foundation: Provide cement stabilized sand foundation under base section in lieu of foundation slab, as shown on Drawings, conforming to requirements of Section 31 23 23.34 - Cement Stabilized Sand.

D. Concrete Foundation: Provide Class A concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section where indicated on Drawings.

2.03 REINFORCING STEEL

A. Conform to requirements of Section 03 21 01 - Concrete Reinforcement.

2.04 MORTAR

A. Conform to requirements of Section 03 01 30.06 - Mortar.

2.05 MISCELLANEOUS METALS

A. Provide cast-iron frames, rings, and covers conforming to requirements of Section 33 05 13 - Frames, Covers, and Grade Rings.

2.06 DROP CONNECTIONS AND STUBS

A. Provide drop connections and stubs conforming to same pipe material requirements used in main pipe, unless otherwise indicated on Drawings.

2.07 PIPE CONNECTIONS TO MANHOLE

A. Sanitary Sewers:

1. Refer to plans.

2.08 SEALANT MATERIALS

A. Approved products in accordance with Contract Documents.

B. Provide sealing materials between precast concrete adjustment ring and manhole cover frame, Adeka Ultraseal P201, or approved equal.

C. Provide external sealing material from Canusa Wrapid Seal manhole encapsulation system, or approved equal.

D. Butyl Sealant: Provide Press-Seal EZ Stick, or equal, for HDPE rings.

2.09 CORROSION RESISTANT MANHOLE MATERIALS

A. Provide new corrosion resistant manhole materials in per Section 33 39 60, Epoxy Liners for Sanitary Sewer Structures.

2.10 BACKFILL MATERIALS

A. Conform to requirements of Section 02222, Excavation and Backfill for Utilities.

2.11 NON-SHRINK GROUT

A. Provide prepackaged, inorganic, flowable, non-gas-liberating, non-metallic, cement-based grout requiring only addition of water.

B. Meet requirements of ASTM C 1107 and have minimum 28-day compressive strength of 7000 psi.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that lines and grades are correct.

B. Determine if subgrade, when scarified and recompacted, can be compacted to 95 percent of maximum Standard Proctor Density according to ASTM D 698 prior to placement of foundation material and base section. When proper density is not reached, moisture condition subgrade until that density is reached or treat as unstable subgrade.

C. Do not build manholes in ditches, swales, or drainage paths unless approved by Owner.

3.02 PLACEMENT

A. Install precast manholes to conform to locations and dimensions shown on Drawings.

B. Place sanitary and storm manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise shown on Drawings.

3.03 MANHOLE BASE SECTIONS AND FOUNDATIONS

A. Place precast base on 12-inch-thick (minimum) foundation of crushed stone wrapped in filter

fabric, cement stabilized sand, or concrete foundation slab. Compact cement-sand in accordance with requirements of Section 03 34 13, Controlled Low Strength Material.

B. Unstable Subgrade Treatment: When unstable subgrade is encountered, notify Owner for examination of subgrade to determine if subgrade has heaved upwards after being excavated. When heaving has not occurred, over-excavate subgrade to allow for 24-inch-thick layer of crushed stone wrapped in filter fabric as foundation material under manhole base. When there is evidence of heaving, provide pile-supported concrete foundation, as detailed on Drawings, under manhole base.

3.04 PRECAST MANHOLE SECTIONS

A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.

B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.

C. Seal any lifting holes with non-shrink grout.

D. Where PVC liners are required, seal joints between sections in accordance with manufacturer's recommendations.

E. Place at least two precast concrete grade rings with thickness of 12 inches or less, under casting.

F. Top of manhole elevations shown on Drawings are approximate, based on pavement and natural ground conditions at the time of the topographic survey. No additional payment will be made if final elevation of manhole ring and cover is higher or lower due to requirements of finished grade or replaced pavement surface.

3.05 PIPE CONNECTIONS AT MANHOLES

A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.

1. Where smooth exterior pipes (i.e. steel, ductile iron or PVC pipes) are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier. Assemblies: "Press-Wedge," "Res-Seal," "Thunderline Link-Seals," or approved equal. See Drawings for placement of assembly in manhole sections.

2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: minimum of 9/16-inch wide. Provide PSX positive seal gasket system by Press-Seal Gasket Corporation or approved equal.

B. Ensure no concrete, cement stabilized sand, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.

C. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install water stop gasket around existing pipe at center of cast-in-place wall. Join ends of split water stop material at pipe spring line using an adhesive recommended and supplied by water stop manufacturer.

D. Test connection for watertight seal before backfilling.

3.06 INVERTS FOR SANITARY SEWERS

A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:

1. Slope of Invert Bench: 1 inch per foot minimum; 1-1/2 inches per foot maximum.
2. Depth of Bench to Invert:
   a. Pipes smaller than 15 inches: one-half of largest pipe diameter.
   b. Pipes 15 to 24 inches: three-fourths of largest pipe diameter.
   c. Pipes larger than 24 inches: equal to largest pipe diameter.
3. Invert Slope through Manhole: 0.10 foot drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawings.

B. Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.07 DROP CONNECTIONS FOR SANITARY SEWERS

A. Backfill drop assembly with crushed stone wrapped in filter fabric, cement stabilized sand, or Class A concrete to form solid mass. Extend cement stabilized sand or concrete encasement minimum of 4 inches outside bells.

B. Install drop connection when sewer line enters manhole higher than 24 inches above invert of manhole.

3.08 STUBS FOR FUTURE CONNECTIONS

A. In manholes, where future connections are indicated on Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.09 MANHOLE FRAME AND ADJUSTMENT RINGS

A. Combine precast concrete and new pipe sections so elevation of installed casting cover matches pavement surface. Seal between concrete riser and precast top section with non-shrink grout; do not use mortar. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on new pipe section in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch high and 1/2-inch wide.

B. Wrap manhole frame and new pipe riser adjustment with external sealing material, minimum 3 inches beyond joint between ring and frame and ring and precast section.

C. For manholes in unpaved areas, set top of frame minimum of 6 inches above existing ground line unless otherwise indicated on Drawings. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.10 BACKFILL

A. Place and compact backfill materials in area of excavation surrounding manholes in accordance

with requirements of Section 02222, Excavation and Backfill for Utilities. Provide embedment zone backfill material, as specified for adjacent utilities, from manhole foundation up to an elevation 12 inches over each pipe connected to manhole. Provide trench zone backfill, as specified for adjacent utilities, above embedment zone backfill.

B. Where rigid joints are used for connecting existing sewers to manhole, backfill under existing sewer up to spring line of pipe with Class B concrete or flowable fill.

3.11 FIELD QUALITY CONTROL

A. Conduct leakage testing of sanitary sewer manholes in accordance with requirements of Section 01 40 00, Quality Requirements.

3.12 PROTECTION

A. Protect manholes from damage until work has been accepted. Repair damage to manholes at no additional cost to Owner.

END OF SECTION

SECTION 33 39 61 CEMENTITIOUS MANHOLE COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This section governs all work, materials and testing required for the cementitious coating of Manholes. Manholes designated for interior coating are listed on the Manhole Rehabilitation Schedule. Manholes designated for interior coating shall be first coated with a cementitious coating follow up an epoxy coating as detailed in Section 33 39 60.

B. Related Specification Sections include, but are not necessarily limited to:

1. Division 00 – Procurement and Contracting Requirements
2. Division 01 – General Requirements
3. Section 33 39 60 – Epoxy Coating

1.2 PRICE AND PAYMENT PROCEDURES

Measurement and Payment shall be in accordance with Section 01025.

1.3 SUBMITTALS

A. Submittals shall be in accordance with Section 01300 – Submittals and Substitutions.

B. All submittals shall be approved by District prior to construction.

1.4 ACTION SUBMITTALS/INFORMATIONAL SUBMITTALS

A. Product Data

1. Submit product data, including each material, component construction, features, configurations and dimension, from pre-approved manufacturer for all materials to be installed.

B. Contractor Data

1.5 FIELD [SITE] CONDITIONS

A. Existing Conditions

1. Contractor is responsible for locating and uncovering all manholes. If the contractor is unable to locate manholes, the Contractor shall notify the Engineer in writing.
2. Manholes to be interior coated may be of brick, block, pre-cast, or poured concrete construction. Some may have a previously applied interior mortar coating.
3. Provide confined space entry, flow diversion and/or bypass plans as necessary to perform the specified work. Perform work in accordance with OSHA Standards.

1.6 QUALITY ASSURANCE

A. Obtain all materials from a single manufacturer.

B. At a minimum, products and installers must meet all of the following criteria to be deemed commercially acceptable:

1. For a Product to be considered commercially acceptable, the product must have a minimum of eighty thousand (80,000) vertical feet and five (5) year history of successful wastewater collection system installations on manholes in the United Stated. In addition, products must provide Third Party test Results supporting the long-term performance and structural strength of the product and such data shall be satisfactory to the Owner. No product will be allowed without Independent Third Party Testing verification.
2. For an installing contractor to be considered commercially acceptable, the installer must satisfy all insurance, financial and bonding requirements for the Owner. The Contractor must have a certification from the manufacturer as a licensed and fully installer of the product. The installer must also have a minimum of eighty thousand (80,000) vertical feet of successful wastewater collection system installations and five (5) year of rehabilitation experience on manholes.

C. Personnel shall have confined space entry certification.

D. Field verification shall be completed by the contractor prior to commencement of work.

E. Contractor shall verify the finished thickness of each rehabilitation method prior to starting the next layer and upon completion of the work. The Engineer my obtain core samples at his discretion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials

1. Cementitious Interior Coating
   a. Quadex QM-1s Restore proprietary pre-blended cement based synthetic granite (Donnafill) enhanced polypropylene fiber reinforced coatings as manufactured by Quadex, LLC (A Vortex Company). Or approved equal shall be used on this project. No material (other than clean potable water) shall be used with or added to the coating material without prior approval or recommendation from the coating material manufacturer.
2. Material Identification
   a. Contractor shall completely identify the types of grout, mortar, patching compounds, sealant, and/or root control chemicals used and provide case histories of successful use or defend the choice of grouting materials based on chemical and physical properties, ease of application, and expected performance, to the satisfaction of the Owner's Representative.
3. Mixing and Handling
   a. Mixing and handling of interior coating, which may be toxic under certain conditions shall be in accordance with the recommendations of the manufacturer and in such a manner as to minimize hazard to personnel. It is the responsibility of the Contractor to provide appropriate protective measures to ensure that materials are under control at all times and are not available to unauthorized personnel or animals. All equipment shall be subject to the approval of the Owner's Representative. Only personnel thoroughly familiar with the handling of the coating material shall perform the coating operations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Notify District and/or Engineer immediately of any changed condition that impacts installation of the proposed frame and cover replacement.

3.2 PREPARATION

A. The contractor shall be responsible for supplying the required material for the replacement of manhole frames and covers, including the unloading, temporary storage, and transporting of the materials.

B. Manhole coating shall not be performed until sealing of manhole frame and grade adjustments and/or pressure grouting or replacement is complete.

3.3 INSTALLATION

A. Preliminary Repairs

1. All foreign materials shall be removed from the manhole interior using high-pressure water spray (minimum 3500 psi). Loose and protruding brick, mortar and concrete shall be removed using a masonry hammer and chisel and/or scrapers. Existing roots and manhole steps shall be removed by cutting them flush with the wall of the manhole.
   a. All unsealed lifting holes, unsealed step holes, voids larger than approximately one-half (1/2) inch in thickness shall be filled with patching compound at least one hour (1) prior to spray application of the first coat.
   b. Active leaks shall be grouted in accordance with Section 33 39 50.
   c. After all repairs have been completed, remove all loose material.
2. Temperature
   a. Normal interior coating operation shall be performed at temperatures of 40°F or greater. No application shall be made when freezing is expected within 24 hours. If ambient temperatures are in excess of 90°F, precautions shall be taken to keep mixing water below 85°F, using ice if necessary.
3. Interior Manhole Coating
   a. Manholes scheduled for interior coating are shown on the Manhole Rehabilitation Schedule. The interior coating shall be applied to the manhole from the bench and trough (including the bench/trough) to the bottom of the frame of the first grade adjustment ring.
   b. The interior coating shall be applied in accordance with the manufacturer's recommendations and the following procedure.
      1) The surface shall be thoroughly cleaned of all foreign materials and matter. Cleaning shall be accomplished by using high-pressure water spray (minimum 3500 psi.)
      2) Place covers over invert to prevent extraneous material from entering the sewer.
      3) The surface prior to application shall be damp without noticeable free water droplets or running water. Coating material shall be spray applied to a minimum uniform thickness of ½-inch minimum. Troweling shall begin immediately following the spray application. The troweled surface shall be smooth with no evidence of previous void areas.

4) After the walls are coated, the invert/bench covers shall be removed and the bench sprayed with epoxy material in such a manner as to produce a bench having a gradual slope from the walls to the invert with the wall/bench intersection built up and rounded to a uniform radius for the full circumference of the intersection. The thickness of the bench shall be no less than 1/2 inch at the invert and shall increase in the direction of the wall so as to provide the required slope. Trough area shall be coated as required to seal all cracks and to provide a smooth surface.

5) The material shall have a minimum of four (4) hours cure time before being subjected to active flow. Ambient conditions in the manhole are adequate for curing as long as the manhole is covered.

6) Traffic shall not be allowed over manholes for 12 hours after reconstruction is complete.

7) Caution should be taken to minimize exposure of applied product to sunlight and air movement. At no time should the finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing the manhole cover. In extremely hot and arid climates manhole should be shaded while reconstruction is in process.

8) No application shall be made to frozen surfaces or if freezing is expected to occur inside the manhole within 24 hours after application. If ambient temperatures are in excess of 95 degrees F, precautions shall be taken to keep the mix temperature at time of application below 90 degrees F. Mix water temperature shall not exceed 85 degrees F. Chill with ice if necessary.

3.4 FIELD QUALITY CONTROL

A. Testing of rehabilitated manholes for water tightness shall be performed by the Contractor in the presence of the Engineer in accordance with the requirement of Section 33 01 30.02.

B. At least two 2-inch cubes shall be taken from each day's work with the date, location and job recorded on each. The cubes shall be sent to a certified testing laboratory for testing. A compression test will be made per ASTM C109, and the results will be furnished to the Owner. Test results shall equal or exceed the manufacturer's published values.

C. Vacuum testing of rehabilitated manholes for water tightness shall be performed by the Contractor after operations are complete in accordance with the Manhole Testing Section 33 01 30.02.

END OF SECTION

DIVISION 40

PROCESS INTERCONNECTIONS

SECTION 40000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

40 05 59.23 STAINLESS STEEL SLIDE GATES

PART 1 GENERAL

1.1. SCOPE OF WORK

This section covers stainless steel slide gates with 4 sides sealing for submerged applications and their associated accessories for operation. The contractor shall furnish all labor, materials, equipment and incidentals required to install and field test the gates shown on the Contract Drawings and specified herein.

1.2. REFERENCES

A. Definitions

Design Head: The maximum differential head that will be applied on the gate under worst case conditions, measured from the gate invert.

Seating Head: Head applied on a wall mounted gate, in the direction that pushes the gate against the wall it is installed on.

Unseating Head: Head applied on a wall mounted gate in the direction pulling the gate away from the wall it is installed on.

Operating Head: The highest differential head that is to be applied on the gate when it needs to be operated, measured from the gate invert.

B. Reference Standards

ANSI/AWWA C561 – Fabricated Stainless Steel Slide Gates.

ANSI/AWWA C542 – Electric Motor Actuators for Valves and Slide Gates.

ASTM A240/A240M – Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and for General Applications.

ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes.

ASTM A582/A582M - Standard Specification for Free-Machining Stainless Steel Bars.

ASTM A790/790M - Standard Specification for Seamless and Welded Ferritic / Austenitic Stainless Steel Pipe.

ASTM B179 - Standard Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes.

ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.

ASTM D4020 - Standard Specification for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials.

ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.3. SUBMITTALS

A. Drawings

The slide gates manufacturer shall submit, for acceptance by the purchaser, general arrangement drawings of the equipment supplied under this section. Drawings must indicate all dimensions that will allow the contractor to ensure coordination with dimensions of the installation environment. Drawings will also show sufficient details to determine compliance with the requirements, including the stainless steel plate thickness used for all components. Drawings shall also include certification that the slide gates supplied meet all requirements of AWWA C561-14.

B. Design Calculations

The gate manufacturer shall submit, for acceptance by the purchaser, design calculations demonstrating compliance with the design requirements of these specifications and those of AWWA C561-14. In particular, calculations shall be submitted for the following gate components:

- Slide
- Seat contact pressure
- Frame
- Yoke
- Stem, stem connection
- Lifting nut
- Manual actuator operating force
- Electric actuator load
- Anchors

C. Test Reports

The gate manufacturer shall submit upon request, for information, the leakage and operation test reports specific to the actual gates that are being supplied demonstrating their compliance with the maximum leakage rate and maximum operating force allowed.

D. Installation, Operation and Maintenance Manual

The gate manufacturer shall provide a manual containing the instructions for installation, operation and maintenance of the slide gates. The manual shall also contain the detailed information on the terms of the 5-year warranty on the products.

1.4. QUALITY ASSURANCE

A. Qualifications

The gates supplied under this section shall be standard products of a manufacturer regularly engaged in the design and manufacturing of water control gates. The specifications are based on FONTAINE-AQUANOX Series 20 Slide Gates manufactured by ISE Metal Inc.

B. Standards and Certifications

The gates supplied under this section shall conform to all requirements of ANSI/AWWA C561-14. The slide gate manufacturer must maintain an ISO-9001 certification and also a company certification for its welding operations from the CWB or AWS.

1.5. DELIVERY

The manufacturer shall use due and customary care in preparing the gates and accessories for shipment. Self contained frame gates shall be shipped assembled with stem and manual operator. When shipping several gates together, every item shipped separately must be clearly marked to the gate it belongs to.

1.6. WARRANTY

The slide gates and manual operating accessories shall be covered by a five (5) year warranty from the manufacturer against defects in materials, design and workmanship. The warranty period will start from the date of delivery of the equipment to the installation site.

PART 2 PRODUCTS

2.1. EQUIPMENT

A. Manufacturers

Gates supplied shall be FONTAINE-AQUANOX Series 20 Slide Gates, as manufactured by ISE Metal Inc. or approved equal.

B. Description

The gates shall be upwards opening of the 4 sides sealing type designed for submergence in water or wastewater applications. They shall have flow control capability by allowing only flow through the open area in partial opening situations. As specified in the gate schedule, each gate shall be either open-frame or self-contained-frame design and either rising or non-rising stem configuration.

C. Performance and Design

1. Slide

The slide consisting of a flat plate with welded reinforcing ribs shall be designed to withstand the design head specified in the gate schedule with a maximum deflection of 1/720 of the gate opening width or 1/16 in (1.6mm) whichever is less and with stresses in the slide limited to 25% of the ultimate tensile, compressive, and shear strength and 50% of the yield strength, whichever is less. Minimum material thickness of all members of the slide shall be ¼ in (6mm).

2. Frame

The gate frame shall be made of formed plates or structural members creating the clear opening of the specified dimensions in a rigid one-piece unit. The mounting and bolting flange of the frame to the wall shall be separate and independent from the seating and sealing plane of the slide. The bottom of the frame will be of the flush invert type. Stresses in the frame under design head shall not exceed 25% of the ultimate tensile, compressive, and shear strength and 50% of the yield strength, whichever is less. Minimum material thickness of all members of the frame shall be ¼ in (6mm).

3. Yoke

Gates specified as self-contained design shall include a yoke consisting of a beam made of formed plates or structural members mounted on top of the frame to permit mounting of the actuator with proper stem alignment by the use of slotted holes in both directions. The yoke shall be sized to limit deflection under the design load to a maximum of 1/360 of the gate opening width or ¼ in (6mm) whichever is less. The yoke design load must be considered as the vertical thrust generated by an 80 lbs (356 N) force on the crank or handwheel (for a manual actuator) or by the actuator in locked rotor condition (for an electric actuator). Per AWWA C561-14, the stresses in the yoke generated by the design load shall not exceed (for a manual actuator) 25% of the ultimate tensile, compressive, and shear strength and 50% of the yield strength, whichever is less, or (for an electric actuator) 2/3 of the yield strength.

4. Guiding and Seating

The slide shall seat and travel on guides made of ultra high molecular weight polyethylene (UHMWPE) designed to perform for the life of the slide gate without replacement. The slide shall be kept in positive contact with the guides on both its upstream and downstream faces, all along its travel in the gate clear opening by an elastomeric cord. Above the gate clear opening, the guides shall extend high enough to ensure that the slide is supported on a minimum of 2/3 of its height when fully opened. The low friction guides shall be secured to the frame by bolted retainers allowing factory adjustment of the contact pressure with the slide. The surface of contact on the side seats shall be large enough to limit the stress under the design head to 600 psi (4137 KPa) without considering the top and bottom seats as load bearing.

5. Sealing

The guides combined with the elastomeric cord will provide sealing on both sides of the opening. Sealing at the top section of the gate will also be achieved with a UHMWPE seat maintained in contact by an elastomeric cord. At the gate invert, the slide shall close on a flush invert rubber seat/seal secured in the bottom member of the gate frame. Under the design seating or unseating head specified in the gate schedule, the slide gates shall restrict leakage to a maximum of 0.04 gpm/ft. (0.5 l/min/m) of clear opening perimeter. Manufacturer shall be able to demonstrate that the sealing system will retain its performance even after 25,000 operating cycles.

6. Stem Connection

In the case of gates with rising stems, the stem or its extension will be connected to the slide by means of a pinned connection. For gates with non-rising stems, the connection to the slide shall be by means of a threaded thrust nut matching the stem threads. Stem connection design shall limit the stress under the design load to a maximum of 25% of the ultimate tensile, compressive, and shear strength and 50% of the yield strength. The stem connection design load shall be the thrust and torque developed when a 80lbs (356N) efforts is applied the crank or handwheel (for a manual actuator), or 1.5 times the thrust and torque developed with the actuator in stalled condition (for electric motors).

7. Stem

The stem configuration shall be rising or non-rising according to the type specified in the schedule. The threads shall be machine rolled ACME left hand threads with double entry to minimize the number of turns required for operation and provide gate opening by counterclockwise rotation of the manual actuator. Surface finish of the machined threads will be 32 micro inch (0.813 µm) or better. For manually operated gates with rising stem, the stem shall be equipped with an adjustable stop collar to prevent over-closing the gate and potentially damaging components.

The stem shall be sized so that its critical buckling load (as determined by the Euler column formula) is higher than the design compression load, defined as the vertical force developed by a 80lbs (356N) effort applied on the crank or handwheel (for a manual actuator), or 1.5 times the thrust and torque developed with the actuator in stalled condition (for electric motors).

8. Couplings

The required stem extensions shall be joined together or to the threaded stem by means of a bolted connection, passing through both pipe and stem.

9. Stem guides

Guides will be provided as required to meet the stem buckling design criteria and positioned per the manufacturer's recommendations to ensure that the length to radius of gyration ratio (l/r) does not exceed 200. The guides shall incorporate a UHMWPE bushing supported by a stainless steel wall bracket adjustable in both horizontal directions.

D. Manual Actuators

1. Operation

Manual actuator of the proper type and mounting location, as listed in the gate schedule or shown on the drawings, shall be provided by the gate manufacturer. The effort required on the manual device to operate the gates shall not exceed 40 lbs (178 N), while to start the gate in motion from the fully closed position with the design pressure, the required effort shall not exceed 60 lbs (267 N). Indication of the opening direction of rotation shall be clearly marked in a permanent manner on the handwheel or crank.

2. Handwheel (**Not Used**)

The handwheel shall be removable and have a minimum diameter of 16" (406mm). It shall drive the lift nut directly or via the extension pipe of self-contained gates or it shall engage the input shaft of the gearbox, when specified.

3. Crank Operated Gearboxes

The gearbox, comprising a lift nut and thrust bearing assembly (as described below), shall be fully enclosed in a casted housing with seals around the lift nut and around the input pinion shaft. The input pinion shaft shall be supported on ball or tapered roller bearings. The removable crank, equipped with a revolving grip shall engage on the input shaft of the gearbox and have a minimum radius of 12" (305mm).

4. Square Nut Actuator (**Not Used**)

The square nut shall be 2" x 2" (50mm x 50mm) designed for mounting in the floor box supplied by the contractor and designed to accommodate a standard T-wrench. T-Wrench shall be supplied by the gate manufacturer in the quantity required by the gate schedule.

5. Actuator Lift Nut and Thrust Bearings

All gates shall include a thrust bearing assembly comprising a threaded bronze lift nut to engage the operating stem. This assembly must be enclosed in a machined stainless steel housing or be an integral part of the gearbox when supplied. Needle roller thrust bearings shall be provided above and below the lift nut to support the operating efforts in closing and opening the gate. The length of thread engagement shall be sufficient to ensure that the maximum pressure on the projected area of thread contact does not exceed 2000 psi (13,8 MPa) at normal maximum operating load and that the PV (pressure velocity) factor does not exceed 30,000. The PV factor is calculated by multiplying the pressure on the projected area of thread contact in psi by the surface velocity in ft/min at the pitch diameter of the threads. For non-rising stem gates, the actuator lift nut shall be keyed to prevent rotation relative to the threaded stem.

6. Mounting

The thrust bearing assembly or the gearbox shall be mounted on the yoke of the gate for all gates specified as self-contained or on a pedestal for gates specified as non self-contained. Pedestal height shall be such that the handwheel or input shaft of the gearbox is located approximately 36" (900mm) above the operating floor. Where shown on the

drawings or when specified, a wall bracket shall be supplied to support the pedestal. The pedestal wall bracket shall be designed and supplied by the gate manufacturer to ensure that it can resist to all operating efforts of the gate based on the same design calculation criteria used for the yoke.

7. Stem Cover

All rising stem gates, weather manual or motorized shall be equipped with a clear stem cover with a closed top and ventilation hole. The cover shall bear graduation in both inches and centimeters to indicate the position of the gate.

E. Motorized Actuators (**Not Used**)

1. When required by the gate schedule or the drawings, motorized actuators shall be supplied as specified in specification section _____. Actuators shall be Rotork IQ3 or Auma SA series, for ON/OFF duty and have the characteristics indicated in the schedule shown below in this section.

F. Anchor Bolts

1. The quantity, size and location of anchor bolts shall be determined by the gate manufacturer and shown on the submittal drawings. The minimum required load capacity of the anchors used for design must also be indicated on the drawings.

G. Materials

Slide, Frame and Yoke	Stainless Steel	ASTM A240, grade 316L or 304L
Side Seal/Guides and Top Seal	Ultra High Molecular Weight Polyethylene (UHMWPE)	ASTM D4020
Flush Invert Bottom Seal	Ethylene Propylene (EPDM)	ASTM D2000
Compression Cord	Ethylene Propylene (EPDM)	ASTM D2000
Wall Gasket	Ethylene Propylene (EPDM)	ASTM D2000
Bolts and Hardware	Stainless Steel	ASTM F593, grade 316
Stem	Stainless Steel	ASTM A582, grade 316 or 304
Thrust Nut and Lift Nut	Aluminum Bronze or Manganese Bronze	ASTM B505, C95800 ASTM B584, C86300
Stem Couplings	Manganese bronze or Stainless Steel	ASTM A582, grade 316

Stem Guide Bracket	Stainless Steel	ASTM A582, grade 316
Stem Guide Bushing	Ultra High Molecular Weight Polyethylene (UHMWPE)	ASTM D4020
Handwheel	Aluminum	ASTM B209, 6061-T6
Crank	Stainless Steel	ASTM A240, grade 316L
Pedestal	Stainless Steel	ASTM F593, grade 316
Gearbox Housing	Cast Iron	ASTM A48 35B/40B
Square Nut	Cast Aluminum	ASTM B179
Stem Cover	Clear PVC	
Stem Cover Cap	PVC	

2.2. FACTORY TESTS

The gates shall be tested in the factory for leakage and for operating force. Leakage shall be measured at the unseating design pressure. Operating force shall be measured with the gate in vertical position, with and without the design pressure. Factory test reports shall be available on request for all gates supplied.

PART 3 EXECUTION

3.1. INSTALLATION

A. It is the responsibility of the Contractor to handle, store and install the gates in strict accordance with the manufacturer's instructions and recommendations. The Contractor shall review the installation drawings and instructions before proceeding to the installation of the gates.

B. The gate assemblies must be installed on a true vertical plane, square and plumb. The operating stem shall be accurately aligned with the gate guides and properly greased.

3.2. FIELD TESTING

A. After installation, the gates must be field tested by the Contractor, in the presence of the Engineer and Owner, to ensure compliance with the requirements of these specifications. Each gate shall be operated on its complete open-close cycle to confirm operation without binding, scraping or distorting. Operating effort on the crank, handwheel or T-wrench shall be observed or measured. In the case of motorized actuators, the operating torque shall be noted, and the initial set-up of each actuator shall be done in accordance with the instructions in the manual.

B. Each gate shall be water tested by the Contractor and sealing performance shall be observed.

C. The Contractor shall supply a detailed report of the field tests to the Engineer for review.

STAINLESS STEEL SLIDE GATES SCHEDULE

Item	MODEL	Qty	SIZE (W x H) (inches)	DESIGN HEAD (ft) Seat.	Uns.	FRAME TYPE	STEM TYPE	ACTUATOR TYPE	ACTUATOR MOUNTING	T-WRENCH Yes/No – Qty
1	204-P2X-36x36-A-RMX-20	1	36 in x 36 in	20	20	Open	Single Rising	CrankOperated Gear Box	Pedestal	No
2	204-P2X-24x24-A-RMX-20	1	24 in x 24 in	20	20	Open	Single Rising	CrankOperated Gear Box	Pedestal	No

ABBREVIATIONS:

FRAME TYPES:
- SC: Self-Contained
- NSC: Non Self-Contained

ACTUATOR TYPES:
- H: Handwheel
- GC: Gearbox and Crank
- GH: Gearbox and Handwheel
- EM: Electric Motor Actuator
- SN: Square Nut

ACTUATOR MOUNTING:
- P: Pedestal Mounted
- PB: Pedestal Mounted with Wall Bracket
- F: Floor Box
- Y: Yoke Mounted

ELECTRIC MOTOR ACTUATOR CHARACTERISTICS (NOT USED)

Item	ID TAG	Qty	ENCLOSURE RATING	POWER SUPPLY	CONTROLS VOLTAGE	INTEGRAL CONTROLS	POSTION TRANS-MITTER	POSI-TIONNER

ABBREVIATIONS:

ENCLOSURE RATINGS:
- WT: Watertight IP68/NEMA 4&6
- EX: Explosion Proof

END OF SECTION

DIVISION 43

PROCESS GAS AND LIQUID HANDLING, PURIFICATION, AND STORAGE EQUIPMENT

SECTION 43000

Huitt-Zollars, Inc. 5822 Cromo, Suite 210 ~ El Paso, Texas 79912 (915) 587- 4339

SECTION 43 10 52 PIPE SUPPORTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit Shop Drawings which shall include the following information:

a. Calculations for special supports and anchors that have not been designed on the Contract Documents, shall be stamped and signed by a Registered Professional Engineer.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Code Compliance

1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, probable forces applied during construction, and stresses on piping, equipment, and structures.

2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping, except as supplemented or modified in this Section.

3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.

2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR.

3. Supplementary members shall be in accordance with the requirements of the 2012 International Building Code, Section 01 33 17 – Seismic and Wind Design Criteria, and shall be as acceptable to the ENGINEER.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment.

2. Hangers shall have a means of vertical adjustment after erection.

3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.

4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.

5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Horizontal Movements

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.

2. Where horizontal pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold-to-hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers

1. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping.

2. Spring-type hangers shall be sized to the manufacturer's printed recommendations and the loading conditions encountered.

3. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate the compression of the spring.

4. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. Thermal Expansion

1. Wherever expansion and contraction of piping is expected, a sufficient number of expansion loops or expansion joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely away from the anchored points.

2. Components shall be structurally suitable to withstand the imposed loads.

G. Heat Transmission

1. Supports, hangers, anchors, and guides shall be designed and insulated such that excessive heat will not be transmitted to the structure or to other equipment.

H. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

I. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

J. Materials of Construction

1. Pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged supports, as well as piping, conduits, and equipment in hydraulic structures within 24 inches of the water level, shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel, unless otherwise indicated.

3. Piping in chemical and corrosive areas shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

K. Point Loads

1. Meters, valves, heavy equipment, and other point loads on PVC, FRP, or other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, FRP, or other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields.

L. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the ENGINEER for any anchor applications not appearing on the table.

2. Anchors shall be in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors

M. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads.

B. Pipe support spacing shall not exceed the maximum indicated spans.

C. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.

D. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

E. Steel Pipe

1. Install supports for steel pipe in accordance with the requirements of AWWA: Manual of Practice MOP-11.

2. For steel pipe sizes not indicated, the support spacing shall be designed such that the stress on the pipe does not exceed 5,000 psi.

3. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule, for the indicated support condition:

PRACTICAL SPANS FOR SIMPLY SUPPORTED PIPE IN 120-DEGREE CONTACT SADDLES, FEET[1]										
Nominal Pipe Diameter, inches	Pipe Wall Thickness, inches									
	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1
6	36	40	44							
8	38	42	45							
10	39	43	46							
12	40	44	47							
14	40	44	47							
16	41	45	48							
18	41	46	49	52						
20	42	46	50	53						
22	42	46	51	54						
24	42	48	52	55	58	60				
26	43	48	52	56	59	61				
28	43	48	53	56	59	62				
30	43	49	53	57	60	63				

[1] Reference: AWWA MOP 11, Table 7-1

F. Ductile Iron Pipe

1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, inches	Support Configuration
ALL DIAMETERS	two supports per pipe length, with one of the two supports located at a joint

G.

H. Copper Tube

1. Install supports for copper tube in accordance with the recommendations of ANSI/MSS SP-69 Pipe Hangers and Supports - Selection and Application, as indicated in the following schedule:

Nominal Tube Size, inches	Support Spacing, feet[1]	
	Water Service	Vapor Service
1/4	5	5
3/8	5	6
1/2	5	6
3/4	5	7
1	6	8
1-1/4	7	9
1-1/2	8	10
2	8	11
2-1/2	9	13
3	10	14
3-1/2	11	15
4	12	16
5	13	18
6	14	20
8	16	23
10	18	25
12	19	28

[1] Reference: ANSI/MSS SP-69, Table 3

I. Schedule 80 PVC Pipe

Install supports for Schedule 80 PVC pipe as indicated in the following schedule:

Support Spacing for Schedule 80 PVC Pipe[1]					
Nominal Pipe Size, inches	Maximum Support Spacing, feet, at Various Temperatures				
	60 deg F	80 deg F	100 deg F	120 deg F	140 deg F
1	6	5.5	5	3.5	3
1-1/2	6.5	6	5.5	3.5	3.5
2	7	6.5	6	4	3.5
3	8	7.5	7	4.5	4
4	9	8.5	7.5	5	4.5
6	10	9.5	9	6	5
8	11	10.5	9.5	6.5	5.5
10	12	11	10	7	6
12	13	12	10.5	7.5	6.5
14	13.5	13	11	8	7

[1] Reference: USACE based on Harvel Plastics Product Bulletin 112/401 (rev, 10/1/95), p. 63; spacing values based on test data developed by the manufacturer for the specific product and continuous spans; the piping is insulated and full of liquid with a specific gravity of 1.0

2.3 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.

2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. **Sandon Pipe Supports, Inc.**

2. **Anvil International**

3. **Houston Pipe Supports**

2.4 COATING

A. Galvanizing

1. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

B. Other Coatings

1. Other than stainless steel or non-ferrous supports, supports shall receive protective coatings suitable for the environment.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ASME B31.1 - Power Piping.

2. Concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.

3. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, and without interference with other WORK.

3.2 FABRICATION

A. Quality Control

1. Pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.

2. Fabricated supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

SECTION 43 10 54 STAINLESS STEEL PIPE (ASTM A 312, MODIFIED)

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide stainless steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 43 10 50 - Piping, General apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. Unless otherwise indicated, stainless steel pipe shall be in accordance with ASTM A 312 - Seamless and Welded Austenitic Stainless Steel Pipe, Type 316, seamless, Schedule 40, with screwed fittings for sizes up to and including 2-1/2 inches and welded fittings or flanged fittings for sizes 3-inches and larger. Stainless steel pipe 12-inches in diameter and larger shall be in accordance with ASTM A 409 - Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service, or A 778 - Welded, Unannealed Austenitic Stainless Steel Tubular Products, Type 316, of the schedules indicated, with welded or flanged joints.

2.2 PIPE JOINTS

A. Stainless steel pipe for sizes 2-1/2 inches and smaller shall have screwed ends with NPT threads made up with Teflon tape. Stainless steel pipe 3-inches and larger and where indicated shall have welded joints with socket-welding fittings, butt-welding fittings, or socket welding flanges. Stainless steel flanges shall have stainless steel bolts and nuts. Where indicated, stainless steel pipe shall have grooved ends for shouldered couplings, except that no pipe with less than Schedule 40 wall thickness shall be grooved. Where indicated, stainless steel pipe shall have plain ends for sleeve-type couplings.

2.3 FITTINGS

A. Threaded Fittings: Forged stainless steel fittings conforming to ASME B 16.11 - Forged Fittings, Socket-Welding and Threaded, Type 316.

B. Socket-Welding Fittings: Forged stainless steel fittings conforming to ASME B 16.11, Type 316.

C. Butt-Welding Fittings: Wrought stainless steel butt-welding fittings conforming to ASTM A 403 - Wrought Austenitic Stainless Steel Piping Fittings, and ASME B 16.9 - Factory-Made Wrought Steel Butt-Welding Fittings, Type 316.

D. Grooved Fittings: Wrought stainless steel grooved fittings conforming to ASTM A 403 and ASME B 16.9, with grooving conforming to AWWA C606 - Grooved and Shouldered Joints, Type 316.

E. Flanged Fittings: Type 316 stainless steel flanged fittings and flanges conforming to ASME B 16.5 - Pipe Flanges and Flanged Fittings.

F. Pressure Class: Unless otherwise indicated, fittings shall be in accordance with the pressure classes called for in the Piping Schedule. Where not indicated, the fittings shall have the same pressure rating as the pipe.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General: Stainless steel pipe shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points. Installation shall be free from defects.

B. Supports and Anchors: Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 43 10 52 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences.

C. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

3.2 PIPE PREPARATION

A. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true. Ends of threaded pipes shall be reamed and filed smooth. Fittings shall be equally cleaned before assembly.

3.3 PIPE JOINTS

A. Threaded Joints: Pipe threads shall conform to ASME B 1.20.1 - Pipe Threads, General Purpose (inch), and shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.

B. Welded Joints: Welded joints shall conform to the specifications and recommendations of ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders per Section 43 10 50 - Piping, General.

1. Field welding shall be minimized to the greatest extent possible by use of couplings and prefabrication of pipe systems at the factory. Pipe butt welds may be performed at the Site, providing the butt welds are performed only with an inert gas shielded process and that other indicated welding requirements are followed rigidly.

2. Residue, oxide, and heat stain shall be removed from any type of field weld and the affected areas adjacent by the use of stainless steel wire brushes, followed by cleaning with an agent such as **Eutectic Company's Euclean** or equal, followed by complete removal of the agent.

C. Grooved Joints: Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conforming to AWWA C606. Grooves shall be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

3.4 INSPECTION AND FIELD TESTING

A. Inspection: The finished installation shall be carefully inspected for proper supports, anchoring, interferences, and damage to pipe, fittings, and coating. Defects shall be repaired.

B. Field Testing: Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule, for a period of not less than one hour without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices as part of the WORK. For additional testing requirements refer to Section 01 74 30 - Pressure Pipe Testing and Disinfection.

1. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

2. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

END OF SECTION

SECTION 43 30 52 - MISCELLANEOUS VALVES

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The CONTRACTOR shall provide miscellaneous valves and appurtenances, complete and operable, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01300-Submittals and Substitutions..

PART 2 -- PRODUCTS

2.1 AIR-VACUUM AND AIR-RELEASE VALVES

A. Air and Vacuum Valves: Air and vacuum valves shall be capable of venting large quantities of air while pipelines are being filled, and allowing air to re-enter while pipelines are being drained. They shall be of the size indicated, with flanged or screwed ends to match piping. Bodies shall be of high-strength cast iron or stainless steel. The float, seat, and moving parts shall be constructed of Type 316 stainless steel. Seat washers and gaskets shall be of a material insuring water tightness with a minimum of maintenance. Valves shall be designed for minimum 150 psi water-working pressure, unless otherwise indicated.

B. Air-Release Valves: Air-release valves shall vent accumulating air while system is in service under pressure and be of the size indicated. Valves shall meet the same general requirements as indicated for air and vacuum valves except that the vacuum feature will not be required. Valves shall be designed for a minimum water-working pressure of 150 psi, unless otherwise indicated.

C. Combination Air Valves: Combination air valves shall combine the characteristics of air and vacuum valves and air release valves by exhausting accumulated air in systems under pressure and releasing or re-admitting large quantities of air while a system is being filled or drained, respectively. Valves shall have the same general requirements as indicated for air and vacuum valves.

D. Sewage Air Release Valves: Sewage air release valves shall vent accumulating gases during system operation. Valves shall have long float stems and bodies to minimize clogging. The same general requirements shall apply as indicated for air and vacuum valves. Each sewage air release valve shall be furnished with the following backwash accessories, fully assembled on the valve:

1. Inlet shut-off valve.

2. Blow-off valve.

3. Clear water inlet valve.

4. Rubber supply hose.

5. Quick disconnect couplings.

E. Manufacturers, or Equal

1. **H-TEC, Inc.**

2. **ARI USA, Inc.**

2.2 BACKFLOW PREVENTER VALVES

A. General

1. Provide backflow preventers that work on the reduced pressure principle.

2. Provide drain lines with air gaps.

3. The backflow preventer valves shall be in accordance with AWWA C511 – Reduced-Pressure Principle Backflow Prevention Assembly.

B. Construction

1. The preventers shall consist of 2 spring-loaded check valves, an automatic differential pressure relief valve, drain valves, and shut-off valves.

2. The body material shall be bronze or cast iron, for a working pressure of not less than 150 psig, with bronze or stainless steel trim.

C. Maintenance Access

1. Provide separate access covers for the check valves and the relief valve.

2. Provide top-entry access to check valve components.

D. Manufacturers, or Equal

1. **Cla-Val Company**

2. **Febco (CMB Industries)**

3. **Watts, ACV**

4. **Wilkins Regulator Division (Zurn Industries)**

2.3 CORPORATION STOPS

A. Unless otherwise indicated, corporation stops shall be made of solid brass for key operation, with screwed ends with corporation thread or iron pipe thread, as required.

B. Manufacturer, or Equal

1. **Ford Meter Box Company, Inc.**

2. **James Jones Company (Watts, ACV)**

3. **Mueller Company**

2.4 PLASTIC VALVES

A. Unless otherwise indicated, all plastic ball valves and check valves shall be true union CPVC, or as shown on the plans.

B. Manufacturer, or Equal

1. **Hayward Industries, Inc.**

2. **Spears Manufacturing, Inc.**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Backflow preventers shall be installed in potable water lines where required by applicable codes or regulations, wherever there is any danger of contamination, and where indicated.

B. Valves shall be installed in accordance with the manufacturer's printed recommendations.

C. Backflow preventers, as well as air and vacuum release valves, shall have piped outlets to the nearest acceptable drain, firmly-supported, and installed in such a way as to avoid splashing and wetting of floors and obstruction of traffic.

- END OF SECTION -

SECTION 43 52 00 HOISTS AND CRANES, GENERAL

PART 1 -- GENERAL

1.1 THE REQUIREMENT

The CONTRACTOR shall provide the hoisting equipment, ancillary steel, and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

The requirements of this Section apply to all hoists and cranes unless indicated otherwise.

1.2 REFERENCE SPECIFICATIONS CODES, AND STANDARDS

Commercial Standards

AISC	Specifications for the Design, Fabrication, and Erection of Structural Steel for Building
AGMA	American Gear Manufacturer's Association
ANSI B30.11	Overhead and Gantry Cranes
ANSI MH 27.1	Underhung Crane and Monorail Systems
ASTM A 36	Carbon Structural Steel
CMAA	A division of Material Handling Industry of America
NEMA	National Electrical Manufacturer's Association
OSHA	29 CFR 1926.550 – Cranes and derricks

1.3 CONTRACTOR SUBMITTALS

Furnish submittals in accordance with the requirements of Section 01300 – Submittals and Substitutions.

Shop Drawings shall include electrical requirements, weights, wheel loads, dimensions, and required clearances.

Technical Manual

Include complete operating and maintenance instructions of the hoist and crane systems.

1.4 QUALITY ASSURANCE

Inspection and Testing Requirements

After installation, the CONTRACTOR shall inspect and test hoists and crane systems in the presence of the manufacturer's service representative, for proper operation and conformance to the indicated requirements.

Acceptance Criteria and Tolerances

The ENGINEER reserves the right to reject any equipment not conforming to the tolerances, deflections, and lateral stiffness as indicated.

1.5 MANUFACTURER'S SERVICES

The CONTRACTOR shall arrange for the hoist or crane manufacturer to furnish the services of a trained, qualified representative for at least one day after the units are installed, for the purpose of inspecting the installation and instructing the OWNER's operating personnel.

PART 2 -- PRODUCTS

2.1 GENERAL

Equipment of similar design shall be from a single manufacturer.

The capacity of each hoist and trolley shall be permanently marked in a conspicuous manner on the equipment.

The wire rope reeving shall be of the 2-part double, cross-mounted or similar appropriate type, to provide a true, vertical lift without drift, unless otherwise indicated.

Hooks shall be of the safety type with a latch.

Motors shall comply with the requirements of Section 26 05 10 – Electric Motors.

The CONTRACTOR shall verify dimensions and clearances in the field prior to installation and shall be responsible for the proper fitting and operation of the equipment.

Manufacturers, or Equal

Engineered Material Handling, Inc. (EMH)

American Crane & Equipment Corp.

2.2 BASIC MATERIALS

Materials shall be new and of the best commercial grade.

Where materials are not indicated, the CONTRACTOR shall have the manufacturer use the most suitable selection for the given application and environment.

2.3 PLANT FABRICATED ITEMS

Fabrication, assembly, and welding shall be performed by factory-trained specialists and certified welders.

2.4 TOOLS AND SPARE PARTS

Tools

The CONTRACTOR shall furnish one complete set of special wrenches or other special tools necessary for the assembly, adjustment, and dismantling of the equipment.

The tools shall be of best quality and furnished in labeled toolboxes of suitable design.

Spare Parts

Furnish spare parts as required by the hoist or crane Section.

The parts shall be properly labeled and identified with the name and number of the equipment to which they belong.

PART 3 -- EXECUTION

3.1 INSTALLATION

Hoist and crane equipment shall be installed in strict accordance with the manufacturer's printed instructions.

Workmanship shall be in accordance with the referenced standards and codes.

Care shall be taken that the structural integrity of beams, columns, walls, floors, and roofs will be maintained at all times.

3.2 FIELD TESTING

After completion of the WORK, the CONTRACTOR shall test hoist and crane equipment in the presence of the manufacturer's field representative, who shall certify in writing that the equipment meets applicable standards and specifications.

- END OF SECTION -

DIVISION 44

POLLUTION AND WASTE CONTROL EQUIPMENT

SECTION 44000

SECTION 44 31 19.01 PACKAGED BIOLOGICAL ODOR CONTROL SYSTEM FOR MODEL I-BOx® 42

1. –GENERAL

1.01 DESCRIPTION

A. SCOPE

1. This section specifies requirements for a packaged 2-stage biological odor control system of unitary construction, including requirements for system construction, components, materials, functional testing, quality and use.

2. The contractor shall furnish all materials, equipment and incidentals required to install a packaged biological odor control system as shown on the drawings and specified herein.

3. The entire system shall consist of the following major components:

   1. Polypropylene Exhaust Fan
   2. FRP Vessel with Integral FRP Inlet Damper
   3. Inorganic Biological Media (Stage 1)
   4. Activated Carbon Media (Stage 2)
   5. Media Irrigation System and Water Cabinet
   6. FRP Electrical Control Panel
   7. Nutrient Tank
   8. Nutrient Pump
   9. Exhaust Stack

4. Inlet ductwork will be provided by the contractor to collect the foul air and deliver it to the fan inlet. The ductwork is specified elsewhere and is not part of this specification.

B. SYSTEM DESCRIPTION

1. The biological odor control system shall consist of an exhaust fan, FRP vessel, inorganic biological media, activated carbon media, irrigation system, control panel, exhaust stack, FRP inlet ductwork, dampers, valves, piping and all other equipment and accessories for a complete system.

2. The complete odor control system shall be packaged and of unitary construction design. All components of the system shall be mounted on the vessel, except for the control panel which shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2,

Group D hazardous area.

3. The packaged biological odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the odor-laden air from the process areas into the biological odor control system for treatment. The biological odor control system shall be a two-stage system. Stage 1 shall utilize an inert, porous, mineral, expanded clay material designed to remove hydrogen sulfide (H_2S) and resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide. Stage 2 shall utilize a pelletized coal activated virgin carbon media to remove any remaining hydrogen sulfide as well as other odorous organic compounds.

   The first stage shall operate with an independently controlled irrigation process to provide Stage 1 media with adequate moisture to sustain bacterial growth and to remove toxic byproducts. The irrigation process shall be controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Nutrients shall trickle down over the media to enhance and sustain the biological activity. The nutrients shall be housed in a tank and shall be dosed into the system by a nutrient pump. A pre-wired control panel shall be provided to ensure proper control and operation of the system. The cleaned air is discharged to the atmosphere after passage through the fan located at the top of the vessel.

4. The odor control system shall be designed for the following operating conditions:

Location	**Influent Splitter Manhole**
Model Number	**I-BOx® 42**
Quantity	1
Airflow Rate, cfm	100
Average Inlet H_2S Conc., ppm	50
Peak Inlet H_2S Conc., ppm	100

The odor control system shall demonstrate the following performance:

INLET	**OUTLET**
1-10 ppm H_2S	0.1 ppm H_2S
>10 ppm H_2S	1.0% of inlet

The pressure drop across the biological odor control system shall not exceed 4.25" at the maximum airflow rate specified above.

C. REFERENCE STANDARDS

1. PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment."

2. ASTM D-883: "Definition of Terms relating to Plastics."

3. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."

4. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."

5. ASTM D-4097-82: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."

6. ASTM C 582 – Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.

1.02 QUALITY ASSURANCE

A. MANUFACTURER REQUIREMENTS

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:

   1. Assume full responsibility for the completeness and proper operation of the biological odor control system.

   2. Have experience; be reputable and qualified in designing and manufacturing biological odor control system equipment. The odor control system manufacturer shall show evidence of at least ten (10) identical 2-stage design installations of the type specified in wastewater plants with specified non-proprietary expanded clay biofiltration media.

   3. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment to facilitate installation and start-up at the jobsite. The overall system footprint, including the vessel, fan, nutrient tank, nutrient pump, water irrigation piping, water cabinet and accessories shall not exceed the dimensions shown on the contract drawings. The control panel shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area. The system equipment layout shall match site requirements. Any exception to this requirement is not acceptable.

4. Supply units with inorganic expanded clay biological odor control media. Provision of organic biological media shall not be acceptable. Systems using any type of structured, synthetic media shall not be acceptable. Systems using any proprietary media shall not be acceptable.
5. The complete biological odor control system, including vessel, fan, media, nutrient tank, nutrient pump, water irrigation cabinet, piping and accessories shall be constructed to be a single piece of unitary construction, except for the control panel which shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area. Any exception to this requirement is not acceptable.

2. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.
3. The owner reserves the right to be present at the manufacturer's facility for visual inspection of equipment to be supplied and to witness factory functional testing.

B. SPECIFIED MANUFACTURERS

1. Biological odor control system shall be I-BOx® system as manufactured and supplied by Integrity Municipal Systems LLC (IMS), Poway, CA, (858) 486-1620. The owner is aware of no other supplier that is an equal to the specified manufacturer and product.
2. The mechanical, structural, process and electrical design has been based on a biological odor control system manufactured by IMS, Poway, CA.

C. WARRANTY

1. The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy. The warranty period shall not extend beyond 18 months from delivery of the system to the jobsite. The warranty does not apply to the carbon media.

D. PRODUCT SUBMITTALS

1. The following product data shall be submitted by the biological odor control system manufacturer for review and approval by the engineer prior to the fabrication of the system:
    1. Shop drawings and catalog literature showing dimensional information, details of piping and fabrication and erection of all materials and equipment furnished under this section
    2. Drawing of general arrangement and major system components
    3. Process and Instrumentation drawing

4. Major system component information and descriptive literature for the following:
   a) Exhaust fan
   b) Nutrient pump
   c) Water irrigation cabinet
   d) Vessel fabrication
   e) System controls and control panel details including power and control wiring diagrams, terminals, and numbers
   f) Miscellaneous instrumentation and accessories
5. Installation instructions
6. Operating weight of all equipment

E. OPERATION AND MAINTENANCE MANUALS

1. Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. A total of two (2) copies of O&M manuals are required.

F. MANUFACTURER SERVICES

1. The system manufacturer shall be present at the jobsite for the following time period after the system is installed, travel time excluded:
   1. Sixteen (16) hours for system startup, certification of proper installation and training of Owner's staff in operation of the system.
   2. Provide one trip for 2 days for these tasks.

2. – PRODUCTS

2.01 BIOLOGICAL ODOR CONTROL SYSTEM

The odor control gas treatment system shall be a once-through biologically active odor removal system treating the odorous air from the contaminated process areas. The system shall be designed for continuous and automatic operation as well as manual operation as required.

The biological odor control system shall be a two-stage system. The system shall consist of one biological treatment stage (Stage 1) followed by an activated carbon polishing stage (Stage 2) in series. The first stage shall be wetted with fresh potable or reuse make-up water. The first stage shall include a spray header to distribute liquid evenly over the media.

FRP vessel, inorganic biological media, activated carbon media, exhaust fan, exhaust stack, nutrient tank, nutrient pump, water irrigation system, air distribution system, control panel and all other required appurtenances shall be pre-assembled as complete 2-stage biological odor control system package.

The biological odor control system shall include a fan located downstream from the system on top of the FRP vessel. The biological odor control system shall be designed to be operated under negative pressure.

Components of the biological odor control system shall comply with this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment except for the control panel which shall ship loose to the jobsite for installation by the contractor at least 3 feet from the Class 1, Division 2, Group D hazardous area.

2.02 FRP VESSEL

A. The biological odor control system shall consist of a fiberglass reinforced plastic (FRP) vessel. The vessel shall be of unitary construction. No modular construction or flanged pieces are allowed for the vessel itself.

B. The system vessel shall have all components pre-mounted and piped. The system vessel shall be shipped as one piece. The system shall be included with all piping, valves and internals. The system top shall be removable for access to the top of the vessel's second stage.

C. The biological odor control system shall be manufactured with the following material of construction according to following fabrication method:

1. Vessel and accessories shall be constructed by the contact molded, hand lay-up method, in accordance with ASTM C 582. The scrubber sidewalls may contain filament wound layers, but they shall also contain contact molded layers.
2. Resin used in fabrication shall be a premium vinyl ester resin such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010. Any material of construction other than FRP with premium grade resin shall not be acceptable.
3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
4. Fabrication:

   General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299, ASTM D-4097 and ASTM C 582. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.

   Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.

   Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven

roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultra violet light inhibitors.

D. Access Manways: The vessel shall be provided with access manways to allow access to the internals of the odor control system. As a minimum, access manways shall be provided between stages.

E. Media support and screen: The system vessel shall be provided with an FRP support system with polypropylene screen to accommodate the biological media and carbon media beds.

F. Vessel Accessories: The system shall be provided with all piping, valves and internals. Air inlet, air outlet, spray headers, drain and all vessel fittings shown on the drawings shall be provided by the Manufacturer. An integral FRP damper shall be provided as a part of the vessel inlet.

G. Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8" thick, full face, EPDM, suitable for the intended service.

H. Neoprene Pad: A ¼" thick, 60 durometer neoprene pad must be placed underneath the scrubber vessel during installation.

2.03 ODOR CONTROL MEDIA

A. The system shall use in stage 1 an inorganic expanded clay biological media as the support substrate for selectively growing sulfur-oxidizing autotrophic bacteria. The media shall be randomly dumped in the vessel to allow a low pressure drop. The media is porous and is resistant to hydrogen sulfide (H_2S) and acidic conditions. The media shall be non-proprietary and commercially available.

B. The system shall use in stage 2 a coal based activated carbon media to adsorb residual H_2S and other odor compounds. This stage shall provide final removal of odors to specified level.

C. Overall media depth shall be a minimum of 51 inches.

2.04 EXHAUST FAN

A. The fan shall be factory assembled complete with fan wheel, fan housing, bearings, drive, drive guard, motor, and unit base.

B. Fan shall be direct drive. Fan shall be centrifugal type. Wheel shall be electronically and dynamically balanced.

C. Fan shall be polypropylene of spark resistant design and motor shall be rated for installation in a Class 1, Division 2, Group D hazardous.

D. Fan performance shall be based on tests conducted in accordance with AMCA 210-85 and ISO 5801.

E. Fan base shall be galvanized steel with enamel coating. No metal parts shall be exposed to the corrosive airstream. All fasteners and hardware shall be 316 stainless-steel.

F. The fan shall be designed for the following specifications:

Model Number	**I-BOx® 42**
Airflow Rate, cfm	100
S.P. up to System Inlet, in W.C.	2.00
Total Pressure Drop, in W.C.	4.25
Motor, HP	2.0

2.05 EXHAUST STACK

A. The scrubber system shall be provided with an exhaust pipe manufactured of PVC.

B. The exhaust pipe shall be connected to the fan outlet.

2.06 SYSTEM ELECTRICAL CONTROL PANEL

A. The electrical control panel shall house all required controls for the entire system. The electrical control panel shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area.

B. The control panel enclosure shall be rated NEMA 4X and shall be made of FRP. The control panel shall be factory tested to full operation with all other components prior to shipment.

C. The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:

1. "On-Off" switch for Exhaust Fan
2. "Exhaust Fan Running" indicator light
3. "Hand-Off-Auto" switch for Nutrient Pump
4. "Nutrient Pump Running" indicator light
5. Push button switch with status lights for water valve
6. Timer relay for on/off control of water valve
7. Control Transformer (480V to 120V)

D. The power supply shall be 480V, 3 ph, 60 Hz.

E. Control panel shall be provided with terminal strip as required for easy wiring connections by the contractor.

2.07 INSTRUMENTATION AND WATER CONTROLS

A. The water irrigation controls shall be mounted in a completely separate FRP water cabinet on the vessel and shall consist of the following components:

1. Ball valves
2. Pressure reducing valve
3. Pressure gauge
4. Solenoid valve
5. Gate control valve
6. Rotameter- Variable area type with a Teflon float, EPR O-rings and PVC fittings. The rotameter shall have a direct reading scale.
7. Nutrient injection connection
8. Nutrient pump

B. An independent media irrigation system is incorporated into Stage 1 to provide the biological media with adequate moisture. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles. Potable water or plant effluent water can be used provided that residual chlorine concentrations are less than 5 ppm.

2.08 PIPING

A. All make-up water and drain piping shall be SCH 80 PVC.

2.09 INTEGRATED NUTRIENT RESERVOIR AND NUTRIENT PUMP

A. Nutrient Addition: The packaged biological odor control system uses a non-proprietary, commercially available fertilizer to provide essential nutrients to optimize the growth of sulfur-oxidizing bacteria. Nutrients supplied as a coating to the support media or proprietary nutrients shall not be allowed. The system shall be equipped with a nutrient addition system that provides a controlled dosage of nutrients that is automatically fed to the irrigation water during each irrigation cycle with the help of a nutrient pump.

B. The Nutrient reservoir shall be integral to the system and mounted on the side of the vessel. The nutrient reservoir shall be made of FRP. Loose nutrient tanks shall not be acceptable.

C. The Nutrient pump shall be solenoid type and shall be mounted in the water cabinet.

2.10 NFPA 820

A. The system shall be designed and fabricated in compliance with National Fire and Protection Agency Code 820. As a minimum, all equipment installed on the system shall be rated for Class 1, Division 2, Group D.

B. All motors and equipment within 3 feet of the airstream shall be rated for Class 1, Division 2, Group D.

C. The local control panel will be remote-mounted from the odor control vessel and

will be shipped loose. The installation and wiring of the remote-mounted control panel to the fan, nutrient pump and solenoid valve shall be the responsibility of the contractor.

3. - EXECUTION

3.01 FACTORY ASSEMBLY AND TESTING

A. Each system shall be pre-assembled at the manufacturing location.

B. System(s) shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design(s) for the project as described in this specification.

C. Engineer and/or Owner reserve the right to be present at the manufacturer's testing facility to witness the factory functional testing. Engineer and/or Owner shall provide intent to witness functional testing at the time of the design submittal review and approval, and manufacturer shall provide notice to Engineer and/or Owner regarding the scheduled time of the functional testing at least five business days in advance of the proposed functional testing.

D. Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.

3.02 DELIVERY AND INSTALLATION

A. System(s) shall be packaged and shipped so as not to incur damage to any portion of the system through handling and installation of the system itself.

B. System(s) shall be installed per the manufacturer's guidelines and recommendations. Installation shall include the re-assembly of any items separately packaged for protection during shipment. Site preparation, utility service and installation are not provided by the Manufacturer under these specifications.

C. It is the contractor's (or owner's) responsibility to provide:

1. FRP inlet piping from pick-up point source to vessel inlet connection.
2. Wiring to/from system control panel to remote-mounted equipment, plant SCADA, etc.
3. Power to system control panel (480V, 3 ph, 60 Hz, 25 Amps)
4. Suitable concrete mounting pads and other incidentals as necessary to complete the installation
5. Drain- a minimum of 1 inch PVC gravity drain to sewer with a barometric trap
6. Water Supply- a ¾" water supply with backflow preventer is required. The nominal water requirements are at a rate of 6.0 gpm and a pressure of 30 psi. Hardness shall not exceed 200 mg/l as calcium carbonate.

3.03 FIELD START-UP

A. A factory representative from manufacturer shall be present at the jobsite for initial system start-up of equipment as specified in section 1.02.F. Factory representative will ensure that system is properly installed, will start-up the system and train owner's personnel.

END OF SECTION

SECTION 44 31 19.02 PACKAGED BIOLOGICAL ODOR CONTROL SYSTEM FOR MODEL I-BOx® 7000

1. –GENERAL

1.01 DESCRIPTION

A. SCOPE

1. This section specifies requirements for a packaged 2-stage biological odor control system of unitary construction, including requirements for system construction, components, materials, functional testing, quality and use.

2. The contractor shall furnish all materials, equipment and incidentals required to install a packaged biological odor control system as shown on the drawings and specified herein.

3. The entire system shall consist of the following major components:

   1. FRP Exhaust Fan
   2. FRP Vessel with Extended Deck
   3. Inorganic Biological Media (Stage 1)
   4. Activated Carbon Media (Stage 2)
   5. Air Distribution System
   6. Media Irrigation System and Water Cabinet
   7. FRP Electrical Control Panel
   8. Nutrient Tank
   9. Nutrient Pump
   10. FRP Exhaust Stack

4. Inlet ductwork will be provided by the contractor to collect the foul air and deliver it to the fan inlet. The ductwork is specified elsewhere and is not part of this specification.

B. SYSTEM DESCRIPTION

1. The biological odor control system shall consist of an exhaust fan, FRP vessel, inorganic biological media, activated carbon media, air and irrigation system, control panel, exhaust stack, dampers, valves, piping and all other equipment and accessories for a complete system.

2. The complete odor control system shall be packaged and of unitary construction design. All components of the system shall be mounted on the

vessel, except for the control panel which shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area.

3. The packaged biological odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the odor-laden air from the process areas into the biological odor control system for treatment. The biological odor control system shall be a two-stage system. Stage 1 shall utilize an inert, porous, mineral, expanded clay material designed to remove hydrogen sulfide (H_2S) and resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide. Stage 2 shall utilize a pelletized coal activated virgin carbon media to remove any remaining hydrogen sulfide as well as other odorous organic compounds.

   The first stage shall operate with an independently controlled irrigation process to provide Stage 1 media with adequate moisture to sustain bacterial growth and to remove toxic byproducts. The irrigation process shall be controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Nutrients shall trickle down over the media to enhance and sustain the biological activity. The nutrients shall be housed in a tank and shall be dosed into the system by a nutrient pump. A pre-wired control panel shall be provided to ensure proper control and operation of the system. The cleaned air is discharged to the atmosphere through the stack at the top of the unit.

4. The odor control system shall be designed for the following operating conditions:

Location	**Phase 1 Wet Well**	**Phase 2 Wet Well (Future)**
Model Number	**I-BOx® 7000**	**I-BOx® 7000**
Quantity	1	1
Airflow Rate, cfm	1,040	1,040
Average Inlet H_2S Conc., ppm	50	50
Peak Inlet H_2S Conc., ppm	100	100

The odor control system shall demonstrate the following performance:

INLET	**OUTLET**
1-10 ppm H_2S	0.1 ppm H_2S
>10 ppm H_2S	1.0% of inlet

The pressure drop across the biological odor control system shall not exceed

5.0” W.C. at the maximum airflow rate specified above.

C. REFERENCE STANDARDS

1. PS 15-69: National Bureau of Standards Voluntary Product Standard “Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment.”

2. ASTM D-883: “Definition of Terms relating to Plastics.”

3. ASTM D-2583: “Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor.”

4. ASTM D-2563: “Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts.”

5. ASTM D-4097-82: “Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks.”

1.02 QUALITY ASSURANCE

A. MANUFACTURER REQUIREMENTS

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:

   1. Assume full responsibility for the completeness and proper operation of the biological odor control system.

   2. Have experience; be reputable and qualified in designing and manufacturing biological odor control system equipment. The odor control system manufacturer shall show evidence of at least ten (10) identical 2-stage design installations of the type specified in wastewater plants with specified non-proprietary expanded clay biofiltration media.

   3. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment to facilitate installation and start-up at the jobsite. The overall system footprint, including the vessel, fan, nutrient tank, nutrient pump, water irrigation piping, water cabinet and accessories, and appurtenances shall not exceed the dimensions shown on the contract drawings. The control panel shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area. The system equipment layout shall match site requirements. Any exception to this requirement is not acceptable.

4. Supply units with inorganic expanded clay biological odor control media. Provision of organic biological media shall not be acceptable. Systems using any type of structured, synthetic media shall not be acceptable. Systems using any proprietary media shall not be acceptable.
5. The complete biological odor control system, including vessel, fan, media, nutrient tank, nutrient pump, water irrigation cabinet, piping and accessories shall be constructed to be a single piece of unitary construction, except for the control panel which shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area. Any exception to this requirement is not acceptable.

2. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.
3. The owner reserves the right to be present at the manufacturer's facility for visual inspection of equipment to be supplied and to witness factory functional testing.

B. SPECIFIED MANUFACTURERS

1. Biological odor control system shall be I-BOx® system as manufactured and supplied by Integrity Municipal Systems LLC (IMS), Poway, CA, (858) 486-1620. The owner is aware of no other supplier that is an equal to the specified manufacturer and product.
2. The mechanical, structural, process and electrical design has been based on a biological odor control system manufactured by IMS, Poway, CA.
3. The biological odor control system provided herein is identical to the biological odor control system already owned and operated by El Paso Water for commonality of parts and Operation and maintenance familiarity and benefit.

C. WARRANTY

1. The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy. The warranty period shall not extend beyond 18 months from delivery of the system to the jobsite. The warranty does not apply to the carbon media.

D. PRODUCT SUBMITTALS

1. The following product data shall be submitted by the biological odor control system manufacturer for review and approval by the engineer prior to the fabrication of the system:

1. Shop drawings and catalog literature showing dimensional information, details of piping and fabrication and erection of all materials and equipment furnished under this section
2. Drawing of general arrangement and major system components
3. Process and Instrumentation drawing
4. Major system component information and descriptive literature for the following:
   a) Exhaust fan
   b) Nutrient pump
   c) Water irrigation cabinet
   d) Vessel fabrication
   e) System controls and control panel details including power and control wiring diagrams, terminals, and numbers
   f) Miscellaneous instrumentation and accessories
5. Installation instructions
6. Operating weight of all equipment

E. OPERATION AND MAINTENANCE MANUALS

1. Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. A total of two (2) copies of O&M manuals are required.

F. MANUFACTURER SERVICES

1. The system manufacturer shall be present at the jobsite for the following time period after the system is installed, travel time excluded:
   1. Twenty-four (24) hours for system startup, certification of proper installation and training of Owner's staff in operation of the system.
   2. Provide one trip for 3 days for these tasks

2. – PRODUCTS

2.01 BIOLOGICAL ODOR CONTROL SYSTEM

The odor control gas treatment system shall be a once-through biologically active odor removal system treating the odorous air from the contaminated process areas. The system shall be designed for continuous and automatic operation as well as manual operation as required.

The biological odor control system shall be a two-stage system. The system shall consist of one biological treatment stage (Stage 1) followed by an activated carbon polishing stage (Stage 2) in series. The first stage shall be wetted with fresh potable or reuse make-up water. The first stage shall include a spray header to distribute liquid evenly over the media.

FRP vessel, inorganic biological media, activated carbon media, exhaust fan, exhaust stack, nutrient tank, nutrient pump, water irrigation system, air distribution system, and all other required appurtenances shall be pre-assembled as complete 2-

stage biological odor control system package. Components of the biological odor control system shall comply with this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment except for the control panel which shall ship loose to the jobsite for installation by the contractor at least 3 feet from the Class 1, Division 2, Group D hazardous area.

2.02 FRP VESSEL

A. The biological odor control system shall consist of a fiberglass reinforced plastic (FRP) vessel with extended deck. The vessel shall be of unitary construction. No modular construction or flanged pieces are allowed for the vessel itself.

B. The system vessel shall have all components pre-mounted and piped. The system vessel shall be shipped as one piece. The system shall be included with all piping, valves and internals. The system top shall be removable for access to the top of the vessel's second stage.

C. The biological odor control system shall be manufactured with the following material of construction according to following fabrication method:

1. Vessel and accessories shall be contact molded manufactured in accordance with NBS PS15-69, ASTM 4097 for contact molding.
2. Resin used in fabrication shall be a premium vinyl ester resin such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010. Any material of construction other than FRP with premium grade resin shall not be acceptable.
3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
4. Fabrication:

   General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.

   Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.

   Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultra violet light inhibitors.

D. Access Manways: The vessel shall be provided with access manways to allow access to the internals of the odor control system. As a minimum, access manways shall be provided between stages.

E. Media support and screen: The system vessel shall be provided with an HDPE and FRP support system with polypropylene screen to accommodate the biological media and carbon media beds.

F. Vessel Accessories: The system shall be provided with all piping, valves and internals. Air inlet, air outlet, spray headers, drain and all vessel fittings shown on the drawings shall be provided by the Manufacturer.

G. Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8" thick, full face, EPDM, suitable for the intended service.

H. Neoprene Pad: A ¼" thick, 60 durometer neoprene pad must be placed underneath the scrubber vessel during installation.

2.03 ODOR CONTROL MEDIA

A. The system shall use in stage 1 an inorganic expanded clay biological media as the support substrate for selectively growing sulfur-oxidizing autotrophic bacteria. The media shall be randomly dumped in the vessel to allow a low pressure drop. The media is porous and is resistant to hydrogen sulfide (H_2S) and acidic conditions. The media shall be non-proprietary and commercially available.

B. The system shall use in stage 2 a coal based activated carbon media to adsorb residual H_2S and other odor compounds. This stage shall provide final removal of odors to specified level.

C. Overall media depth shall be a minimum of 48 inches.

2.04 EXHAUST FAN

A. General. Fan shall be centrifugal design manufactured of FRP with a radial blade wheel. No other material of construction is acceptable. The wheel shall be statically and dynamically balanced. The fan inlet shall be slip type and the fan outlet shall have a flanged nozzle. The fan will be provided with a double lip type shaft seal.

B. Fan shall be supplied with a TEFC motor rated for installation in a Class 1, Division 2, Group D hazardous area and with 1.15 service factor suitable for 3ph/60Hz/480V service. The fan shall be direct driven. The motor shall be inverter-duty.

C. Performance. The fan shall be tested and rated in accordance with AMCA and shall bear the AMCA seal.

D. The fan shall be New York Blower, Hartzell or equal.

E. The fan shall be designed for the following specifications:

Model Number	**I-BOx® 7000**
Airflow Rate, cfm	1,040
S.P. up to System Inlet, in W.C.	2.0
Total Pressure Drop, in W.C.	5.0
Motor, HP	5.0

2.05 FRP EXHAUST STACK

A. The scrubber system shall be provided with an exhaust stack manufactured of FRP.

B. The exhaust stack shall be contact molded and manufactured in accordance with NBS PS15-69 and ASTM D-4097 for contact molding. The resin used in the fabrication of the exhaust stack shall be the same as that used for the main vessel such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal.

2.06 SYSTEM ELECTRICAL CONTROL PANEL

A. The electrical control panel shall house all required controls for the entire system. The electrical control panel shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area.

B. The control panel enclosure shall be rated NEMA 3R and shall be made of FRP. The control panel shall be factory tested to full operation with all other components prior to shipment.

C. The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:

1. "On-Off" switch for Exhaust Fan
2. "Exhaust Fan Running" indicator light
3. VFD for exhaust fan
4. "Hand-Off-Auto" switch for Nutrient Pump
5. "Nutrient Pump Running" indicator light
6. "Nutrient Tank Low" indicator light
7. Push button switch with status lights for water valve
8. Timer relay for on/off control of water valve
9. Control Transformer (480V to 120V)

D. The power supply shall be 480V, 3 ph, 60 Hz.

E. Control panel shall be provided with terminal strip as required for easy wiring connections by the contractor.

2.07 INSTRUMENTATION AND WATER CONTROLS

A. The water irrigation controls shall be mounted in a completely separate FRP water cabinet on the vessel and shall consist of the following components:

1. Ball valves
2. Pressure reducing valve
3. Pressure gauge
4. Solenoid valve
5. Gate control valve
6. Rotameter- Variable area type with a Teflon float, EPR O-rings and PVC fittings. The rotameter shall have a direct reading scale.
7. Nutrient injection connection
8. Water fill piping for nutrient
9. Nutrient pump

B. An independent media irrigation system is incorporated into Stage 1 to provide the biological media with adequate moisture. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles. Potable water or plant effluent water can be used provided that residual chlorine concentrations are less than 5 ppm.

2.08 PIPING

A. All make-up water and drain piping shall be SCH 80 PVC.

2.09 INTEGRATED NUTRIENT RESERVOIR AND NUTRIENT PUMP

A. Nutrient Addition: The packaged biological odor control system uses a non-proprietary, commercially available fertilizer to provide essential nutrients to optimize the growth of sulfur-oxidizing bacteria. Nutrients supplied as a coating to the support media or proprietary nutrients shall not be allowed. The system shall be equipped with a nutrient addition system that provides a controlled dosage of nutrients that is automatically fed to the irrigation water during each irrigation cycle with the help of a nutrient pump.

B. The Nutrient reservoir shall be integral to the system and mounted on the system deck. The nutrient reservoir shall be made of FRP. The nutrient reservoir shall have a float-type level switch to detect a low level. Loose nutrient tanks shall not be acceptable.

C. The Nutrient pump shall be solenoid type and shall be mounted in the water cabinet.

2.10 NFPA 820

A. The system shall be designed and fabricated in compliance with National Fire and Protection Agency Code 820. As a minimum, all equipment installed on the system shall be rated for Class 1, Division 2, Group D.

B. All motors and equipment within 3 feet of the airstream shall be rated for Class 1, Division 2, Group D.

C. The local control panel will be remote-mounted from the odor control vessel and will be shipped loose. The installation and wiring of the remote-mounted control panel to the fan, nutrient pump and solenoid valve shall be the responsibility of the contractor.

3. - EXECUTION

3.01 FACTORY ASSEMBLY AND TESTING

A. Each system shall be pre-assembled at the manufacturing location.

B. System(s) shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design(s) for the project as described in this specification.

C. Engineer and/or Owner reserve the right to be present at the manufacturer's testing facility to witness the factory functional testing. Engineer and/or Owner shall provide intent to witness functional testing at the time of the design submittal review and approval, and manufacturer shall provide notice to Engineer and/or Owner regarding the scheduled time of the functional testing at least five business days in advance of the proposed functional testing.

D. Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.

3.02 DELIVERY AND INSTALLATION

A. System(s) shall be packaged and shipped so as not to incur damage to any portion of the system through handling and installation of the system itself.

B. System(s) shall be installed per the manufacturer's guidelines and recommendations. Installation shall include the re-assembly of any items separately packaged for protection during shipment. Site preparation, utility service and installation are not provided by the Manufacturer under these specifications.

C. It is the contractor's (or owner's) responsibility to provide:

1. FRP inlet piping from pick-up point source to fan inlet connection.
2. Wiring to/from system control panel to remote-mounted equipment, plant SCADA, etc.
3. Power to system control panel (480V, 3 ph, 60 Hz, 25 Amps)
4. Suitable concrete mounting pads and other incidentals as necessary to complete the installation

5. Drain- a minimum of 2 inches for I-BOx 7000 PVC gravity drain to sewer with a barometric trap
6. Water Supply- a ¾ inch water supply with backflow preventer is required. The nominal water requirements is 8.0 gpm for the I-BOx 7000 and a pressure of 30 psi. Hardness shall not exceed 200 mg/l as calcium carbonate.

3.03 FIELD START-UP

A. A factory representative from manufacturer shall be present at the jobsite for initial system start-up of equipment as specified in section 1.02.F. Factory representative will ensure that system is properly installed, will start-up the system and train owner's personnel.

END OF SECTION

44 33 19.03 PACKAGED BIOLOGICAL ODOR CONTROL SYSTEM FOR MODEL I-BOx® 8010

1. –GENERAL

1.01 DESCRIPTION

A. SCOPE

1. This section specifies requirements for a packaged 2-stage biological odor control system of unitary construction, including requirements for system construction, components, materials, functional testing, quality and use.

2. The contractor shall furnish all materials, equipment and incidentals required to install a packaged biological odor control system as shown on the drawings and specified herein.

3. The entire system shall consist of the following major components:

   1. FRP Exhaust Fan
   2. FRP Vessel with Extended Deck
   3. Inorganic Biological Media (Stage 1)
   4. Activated Carbon Media (Stage 2)
   5. Air Distribution System
   6. Media Irrigation System and Water Cabinet
   7. FRP Electrical Control Panel
   8. Nutrient Tank
   9. Nutrient Pump
   10. FRP Exhaust Stack

4. Inlet ductwork will be provided by the contractor to collect the foul air and deliver it to the fan inlet. The ductwork is specified elsewhere and is not part of this specification.

B. SYSTEM DESCRIPTION

1. The biological odor control system shall consist of an exhaust fan, FRP vessel, inorganic biological media, activated carbon media, air and irrigation system, control panel, exhaust stack, dampers, valves, piping and all other equipment and accessories for a complete system.

2. The complete odor control system shall be packaged and of unitary construction design. All components of the system shall be mounted on the vessel, except for the control panel which shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area.

3. The packaged biological odor control system shall be a once-through system. The system is equipped with an exhaust fan that continuously draws the odor-laden air from the process areas into the biological odor control system for treatment. The biological odor control system shall be a two-stage system. Stage 1 shall utilize an inert, porous, mineral, expanded clay material designed to remove hydrogen sulfide (H_2S) and resist compaction and degradation from the acidic sulfates of the biological oxidation of the hydrogen sulfide. Stage 2 shall utilize a pelletized coal activated virgin carbon media to remove any remaining hydrogen sulfide as well as other odorous organic compounds.

   The first stage shall operate with an independently controlled irrigation process to provide Stage 1 media with adequate moisture to sustain bacterial growth and to remove toxic byproducts. The irrigation process shall be controlled by a programmed timing sequence that actuates a solenoid valve located on the water supply piping. Nutrients shall trickle down over the media to enhance and sustain the biological activity. The nutrients shall be housed in a tank and shall be dosed into the system by a nutrient pump. A control panel shall be provided to ensure proper control and operation of the system. The cleaned air is discharged to the atmosphere through the stack at the top of the unit.

4. The odor control system shall be designed for the following operating conditions:

Location	**Phase 2 Wet Well (Future)**
Model Number	**I-BOx® 8010**
Quantity	1
Airflow Rate, cfm	1,838
Average Inlet H_2S Conc., ppm	50
Peak Inlet H_2S Conc., ppm	100

The odor control system shall demonstrate the following performance:

INLET	**OUTLET**
1-10 ppm H_2S	0.1 ppm H_2S
>10 ppm H_2S	1.0% of inlet

The pressure drop across the biological odor control system shall not exceed 5.0” W.C. at the maximum airflow rate specified above.

C. REFERENCE STANDARDS

1. PS 15-69: National Bureau of Standards Voluntary Product Standard "Custom Contact Molded Reinforced Polyester Chemical Resistant Process Equipment."

2. ASTM D-883: "Definition of Terms relating to Plastics."

3. ASTM D-2583: "Test for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor."

4. ASTM D-2563: "Recommended Practice for Classifying Visual Defects in Glass Reinforced Plastic Laminate Parts."

5. ASTM D-4097-82: "Standard Specifications for Contact Molded Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks."

1.02 QUALITY ASSURANCE

A. MANUFACTURER REQUIREMENTS

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:

   1. Assume full responsibility for the completeness and proper operation of the biological odor control system.

   2. Have experience; be reputable and qualified in designing and manufacturing biological odor control system equipment. The odor control system manufacturer shall show evidence of at least ten (10) identical 2-stage design installations of the type specified in wastewater plants with specified non-proprietary expanded clay biofiltration media.

   3. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment to facilitate installation and start-up at the jobsite. The overall system footprint, including the vessel, fan, nutrient tank, nutrient pump, water irrigation piping, water cabinet and accessories, and appurtenances shall not exceed the dimensions shown on the contract drawings. The media shall be shipped loose to the jobsite for field installation by the contractor. The control panel shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area. The system equipment layout shall match site requirements. Any exception to this requirement is not acceptable.

   4. Supply units with inorganic expanded clay biological odor control media. Provision of organic biological media shall not be acceptable. Systems using any type of structured, synthetic media shall not be acceptable. Systems using any proprietary media shall not be acceptable.

   5. The complete biological odor control system, including vessel, fan, media, nutrient tank, nutrient pump, water irrigation cabinet, piping and accessories shall be constructed to be a single piece of unitary construction, except for the control panel which shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area. The media shall ship loose to the jobsite for field installation by the contractor. Any

exception to this requirement is not acceptable.

2. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.

3. The owner reserves the right to be present at the manufacturer's facility for visual inspection of equipment to be supplied and to witness factory functional testing.

B. SPECIFIED MANUFACTURERS

1. Biological odor control system shall be I-BOx® system as manufactured and supplied by Integrity Municipal Systems LLC (IMS), Poway, CA, (858) 486-1620. The owner is aware of no other supplier that is an equal to the specified manufacturer and product.

2. The mechanical, structural, process and electrical design has been based on a biological odor control system manufactured by IMS, Poway, CA.

3. The biological odor control system provided herein is identical to the biological odor control system already owned and operated by El Paso Water for commonality of parts and Operation and maintenance familiarity and benefit.

C. WARRANTY

1. The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy. The warranty period shall not extend beyond 18 months from delivery of the system to the jobsite. The warranty does not apply to the carbon media.

D. PRODUCT SUBMITTALS

1. The following product data shall be submitted by the biological odor control system manufacturer for review and approval by the engineer prior to the fabrication of the system:

   1. Shop drawings and catalog literature showing dimensional information, details of piping and fabrication and erection of all materials and equipment furnished under this section
   2. Drawing of general arrangement and major system components
   3. Process and Instrumentation drawing
   4. Major system component information and descriptive literature for the following:
      a) Exhaust fan
      b) Nutrient pump
      c) Water irrigation cabinet
      d) Vessel fabrication
      e) System controls and control panel details including power and control wiring diagrams, terminals, and numbers
      f) Miscellaneous instrumentation and accessories
   5. Installation instructions
   6. Operating weight of all equipment

E. OPERATION AND MAINTENANCE MANUALS

1. Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. A total of two (2) copies of O&M manuals are required.

F. MANUFACTURER SERVICES

1. The system manufacturer shall be present at the jobsite for the following time period after the system is installed, travel time excluded:
    1. Twenty-four (24) hours for system startup, certification of proper installation and training of Owner's staff in operation of the system.
    2. Provide one trip for 3 days for these tasks

2. PRODUCTS

2.01 BIOLOGICAL ODOR CONTROL SYSTEM

The odor control gas treatment system shall be a once-through biologically active odor removal system treating the odorous air from the contaminated process areas. The system shall be designed for continuous and automatic operation as well as manual operation as required.

The biological odor control system shall be a two-stage system. The system shall consist of one biological treatment stage (Stage 1) followed by an activated carbon polishing stage (Stage 2) in series. The first stage shall be wetted with fresh potable or reuse make-up water. The first stage shall include a spray header to distribute liquid evenly over the media.

FRP vessel, inorganic biological media, activated carbon media, exhaust fan, exhaust stack, nutrient tank, nutrient pump, water irrigation system, air distribution system, and all other required appurtenances shall be pre-assembled as complete 2-stage biological odor control system package. Components of the biological odor control system shall comply with this specification. The entire system shall be pre-assembled, piped, wired, and factory tested prior to shipment except for the control panel and media. The control panel shall ship loose to the jobsite for installation by the contractor at least 3 feet from the Class 1, Division 2, Group D hazardous area. The media shall ship loose to the jobsite for field installation in the vessel by the contractor.

2.02 FRP VESSEL

A. The biological odor control system shall consist of a fiberglass reinforced plastic (FRP) vessel with extended deck. The vessel shall be of unitary construction. No modular construction or flanged pieces are allowed for the vessel itself.

B. The system vessel shall have all components pre-mounted and piped. The system vessel shall be shipped as one piece. The system shall be included with all piping, valves and internals. The system top shall be removable for access to the top of the vessel's second stage.

C. The biological odor control system shall be manufactured with the following material of construction according to following fabrication method:

1. Vessel and accessories shall be contact molded manufactured in accordance with NBS PS15-69, ASTM 4097 for contact molding.

2. Resin used in fabrication shall be a premium vinyl ester resin such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal. The resin shall be reinforced with an inner veil of suitable synthetic organic fiber such as Nexus 111-00010. Any material of construction other than FRP with premium grade resin shall not be acceptable.
3. Reinforcement: Glass fiber reinforcement used shall be commercial grade corrosion resistant borosilicate glass.
4. Fabrication:

   General: Fabrication shall be in accordance with NBS PS 15-69, ASTM D 3299 and ASTM D-4097. All non-molded surfaces shall be coated with resin incorporating paraffin to facilitate a full cure of the surface. All cut edges, bolt holes, secondary bonds shall be sealed with a resin coat prior to the final paraffinated resin coat.

   Corrosion Liner: The inner surface of all laminates shall be resin rich and reinforced with one NEXUS 111-00010 with a minimum thickness of 10 mils. The interior corrosion layer shall consist of two layers of 1 1/2 oz. per sq. ft. chopped strand mat. The total corrosion liner thickness shall be a minimum of 100 mils.

   Structural Laminate: Structural laminates shall consist of alternating layers of 1-1/2 oz per sq. ft mat of chopped glass and 24 oz per sq. yard woven roving applied to reach a designed thickness. The exterior shall be surface coated with white gel coat containing ultra violet light inhibitors.

D. Access Manways: The vessel shall be provided with access manways to allow access to the internals of the odor control system. As a minimum, access manways shall be provided between stages.

E. Media support and screen: The system vessel shall be provided with an HDPE and FRP support system with polypropylene screen to accommodate the biological media and carbon media beds.

F. Vessel Accessories: The system shall be provided with all piping, valves and internals. Air inlet, air outlet, spray headers, drain and all vessel fittings shown on the drawings shall be provided by the Manufacturer.

G. Hardware and Gaskets: All hardware and anchor lugs shall be 316 stainless-steel. All bolts shall be designed for the specified loads. Gaskets shall be a minimum of 1/8” thick, full face, EPDM, suitable for the intended service.

H. Neoprene Pad: A ¼” thick, 60 durometer neoprene pad must be placed underneath the scrubber vessel during installation.

2.03 ODOR CONTROL MEDIA

A. The system shall use in stage 1 an inorganic expanded clay biological media as the support substrate for selectively growing sulfur-oxidizing autotrophic bacteria. The media shall be randomly dumped in the vessel to allow a low pressure drop. The media is porous and is resistant to hydrogen sulfide (H_2S) and acidic conditions. The media shall be non-proprietary and commercially available.

B. The system shall use in stage 2 a coal based activated carbon media to adsorb residual H_2S and other odor compounds. This stage shall provide final removal of odors to specified level.

C. Overall media depth shall be a minimum of 48 inches.

2.04 EXHAUST FAN

A. Exhaust Fan: Fan shall have fiberglass reinforced plastic centrifugal backward inclined impeller. Wheel shall be statically and dynamically balanced. Resin shall be suitable for exposure to the specific service conditions. Shaft shall be 316SS. Shaft seal shall be Teflon or Neoprene.

B. Bearings shall be heavy duty, self-aligning grease lubricated ball type with minimum of 100,000 hour B-10 life. OSHA approved weather cover shall be provided. Motor shall be TEFC and rated for installation in a Class 1, Division 2, Group D hazardous area with a 1.15 service factor. Motor shall be suitable for 3/60/480V service. Fan shall be provided with a constant V-belt drive. The motor shall be inverter-duty, suitable for use with a VFD.

C. Fan housing shall be constructed of fiberglass and reinforced with rigid bracing to increase structural integrity. No other material of construction is acceptable. Bearing support brackets shall be positioned to directly oppose belt tension forces. Fan housing shall be a curved scroll design. The fan inlet shall be slip type and the fan outlet shall have a flanged connection. The fan shall be mounted on the vessel's deck. No exceptions are allowed.

D. The fan shall be New York Blower, Hartzell or equal.

E. The fan shall be designed for the following specifications:

Model Number	**I-BOx® 8010**
Airflow Rate, cfm	1,838
S.P. up to System Inlet, in W.C	2.0
Total Pressure Drop, in W.C	5.0
Motor, HP	5.0

2.05 FRP EXHAUST STACKS

A. The scrubber system shall be provided with exhaust stacks manufactured of FRP.

B. The exhaust stacks shall be contact molded and manufactured in accordance with NBS PS15-69 and ASTM D-4097 for contact molding. The resin used in the fabrication of the exhaust stack shall be the same as that used for the main vessel such as Hetron 922 or Derakane 411 by Ashland Chemical, Vipel F010 by AOC or approved equal.

2.06 SYSTEM ELECTRICAL CONTROL PANEL

A. The electrical control panel shall house all required controls for the entire system. The electrical control panel shall be shipped loose for installation by the contractor at the jobsite at least 3 feet from the Class 1, Division 2, Group D hazardous area.

B. The control panel enclosure shall be rated NEMA 3R and shall be made of FRP. The control panel shall be factory tested to full operation with all other components prior to shipment.

C. The control panel shall provide electrical control for the entire system with as a minimum the following switches, alarms and accessories:

1. "On-Off" switch for Exhaust Fan
2. "Exhaust Fan Running" indicator light
3. VFD for exhaust fan
4. "Hand-Off-Auto" switch for Nutrient Pump
5. "Nutrient Pump Running" indicator light
6. "Nutrient Tank Low" indicator light
7. Push button switch with status lights for water valve
8. Timer relay for on/off control of water valve
9. Control Transformer (480V to 120V)

D. The power supply shall be 480V, 3 ph, 60 Hz.

E. Control panel shall be provided with terminal strip as required for easy wiring connections by the contractor.

2.07 INSTRUMENTATION AND WATER CONTROLS

A. The water irrigation controls shall be mounted in a completely separate FRP water cabinet on the vessel and shall consist of the following components:

1. Ball valves
2. Pressure reducing valve
3. Pressure gauge
4. Solenoid valve
5. Gate control valve
6. Rotameter- Variable area type with a Teflon float, EPR O-rings and PVC fittings. The rotameter shall have a direct reading scale.
7. Nutrient injection connection
8. Water fill piping for nutrient
9. Nutrient pump

B. An independent media irrigation system is incorporated into Stage 1 to provide the biological media with adequate moisture. The system shall be designed to irrigate the top of the first media bed with complete and even coverage via spray nozzles. Potable water or plant effluent water can be used provided that residual chlorine concentrations are less than 5 ppm.

2.08 PIPING

A. All make-up water and drain piping shall be SCH 80 PVC.

2.09 INTEGRATED NUTRIENT RESERVOIR AND NUTRIENT PUMP

A. Nutrient Addition: The packaged biological odor control system uses a non-proprietary, commercially available fertilizer to provide essential nutrients to optimize the growth of sulfur-oxidizing bacteria. Nutrients supplied as a coating to the support media or proprietary nutrients shall not be allowed. The system shall be equipped with a nutrient addition system that provides a controlled dosage of nutrients that is automatically fed to the irrigation water during each irrigation cycle with the help of a nutrient pump.

B. The Nutrient reservoir shall be integral to the system and mounted on the system deck. The nutrient reservoir shall be made of FRP. The nutrient reservoir shall have a float-type level switch to detect a low level. Loose nutrient tanks shall not be acceptable.

C. The Nutrient pump shall be solenoid type and shall be mounted in the water cabinet.

2.10 NFPA 820

A. The system shall be designed and fabricated in compliance with National Fire and Protection Agency Code 820. As a minimum, all equipment installed on the system shall be rated for Class 1, Division 2, Group D.

B. All motors and equipment within 3 feet of the airstream shall be rated for Class 1, Division 2, Group D.

C. The local control panel will be remote-mounted from the odor control vessel and will be shipped loose. The installation and wiring of the remote-mounted control panel to the fan, nutrient pump and solenoid valve shall be the responsibility of the contractor.

3. EXECUTION

3.01 FACTORY ASSEMBLY AND TESTING

A. Each system shall be pre-assembled at the manufacturing location.

B. System(s) shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design(s) for the project as described in this specification.

C. Engineer and/or Owner reserve the right to be present at the manufacturer's testing facility to witness the factory functional testing. Engineer and/or Owner shall provide intent to witness functional testing at the time of the design submittal review and approval, and manufacturer shall provide notice to Engineer and/or Owner regarding the scheduled time of the functional testing at least five business days in advance of the proposed functional testing.

D. Factory testing shall include visual inspection of all equipment, complete assembly and functional operating testing of components including piping and equipment check, and verification of control panel wiring and operation.

3.02 DELIVERY AND INSTALLATION

A. System(s) shall be packaged and shipped so as not to incur damage to any portion of the system through handling and installation of the system itself.

B. System(s) shall be installed per the manufacturer's guidelines and recommendations. Installation shall include the re-assembly of any items separately packaged for protection during shipment. Site preparation, utility service and installation are not provided by the Manufacturer under these specifications.

C. It is the contractor's (or owner's) responsibility to provide:

1. FRP inlet piping from pick-up point source to fan inlet connection.
2. Wiring to/from remote-mounted control panel to system-mounted equipment, plant SCADA, etc.
3. Power to system control panel (480V, 3 ph, 60 Hz, 25 Amps)
4. Suitable concrete mounting pads and other incidentals as necessary to complete the installation
5. Drain- a minimum of 2 inches PVC gravity drain to sewer with a barometric trap
6. Water Supply- a 1-inch water supply with backflow preventer is required. The nominal water requirements are at a rate of 14.0 gpm and a pressure of 30 psi. Hardness shall not exceed 200 mg/l as calcium carbonate.

3.03 FIELD START-UP

A. A factory representative from manufacturer shall be present at the jobsite for initial system start-up of equipment as specified in section 1.02.F. Factory representative will ensure that system is properly installed, will start-up the system and train owner's personnel.

END OF SECTION