AGREEMENT AND SPECIFICATIONS

JONATHAN ROGERS WATER TREATMENT PLANT
SETTLING POND GATE IMPROVEMENTS

BID NUMBER 87-22

VOLUME 1 OF 2

CONTRACT DOCUMENTS

SEPTEMBER 20, 2022
BID SET

CIP No. _____
Eng. / Proj. ID __-_____ / _____

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AGREEMENT AND SPECIFICATIONS

JRWTP SETTLING POND GATE IMPROVEMENTS

VOLUME 1 of 2

CONTRACT DOCUMENTS & TECHNICAL SPECIFICATIONS

BID NO. 87-22

SEPTEMBER 2022

Digitally signed by Sanaan C. Villalobos
Contact Info: Carollo Engineers, Inc.
Date: 2022.09.20 15:19:26-06'00'

TBPELS No. F-882

303 NORTH OREGON STREET, SUITE 300 • EL PASO, TEXAS 79901 • P. 915.351.0406

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EL PASO WATER

JRWTP SETTLING POND GATE IMPROVEMENTS

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CIVIL

Digitally signed by Alice Asha Chikerema
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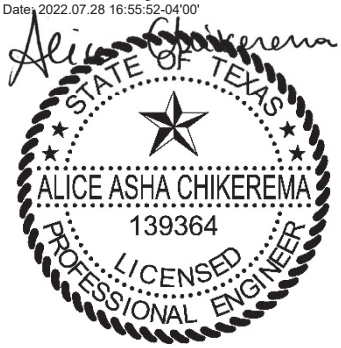
Date: 2022.07.28 16:55:52-04'00'



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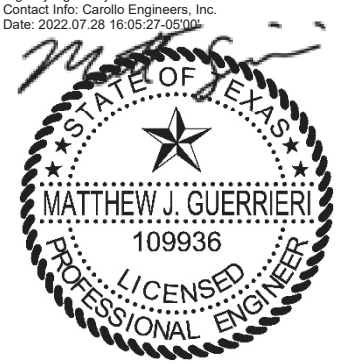
Contact Info: Carollo Engineers, Inc.
Date: 2022.07.28 16:05:27-05'00'



ELECTRICAL

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EL PASO WATER

JRWTP SETTLING POND GATE IMPROVEMENTS

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EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

PSB BID NO. 87-22

INFORMAL NOTICE

Sealed proposals for construction of JRWTP Settling Pond Gate Improvements 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 October 26, 2022, 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:

1. Mobilization/Demobilization, Bonds, and Insurance
2. Installation of electric actuators for the existing 16 gates at the each of the draw-off, flow and intertie pond structures.
3. Construction and installation of duct banks and electrical panels.
4. Construction and installation of shade canopies over gate operators at the 10 gate platform locations.
5. Incorporation of new electrical actuators open/close signals to existing SCADA system.
6. Repair and reconstruction of existing improvements affected by the Work, and incidentals for a complete and operable facility

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 October 11, 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.

SECTION 00020

INVITATION TO BID

Sealed proposals for construction of JRWTP Settling Pond Gate Improvements, 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 October 26, 2022, 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 at the end of this 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 Work consists of improvement of gates at Jonathan Rogers Water Treatment Plant (JRWTP) settling water ponds including:

1. Mobilization/Demobilization, Bonds, and Insurance
2. Installation of electric actuators for the existing 16 gates at the each of the draw-off, flow and intertie pond structures.
3. Construction and installation of duct banks and electrical panels.
4. Construction and installation of shade canopies over gate operators at the 10 gate platform locations.
5. Incorporation of new electrical actuators open/close signals to existing SCADA system.
6. Repair and reconstruction of existing improvements affected by the Work, and incidentals for a complete and operable facility

Repair and reconstruction of existing improvements affected by the Work, and incidentals for complete and usable facility.

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 October 11, 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:

Join on your computer, mobile app or room device

Click here to join the meeting
Meeting ID: 256 784 883 989
Passcode: fPzM9d

Download Teams | Join on the web
Or call in (audio only)
+1 915-255-2297,,351230500# United States, El Paso
Phone Conference ID: 351 230 500#

BID OPENING INSTRUCTIONS

Bid Openings are now to be broadcast through "GoToMeeting" format.

To View Bid Opening Click the Link Below:

87-22 JRWTP Settling Pond Gate Improvements
Oct 26, 2022, 2:00 – 2:30 PM (America/Denver)

Please join my meeting from your computer, tablet or smartphone.
https://meet.goto.com/175429381

You can also dial in using your phone.
Access Code: 175-429-381
United States (Toll Free): 1 866 899 4679
United States: +1 (571) 317-3116

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

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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,*

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. Key personnel for this project consist of the Bidder's Project Manager, Foreman, and Master Electrician.
2. A single manufacturer who shall have sole responsibility for the electrical actuators shall provide all components to include motors and stems and pedestals if necessary. The electrical actuator manufacturer shall have at least ten successful years of experience in the design, construction, and operation of equipment of the type specified at a minimum of ten installations in the United States.
3. Bidder or Bidder's key personnel shall have experience in installation of electrical actuators in existing gate structures. Bidder shall demonstrate a minimum of five successful electrical actuators and related electrical work installation projects, in the past five years.
4. Project involves extensive electrical work. Bidder must demonstrate two successful projects with similar complexity or scope of electrical work. Bidder and Master Electrician must demonstrate a minimum of two successful projects requiring electrical work of similar scope and value. Provide prime or subcontractor qualifications and the qualifications of the Master Electrician.

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 with his or her bid 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 unless 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. EXAMINATION OF CONTRACT DOCUMENTS AND SITE *(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 11th day of October, 2022 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: JRWTP Settling Pond Gate Improvements

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.

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

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SECTION 00300

BID FORM

PROJECT IDENTIFICATION: El Paso Water Utilities

JRWTP Settling Pond Gate Improvements

BID NO.: 87-22

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	L.S.	Insurance, Bonds, and Move-In Related Expenses, Not to Exceed 5% of Bid Item Nos. 2 through7. If Item No. 1 exceeds 5%, bid may be deemed non-responsive).	$_____	$_____
2.	1	L.S.	Furnish and Install Electric Actuator with corresponding VCP at Each of the 16 Draw-off, Flow, or Intertie Structure at JRWTP Ponds, Complete in Place with all Appurtenances	$_____	$_____
3.	1	L.S.	Furnish and Install the Electrical System Associated with the New Electrical Actuators, Including Duct Banks, Conduits, Pull-boxes, Handholes, Complete in Place with all Appurtenances	$_____	$_____
4.	1	L.S.	Incorporate New Electrical Actuators to Existing SCADA System, Complete in Place	$_____	$_____
5.	1	L.S.	Furnish and Install Canopy at each Gate Platform Structure, Complete in Place with all Appurtenances	$_____	$_____

Item No.	Estimated Quantity	UOM	Brief Description of Item	Unit Bid Price	Extended Amount (Qty. x Unit Price)
6.	1	L.S.	Site Work to Include Site Demolition, Paving, Curbs and Gutters, Sidewalks, and Bollards, Complete in Place with all Appurtenances	$_____	$_____
7.	1	ALL.	ALLOWANCE for the Replacement of Existing Stems and Pedestals, Complete in Place with all Appurtenances	$600,000.00	$600,000.00

TOTAL BID PRICE (ITEMS 1 THROUGH 7) $ _____

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 336 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 366 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), or Other (not either SLBE, WBE MBE,) 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 JRWTP Settling Pond Gate Improvements (Name of Project), Bid No. _____, 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

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:	2019		2020		2021	
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: _____

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 is _____, _____, _____, _____, _____.
(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

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._____. 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:

_____

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. _____: 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:

_____

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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

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

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

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

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

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

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

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

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

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

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

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.

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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:

JRWTP SETTLING POND GATE IMPROVEMENTS

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 Work consists of improvement of gates at Jonathan Rogers Water Treatment Plant (JRWTP) settling water ponds including:

1. Mobilization/Demobilization, Bonds, and Insurance
2. Installation of electric actuators for the existing 16 gates at the each of the draw-off, flow and intertie pond structures.
3. Construction and installation of duct banks and electrical panels.
4. Construction and installation of shade canopies over gate operators at the 10 gate platform locations.
5. Incorporation of new electrical actuators open/close signals to existing SCADA system.
6. Repair and reconstruction of existing improvements affected by the Work, and incidentals for a complete and operable facility.

ARTICLE 2. ENGINEER

The Project has been designed by Carollo Engineers, 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 336 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 366 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.

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 JRWTP Settling Pond Gate Improvements consisting of division numbers 01 through 46, and Exhibits as listed in table of contents thereof.

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

JRWTP SETTLING POND GATE IMPROVEMENTS

(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	CONTRACTOR: _____ _____ _____
By _____ Purchasing Agent		By _____

Name: _____

Title: _____

Address for giving notices:

1154 Hawkins Boulevard
El Paso, Texas 79925

Address for giving notices:

_____

_____

Date Signed _____

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 Plan
	11. Stormwater Pollution Prevention Plan
	12. Health and Safety Plan

- **Deliver all items to the OWNER's Purchasing Department**
- **Deliver electronic copies of items 7-12 to EPWater Project Manager**

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TEXAS COMPTROLLER OF PUBLIC ACCOUNTS

SUSAN COMBS • COMPTROLLER • AUSTIN, TEXAS 78774

July 30, 2007

CERTIFICATE OF ACCOUNT STATUS

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)

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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

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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

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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 :	
INSURER B :	
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED

Specimen/Sample Certificate Form

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	$
	GEN'L AGGREGATE LIMIT APPLIES PER:						GENERAL AGGREGATE	$
	☐ POLICY ☐ PRO-JECT ☐ LOC						PRODUCTS - COMP/OP AGG	$
								$
	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 Y / N						☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? ☐	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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EL PASO WATER UTILITIES - PUBLIC SERVICE BOARD

ENGINEER'S CERTIFICATE OF SUBSTANTIAL COMPLETION

JRWTP SETTLING POND GATE IMPROVEMENTS, BID NO. 87-22

(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

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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.

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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

NSPE®
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NUCA
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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

NOTE: EJCDC publications may be purchased at www.ejcdc.org, or from any of the sponsoring organizations above.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

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

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

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.

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.

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.

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.

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

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.

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

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.

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

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.

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.

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

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.

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

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;

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

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

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

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

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

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.

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);

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

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.

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.

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;

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.

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.

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.

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.

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.

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.

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.

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

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.

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

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.

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.

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.

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.

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.

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.

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.

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.

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:

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.

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

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

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

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

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.

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

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

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.

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,

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,

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

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.

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;

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

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

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.

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,

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.

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,

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

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.

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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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 **El Paso Airport** weather monitoring station at **6701 Convair Rd, El Paso, TX 79925** . 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
None		

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
Jonathan W. Rogers Water Treatment Plant	March, 1990	Gate Locations and Tags
Jonathan W. Rogers Water Treatment Plant Expansion Project	June, 1999	Gate Locations and Tags
Jonathan W. Rogers Water Treatment Plant Ozone System and Support Facilities Design	November, 2017	Site Improvements

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

None		

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
None		

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) None.

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 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 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	$2,000,000 $2,000,000

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 the full replacement cost of the Work. 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) N/A

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: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, 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 7:30 am - 5:00 pm .

2. Owner's legal holidays are all federal observed holidays.

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.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 *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. 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 6 pages, applicable to the Project is part of the Contract Documents.

b. Federal Davis-Bacon minimum prevailing wage rates 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 a third-party Consultant retained by OWNER. The authority and responsibilities of Owner's Site Representative follow:

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.

c. 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; and assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's operations on the Site.

2) Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

d. Shop Drawings and Samples:

1) Receive Samples that are furnished at the Site by Contractor and notify Engineer of availability of Samples for examination.

2) 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.

e. 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) Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to Engineer.

f. 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.

g. 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.

h. 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, 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 of 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.

i. 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.

j. 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.

k. 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.

l. 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. Participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

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 Milestones: 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 performed to achieve the Milestone within the time limits specified for Milestones in Specification Section 01010, Summary of Work, plus any changes thereof allowed in accordance with Article 11 of the General Conditions. Owner and Contractor 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 performed to achieve the Milestone 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 $_____ for each day that expires after the time specified in the Contract Documents for achieving the Milestones (adjusted for changes thereof, if any, made in accordance with Article 11 of the General Conditions) until the Work is sufficiently complete to achieve the associated Milestone. In the event of multiple Milestones, Contractor is liable for liquidated damages for each missed Milestone, but liquidated damages for more than one missed Milestone will not be cumulative (e.g., maximum daily rate of liquidated damages under this Paragraph SC-11.11.B is $____ per day).

C. 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 $500.00 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 $1500.00 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 **RSMeans Data**. 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 .

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.

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 **5** years 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).

EXHIBIT A - GEOTECHNICAL BASELINE REPORT SUPPLEMENT TO THE SUPPLEMENTARY CONDITIONS

1.01 *Definitions*

SC-1.01 Add to the list of definitions in Paragraph 1.01.A by inserting the following as numbered items in their proper alphabetical positions:

1. Geotechnical Baseline Report (GBR) — The interpretive report prepared by or for Owner regarding subsurface conditions at the Site and containing specific baseline geotechnical conditions that may be anticipated or relied upon for bidding and contract administration purposes, subject to the controlling provisions of the Contract, including the GBR's own terms. The GBR is a Contract Document.

2. Geotechnical Data Report (GDR) — The factual report that collects and presents data regarding actual subsurface conditions at or adjacent to the Site, including Technical Data and other geotechnical data, prepared by or for Owner in support of the Geotechnical Baseline Report. The GDR's content may include logs of borings, trenches, and other site investigations, recorded measurements of subsurface water levels, the results of field and laboratory testing, and descriptions of the investigative and testing programs. The GDR does not include an interpretation of the data. If opinions, or interpretive or speculative non-factual comments or statements appear in a document that is labeled a GDR, such opinions, comments, or statements are not operative parts of the GDR and do not have contractual standing. Subject to that exception, the GDR is a Contract Document.

5.03 *Subsurface and Physical Conditions*

SC-5.03 Delete Paragraph 5.03 in its entirety and replace with the following:

5.03 *Subsurface and Physical Conditions*

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

1. those reports of explorations and tests of subsurface conditions at or adjacent to the Site (other than any Geotechnical Data Report or Geotechnical Baseline Report) that contain Technical Data. Such reports are as follows:

a. None.

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. Such drawings are as follows:

a. Drawings Title: **Jonathan W. Rogers Water Treatment Plant, Jonathan W. Rogers Water Treatment Plant Expansion Project**

b. Date of Drawings: **March, 1990; June,1999**

c. Technical Data in drawings upon which Contractor may rely:

- Paving-grading record data

3. Contractor may examine copies of reports and drawings identified immediately above that were not included with the Bidding Documents at the EPWater Main Office during regular business hours, or may request copies from Engineer, at the cost of reproduction.

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 SC-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 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 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; or

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

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.

5.04 *Differing Subsurface or Physical Conditions*

SC-5.04 Delete Paragraph 5.04 in its entirety and replace with the following:

5.04 *Differing Subsurface or Physical Conditions*

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

1. differs materially from conditions shown or indicated in the GBR; or

2. differs materially from conditions shown or indicated in the GDR, to the extent the GBR is inapplicable; or

3. differs materially from conditions shown or indicated in Contract Documents other than the GBR or GDR, to the extent the GBR and GDR are inapplicable; or

4. to the extent the GBR and GDR are inapplicable, 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; or

5. to the extent the GBR and GDR are inapplicable, is of such a nature as to require a change in the Drawings or Specifications; or

6. to the extent the GBR and GDR are inapplicable, 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 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 the necessity of Owner's obtaining 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 SC-5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption or continuation 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 or continuation 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 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 SC-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 of the General Conditions; 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; or

    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 as required by Paragraph SC-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 must 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 of the General Conditions governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 of the General Conditions governs rights and responsibilities regarding Hazardous Environmental Conditions. The

provisions of Paragraphs SC-5.03 and SC-5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

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Contractor Insurance Check List

Project	JRWTP Settling Pond Gate Improvements			
Bid Number	87-22			
Job Description				
Contract Cost				
Final Completion				
Contractor				
Engineer	Carollo Engineers, Inc.			
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.

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: _____

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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					

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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.

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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 decision(s) is/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	Building Construction within an envelope of five feet from a building.
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	All elements outside the building limits including, but not limited to, demolition, pond, and landscaping.

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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.

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EL PASO WATER
2020 Building Construction Trades Wage 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.

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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

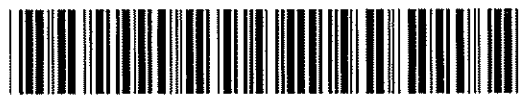
_____ Federal Tax I. D. Number

_____ 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



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SECTION 01_11_00

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Detailed description of the Work.

1.02 THE WORK

A. The Work consists of improvement of gates at Jonathan Rogers Water Treatment Plant (JRWTP) settling water ponds including:
   1. Installation of electric actuators on the existing 16 gates.
   2. Construction and installation of duct banks and electrical panels.
   3. Construction and installation of shade canopies over each gate operator at 10 locations.
   4. Repair and reconstruction of existing improvements affected by the Work, and incidentals for complete and usable facility.

1.03 LOCATION OF PROJECT

A. The Work is located at Jonathan Rogers Water Treatment Plant at 10000 Southside Rd, El Paso, TX 79927 .

1.04 OWNER ASSIGNED SUBCONTRACTORS (NOT USED)

1.05 OWNER FURNISHED EQUIPMENT (NOT USED)

1.06 ACTIVITIES BY OTHERS (NOT USED)

1.07 PARTIAL USE OR OCCUPANCY (NOT USED)

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

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SECTION 01_14_00

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 SUBMITTALS

A. Baseline Schedule with MOP tasks.

B. Method of Procedure (MOP) Form.

C. Method of Procedure (MOP) Log.

D. Progress Schedule with MOP tasks.

1.03 METHOD OF PROCEDURE (MOP)

A. Comply with MOP Instructions as specified in Attachment A - Method of Procedure (MOP).

B. Prepare MOP for the following conditions:
   1. Shutdowns, diversions, and tie-ins to the existing facility.
   2. Process start-up activities.
   3. Power interruption and tie-ins.
   4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
   5. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.

D. Submit Baseline Schedule, as specified in Section 01_32_21 - Schedules and Reports with proposed MOPs.

E. Submit MOP Log at construction progress meetings.

F. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

G. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.04 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

A. Perform abandoned pipe Work as per Selective Alterations and Demolition.

B. Water projects:
   1. The Jonathan Roger Water Treatment Plant is one of the EPWater's source of drinking water.
   2. Conduct Work such that the Owner's ability to meet its customer's demands for treated drinking water shall not be impaired or reduced in terms of the required quantity or quality of treated water. Do not impair the operational capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
   3. Conduct commissioning activities as specified in Section 01_75_17 - Commissioning in a manner that will not impair capabilities of essential elements of the treatment process or reduce treatment capacity below levels sufficient to meet demands for water throughout the contract time. The quantities of and quality of treated water required are described in this Section.
   4. PCIS Optimization and Fine-Tuning as specified in Section 01_75_17 - Commissioning.
   5. The status of the treatment plant shall be defined as "operational" when the plant is capable of meeting the Owner's customer's demands for treated drinking water in terms of the required quantity or quality of treated water as defined in this Section.

1.05 COMPLIANCE WITH DRINKING WATER PERMIT

A. The existing facility is operating under the terms of a Drinking Water permit issued by the Texas Commission on Environmental Quality (TCEQ).
   1. This permit specifies the water quality limits that the plant must meet prior to discharge of finished water.
   2. A copy of the existing permit is on file for review at the Jonathan Roger Water Treatment Plant.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the Owner for water quality violations caused by actions of the Contractor.

D. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational

E. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.
   1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

F. Bear the costs for exceeding the drinking water standards of $10,000 per day for each day of the occurrence and each subsequent day of a boil water notice.

1.06 UTILITIES

A. Provide advance notice to and utilize services of utility agencies for location and marking of underground utilities operated by utility agencies other than the Owner.

B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

C. New yard utilities were designed using existing facility drawings.
   1. Field verification of utilities locations was not performed during design.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on the Drawings.

1.07 WORK BY OTHERS

A. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

1.08 SHUTDOWN CONSTRAINTS

A. General shutdown constraints:
   1. Execute the Work while the existing facility is in operation.
   2. Some activities may be accomplished without a shutdown.
   3. Apply to activities of construction regardless of process or work area.
   4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
   5. Organize work to be completed in a minimum number of shutdowns.
   6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
   7. Shutdown MOPs:
      a. Advise the Engineer a minimum of 3 weeks prior to need for any complete or partial plant shutdown for tie-ins.
      b. Prepare and submit MOP to Engineer for any complete or partial plant shutdown required a minimum of 2 weeks prior to the shutdown.
      c. Owner’s written approval of MOP is required prior to beginning Work.
   8. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
   9. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
   10. Owner maintains the ability to abort on the day of the scheduled shutdown.
   11. Unplanned shutdowns due to emergencies are not specified in this Section.

B. Process, electrical and instrumentation - tie-in shutdowns:
   1. Schedule no more than 1 tie-in shutdown per day.

1.09 WORK RESTRICTIONS

A. Ponds will remain full during construction period.

B. Construction must take place during off season when the plant is not operating.

C. Provide safe, continuous access to process control equipment for plant operations and maintenance personnel.

D. Construction must not interfere with maintenance operation.

E. Maintain truck access to the main plant complex.

F. Regular work hours for the project will be from 7 a.m. to 3 p.m.

G. The delivery hours will be from 7 a.m.to 2:30 p.m. Any assistance with forklifts can be provided during this time.

H. One of the plant technicians will be required to be present on-site if the Contractor plans to stay late (e.g., after 5 p.m.)

I. The Contractor shall follow the Safety precautions and ensure no littering at the site.

J. The Contractor shall share the list of staff involved in the project with the security guard for site access.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT A - METHOD OF PROCEDURE (MOP)

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"METHOD OF PROCEDURE" (MOP)
Instructions and Forms

Definition and Purpose

"Method of Procedure" (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	No later than 7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	No later than 7 days prior to work
Contractor	6. Complete Readiness Checklist.	No later than 5 days prior to work
Contractor	7. Complete Safety Checklist.	Immediately prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

ATTACHMENT B - METHOD OF PROCEDURE (MOP) FORM

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METHOD OF PROCEDURE (MOP) FORM

Owner: _____ **Date:** _____

Contractor: _____ **Carollo Project No.:** _____

Project Name: _____ **Submittal No.:** _____

Submittal Title: _____ **Spec/Dwg. Reference:** _____

MOP #	Task Title *(Provide <10 word title)*:	Submittal Date: *(No later than 28 days prior to work)*

SCHEDULE OF WORK ACTIVITY START: *(Date/Time)* END: (Date/Time)

REQUESTOR:

PRIMARY POINT OF CONTACT: PHONE/PAGER:

SECONDARY POINT OF CONTACT: PHONE/PAGER:

NOTIFY ☐ Control Room, Phone ☐ Security, Phone

BUILDING: LOCATION OF WORK FLOOR/LEVEL:

DESCRIPTION OF WORK: *(Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)*

Task Summary: _____

Processes Affected: _____

Trades Affected: _____

WORK PLAN:

Work Sequencing: _____

Process Isolation: _____

Spill Prevention Plan: _____

Contingency Plans: _____

CRITICAL EQUIPMENT/TOOLS: *(pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)*

☐	Acoustic Ceiling/or Walls Access	☐	Excavation Permit	☐	Lock Out/Tag Out
☐	Chemical Use Approval	☐	Fire Sprinkler Impairment	☐	Life Safety Systems
☐	Confined Space Permit	☐	Flammable Materials	☐	Roof Protocol
☐	Critical Lift Plan	☐	Flush / Discharge	☐	Work After Dark
☐	Energized Electrical Work	☐	High Pressure Test	☐	
☐	Elect. Panel Schedules	☐	Hot Work/Open Flame	☐	

EXISTING SERVICE(S) AT RISK:

☐	Breathing Air	☐	Elect Normal	☐	Process Access	☐	Telephones
☐	Chemical Distribution	☐	Fire Protection	☐	Safety Showers	☐	UPS
☐	City Water	☐	HVAC	☐	SCADA	☐	VAX/DATA
☐	Communication	☐	Inert Gas	☐	Security	☐	
☐	Domestic Drain	☐	Instrument - Air	☐	Solvent Drain	☐	
☐	Elect-Bus Duct	☐	Life Safety System	☐	Specialty Gases	☐	

☐	Elect Emergency	☐	Natural Gas	☐	Storm Drain	☐	

REVIEWER'S INSTRUCTIONS / COMMENTS: _____

☐ PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:

	Full Name (printed)	**Signature**	**Phone**	**Date**
Submitted By				
System Owner				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				

ATTACHMENT C - READINESS CHECKLIST

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READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____

2. Review work plan: _____

3. Review contingency plan: _____

ATTACHMENT D - SAFETY CHECKLIST

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
   a. Emergency exits: _____
   b. Emergency shower and eyewash: _____
   c. Telephones and phone numbers: _____
   d. Shut-off valve: _____
   e. Electrical disconnects: _____
2. Inspect work area:
   a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
   a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/Tagout Procedure:
   a. Lockout/tagout energy sources before beginning work.
   b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
   c. Make sure the lines are depressurized.
5. Overhead work:
   a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
   b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
   c. Spotter assigned and in position.
   d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
   a. Shepherd's hook.
   b. ARC flash protection.
   c. Fire extinguisher.
   d. Other: _____.
7. Accidents:
   a. Should accidents occur, do not shut off and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
   a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
   a. Do not obstruct evacuation routes.
   b. Take time to survey the area for evacuation routes.

ATTACHMENT E - METHOD OF PROCEDURE (MOP) LOG

METHOD OF PROCEDURE (MOP) LOG
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

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SECTION 01_20_20

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for measurement and payment of Work under this Contract for lump sum items and unit prices.

1.02 REFERENCES

A. Occupational Safety and Health Administration (OSHA).

1.03 LUMP SUM ITEMS

A. Item 1: Insurance, Bonds, and Mobilization, Demobilization and Related Expenses:
   1. Measurement:
      a. Limit amounts included under mobilization to the following items and shall not exceed 5% of bid items 2 thru 7:
         1) Moving on the site any equipment required for first month operations.
         2) Installing temporary construction power, wiring, and lighting facilities.
         3) Establish and submit fire protection plan and safety program.
         4) Provide temporary facilities as specified in Section 01_50_00 - Temporary Facilities and Controls.
            a) Providing on-site sanitary facilities and potable water facilities as specified.
            b) Providing field office trailers for the Contractor and the Engineer, complete with specified furnishings and utility services including telephones and internet.
            c) Developing construction water supply.
         5) Arranging for and erection of Contractor's work and storage yard, employee parking facilities, and entrance road.
         6) Submit required insurance certificates and bonds.
         7) Obtaining required permits, licenses, and fees.
         8) Submit preliminary schedule of values of the Work.
         9) Submit preliminary schedule and develop baseline schedule.
         10) Submit cash flow in tabular and graphical formats.
         11) Submit Schedule of Submittals.
         12) Submit standardized traffic maintenance and control plans.
         13) Post OSHA, Department of Labor, state, and other required notices.
         14) Location and flagging of construction and clearing.
         15) Submit Contractor's quality control plan.
         16) Submit pre-construction photographs and videos.
         17) Provide and erect the project sign.
         18) Have Contractor's project manager and/or general superintendent on job site full-time.
   2. Payment:
      a. Furnish data and documentation to substantiate the amounts claimed under mobilization costs.

b. Payment for mobilization shall not be made until mobilization items listed above have been completed as specified.
c. Limit price for mobilization to no more than 5 percent of Contract Price.
d. Lump sum.

B. Item 2: Actuators:
1. Measurement:
a. This pay item includes all labor, equipment and materials required to furnish and install 16 new electric actuators with corresponding Vendor Control Panel (VCP) at each of the draw-off, flow and intertie structures at the JRWTP ponds to provide a complete and operable system.
b. Measurement for payment will be a percentage of Lump Sum based on completed work.
2. Payment:
a. Percentage of Lump Sum based on work complete

C. Item 3: Electrical System
1. Measurement:
a. This pay item includes all labor, equipment, and materials required to furnish and install the electrical system associated with the new electrical actuators. This may include but is not limited to; wiring, conduits, motors, controls, enclosures, lighting, tie-ins to existing infrastructure, coordination with utilities, trenching, backfilling, compacting, and other items required to provide a complete and operable system.
b. This includes but is not limited to; site demolition, grading, paving, curbs and gutters, sidewalks, fencing, installation of bollards, railing, hand railing, grating and all related appurtenances to provide a complete and operable system.
c. Measurement for payment will be a percentage of Lump Sum based on completed work.
2. Payment
a. Percentage of Lump Sum based on work complete.

D. Item 4: Instrumentation and Control System
1. Measurement
a. This pay item includes all labor, equipment, and materials required to incorporate the new electrical actuators to the plant existing SCADA system. This may include but is not limited to; wiring, conduits, controllers, switches, panels, enclosures, integration into existing infrastructure, coordination with utilities, trenching, backfilling, compacting, and other items required to provide a complete and operable system.
b. Measurement for payment will be a percentage of Lump Sum based on completed work.
2. Payment
a. Percentage of Lump Sum based on work complete.

E. Item 5: Canopies
1. Measurement
a. This pay item includes all labor, equipment, and materials required to furnish and install a canopy at each gate platform structure complete in place with all appurtenances. This may include but is not limited to;

materials testing and inspection, and other items required to provide a complete and operable system.
b. Measurement for payment will be a percentage of Lump Sum based on completed work.

2. Payment
a. Percentage of Lump Sum based on work complete.

F. Item 6: Site Work
1. Measurement
a. This pay item includes all labor, equipment, and materials required to furnish and install all site and demolition related items and appurtenances. This includes but is not limited to; site demolition, grading, paving, curbs and gutters, pavement demolition, replacement and repair, railing, grating and all related appurtenances to provide a complete and operable system.
b. Measurement for payment will be a percentage of Lump Sum based on completed work.

2. Payment
a. Percentage of Lump Sum based on work complete.
b.

1.04 ALLOWANCES

A. Item 7: Stems and Pedestal Replacement
1. Measurement
a. This pay item includes all labor, equipment, and materials required to replace existing stems and pedestals if necessary for the installation of new actuators.

2. Payment
a. $600,000.00 allowance stems and pedestal replacement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01_29_73

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for preparation, format, and submittal of Schedule of Values.

1.02 PREPARATION

A. Schedule of Values shall be a listing of all cost loaded, on-site construction activities from the progress schedule, listed in numerical order, showing that the sum total of all cost-loaded activities equal the Contract value.

B. When the schedule is changed or revised to include added or deleted work, the Schedule of Values shall also be revised such that the sum total of all cost-loaded activities continuously equal the current Contract value.
   1. Equate the aggregate of these costs to the Lump Sum Contract Price.

C. Prepare Schedule of Values identifying costs of Major Items of Work.

1.03 SUBMITTALS

A. Submit Schedule of Values for the Preliminary Schedule as specified in, Section 01_32_21 - Schedules and Reports.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

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SECTION 01_29_77

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for preparation and submittal of Applications for Payment.

1.02 FORMAT

A. Develop satisfactory spreadsheet-type form generated by downloading cost data from the Progress Schedule.
   1. Submit payment requests using Section 00820- EPWater Standard Application for Payment and attach spreadsheet with cost data related to Progress Schedule.

B. Fill in information required on form.

C. When Change Orders are executed, add Change Orders at end of listing of scheduled activities:
   1. Identify change order by number and description.
   2. Provide cost of change order in appropriate column.

D. After completing, submit Application for Payment.

E. Engineer will review application for accuracy. When accurate, Engineer will transmit application to Owner for processing of payment.

F. Execute application with signature of responsible officer of Contractor.

1.03 SUBSTANTIATING DATA

A. Provide Substantiating Data identifying:
   1. Project.
   2. Application number and date.
   3. Cost flow summary.
   4. Updated schedule of values.
   5. Progress schedule.
   6. Detailed list of enclosures.
   7. Stored products log.
   8. Equipment log.
   9. Submit “certified” payroll, if applicable.
   10. Record (as-built) documents.
   11. Photos and videos from current pay period.
   12. Applicable unconditional waiver and release on progress payment for previous payment made by Owner.

1.04 SUBMITTALS

A. Submit 5 copies of Application for Payment and Substantiating Data with cover letter.

1.05 PAYMENT REQUESTS

A. Prepare progress payment requests on a monthly basis. Base requests on the breakdowns of costs for each scheduled activity and the percentage of completion for each activity.

B. Indicate total dollar amount of work planned for every month of the project. Equate sum of monthly amounts to Lump Sum Contract Price.

C. Generate Progress Payment request forms by downloading cost data from the schedule information to a spreadsheet type format.

D. Identify each activity on the Progress Schedule that has a cost associated with it, the cost for each activity, the estimated percent complete for each activity, and the value of work completed for both the payment period and job to date.

E. Prepare summary of cost information for each Major Item of Work listed in the Schedule of Values. Identify the value of work completed for both the payment period and job to date.

F. Payment period:
   1. Monthly Application for Payment period shall begin on the 1st day of each month, and end on the last day of each month.
   2. Submit Application for Payment to Engineer no later than the 5th day of each month for work completed the previous month.
   3. Engineer will finalize and submit recommendation for Application for Payment to Owner by the 15th day of each month to allow time for processing and approval.

1.06 COST SUMMARIES

A. Prepare Summary of Cost Information for each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.

B. Cash flow summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_31_19

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
   1. Qualifications of Meeting Participants.
   2. Pre-construction Conference.
   3. Progress Meetings.
   4. Pre-Installation Meetings.
   5. Schedule Update Meetings.
   6. Quality Control Meetings.
   7. Pre-Shutdown Meetings.
   8. Pre-Process Start-up Meetings.
   9. Electrical and Instrumentation Coordination Meetings.
   10. Close-out meeting.
   11. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 BASIC MEETING REQUIREMENTS

A. Attendees:
   1. Meeting leader shall require attendance of parties directly affecting, or affected by, Work being discussed at the meeting.

B. Location:
   1. In location convenient for most invitees.

C. Notification:
   1. Meeting leader shall notify attendees of meeting, including an agenda, a minimum of 7 days prior to meeting.

D. Agenda:
   1. Meeting leader shall prepare copies of agenda for participants and distribute at the meeting.
   2. Minimum requirements:
      a. Meeting purpose:
      b. Review minutes of previous meeting.
      c. Safety and security.
      d. Action items.
      e. Next meeting.

E. Meeting minutes:
   1. Meeting leader shall provide draft minutes within 7 days of meeting and send to all attendees for comment within 7 days.
   2. Meeting leader shall incorporate comments from attendees and submit final meeting minutes to attendees within 7 days of receipt of comments.

1.04 PRE-CONSTRUCTION CONFERENCE

A. Engineer leads the meeting.

B. Timing:
   1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

C. Attendees:
   1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.
   2. Review minutes of previous meeting.
   3. Adequacy of distribution of Contract Documents.
   4. Distribution and discussion of list of major subcontractors and suppliers.
   5. Proposed progress schedules and critical construction sequencing.
   6. Major equipment deliveries and priorities.
   7. Project coordination.
   8. Designation of responsible personnel.
   9. Procedures and processing of:
      a. Field decisions.
      b. Proposal requests.
      c. Submittals - separate ,meeting.
      d. Change Orders.
      e. Request for Information/Interpretations.
      f. Applications for Payment.
      g. Record Documents.
   10. Use of premises:
      a. Office, construction, and storage areas.
      b. Owner's requirements.
   11. Construction facilities, controls, and construction aids.
   12. Temporary utilities.
   13. Safety and first aid procedures.
   14. Security procedures.
   15. Housekeeping procedures.
   16. Safety and security.
   17. Action items.
   18. Next meeting.

1.05 PRE-SUBMITTAL CONFERENCE

A. Engineer leads the meeting.

B. Timing:
   1. Prior to producing any submittals.

C. Attendees:
   1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors, individual equipment manufacturers furnishing major pieces of equipment, and others involved in performance of the Work, and others necessary to agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Reviewing the entire Project, equipment, schedules, and submittal requirements.
   2. Review equipment list.
   3. Review submittal schedule.
   4. Format of submittals.
   5. Procedures and processing of submittals.
      a. Review turn-around time.
   6. Discuss specific electrical and instrumentation and controls submittal requirements.
   7. Safety and security.
   8. Action items.
   9. Next meeting.

1.06 PROGRESS MEETINGS

A. Engineer will lead the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Attendees:
   1. Owner, Engineer, Contractor, Contractor’s Project Manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.
   2. Additional invitees:
      a. Owner utility companies when the Work affects their interests, and others necessary to agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. To discuss project progress.
   2. Review minutes of previous meeting.
   3. Safety and security.
   4. Construction schedule summary.
   5. Review of 6 weeks schedule.
   6. Review of off-site fabrication and delivery schedules.
   7. Review of submittals schedule and status of submittals.
   8. Request for information (RFI’s) status.

9. MOP's/shutdown coordination.
10. Change order management status.
11. Maintenance of quality standards (QA/QC).
12. Field observations, problems, and conflicts.
13. Commissioning.
14. Partnering recognition status (optional).
15. General Items.
16. Action items.
17. Next meeting.

1.07 SCHEDULE UPDATE MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum monthly intervals.

C. Attendees:
   1. Owner, Engineer, Contractor, Contractor's Project Manager, General Superintendent, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.
   2. Additional invitees:
      a. Owner utility companies when the Work affects their interests and others necessary to the agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Discuss project schedule.
   2. Review minutes of previous meeting.
   3. Review Monthly Schedule, (Actual Progress and Variance).
      a. "Activities Started/Completed" this period.
      b. "Activities Started/Completed" "Variance" Baseline vs. current.
      c. "Added/Deleted Activities".
      d. "Revised Activity Descriptions".
      e. Any significant Proposed Logic Changes.
   4. Review milestone "Substantial Completion" Schedule:
      a. "Critical" Activities - "Critical Area, Float and Vital Statistics".
   5. Review "Cumulative and Monthly Costs" graph.
   6. Review "Budgeted Cost" indicating the Current Project Budgeted Cost.
   7. Safety and security.
   8. Action items.
   9. Next meeting.

1.08 QUALITY CONTROL MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Attendees:
   1. Engineer, Construction Manager and staff, Contractor's Quality Control Manager, and staff.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Discuss quality control activities.
    2. Review minutes of previous meeting.
    3. Review of Work progress and schedule.
    4. Review of out-of-compliance inspection or test results.
    5. Field observations, problems, and decisions.
    6. Review of offsite fabrication and delivery schedules.
    7. Planned progress during succeeding work period.
    8. Coordination of required inspections and tests.
    9. Review 6-week schedule report with upcoming inspections and special tests.
    10. Maintenance of quality and work standards.
    11. Other business relating to Work.
    12. Safety and security.
    13. Action items.
    14. Next meeting.

1.09 PRE-INSTALLATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
    1. When specified in Technical Sections or requested by Engineer, convene pre-installation meeting at Project site before commencing Work of specific section.

C. Agenda minimum requirements:
    1. Meeting purpose:
        a. Review conditions of installation, preparation and installation procedures.
        b. Review coordination with related work.
    2. Review minutes of previous meeting.
    3. Safety and security.
    4. Action items.
    5. Next meeting.

1.10 PRE-SHUTDOWN MEETINGS

A. Contractor leads the meeting.

B. Timing:
    1. Short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP require a pre-shutdown meeting at Project site prior to commencing shutdown for tie-in or modification of specific plant systems.

C. Attendees:
    1. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner’s construction, operations, and maintenance staff.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Coordinate shutdown activities.
    2. Review minutes of previous meeting.

3. Review accepted Construction Method of Procedure (MOP), as specified in Appendix A of Section 01_14_00 - Work Restrictions, including conditions of shutdown, preparation, and installation procedures.
4. Review timelines and sequences.
5. Review responsibilities.
6. Review dry run plan and schedule, as necessary.
7. Review coordination with related work.
8. Safety and security.
9. Action items.
10. Next meeting.

1.11 COMMISSIONING COORDINATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
1. Separate commissioning coordination meetings will be scheduled as required by Engineer.

C. Attendees:
1. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, Commissioning Coordinator, specific work crews, Owner's operations, and maintenance staff.

D. Agenda minimum requirements:
1. Meeting purpose:
   a. Coordinate commissioning activities.
2. Review minutes of previous meeting.
3. Review Commissioning Schedule.
4. Review Owner Training Schedule.
5. Review test plans.
6. Review accepted Construction Method of Procedure (MOP), as specified in Appendix A of Section 01_14_00 - Work Restrictions.
7. Owner makes final decision for commissioning GO or NO GO.
8. Safety and security.
9. Action items.
10. Next meeting.

1.12 INSTRUMENTATION AND CONTROL COORDINATION MEETINGS

A. Meetings and conferences as specified in Section 40_61_00 - Common Work Results for Process Control and Instrumentation Systems.

1.13 CLOSE-OUT MEETING

A. Engineer leads the meeting.

B. Timing:
1. After punch list items are completed.

C. Attendees:
1. Owner, Engineer, Contractor, Contractor's Project Manager, and Superintendent.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Coordinate close-out activities.
   2. Review minutes of previous meeting.
   3. Review punch list completion.
   4. Transfer of record documents.
   5. Finalize payment.
   6. Safety and security.
   7. Action items.
   8. Next meeting.

1.14 POST CONSTRUCTION MEETING

A. Engineer leads the meeting.

B. Attendees:
   1. Engineer, Contractor, appropriate manufacturers, and installers of major units of constructions, affected subcontractors, and Owner's operations and maintenance staff.

C. Timing:
   1. About 11 months after date of Substantial Completion.

D. Location:
   1. Meet in Owner's office or other mutually agreed upon place.

E. Agenda minimum requirements:
   1. Meeting purpose:
      a. Review project for compliance with Contract Documents.
   2. Inspect the Work and draft list of items to be completed or corrected.
   3. Review service and maintenance contracts and take appropriate corrective action when necessary.
   4. Complete or correct defective work and may extend correction period.
   5. Safety and security.
   6. Action items.
   7. Next meeting.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

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SECTION 01_31_24

WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for web-based construction document management.

1.02 REQUIREMENTS

A. Owner, Engineer, and Contractor shall use Procore for submission of all data and documents (unless specified otherwise in this Section) throughout the duration of the Contract.
   1. Procore is a web-based electronic media site hosted by Procore.
   2. Procore will be made available to all Contractor's personnel, subcontractor personnel, suppliers, consultants, Owner representatives, and Engineer by Owner.
   3. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of Contract Documentation.
   4. Procore shall be the primary means of project information submission and management.

1.03 USER ACCESS LIMITATIONS

A. Provide a list of Contractor's key Procore personnel for the Engineer's acceptance. The Engineer reserves the right to perform a security check on all potential users. The Contractor will be allowed to add additional personnel and subcontractors to Procore.

B. The Engineer will grant initial access to Procore by creating user profiles to accepted Contractor personnel. User profiles will define levels of access into the system; determine assigned function based authorizations and user privileges. Subcontractors and suppliers will be given access to Procore by and through the Contractor. Contractor is responsible for adding and removing users from the system after the initial setup by the Engineer.

1.04 JOINT OWNERSHIP OF DATA

A. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the Procore system) by Engineer and Contractor will be jointly owned.

1.05 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

A. Review comments made (or lack thereof) by Owner on Contractor submitted documentation shall not relieve Contractor from compliance with requirements of the Contract Documents. Contractor is responsible for managing, tracking, and

documenting the Work to comply with the requirements of the Contract Documents. Owner's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

1.06 COMPUTER REQUIREMENTS

A. Contractor shall use computer hardware and software that meets the requirements of the Procore system as recommended by Procore to access and utilize Procore. As recommendations are modified by Procore, Contractor will upgrade their system(s) to meet or exceed the recommendations. Upgrading of Contractor's computer systems will not be justification for a cost or time modification to the Contract.

B. Contractor shall ensure that connectivity to the Procore system is accomplished through DSL, cable, T-1 or wireless communications systems. The minimum bandwidth requirements for using the system is 128 kb/s. It is recommended a faster connection be used when uploading pictures and files into the system.

C. Procore supports the current and prior 2 major versions of Chrome, Mozilla's Firefox, Microsoft's Internet Explorer and Apple's Safari on a rolling basis.
   1. Each time a new version of one of these browsers is released, Procore will begin supporting the update and stop supporting the fourth-oldest version.

1.07 CONTRACTOR RESPONSIBILITY

A. Contractor shall be responsible for the validity of their information placed in Procore and for the abilities of their personnel.

B. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on Procore shall be the responsibility of the Contractor.

C. Accepted users shall be knowledgeable in the use of computers, including Internet Browsers, email programs, cad drawing applications, and Adobe Portable Document Format (PDF) document distribution program.

D. Contractor shall utilize the existing forms in Procore to the maximum extent possible. If a form does not exist in Procore the Contractor must include a form of their own or provided by Engineer as an attachment to a submittal.

E. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. Contractor is responsible for the training of their personnel in the use of Procore (outside what is provided by Owner) and the other programs indicated above as needed.

1.08 TRAINING

A. The Owner has arranged and paid for web-based training on Procore for the Contractor.

B. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate Contractor's training.

PART 2 PRODUCTS

2.01 DESCRIPTION

A. Procore project management application (no equal). Provided by Procore, www.procore.com.

PART 3 EXECUTION

3.01 PROCORE UTILIZATION

A. Procore shall be utilized in connection with all document and information management required by these Contract Documents.

3.02 SUBMITTALS

A. Use Procore for submittals.

B. Content: As specified in Section 01_33_00 - Submittal Procedures.

C. Format: As specified in Section 01_33_00 - Submittal Procedures.

D. Submit Portable Document Format (PDF) documents to the Procore submittal work flow process and forms.
   1. Consolidate electronic format submittals with multiples pages into a single file.

E. Hardcopy submittals:
   1. Contractor shall provide 3 hard copies of submittals within 14 days of the Submittal being closed.
   2. Hardcopy requirements as specified in Section 01_33_00 - Submittal Procedures.

F. Samples:
   1. Contractor shall enter submittal data information into Procore.
   2. Attach a copy of the submittal form(s) to the sample.

G. Record And Closeout Submittals:
   1. Operation and maintenance data as specified in Section 01_78_24 - Operation and Maintenance Manuals.
   2. Extra materials, spare parts, etc.

3.03 REQUESTS FOR INFORMATION/INTERPRETATION (RFI)

A. Use Procore for RFIs.

3.04 OFFICIAL CORRESPONDENCE

A. Use Procore for memos, notices, change proposals, or any official correspondence.

3.05 INSPECTION REQUESTS

A. Use Procore to request inspection for a portion of Work that is ready for inspection and prior to covering up the Work.

3.06 FINANCIAL SUBMITTALS

A. Use Procore for financial submittals as specified in Section 01_33_00 - Submittal Procedures.

3.07 OTHER

A. Use Procore for daily reports, meeting agendas and minutes, and other construction documents.

END OF SECTION

SECTION 01_32_21

SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Schedules and reports.

1.02 SUBMITTAL REQUIREMENTS

A. Submit preliminary and baseline schedule.

B. Submit preliminary and baseline schedule of values.

C. Submit preliminary and baseline schedule of submittals.

D. Submit, on a monthly basis, updated schedules as specified.

E. Submit final schedule update as specified.

F. Submit revised schedules and time impact analyses as specified.

G. Submit schedules in the media and number of copies as follows:
   1. Provide each submittal in PDF format and in other formats specified in this Section.
   2. 3 sets of the CPM network and/or bar chart (as specified by the Owner) on D-size sheets.
      a. Color-coding to be specified by the Owner.
   3. 3 sets of tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.
   4. 2 sets of CPM Schedule data electronic files in a native backed-up file (.xer).

1.03 SCHEDULER

A. Designate, in writing and within 5 calendar days after Notice of Award, the person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Qualifications of scheduler:
   1. Authority to act on behalf of Contractor.
   2. A minimum of 5 years verifiable experience in preparation of construction schedules for projects of similar value, size, and complexity.
   3. Knowledge of critical path method (CPM) scheduling utilizing Primavera P6 Professional or SureTrak or Microsoft Project software.

C. References:
   1. Submit written reference of 3 project Owners who have personal experience with this scheduler on previous projects.
   2. Identify name, address, telephone number, project name, and cost.

D. Scheduler:
   1. Dedicated full time to this project, located on-site. All scheduling software and hardware located on-site.
   2. Scheduler will attend all project meetings called for as specified in Section 01_31_19 - Project Meetings.

E. Owner reserves the right to disapprove scheduler when submitted by Contractor if not qualified.

F. Owner reserves the right to remove scheduler from the project if found to be unqualified.

1.04 SCHEDULING FORMAT AND SOFTWARE

A. Schedule format: Utilize CPM format.

B. Prepare computerized schedule utilizing Primavera P6 Professional or SureTrak or Microsoft Project software, most current version.
   1. Provide 1 licensed copy of the scheduling software to the engineer, registered in the Engineer's name, for the duration of the project.
   2. The provided copy of the software shall be a standalone version for installation on a standalone computer.

C. Contractor and Engineer must agree on the format.

1.05 PRECONSTRUCTION SCHEDULING MEETING

A. Engineer will conduct Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent, and scheduler within 7 calendar days after Notice to Proceed.
   1. This meeting is separate from the Preconstruction Conference Meeting and is intended to exclusively cover schedule issues.

B. At the meeting, review scheduling requirements.
   1. These include schedule preparation, reporting requirements, labor and equipment loading, updates, revisions, and schedule delay analysis
   2. Present schedule methodology, planned sequence of operations, cost and resource loading methodology, and proposed activity coding structure.
   3. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule.
      a. Example 1: 2014_07_30 rev 1 draft baseline schedule.xer.
      b. Example 2: 2014_09_30 rev 2 sep final update.xer.
   4. Coding structure:
      a. Submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the project schedule.
      b. A minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work, Submittal/Procurement/Construction and Responsibility/Subcontractor. Refer to NETWORK DETAILS AND GRAPHICAL OUTPUT for listing of activity categories to be included in the schedule.

C. Filing: Post submitted files to Owner's construction document control system.

1.06 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review Baseline Schedule, Schedule Updates, Schedule Revisions and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and Owner will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt.

C. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

D. Revise and resubmit schedule in accordance with Engineer’s comments within 7 calendar days after receipt of such comments or request joint meeting to resolve objections.

E. If Engineer requests a meeting, the Contractor and all major subcontractors must participate in the meeting with Engineer.
   1. Revise and resubmit schedule within 7 calendar days after meeting.

F. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

G. Engineer’s submittal review response:
   1. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner.
   2. Engineer’s submittal review response for schedule submittal will be “Receipt Acknowledged - Filed for Record” including applicable comments.
   3. Acceptance of the schedules by the Owner is for general conformance with the Contract Documents and for Owner’s planning information and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the contract completion dates. Omissions and errors in the accepted schedules shall not excuse performance less than that required by the Contract Documents. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor’s plan, sequence or means, methods, and techniques of construction.

1.07 SCHEDULE UPDATES

A. Any update:
   1. Prepare update using most recent accepted version of schedule including:
      a. Actual start dates of activities that have been started.
      b. Actual finish dates of activities that have been completed.
      c. Percentage of completion of activities that have been started but not finished.
      d. Actual dates on which milestones were achieved.
      e. Update activities by inputting percent complete figures with actual dates.
      f. Use retained logic in preparing Schedule Updates.

g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.

B. Monthly updates:
1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.
1) Identify added activities in manner distinctly different from original activity designations.
b. Changes in sequence or estimated duration of activities.
c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
d. Assumptions made and activities affected by incorporating change order work into the schedule.
2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.
3. Since Monthly Schedule Update is the application for progress payment required as specified in Section 01_29_77 - Applications for Payment, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:
1. Update the schedule prior to weekly progress meeting.
a. Identify overall progress of each Major Item of Work in the Summary Schedule.
b. If there are significant changes to the schedule, submit a written report at the weekly progress meeting.
2. Should monthly Schedule Update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as “Project Float”.
3. Should monthly Schedule Update show project completion later than current Contract completion date, prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.08 REVISIONS TO SCHEDULE

A. Submit Revised Schedule within 5 days:
1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
3. When the schedule does not represent the actual progress of activities.
4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.

B. Create a separate submittal for Schedule Revisions.
   1. Comply with schedule updates as specified in this Section.
   2. Do not submit with Schedule Updates.

C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the Owner.
   1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.09 ADJUSTMENT OF CONTRACT TIMES

A. Contract Time will be adjusted only for causes specified in Contract Documents.
   1. Non-excusable delay:
      a. Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date).
      b. No time extensions will be granted for non-excusable delays.
   2. Excusable delay:
      a. Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date.
      b. The Contractor is entitled to a time extension only.
      c. No other damages will be approved.
   3. Compensable delay:
      a. Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date.
      b. The Contractor is entitled to a time extension and delay damages.
   4. Concurrent delay:
      a. Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
      b. Exception to concurrent delay: Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date. When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

B. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path.
   1. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.

C. Time Impact Analysis:
   1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the schedule by:
      a. Inserting new activities associated with the delay event into the schedule.

b. Revising activity logic.
c. Revising activity durations.

2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
3. The Time Impact Analysis submittal must include the following information:
   a. A fragment of the portion of the schedule affected by the delay event.
   b. A narrative explanation of the delay issue and how it impacted the schedule.
   c. A schedule file used to perform the Time Impact Analysis.

D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

E. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.
   1. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
   1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.

G. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.

H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.

I. Notify Engineer of a request for Contract Time adjustment.
   1. Submit request as specified in the Contract Documents.
   2. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

J. The Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
   1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule Update.
   2. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of

time adjustment in the Progress Schedule as the Engineer may accept as appropriate for such interim purpose.

3. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made.
4. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

1.10 SCHEDULE PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints.
   1. Failure to conform to requirement may result in termination for cause.

B. Contractor's bid covers all costs associated with the execution of the Work in accordance with the Progress Schedule.

C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare schedule utilizing Precedence Diagramming Method (PDM).

E. Prepare schedule utilizing activity durations in terms of working days.
   1. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries.
   2. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.
   3. Coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract.
   1. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule.
   2. Contract requirements are not waived by Owner’s acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

G. Reference schedule to working days with beginning of Contract Time as Day "1".

H. Baseline Schedule and Project Completion:
   1. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor’s schedule completion date.
   2. Adjust accordingly any Contract milestone dates.

I. Imposed dates, hidden logic prohibited: Do not use imposed dates or hidden logic in preparation of schedule.

J. Interim milestone dates, operational constraints:
   1. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule.
   2. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

K. Contract float is for the mutual benefit of both Owner and Contractor.
   1. Changes to the project that can be accomplished within this available period of float may be made by Owner without extending the Contract Time, by utilizing float.
   2. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date.
   3. Likewise, Contractor may utilize float to offset delays other than delays caused by Owner.
   4. Mutual use of float can continue until all available float shown by schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract Time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.
   5. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for, use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

L. Resource loading and leveling: Input labor and equipment data on each schedule activity.
   1. Manpower data consist of the man-hours estimated to perform each task, categorized by trade.
   2. Equipment data consist of equipment hours estimated to perform each task, categorized by piece of equipment. Optimize and level manpower and equipment requirements.
   3. Resource leveling reflect a reasonable plan for accomplishing Work.
   4. Individual activities may be sequenced within limits of available float.
   5. Keep to a minimum critical or near critical paths resulting from use of labor or equipment restraints.
   6. Near critical path identified as path with 15 or less working days of float.

M. Schedule logic:
   1. Assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment.
   2. Form basis for assembly of schedule logic on the following criteria:
      a. Which activities must be completed before subsequent activities can be started?
      b. Which activities can be performed concurrently?
      c. Which activities must be started immediately following completed activities?
      d. What major facility, equipment, or manpower restrictions are required for sequencing these activities?

N. Major subcontractor, parallel prime contractor sign off:
   1. Provide written confirmation of concurrence from all major subcontractors and independent prime contractors on site with all schedule submittals.
   2. Term “major subcontractor” as used in this Section means any subcontractor, at any tier, with a subcontract worth 5 percent or more of the total cost of the Work.

O. Schedule windows for Owner-furnished, Contractor-installed equipment or materials:
   1. Immediately after Award of Contract, obtain from Engineer anticipated delivery dates of Owner furnished equipment or materials.
   2. Show these dates in the schedule in same manner indicated by Engineer.

P. Commissioning schedule:
   1. Commissioning activities and milestones shall be an integral part of the overall project schedule.
   2. Commissioning activities and milestones shall be extracted from the main project schedule to provide a separate commissioning schedule that is submitted each time the project schedule is submitted.

Q. Cost loading: All schedules:
   1. Only on-site construction activities.
   2. The sum total of all cost loaded activities equal to the current value of the Contract, including change orders, at all times.
   3. Payment for mobilization or payment for materials or equipment delivered to the site, not yet incorporated into the Work,
   4. Owner acceptance of the Baseline Schedule creates the Schedule of Values required as specified in Section 01_29_73 - Schedule of Values.
   5. Provide updated Schedule of Values as the monthly Payment Application as specified in Section 01_29_77 - Applications for Payment.
   6. Payments will not be made until updated Schedule of Values is accepted.

1.11 NETWORK DETAILS AND GRAPHICAL OUTPUT

A. Produce a clear, legible, and accurate calendar based, time scaled, and graphical network diagram.
   1. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished.
   1. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Indicate the critical path for the project.

E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone.
   1. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.

F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.

G. Include, in addition to construction activities:
   1. Submission dates and review periods for major equipment submittals, shoring submittals, and indicator pile program:
      a. Shoring reviews: Allow 4-week review period for each shoring submittal.
      b. Pile indicator program: Allow 3-week review period for analysis of program.
   2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
   3. Equipment and long-lead material deliveries over 8 weeks.
   4. Approvals required by regulatory agencies or other third parties.

H. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

I. Identify the execution of the following:
   1. Mobilization.
   2. All required submittals and submittal review times showing 30 calendar day duration for such activities and equal amount of time for re-submittal reviews.
   3. Equipment and materials procurement/fabrication/delivery.
   4. Grading, subbase, base, and paving.
   5. Concrete, including installation of forms and reinforcement, placement of concrete, curing, stripping, finishing, and patching.
   6. Metal fastenings, framing, structures, and fabrications.
   7. Waterproofing and dampproofing, insulation, roofing and flashing, and sealants.
   8. Trenching, pipe laying, and trench backfill and compaction.
   9. Valves, gates, and operators, including identification of order lead-time, installation, and testing.
   10. Electric transmission, service, and distribution equipment, including identification of ordering lead-time, and factory testing.
   11. Other electrical work including lighting, heating and cooling, and special systems, including identification of ordering lead-time.
   12. Instrumentation and controls, including identification of ordering lead-time.
   13. Preliminary testing of equipment, instrumentation, and controls.
   14. Commissioning Phase:
      a. Source Testing.
      b. Owner Training.
      c. Installation Testing.
      d. Functional Testing.
   15. Process Start-up Phase:
      a. Process Start-up.
      b. Process Operational Period.
      c. Instrumentation and Controls Performance Testing.

16. Substantial completion.
17. Punch list work.
18. Demobilization.

1.12 WEATHER DAY ALLOWANCE

A. Definition:
   1. Weather conditions that prevent or inhibit the Contractor's performance of the Work and affect the Critical Path indicated on the Schedule shall be referred to as a Weather Day.
   2. A Weather Day is defined as the Contractor being unable to perform at least 4 hours of work on the Critical Path.

B. Allowance:
   1. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Days Allowance".

C. Actual weather day:
   1. Insert a weather delay activity in critical path to reflect actual weather day occurrences when weather days are experienced and accepted by Engineer.
   2. Reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float.
   3. The Contractor shall provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and shall describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted.
      a. A schedule update will not suffice as a written notice.
      b. The Engineer will determine if the weather day constitutes a use of a portion of the Weather Day Allowance.
      c. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions.
      d. Weather days are considered excusable delay as defined in this Section.

1.13 ALLOWANCE FOR OWNER-CAUSED DELAY

A. Allowance:
   1. Include as a separate identifiable activity on the critical path, an activity labeled "Allowance for Owner-Caused Delay."
   2. Insert this activity at the end of the schedule, following the Project Completion Milestone.
   3. Duration of this activity is specified in Bid Form.
      a. The duration of this Owner-Caused Delay Allowance is in addition to the contractual time frame.

B. Actual delay:
   1. Insert an activity in critical path to reflect actual Owner-caused delay occurrences when Owner-caused delay days are experienced and accepted by Engineer.
      a. Identify this activity as an Owner-caused delay.

2. Reduce duration of Owner-Caused Delay Allowance activity as Owner-caused delays are experienced and inserted into the schedule. Remaining days in Owner-Caused Delay Allowance at completion of project is considered float.

1.14 PRELIMINARY SCHEDULE AND PRELIMINARY SCHEDULE OF VALUES

A. Due date:
   1. Submit proposed preliminary schedule and Preliminary Schedule of Values within 14 calendar days after Notice to Proceed.
   2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule and Preliminary Schedule of Values to review and make necessary adjustments.
   3. Submit revised preliminary schedule and Preliminary Schedule of Values within 5 calendar days after meeting.
   4. Update Preliminary Schedule and Preliminary Schedule of Values monthly during first 90 calendar days after Notice to Proceed.
      a. Use Preliminary Schedule and Preliminary Schedule of Values as the payment application as specified in Section 01_29_77 - Applications for Payment.

B. Format:
   1. Schedule of manpower and costs for all activities for first 90 calendar days of Work after receipt of Notice to Proceed.
      a. Provide realistic and level manpower and costs so as not to have unusual manpower requirements.
   2. Schedule of costs:
      a. Schedule of Values as specified in Section 01_29_73 - Schedule of Values for first 90 calendar days of Work.
      b. Submittal and acceptance of Preliminary Schedule is condition precedent to making of progress payments as specified in Section 01_29_77 - Applications for Payment and payments for mobilization costs otherwise provided for in the Contract.
      c. Proceed with pay item Work after Preliminary Schedule and schedule of costs have been accepted by Owner.

C. Incorporate unchanged, the accepted Preliminary Schedule as first 90 calendar days of activity in Contractor's Baseline Schedule.

1.15 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals shall include submittals required in the Contract Documents but not limited to test plans, training plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.
   1. Data for "Or Equals" or substitutions shall be submitted with the Schedule of Submittals.

B. Preliminary Schedule of Submittals:
   1. Due date: After Preliminary Schedule has been submitted and accepted by Owner.
   2. Format:
      a. Include submittals anticipated in the first 90 calendar days after award of contract using early start dates.

b. Indicate week and month anticipated for submittal to Engineer.
c. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
    1) “Priority” indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
    2) Engineer will endeavor to provide early review of “Priority” submittals where possible.
d. List of “Or Equals” or substitutions.

3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to Owner making progress payments during the first 90 calendar days after award of contract.

C. Final Schedule of Submittals:
1. Due date: 30 days after Baseline Schedule has been submitted and accepted by Owner.
2. Format:
    a. Include submittals using early start dates.
    b. Include all submittals, including those required in the Preliminary Schedule of Submittals.
    c. Indicate week and month anticipated for submittal to Engineer.
    d. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
        1) “Priority” indication will not alter review times specified in Section 01_33_00 - Submittal Procedures.
    e. Data for “Or Equals” or substitutions.
3. Submittal of Final Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

D. Provide updated Schedule of Submittals with updated schedules if schedule revisions change listing and timing of submittals.

1.16 BASELINE SCHEDULE AND BASELINE SCHEDULE OF VALUES

A. Due date: No more than 45 calendar days after Notice to Proceed.

B. Format:
1. Schedule: Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.
2. Schedule of Values: As specified in Section 01_29_73 - Schedule of Values.

C. Acceptance of the Baseline Schedule and Baseline Schedule of Values by the Owner is a condition precedent to making payments as specified in Section 01_29_77 - Applications for Payment after the first 90 calendar days after Notice to Proceed.

1.17 SUMMARY SCHEDULE

A. Due date: At weekly progress meetings and after each Schedule Update or Schedule Revision.

B. Format:
   1. Consolidate groups of activities associated with Major Items of Work shown on Baseline Schedule.
   2. intended to give an overall indication of the project schedule without a large amount of detail.

1.18 COST FLOW SUMMARY

A. Due date: After Baseline Schedule has been submitted and accepted by the Owner, submit on a monthly basis as specified in Section 01_29_77 - Applications for Payment.

B. Format:
   1. Tabular and graphic report showing anticipated earnings each month of the Contract period.
   2. Base tabulation on the summation of the cost-loaded activities each month.
   3. Show planned amounts.
   4. Show actual earned amounts and anticipated remaining earnings.
   5. Spreadsheet format of all schedule activities showing cost and percentage completion during the current month for which payment is sought.

1.19 PROGRESS SCHEDULE AND UPDATED SCHEDULE OF VALUES

A. Due date: Submit on a monthly basis as specified in Section 01_29_77 - Applications for Payment.

B. Format: Schedule of Values: As specified in Section 01_29_73 - Schedule of Values.

1.20 WEEKLY SCHEDULE

A. Due date: At every weekly progress meeting.

B. Format:
   1. Contractor and Engineer must agree on the format.
   2. 6-Week Schedule showing the activities completed during the previous week and the Contractor’s schedule of activities for following 5 weeks.
   3. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format.
      a. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule as specified in this Section.
   4. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

1.21 MANPOWER SCHEDULE

A. Due date: With progress payments after Baseline Schedule has been submitted and accepted by Owner.

B. Format:
   1. Schedule histogram depicting total craft manpower and craft manpower for Contractor's own labor forces and those of each subcontractor.
   2. Submit electronically in Excel format, with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until manpower schedule is provided.

1.22 EQUIPMENT SCHEDULE

A. Due date: With any progress payment after Baseline Schedule has been submitted and accepted by Owner if it includes payment for equipment.

B. Format:
   1. Tabular report listing each major piece of construction equipment to be used in performing the Work.
   2. Include major equipment for Contractor and each subcontractor.
   3. Submit electronically in Excel format with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until equipment schedule is provided.

1.23 COMMISSIONING SCHEDULE

A. Proposed Commissioning Schedule:
   1. Schedule requirements: As specified in Section 01_75_17 - Commissioning.
   2. Submittal due date: As specified in Section 01_75_17 - Commissioning.
   3. Engineer response due within 20 calendar days of receipt.
   4. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and Owner comments.

B. Construction Schedule can include the Commissioning Schedule after Engineer acceptance of the Proposed Commissioning Schedule.
   1. Capable of extracting a stand-alone Commissioning Schedule.
   2. Capable of extracting a stand-alone Owner Training Schedule.

C. Monthly update requirements:
   1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
   2. Include activities not previously included in the previously accepted detail work plan Commissioning Schedule.
   3. Change Order required for any change to contractual dates.
   4. Reviews of these submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.24 FINAL SCHEDULE

A. The final Schedule Update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
   2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_32_34

PHOTOGRAPHIC AND VIDEOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for photographs and videos.

B. The purpose of the photographs and videos is to document the condition of the facilities prior to the Contractor beginning work at the Project site, the progress of the Work, and the Project site after Substantial Completion of the Work.

C. The scope of the photographic and videographic documentation shall be the sole responsibility of the Contractor but shall be acceptable to the Engineer.

1.02 SUBMITTALS

A. Photographer qualifications.

B. Pre-construction photographs and videos: Submit prior to beginning work at the Project site or prior to the Preconstruction Conference specified in Section 01_31_19 - Project Meetings, whichever occurs earlier.

C. Construction photographs and videos: Submit with each application for payment.

D. Post-construction photographs and videos: Submit with project closeout documents as specified in Section 01_77_00 - Closeout Procedures.

1.03 PHOTOGRAPHER

A. Photographer qualified and equipped to photograph either interior or exterior exposures, with lenses ranging from wide angle to telephoto.

B. Submit example work of previous photographs and video recording meeting the requirements of this Section.
   1. Provide to Engineer no later than the pre-construction conference.
   2. Provide photographs used for site examination.
   3. Provide video of site examination.
   4. Provide samples that used same camera and lighting equipment proposed for the Work.
   5. Engineer will review work examples to determine if the quality of the images is acceptable.
   6. Contractor is responsible for modifications to equipment and/or inspection procedures to achieve report material of acceptable quality.
   7. Do not commence Work prior to approval of the material by the Engineer.
   8. Once accepted, the standard report material shall serve as a standard for the remaining work.

1.04 KEY PLAN

A. Submit key plan of Project site with notation of vantage points marked for location and direction of each photograph.

B. Include the same label information as the corresponding set of photographs.

1.05 PHOTOGRAPHS

A. Provide prints of each photograph for each area of Work.

B. Provide a digital copy of each photograph for each area of Work.
   1. Monthly: Indexed digital flash drive.
   2. Project record documents:
      a. Catalog and index prints in chronological sequence.
      b. Include typed table of contents.

1.06 PRE-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs and video of the condition entire site including each area of Work prior to the start of Work.
   1. Areas to be photographed and videoed shall include the site of the Work and all existing facilities, either on or adjoining the Project site, including the interior of existing structures, that could be damaged as a result of the Contractor's Work.
   2. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.

1.07 CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs and videos of construction in each area of Work throughout progress of Work including a key plan designating where each photograph was taken.

B. Take site and interior photographs and videos from differing directions of building demolition, pre-excavation, footing excavation, soil testing, utility crossings, installation of bypass piping, excavation of access pits, installation of lining system in pipes, rehabilitation of manholes, building modifications, utilities, electrical and instrumentation modifications, and other applicable activities indicating relative progress of the work.

C. Take photos a maximum of 7 calendar days prior to submittal.

1.08 POST-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs of the entire site including each area of Work at the completion of Work.
   1. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.
   2. Take photos and video from same points in same direction as pre-construction examination.

B. Submittal of photos and videos is a condition of final payment.

PART 2 PRODUCTS

2.01 MEDIA

A. Digital media:
   1. Flash drive compatible with current Microsoft Windows.
   2. Provide photos as individual, indexed JPG files with the following characteristics:
      a. Compression shall be set to preserve quality over file size.
      b. Highest resolution JPG images shall be submitted. Resizing to a smaller size when high resolution JPGs are available shall not be permitted.
      c. JPG image resolution shall be 5 megapixels at 2,400 by 1,800 or higher.
      d. Images shall have clean rectangular images. Artistic borders, beveling, drop shadows, etc., are not permitted.
   3. Identification: On photograph, provide the following information:
      a. Name of project.
      b. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
      c. Description of vantage point, indicating location and direction by compass point.

B. Videos:
   1. Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
   2. Digital color video format.
   3. Provide audio portion of the composite video sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
   4. Identification: On each copy provide a label with the following information:
      a. Name of project.
      b. Date video was recorded.
   5. Submit 1 copy of each video within 7 days of recording.
   6. Display continuous running time.
   7. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.

PART 3 EXECUTION

Not used.

END OF SECTION

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SECTION 01_33_00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements and procedures for submittals to confirm compliance with Contract Documents.

1.02 GENERAL INSTRUCTIONS

A. Contractor is responsible to determine and verify field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved shop drawings and Contract Document requirements.

B. Provide submittals:
   1. That are specified or reasonably required for construction, operation, and maintenance of the Work.
   2. That demonstrate compliance with the Contract Documents.

C. Where multiple submittals are required, provide a separate submittal for each specification section.
   1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
      a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
      b. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.

D. Prepare submittals in the English language. Do not include information in other languages.

E. Present measurements in customary American units (feet, inches, pounds, etc.).

F. Must be clear and legible, and of sufficient size for presentation of information.

G. Page size other than drawings:
   1. Minimum page size will be 8 1/2 inches by 11 inches:
   2. Maximum page size will be 11 inches by 17 inches.

H. Drawing sheet size:
   1. Maximum sheets size: 22-inch by 34-inch.
      a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
      b. Minimum font size: 1/8 inch minimum.

2. 11-inch by 17-inch sheet:
    a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
    b. Minimum font size: 1/8 inch minimum.

I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

J. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.

1.03 SUBMITTAL ORGANIZATION

A. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

B. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

C. Bookmarks:
1. Bookmarks shall match the table of contents.
2. Bookmark each section (tab) and heading.
3. Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
4. At file opening, display all levels of bookmarks as expanded.

D. Where applicable (i.e., except for drawings, figures, etc.) submittal content shall be electronically searchable utilizing the PDF file as submitted.

E. Thumbnails optimized for fast web viewing.

F. Sequentially number pages within the tabbed sections:
1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

G. Attachments:
1. Specification section: Include with each submittal a copy of the relevant specification section.
    a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
    b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates.
    a. Indicate either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
    b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
    c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.

H. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements.
   1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
   2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
   3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

I. Contractor: Prepare "Or Equal" submittal information.
   1. Provide standard submittal requirements.
      a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
   2. Provide reason the specified product is not being provided.
   3. Explain the benefits to the Owner for accepting the "Or Equal".
   4. Itemized comparison of the proposed "Or Equal" with product specified including a list of significant variations:
      a. Design features.
      b. Design dimensions.
      c. Installation requirements.
      d. Operations and maintenance requirements.
      e. Availability of maintenance services and sources of replacement materials.
   5. Reference projects where the product has been successfully used:
      a. Name and address of project.
      b. Year of installation.
      c. Year placed in operation.
      d. Name of product installed.
      e. Point of contact: Name and phone number.
   6. Define impacts:
      a. Impacts to other contracts.
      b. Impacts to other work or products.
   7. Contractor represents the following:
      a. Contractor bears the burden of proof of the equivalency of the proposed "Or Equal".
      b. Proposed "Or Equal" is equal or superior to the specified product.
      c. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed "Or Equal", unless Owner requires a Special Warranty.
      d. Contractor will coordinate installation of accepted "Or Equal" into the Work and will be responsible for the costs to make changes as required to the Work.
      e. Contractor waives rights to claim additional costs caused by proposed "Or Equal" which may subsequently become apparent.

J. Contractor: Prepare substitution submittal information.
   1. Provide standard submittal requirements.
      a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
   2. Provide reason the specified product is not being provided.
   3. Explain the benefits to the Owner for accepting the substitution.

4. Itemized comparison of the proposed substitution with product specified including a list of significant variations:
    a. Design features.
    b. Design dimensions.
    c. Installation requirements.
    d. Operations and maintenance requirements.
    e. Availability of maintenance services and sources of replacement materials.
5. Reference projects where the product has been successfully used:
    a. Name and address of project.
    b. Year of installation.
    c. Year placed in operation.
    d. Name of product installed.
    e. Point of contact: Name and phone number.
6. Define impacts:
    a. Impacts to Contract Price.
        1) Required license fees or royalties.
        2) Do not include costs under separate contracts.
        3) Do not include Engineer's costs for redesign or revision of Contract Documents.
    b. Impacts to Contract Time.
    c. Impacts to Contract Scope.
    d. Impacts to other contracts.
    e. Impacts to other work or products.
7. Contractor represents the following:
    a. Contractor shall pay associated costs for Engineer to evaluate the substitution.
    b. Contractor bears the burden of proof of the equivalency of the proposed substitution.
    c. Proposed substitution does not change the design intent and will have equal performance to the specified product.
    d. Proposed substitution is equal or superior to the specified product.
    e. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution, unless Owner requires a Special Warranty.
    f. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
    g. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

1.04 SUBMITTAL METHOD AND FORMAT

A. Submittal identification numbering:
   1. Number each submittal using the format defined below:

	Spec Section Number	Dash	Initial Submittal - Sequential Number	Decimal Point	Subsequent Submittal Revisions Sequential Number
Example 1 Description	*Cast-In-Place Concrete*		*8th initial submittal*		
	00_30_30	-	0008		
Example 2 Description	*Cast-In-Place Concrete*		*8th initial submittal*		*First revision to the 8th initial submittal*
	00_30_30	-	0008	.	1

B. Submittals in electronic media format:
   1. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.
   2. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).
   3. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).
   4. Contractor using other software shall be required to provide to the Engineer conclusive evidence of 100-percent data transfer compatibility.

C. Contractor:
   1. Submit the hard copy submittal in the format provided in Attachment A - Contractor Submittal Transmittal Form.
      a. Provide the following number of copies of submittal:
         1) Total: 4 copies minimum except where noted.
         2) Owner: 1 copy.
         3) Engineer: 3 copies.

1.05 SUBMITTAL PROCEDURE

A. Engineer: Review submittal and provide response:
   1. Review description:
      a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
      b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.

c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
d. Engineer's review does not extend to:
    1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.
    2) Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
    3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
e. Engineer can Approve or Not Approve any exception at their sole discretion.

2. Review timeframe:
    a. Except as may be provided in technical specifications, a submittal will be returned within 30 days.
    b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
    c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
    d. Critical submittals:
        1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.
3. Schedule delays:
    a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
        1) Engineer has failed to review and return first submission within the agreed upon time frame.
        2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.
4. Review response will be returned to Contractor with one of the following dispositions:
    a. Approved:
        1) No Exceptions:
            a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.
        2) Make Corrections Noted - See Comments:
            a) The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
            b) Resubmittal not required.
        3) Make Corrections Noted - Confirm:
            a) The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
            b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

b. Not approved:
    1) Correct and resubmit:
        a) Contractor may not proceed with the Work described in the submittal.
        b) Contractor assumes responsibility for proceeding without approval.
        c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.
    2) Rejected - See Remarks:
        a) Contractor may not proceed with the Work described in the submittal.
        b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.
c. Receipt acknowledged - Filed for record:
    1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
d. Receipt acknowledged with comments - Resubmit:
    1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.

B. Contractor: Prepare resubmittal, if applicable:
    1. Clearly identify each correction or change made.
    2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented throughout the submittal and numbered consistent with the Engineer's numbering.
        a. Acceptable responses to Engineer's comments are listed below:
            1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
            2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
        b. Reviews and resubmittals:
            1) Contractor shall provide resubmittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
            2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment. Responses such as "acknowledged" or "noted" are not acceptable.
            3) Resubmittals which do not comply with this requirement may be rejected and returned without review.

4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.

c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.

3. Resubmittal timeframe:
   a. Contractor shall provide resubmittal within 15 days.
   b. When a resubmittal cannot be returned within the specified period, Contractor shall notify Engineer in writing.
4. Review costs:
   a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
   b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.06 PRODUCT DATA

A. Edit submittals so that the submittal specifically applies to only the product furnished.

B. Neatly cross out all extraneous text, options, models, etc. that do not apply to the product being furnished, so that the information remaining is only applicable to the product being furnished.

1.07 SHOP DRAWINGS

A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of shop drawings.

B. Indicate project designated equipment tag numbers for submittal of devices, equipment, and assemblies.

1.08 SAMPLES

A. Details:
   1. Submit labeled samples.
   2. Samples will not be returned.
   3. Provide number of sample submittals as below:
      a. Total: 3 minimum.
         1) Owner: 1.
         2) Engineer: 2.
         3) Contractor: None.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT A - CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	Click here to enter text.	**Date:**	MM/DD/YYYY
Contractor:	Click here to enter text.	**Project No.:**	XXXXX.XX
Project Name:	Click here to enter text.	**Submittal Number:**	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal / Equipment Supplier			
Spec ##:	Spec ##.	**Subject:**	Click here to enter text.
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Submittal Certification		
Check Either (A) or (B):		
☐	(A)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.
☐	(B)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.
Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.		
General Contractor's Reviewer's Signature:		
Printed Name:		
In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.		
Firm: Click here to enter text.	**Signature:**	**Date Returned:** XX/XX/XXXX

PM/CM Office Use	
Date Received GC to PM/CM:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

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SECTION 01_35_73

DELEGATED DESIGN PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Delegated Design Procedures.

1.02 GENERAL

A. Delegated Design - Professional design services assigned to the Contractor by express delegation in the Contract Documents. Work is “Delegated Design” where the Technical Sections require the Contractor to provide professional design services and to submit signed and sealed documents from a registered Professional Engineer.

B. Contractor’s Professional Engineer – The design professional retained by the Contractor to perform Delegated Design.

C. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents.
   1. Requirements of Delegated Design component as specified in the technical section and as indicated on the Drawings.
   2. 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 Delegated Design.

D. Contractor shall cause such Delegated Design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal shall appear on drawings, calculations, specifications, certifications, and submittals prepared by such design professional.
   1. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
   2. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.
   3. Such design professional shall issue certifications of design required by Laws and Regulations.
   4. 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 shall bear the written approval of Contractor’s design professional when submitted by Contractor to Engineer.

E. 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 Delegated Design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

F. Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to a Delegated Design will be only for the following limited purposes:
   1. Confirming that submittal is in conformance with the performance and design criteria specified in the Contract Documents.

1.03 CONTRACTOR'S PROFESSIONAL ENGINEER

A. Contractor or Subcontractor shall retain a licensed professional engineer to perform Delegated Design.

B. Qualifications:
   1. Holding a current license to perform the specified design in the same jurisdiction as the Project site.
   2. Experienced in designing similar systems of similar complexity.

C. Insurance:
   1. Provide Contractor's Professional Engineer's Professional Liability Insurance as specified Section 00800 - Supplementary Conditions. If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of 2 years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

D. Responsibilities:
   1. Review and design in accordance with system performance and design criteria stated in the Contract Documents.
      a. Prepare written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
   2. Sign and seal design reports, calculations, design drawings and specifications, and other design Submittals for the Delegated Design Work.
   3. Review and submit written approval of submittals related to the Delegated Design Work.
   4. Design modifications to the Delegated Design Work as required.
   5. Visit the Site, as required, to verify that installation of the Delegated Design Work is in conformance with the Delegated Design drawings and specifications.
   6. Submit through Contractor to Engineer written, signed, and sealed certification that the installed Delegated Design Work complies with Contractor's professional engineer's design.

1.04 SUBMITTALS

A. Prior to the start of Delegated Design:
   1. Contractor's Professional Engineer's qualifications:
      a. Experience for the Delegated Design.
      b. Evidence of professional engineering license.
   2. Contractor's Professional Engineer Professional Liability Insurance certificate.

B. Delegated Design:
   1. Product data:
      a. Details related to the Delegated Design as specified in technical sections to completely describe the system.
   2. Design documents with signature and seal from the Contractor's Professional Engineer.
      a. Design documents include but are not limited to drawings, calculations, specifications, inspection reports, and certifications.
   3. Lists and schedules:
      a. Prepare and submit lists or schedules of items where delegated design is required by the Contract Documents.
      b. Group items by location in the Work.
         1) When "Area Numbers" are indicated on the Contract Drawings, group lists in accordance with those "areas."
         2) For work without area numbers, group using logical divisions acceptable to Engineer.
         3) Group items within each "area" as follows:
            a) Systems.
            b) Components.
            c) Supports.
            d) Anchorage.
            e) Bracing.

C. Construction services:
   1. Contractor's Professional Engineer's comments on submittals.
   2. Other construction documents, as required.

1.05 ENGINEER RESPONSE TO DELEGATED DESIGN SUBMITTALS

A. The Engineer response will be either of the following:
   1. Approved. Make Corrections Noted - See Comments:
      a. The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
      b. The review was for the limited purpose of determining that the document was stamped by a Professional Engineer and that such design is generally consistent with and will not negatively affect the design concept presented in the Contract Documents.
   2. Rejected - See Remarks:
      a. Contractor may not proceed with the Work described in the submittal.
      b. The submittal does not meet the intent of the Contract Documents.
      c. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_41_00

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION (AHJ)

A. Also referred to as the permitting agency.

B. Building Department: City of El Paso.

C. Fire Department: El Paso Fire Department.

D. Regulatory Agency: Texas Commission on Environmental Quality.

1.03 APPLICABLE CODES

A. International Code Council (ICC).
   1. Building code:
      a. International Building Code (IBC), 2015.
      b. International Existing Building Code (IEBC), 2015.
   2. Electrical code:
      a. National Fire Protection Association (NFPA), NFPA 70: National Electrical Code (NEC), 2014.
   3. Energy code:
      a. International Energy Conservation Code (IECC), 2015.
   4. Fire code:
      a. International Fire Code (IFC), 2015.
   5. Fuel gas code:
      a. International Fuel Gas Code (IFGC) – 2015.
   6. Mechanical code:
      a. International Mechanical Code (IMC), 2015.
   7. Plumbing code:
      1) International Plumbing Code (IPC), 2015.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

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SECTION 01_45_00

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mock-up requirements.
   5. Authority and duties of Owner’s representative or inspector.
   6. Sampling and testing.
   7. Testing and inspection services.
   8. Contractor’s responsibilities.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. When specified, products will be tested and inspected either at point of origin or at Work site:
   1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
   2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.

I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

A. ASTM International (ASTM):
   1. E329 - Standard for Agencies Engaged in Construction Inspection, Testing or Special Inspection.

B. National Institute of Standards and Technology (NIST).

1.05 PRODUCT REQUIREMENTS

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.06 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.07 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE OR INSPECTOR

A. Owner’s Project Representative employed or retained by Owner is authorized to inspect the Work.

B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.

C. Deficiencies or defects in the Work which have been observed will be called to Contractor's attention.

D. Inspector will not:
   1. Alter or waive provisions of Contract Documents.
   2. Inspect Contractor's means, methods, techniques, sequences, or procedures for construction.
   3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for Contractor. Supervise, control, or direct Contractor's safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether Contractor's employees or others.

E. Inspector will:
   1. Conduct on-site observations of the Work in progress to assist Engineer in determining when the Work is, in general, proceeding in accordance with Contract Documents.
   2. Report to Engineer whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special procedures.

1.08 SAMPLING AND TESTING

A. General:
   1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
   2. When specified in sections where products are specified:
      a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
      b. Test materials in accordance with standards of national technical organizations.

B. Sampling:
   1. Furnish specimens of materials when requested.
   2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
   3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
   4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

1.09 TESTING AND INSPECTION SERVICES

A. Contractor will employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the technical specifications for various work and materials.

B. Owner will employ and pay for specified services of an “Owner’s independent testing firm” certified to perform testing and inspection as required in the technical specifications for various work and materials or stipulated in Section 01_45_24 - Regulatory Quality Assurance to confirm Contractor’s compliance with Contract Documents.

C. The Owner’s independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner and requested by the Engineer.

D. The qualifications of laboratory that will perform the testing, contracted by the Owner or by the Contractor, shall be as follows:
   1. Has authorization to operate in the state where the project is located.
   2. Meets “Recommended Requirements for Independent Laboratory Qualification,” published by American Council of Independent Laboratories.
   3. Meets requirements of ASTM E329.
   4. Laboratory Staff: Maintain full time specialist on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to NIST or accepted values of natural physical constants.
   6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NIST during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.

E. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing inspections and source quality control as required by Engineer or Owner.

F. Contractor shall cooperate with Owner’s independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and Owner’s independent testing firm 48 hours prior to expected time for operations requiring testing.
   2. Make arrangements with Owner’s independent testing firm and pay for additional samples and tests required for Contractor’s use.

G. Limitations of authority of testing Laboratory: Owner’s independent testing firm or Laboratory is not authorized to:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

H. Testing and employment of an Owner’s independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same Owner’s independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. The Owner's independent testing firm responsibilities will include:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Engineer.
   7. Attend preconstruction meetings and progress meetings.

K. Owner's independent testing firm individual test reports: After each test, Owner's independent testing firm will promptly submit electronically and 3 hard copies of report to Engineer and to Contractor. Include the following:
   1. Date issued.
   2. Project title and number.
   3. Name of inspector.
   4. Date and time of sampling or inspection.
   5. Identification of product and specifications section.
   6. Location in Project.
   7. Type of inspection or test.
   8. Date of test.
   9. Certified test results stamped and signed by a registered Engineer in the state where the project is located.
   10. Summary of conformance with Contract Documents.
   11. When requested by Engineer, the Owner's independent testing firm will provide interpretation of test results.

L. Owner's independent testing firm will provide monthly report of certification to identify all work performed for special inspections and other contract requirements on this project. The following certified monthly report at a minimum will include but not limited to:
   1. Results of testing.
   2. Testing logs.
   3. Outstanding deficiencies.
   4. Various statistical data.
   5. Testing curves (up to 4 types) as required by the Engineer.

1.10 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Owner's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

B. Secure and deliver to Owner's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

C. Provide to Owner's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

D. Furnish electronically and 5 hard copies of product test reports.

E. Furnish incidental labor and facilities:
   1. To provide access to construction to be tested.
   2. To obtain and handle samples at Work site or at source of product to be tested.
   3. To facilitate inspections and tests.
   4. For storage and curing of test samples.

F. Notify Owner's independent testing firm or laboratory 48 hours in advance of when observations, inspections and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_45_17

CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contractor Quality Control Plan.

1.02 SUBMITTALS

A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager.

B. Contractor's Daily Quality Control Report: Submit to Engineer within 1 day of completion of each inspection.

C. Daily Inspection Report: Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.

B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifying registrations.

B. Minimum qualifications: Candidate must have a minimum of 10 years of experience on projects of similar type and size.

1.05 COVERING WORK

A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to Article 14 of the General Conditions.

1.06 CONTRACTOR'S QUALITY CONTROL PROGRAM

A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined

requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.

B. CQC personnel:
   1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
   2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
   3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.

C. CQC Plan:
   1. Contractor's CQC Plan shall include a statement by the Senior Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
   2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
   3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
   4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
   5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
   6. Commissioning quality control: Include procedures to verify that the commissioning requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
   7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
   8. Procedures to preclude the covering of deficient or rejected Work.
   9. Procedures for halting or rejecting Work.
   10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.
   11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.

D. Daily Inspection Report: Include, at a minimum:
   1. Inspection of specific work.
   2. Quality characteristics in compliance.

3. Quality characteristics not in compliance.
4. Corrective/remedial actions taken.
5. Statement of certification.
6. CQC Manager's signature.
7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.

E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
   1. Personnel responsible for identifying deficient and non-complying items within Work.
   2. How and by whom deficient and non-compliant items are documented "in the field."
   3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
   4. Tracking processes and tracking documentation for deficient and non-conforming Work.
   5. Personnel responsible for achieving resolution of outstanding deficiencies.
   6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.

G. Documented control/quality records:
   1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to ensure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Engineer.
   2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification and certification records, procedures, and document review records.
   3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
   4. Develop a list of specific records as required by the Contract Documents that will be furnished to Engineer at the completion of activities.

H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole discretion, and without cause, may direct Contractor to remove and replace the CQC Plan Manager.
   1. Acceptance of the CQC Plan by the Engineer is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
   2. After acceptance of the CQC Plan, notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_45_24

REGULATORY QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: This Section describes project regulatory requirements for quality assurance that includes special inspections, special certification, and structural observation.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete.
   2. 530 – Building Code Requirements for Masonry Structures.
   3. 530.1 – Specification for Masonry Structures.

B. American Institute of Steel Construction (AISC):
   1. 360 – Specification for Structural Steel Buildings.

C. American Society of Civil Engineers (ASCE):
   1. 7 - Minimum Design Loads for Buildings and Other Structures.

D. American Welding Society (AWS):
   1. D1.3 - Structural Welding Code - Sheet Steel.
   2. D1.4 - Structural Welding Code - Reinforcing Steel.

E. ASTM International (ASTM):
   1. A706 – Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   3. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   4. C1611 Standard Test Method for Slump Flow of Self-Consolidating Concrete.

F. International Building Code (IBC) 2015 with City of El Paso amendments.

G. The Masonry Society (TMS):
   1. 402 – Building Code for Masonry Structures.
   2. 602 – Specifications for Masonry Structures.

1.03 DEFINITIONS

A. Special Certification: Certification for designated seismic systems that demonstrates compliance with performance requirements.

B. Special Inspection: Inspection of the materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.

C. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

D. Special Inspection, Periodic: The part-time, or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed and at the completion of the work.

E. Structural Observation: The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system.

1.04 DESCRIPTION

A. This Section describes special inspections, special certification and structural observation of structural assemblies and components to be performed in compliance with the building code specified in Section 01_41_00 - Regulatory Requirements.

B. The special certification and special inspections specified in this Section are in addition to the requirements specified in Section 01_45_00 - Quality Control, and by the individual Sections.

1.05 SUBMITTALS

A. Contractor shall submit special certifications for designated seismic systems.

B. Contractor shall schedule and coordinate the submittal of Special Inspection reports and test results prepared by others.

1.06 SPECIAL INSPECTION

A. Owner will employ 1 or more special inspectors who will provide special inspections during construction.

B. Special inspector(s) shall be qualified for inspection of the particular type of materials or operations requiring special inspection.

C. Testing laboratory: Testing that is required to satisfy the requirements of special inspection will be performed by the Owner's testing laboratory as specified in Section 01_45_00 - Quality Control.

D. Duties of Special Inspector:
   1. General: Required duties of the special inspector(s) shall be as described in Chapter 17 of the building code specified in Section 01_41_00 - Regulatory Requirements.
   2. Reporting: Special inspector(s) shall provide reports of each inspection to the Owner and shall distribute copies of inspection reports to the Engineer and Contractor as required.
      a. Reports shall, at a minimum, include the following items:
         1) Date and time of inspection, and name(s) of individual(s) performing the inspection.

2) Structures and areas of the structure where work or testing was observed.
3) Discrepancies between the requirements of the Contract Documents and the work or testing observed.
4) Other areas of deficiency in the Work.

E. Special inspections shall not be construed as fulfilling the requirements for structural observation.

F. Owner or special inspector are responsible to select materials for special inspection.
1. It is not acceptable for Contractor to select materials for special inspection.

1.07 SPECIAL CERTIFICATION

A. Contractor shall be responsible for providing equipment that meets the special certification requirements of the building code specified in Section 01_41_00 – Regulatory Requirements.

B. The following designated seismic systems shall be subject to the testing and qualification requirements of the regulatory building code, as specified in Section 01_41_00 – Regulatory Requirements and shall require special certification as set forth in ASCE 7, Section 13.2:
1. Mechanical equipment that is assigned an importance factor of 1.50 as specified in Section 01_81_50 - Design Criteria.
2. All electrical equipment.

C. Special certification requirements for designated seismic systems:
1. Submittals for mechanical and electrical equipment identified in this Section as designated seismic systems shall include certification that the equipment is seismically qualified. Certifications shall be subject to review and acceptance by Owner.
2. Certifications may be at least 1 of the following in accordance with ASCE 7, Section 13.2:
a. Analysis.
b. Testing.
c. Experience data.

1.08 STRUCTURAL OBSERVATION

A. Owner will employ 1 or more registered design professionals who will provide structural observation(s) during construction.
1. Registered design professional shall be a civil or structural engineer currently licensed as such in the state where the project is located and regularly engaged in structural design equivalent to or similar to those indicated on the Drawings.

B. Structural observations shall not be construed as fulfilling the requirements for special inspections.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS

A. The Owner will provide special inspection of following types of work as described in in Section 1705 of the building code as specified in Section 01_41_00 - Regulatory Requirements wherever such work occurs unless otherwise specified.

3.02 SPECIAL CERTIFICATION

A. Special inspector shall examine the designated seismic system(s) specified and determine whether the designated system components, including anchorage, are consistent with the evidence of compliance submitted for special certification.

3.03 STRUCTURAL OBSERVATION

A. The following work requires structural observation in accordance with Section 1704.5 of the building code specified in Section 01_41_00 - Regulatory Requirements.
   1. All structures in all areas:
      a. Foundations.
      b. Elevated slabs.

3.04 SCHEDULE

A. Contractor shall allow time necessary for special inspections and structural observation specified herein.

B. Sufficient notice shall be given so that the special inspections and structural observations can be performed. Contractor shall allow time for individuals performing special inspection and structural observation to travel to the site.

3.05 PROCEDURE

A. The special inspector will immediately notify the Engineer of any corrections required and follow notification with appropriate documentation.

B. Contractor shall not proceed until the work is satisfactory to the Engineer.

END OF SECTION

ATTACHMENT A - CONCRETE SPECIAL INSPECTION SCHEDULE

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CONCRETE SPECIAL INSPECTION SCHEDULE
(Includes: cast-in-place, precast, prestressed, precast-prestressed, and shotcrete.)

Verification and Inspection	Reference Standard ACI 318-14 AWS D1.4-18 IBC 2018	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
1. Inspect reinforcement, including prestressing tendons, and verify placement.	ACI 318: 20, 25.2, 25.3, 26.6.1-26.6.3 IBC: 1908.4		●
2. Reinforcing bar welding:			
a. Verify weldability of reinforcing bars other than ASTM A706;	AWS D1.4 ACI 318: 26.6.4		●
b. Inspect single-pass fillet welds, maximum 5/16"; and	AWS D1.4 ACI 318: 26.6.4		●
c. Inspect all other welds.	AWS D1.4 ACI 318: 26.6.4	●	
3. Inspect anchors cast in concrete.	ACI 318: 17.8.2		●
4. Inspect anchors post-installed in hardened concrete members.			
a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads.	ACI 318: 17.8.2.4	●	
b. Mechanical anchors and adhesive anchors not defined in 4.a.	ACI 318: 17.8.2		●
5. Verify use of required design mix.	ACI 318: 19, 26.4.3, 26.4.4 IBC: 1904.1, 1904.2, 1908.2, 1908.3		●
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	ASTM C172 ASTM C31 ACI 318: 26.5, 26.12 IBC: 1908.10	●	
7. Inspect concrete and shotcrete placement for proper application techniques.	ACI 318: 26.5 IBC: 1908.6, 1908.7, 1908.8	●	
8. Verify maintenance of specified curing temperature and techniques.	ACI 318: 26.5.3-26.5.5		●

Verification and Inspection	Reference Standard ACI 318-14 AWS D1.4-18 IBC 2018	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
	IBC: 1908.9		
9. Inspect prestressed concrete for:			
a. Application of prestressing forces; and	ACI 318: 26.10	●	
b. Grouting of bonded prestressing tendons.	ACI 318: 26.10	●	
10. Inspect erection of precast concrete members.	ACI 318: 26.9		●
11. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	ACI 318: 26.11.2		●
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	ACI 318: 26.11.1.2.(b)		●

Notes:

(1) The "●" represents a required inspection activity for the project where it occurs.

SECTION 01_50_00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Furnishing, maintaining, and removing construction facilities and temporary controls, including temporary utilities, construction aids, barriers and enclosures, security, access roads, temporary controls, project sign, field offices and sheds, and removal after construction.

1.02 REFERENCE

A. American National Standards Institute (ANSI).

B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Submit as specified in Section 01_33_00 - Submittal Procedures.

1.04 TEMPORARY UTILITIES

A. Temporary electrical power:
   1. Arrange with local utility to provide adequate temporary electrical service.
   2. Owner provides the power.
      a. Owner will indicate electrical power locations during mobilization.
      b. The Contractor is responsible for providing breakers, switches, transformers, and cables required to obtain temporary power from these location(s).
      c. The Owner will pay charges for construction power obtained from these locations.
   3. Provide and maintain adequate jobsite power distribution facilities conforming to applicable Laws and Regulations.
   4. Provide, maintain, and pay for electric power for performance of the Work .

B. Temporary electrical lighting:
   1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
   2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
      a. Prior to Substantial Completion of the Work, replace bulbs, lamps, or tubes used by Contractor for lighting.

C. Temporary heating, cooling, and ventilating:
   1. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.

2. Permanent heating system may be utilized when sufficiently completed to allow safe operation.

D. Temporary water:
   1. Pay for and construct facilities necessary to furnish potable water for human consumption and non-potable water for use during construction.
   2. Remove temporary piping and connections and restore affected portions of the facility to original condition before Substantial Completion.
   3. Pay for water used for construction prior to Substantial Completion.

E. Temporary sanitary facilities:
   1. Provide suitable and adequate sanitary facilities that are in compliance with applicable Laws and Regulations.
   2. Existing facility use is not allowed.
   3. At completion of the Work, remove sanitary facilities and leave site in neat and sanitary condition.

F. Temporary fire protection:
   1. Provide fire protection required to protect the Work and ancillary facilities.

G. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.

H. Utilities in existing facilities: As specified in Section 01_14_00 - Work Restrictions.

1.05 CONSTRUCTION AIDS

A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.

B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.

C. Design temporary supports with adequate safety factor to ensure adequate load bearing capability:
   1. When requested, submit design calculations by professional registered engineer prior to application of loads.
   2. Submitted design calculations are for information and record purposes only.

D. Accident prevention:
   1. Exercise precautions throughout construction for protection of persons and property.
   2. Observe safety provisions of applicable Laws and Regulations.
   3. Guard machinery and equipment and eliminate other hazards.
   4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
   5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.

E. Barricades:
   1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
   2. Provide barriers with flashing lights after dark.

3. Keep barriers in place until excavations are entirely backfilled and compacted.
4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.

F. Warning devices and barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers:
   1. Provide devices in accordance with minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.

G. Hazards in public right-of-way:
   1. Comply with local jurisdiction standards and requirements for right-of-way barricades and other safety devices.
   2. Mark at reasonable intervals, trenches, and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours:
      a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
   3. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades:
      a. During hours of darkness, provide warning lights at close intervals.

H. Hazards in protected areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

I. Above grade protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.

J. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage, or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.

K. Fences:
   1. Enclose site of the Work with fence adequate to protect the Work against acts of theft, violence, and vandalism.
   2. Enclose temporary offices and storage areas with fence adequate to protect temporary facilities against acts of theft, violence, and vandalism.
   3. When entire or part of site is to be permanently fenced, permanent fence may be built to serve for both permanent and temporary protection of the work site, provided that damaged or defaced fencing is replaced prior to Substantial Completion.
   4. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons.
      a. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.
   5. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
   6. Fence temporary openings when openings are no longer necessary.

1.06 SECURITY

A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.07 ACCESS ROADS

A. General:
   1. Build and maintain access roads to and on site of the Work to provide for delivery of material and for access to existing and operating plant facilities on site.
   2. Build and maintain dust free roads which are suitable for travel at 20 miles per hour.

B. Off-site access roads:
   1. Build and maintain graded earth roads.
   2. Build roads only in public right-of-way or easements obtained by Owner.
   3. Obtain rights-of-way or easements when electing to build along other alignment.

C. On-site access roads:
   1. Maintain access roads to storage areas and other areas to which frequent access is required.
   2. Maintain similar roads to existing facilities on site of the Work to provide access for maintenance and operation.
   3. Protect buried vulnerable utilities under temporary roads with steel plates, wood planking, or bridges.
   4. Maintain on-site access roads free of mud.
   5. Provide controls to prevent vehicles leaving the site from tracking mud off the site onto the public right-of-way.

1.08 TEMPORARY CONTROLS

A. Dust control:
   1. Prevent dust nuisance caused by operations, unpaved roads, excavation, backfilling, demolition, or other activities.
   2. Control dust by sprinkling with water, use of dust palliatives, modification of operations, or other means acceptable to agencies having jurisdiction.

B. Noise control:
   1. Comply with noise and work hours regulations by local jurisdiction.
   2. In or near inhabited areas, particularly residential, perform operations in manner to minimize noise.
   3. In residential areas, take special measures to suppress noise during night hours.

C. Mud control:
   1. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

1.09 PROJECT SIGN

A. Provide and maintain Project identification sign consisting of painted 8-foot wide by 4-foot high exterior grade plywood and minimum 10-foot long, 4 by 4 lumber posts, set in ground at least 3 feet, with exhibit lettering by professional sign painter using no more than 5 sign colors:
   1. List at least the title of the Project, and names of the Owner, Engineer, Construction Manager and Contractor.
   2. Identify Contractor's, Engineer's, and Construction Manager's names in upper right-hand corner underneath the bid number.

B. On third and fourth lines of printing, paint appropriate dollar amounts.

C. Erect Project identification sign where directed by Engineer within 14 days after the issuance of the Notice to Proceed.

D. Replace or repair the project sign if it is damaged or covered with graffiti within 2 working days of observation or notification of damage or graffiti.

1.10 CONTRACTOR FIELD OFFICES AND SHEDS

A. Maintain on Project Site weather tight space in which to keep copies of Contract Documents, progress schedule, shop drawings, and other relevant documents.

B. Provide field office with adequate space to examine documents and provide lighting and telephone service in that space.

C. Engineer field office:
   1. Provide separate field office on project site for the exclusive use of the Engineer, as follows:
      a. Size: Approximately 8 feet by 36 feet with 8-foot minimum ceiling height.
   2. Arrange and pay for:
      a. A continuous supply of toilet paper, paper hand towels and hand soap for each washroom.
      b. Private telephone line(s).
      c. Bottled drinking water service with hot and cold dispenser including water cups.
      d. Provide and maintain First Aid Kit and Cabinet in accordance with ANSI Z 308.1, and OSHA requirements.

1.11 FIELD OFFICE DATA SERVICE AND EQUIPMENT

A. Provide the following data services for the duration of the project.

B. Contractor is responsible for maintenance of service and hardware.

C. Data service will be dedicated to the Engineer and not shared with any other party.

D. Contractor provide a durable and weather tight system for connecting the trailer to the service provider's facilities at the jobsite boundary.

E. Data service:
   1. Internet service provided by client.
      a. Minimum Internet bandwidth speed:
         1) Download: 100 Million bits per second (Mbps).
         2) Upload: 10 Million bits per second (Mbps).
      b. Modem, if applicable: Disable the wireless radio.

F. Printer/Scanner:
   1. Manufacturers: The following or equal:
      a. Canon Color Digital Multifunction printer (ImageRUNNER Advance C3330i).
   2. Functions:
      a. Print, scan, and sort 11 inch by 17 inch and smaller paper size.
      b. Send and receive Fax.
   3. Maintenance contract: Onsite maintenance for duration of project.
   4. Supplies: Paper (8 1/2 inch by 11 inch, 8 1/2 inch by 14 inch, and 11 inch by 17 inch) trays, toner, and other supplies for duration of project.

1.12 REMOVAL

A. Remove temporary facilities and controls before inspection for Substantial Completion or when directed.

B. Clean and repair damage caused by installation or use of temporary facilities.

C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.

D. Restore existing facilities used during construction to specified or original condition.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_60_00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for tangible materials, raw or manufactured, that become part of the project.

1.02 REFERENCES

A. NSF International (NSF):
   1. 60 - Technical Requirements.
   2. 61 - Drinking Water System Components - Health Effects.

1.03 DEFINITIONS

A. Certificates: Documents that the work is in accordance with the Contract Documents.

B. Extra stock materials: Extra stock materials provided for the Owner's use in facility operation and maintenance.

C. Manufacturer's instructions:
   1. Stipulations, directions, and/or recommendations issued form by the manufacturer of the product addressing handling, installation, erection, and/or application of the product.

D. Products:
   1. Raw materials, finished goods, equipment, systems, and shop fabrications.

E. Product data:
   1. Public information about the product which is found in the manufacturer's catalogs or on their web site including catalog pages, data sheets, bulletins, layout drawings, exploded views, and brochures.

F. Samples:
   1. As defined in the General Conditions and Supplementary Conditions.
   2. Full-size actual products or pieces of products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.

G. Schedules:
   1. Product parts and materials lists.

H. Shop drawings:
   1. As defined in the General Conditions and Supplementary Conditions.

2. Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown in the contract documents. Shop drawings could include graphic line-type drawings and single-line diagrams.

I. Spare parts:
   1. Duplicate parts necessary to replace a damaged or worn part of the product.
   2. Consumables such as operating fluids.

J. Special tools:
   1. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.

K. Submittals:
   1. As defined in the General Conditions and Supplementary Conditions.
   2. Samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform to the Contract Documents.

1.04 SUBMITTALS

A. Products in contact with drinking water:
   1. Provide certification for by an independent ANSI accredited third party.
      a. In accordance with NSF 61.
      b. Weighted average lead content of less than 0.25 percent in accordance with NSF 372.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide products by same manufacturer when products are of similar nature, unless otherwise specified.

B. Provide like parts of duplicate units that are interchangeable.

C. Provide equipment or product that has not been in service prior to delivery, except as required by tests.

D. Provide products produced by manufacturers regularly engaged in the production of these products.

E. Provide products that bear approvals and labels as specified.

2.02 MATERIAL

A. Dissimilar metals:
   1. Separate contacting surfaces with dielectric material.
   2. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials as specified.

B. Products in contact with drinking water or water in the process of becoming drinking water in accordance with NSF 60 or NSF 61 by an independent ANSI accredited third party.

C. Edge grinding:
   1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence.

D. Use anti-galling compound on threads of stainless steel fasteners during factory assembly.

E. Provide anti-galling compound with stainless steel fasteners shipped for field assembly.

F. Aluminum in contact with concrete or masonry: Apply epoxy mastic as per coating system EPX-M-5.

G. Provide new pipe manufactured for the project, not from manufacturer's inventory, under the following conditions:
   1. Pipes 24-inch diameter and larger.
   2. Pipe manufactured more than 6 months prior to delivery if the pipe material or its coating is subject to UV degradation.
   3. Ductile iron pipe with cement-mortar lining manufactured more than 6 months prior to delivery to the project.
   4. Steel pipe 6-inch diameter and larger.

H. Mark each length of pipe in accordance with applicable standards.

2.03 PRODUCT SELECTION

A. Provide products with Engineer approved submittals.

B. When products are specified by standard or specification designations of technical societies, organizations, or associations only, provide products that meet or exceed reference standard and Specifications.

C. When products are specified with names of manufacturers but no model numbers or catalog designations, provide Products by one of named manufacturers that meet or exceed Specifications.

D. When products are specified with names of manufacturers and model numbers or catalog designations, provide Products with model numbers or catalog designations by one of named manufacturers.

E. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
   1. Products specified by brand or trade name, model number, or catalog designation.
   2. Products by one of named manufacturers proven, in accordance with requirements for an "or equal", including Engineer’s approval, to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.

F. When Products are specified with only one manufacturer followed by "or Equal," provide:
   1. Products meeting or exceeding Specifications by specified manufacturer.
   2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

G. When Products are specified by naming 2 or more manufacturers with 1 manufacturer as a "Basis of Design":
   1. Any of the named manufacturers can be submitted.
   2. If the product submitted requires a change in the scope (dimensions, configuration, physical properties, etc.), schedule (longer lead time), or budget, the Contractor must submit a substitution request.

2.04 SHIPMENT

A. Requirements prior to shipment of equipment:
   1. Engineer approved shop drawings.
   2. Engineer approved Manufacturer’s Certificate of Source Testing as specified in the Technical Sections .
   3. Draft operations and maintenance manuals, as specified in Section 01_78_24 - Operation and Maintenance Manuals, when required by specifications.

B. Prepare products for shipment by:
   1. Tagging or marking to agree with delivery schedule or shop drawings.
   2. Including complete packing lists and bills of material with each shipment.
   3. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.
   4. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

C. Transport products by methods that avoid product damage.

D. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

2.05 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. Provide spare parts and maintenance products as required by Technical Sections.
   1. Submit completed Attachment A - Spare Parts, Maintenance Products, and Special Tools Inventory List.

B. Provide one set of special tools required to install or service the equipment.

C. Box, tag, and clearly mark items.

D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by Owner.

PART 3 EXECUTION

3.01 DELIVERY AND HANDLING

A. Handle equipment in accordance with manufacturer's instructions.

B. Provide construction equipment and personnel to handle products by methods to prevent soiling or damage.

C. Upon delivery, promptly inspect shipments:
   1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
   2. Acceptance of shipment does not constitute final acceptance of equipment.

D. Spare parts, maintenance products, special tools.
   1. Immediately store in accordance with the manufacturer's instructions.
   2. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
      a. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
   3. With Owner's written request for advanced delivery of spare parts, maintenance products, and special tools.
      a. Deliver requested items and deduct them from the inventory list.
      b. Provide transmittal documentation.
   4. Store large items individually:
      a. Weight: Greater than 50 pounds.
      b. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
      c. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
         4) Store smaller items in spare parts box:
      d. Weight: Less than 50 pounds.
      e. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
      f. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
         4) Spare parts and special tools box:
      g. Box material: Waterproof, corrosion resistant.
      h. Hinged cover:
         1) Locking hasp.
      i. Spare parts inventory list taped to underside of cover.
      j. Clearly labeled:
         1) The words “Spare Parts and/or Special Tools”.
         2) Equipment tag number.
         3) Equipment manufacturer.
         4) Subassembly component, if appropriate.

3.02 STORAGE AND PROTECTION

A. Immediately store and protect products until installed in Work.

B. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project.
   1. Storage of equipment shall be in strict accordance with the “instructions for storage” provided by the manufacturer.
      a. Including connection of heaters, lubrication, rotating shafts, etc.
   2. The Contractor shall furnish a copy of the manufacturer’s instructions for storage to the Engineer prior to storage of equipment and materials.

C. Store products with seals and legible labels intact.

D. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage.
   1. Repaint or recoat damaged painted or coated surfaces.

E. Exterior storage of fabricated products:
   1. Place on aboveground supports that allow for drainage.
   2. Cover products subject to deterioration with impervious sheet covering.
   3. Provide ventilation to prevent condensation under covering.

F. Store moisture sensitive products in watertight enclosures.

G. Store loose granular materials on solid surfaces in well-drained area.
   1. Prevent materials mixing with foreign matter.
   2. Provide access for inspection.

H. When needed and approved by the Engineer, offsite storage location shall be within 20 miles of the project site.
   1. Provide proof of insurance coverage for products stored offsite.

I. Payment will not be made for equipment and materials improperly stored or stored without providing Engineer with the manufacturer's instructions for storage.

J. Provide an equipment log and stored products log with monthly pay applications.
   1. Data includes as a minimum: The storage location, equipment or product identification, date stored, date of inspection/maintenance, date removed from storage, copy of manufacturer’s recommended storage guidelines, description of inspection/maintenance activities performed, and signature of party performing inspection/maintenance.

3.03 INSTALLATION

A. Inspect hardware or fittings prior to product installation.

B. Use anti-galling compound on stainless steel threads used for field assembly.

3.04 PROTECTION AFTER INSTALLATION

A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
   1. Remove covering when no longer needed.
   2. Replace corroded, damaged, or deteriorated equipment, product, or parts before acceptance of the project.

B. Update equipment log with monthly pay applications.
   1. Data includes as a minimum: Description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

END OF SECTION

ATTACHMENT A - SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

Owner: _____ **Date:** _____

Contractor: _____ **Project No.:** _____

Project Name: _____

Inventory List				
Spec Number: _____		Spec Title _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	**Subassembly Component**	**Description**	**Manufacturer's Part Number**	**Storage Location**

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SECTION 01_75_17

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Commissioning.

1.02 DEFINITIONS

A. Commissioning: The process of planning for, testing of, and start-up of systems, subsystems, equipment, components, and devices of the Work to demonstrate, through documented verification, that the Work has successfully met the Contract Documents. It includes training the Owner's staff on operation and maintenance of the installed Work.

B. Commissioning Phases: The activities of commissioning are grouped into the phases defined in the following table.

Table 1 - Commissioning Phases.

TABLE 1 - COMMISSIONING PHASES		
Planning Phase	**Testing and Training Phase**	**Start-Up Phase**
Owner Training Plan and Schedule	Source Testing	Process Start-Up
Commissioning Schedule	Owner Training	Process Operational Period
Subsystem Testing Plan	Installation Testing	PCIS Optimization and Fine-Tuning
Clean Water Facility Testing Plan	Functional Testing	
	Clean Water Facility Testing	
	Closeout Documentation	

1. Attachment A provides Commissioning Flowcharts.

C. Component: A part of a system that does not have an electrical connection or internal electronics. Examples: Piping and pressure gauges.

D. Device: A part of a system that has electrical connections or internal electronics. Examples: level transmitter or pressure transmitter.

E. Equipment: A factory or field assembled apparatus that performs an identifiable function. Examples: pumps, motors, VFDs, MCCs.

F. Functional Testing: Testing performed on a completed subsystem or system to demonstrate that the system meets the specified requirements. Example systems: backwash system, dewatering system.

G. Installation Verification: Testing to demonstrate that equipment or system and associated components or devices have been properly installed. Example equipment: pumps, meters, and blowers with associated piping.

H. Manufacturer's Certificate of Functional Compliance: The form completed by the manufacturer to confirm that testing of the installed equipment or system has been performed and the results conform to the specified performance. The form is provided in Attachment D provided at the end of this Section.

I. Manufacturer's Certificate of Installation Verification: The form completed by the manufacturer to confirm that the equipment or system is installed in conformance with the Contract. The form is provided in Attachment C at the end of this Section.

J. Manufacturer's Certificate of Source Testing: The form completed by the manufacturer to confirm that the specified source tests have been performed and the results conform to the specified requirements. The form is provided in Attachment B at the end of this Section.

K. Owner Training: The Owner's staff is trained by the Contractor, with assistance from manufacturer, to operate and maintain the completed Work. This is sometimes referred to as Vendor Specific Training.

L. Process Stream: A series of liquid or solids flow processes that are designed to improve the water quality to meet regulatory permit requirements.

M. Source Testing: Test equipment or products for performance at point of manufacture or assembly for the requirements specified in the Contract Documents. Also referred to as factory testing and factory acceptance testing (FAT).

N. Start-Up Phase: The phase when Start-Up occurs.

O. Start-Up: Operating the Work with test water to verify the Work meets the Contract Documents.

P. Subsystem: A grouping of equipment, components, and devices that is a part of a larger system and that perform a single definable function. Examples: sand filters, filter backwash.

Q. System: A grouping of equipment, components, and devices that perform a single definable function. If a system is a part of a larger system, it is referred to as a subsystem Examples: Flocculation and sedimentation, filtration.

R. System Testing: Testing of a completed system for an extended time period. Examples: Headworks, filtration.

S. Water Management Plan: A plan to manage the test water used for commissioning from source to disposal. The test water may be clean water, potable water, non-potable water, or process water (e.g., raw water, plant water, sludge). The plan

demonstrates how water will be produced, conveyed, treated, disposed of as directed by the plant manager, and/or recycled.

1.03 SUBMITTALS

A. Qualifications:
   1. Commissioning Coordinator's qualifications.
      a. Submit to Engineer no later than 30 days after Notice to Proceed.
      b. Describe previous similar experience on similar projects with a list of references including phone numbers.
      c. Provide names and qualifications of commissioning assistants, if applicable.
   2. Manufacturer's representative's qualifications.
      a. Submit to Engineer no later than 30 days in advance of required services.
      b. Representative's name, phone, and e-mail address:
         1) May use 2 representatives: 1 for field testing and 1 for Owner Training.
         2) Provide resume stating instructor's technical expertise and instructional technology skills and experience.

B. Schedules:
   1. Commissioning Schedule containing all commissioning activities.
   2. Owner Training Schedule.

C. Certificates:
   1. Manufacturer's Certificate of Source Testing.
   2. Manufacturer's Certificate of Installation Verification.
   3. Manufacturer's Certificate of Functional Compliance.

D. Test Plans:
   1. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
      a. Engineer approval of draft Test Plans required for successful completion of Planning Phase.
   2. Submit final Test Plan a minimum of 30 calendar days prior to testing.
      a. Engineer approval of final Test Plan required prior to start of testing.

E. Test Reports:
   1. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
      a. Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
   2. Submit final Test Report a minimum of 30 calendar days after testing.

F. Manufacturer's representatives field notes and data.

G. Owner Training:
   1. Prior to the training session:
      a. Training instructor qualifications.

b. Training course materials: Due 30 calendar days prior to initial training session.
    1) If Owner requires, Continuing Education Units (CEUs), submit training materials to state regulatory agency in sufficient time to obtain approval for training prior to the training.
    2) Drafts of training agenda, lesson plan, presentation, handouts, and list of audio-visual aids.
    3) Format: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.

2. Post training session:
    a. Training course materials: Due 14 calendar days after class completion.
        1) Recordings.
        2) Class attendance sheet.
        3) Final version of training agenda, final lesson plan, presentation, handouts, and audio-visual aids.
        4) Format: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.
    b. Provide materials for all sessions of the class in a single transmittal.
    c. If the Owner requires training CEUs, issue training CEU certificates approved by the state regulatory agency to Owner's staff who successfully completed the training.

1.04 COMMISSIONING COORDINATOR (CC) (NOT USED)

1.05 MANUFACTURER'S REPRESENTATIVES

A. Qualifications: as specified below and in the Technical Sections:
1. For Installation and Functional Testing:
    a. Factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
2. Training instructor qualifications:
    a. Provide resume stating instructor's technical preparation and instructional technology skills and experience.
    b. If CEUs are required, the operator training instructors must comply with state regulatory.
    c. Knowledgeable in the equipment/system for which they are training.
    d. Experienced in conducting classes.
    e. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
3. Representatives to be approved by Owner and Engineer.
4. No substitute representatives without written approval by Owner and Engineer.

B. Duties:
1. Determine if additional time and/or trips (beyond those specified in the Technical Sections) is required to perform the specified services.
2. Coordinate services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.

3. Perform on-site services as specified in the Technical Sections:
4. Provide daily copies of manufacturer's representatives field notes and data to Contractor.

1.06 PLANNING PHASE

A. Overview of Planning Phase:
   1. Define approach and timing for commissioning.
   2. Obtain Engineer approval of draft Test Plans.

B. Test Plans.
   1. Define approach and timing for:
      a. Testing and Training Phases.
         1) Major systems, with separate plans for each system.
      b. Start-Up Phase.
   2. Test Plan minimum requirements:
      a. As specified in this Section and other Technical Sections.
      b. Prepared by Contractor as a result of discussions and planning emerging from regularly conducted commissioning meetings for tests as specified in the Contract.
      c. Define the following items for each Test:
         1) Purpose of the test.
         2) Identification of each item of equipment/system, including system designation, location, tag number, control loop identifier, etc.
         3) Description of the pass/fail criteria that will be used.
         4) Listing of pertinent reference documents (Contract and industry standards or sections applicable to the testing).
            a) Credentials of test personnel.
         5) Test equipment:
            a) Product data.
            b) Appropriate calibration records.
               (1) Drawings or photographs of test stands and/or test apparatus.
            c) Duration: Determine test durations with Owner’s input.
         6) Detailed step-by-step test procedures.
            a) Setup.
         7) The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests were being performed as planned.
         8) Include all steps in the procedures.
         9) Define temporary systems (pumps, piping, etc.), shutdown requirements for existing systems.
         10) Furnish labor, power, tools, equipment, instruments, and services required for and incidental to completing testing activities.
   3. Test forms minimum requirements:
      a. Name of product to be tested.
      b. Test date.
      c. Names of persons conducting the test.
      d. Names of persons witnessing the test, where applicable.
      e. Test data.
      f. Applicable project requirements as specified in the Technical Sections.

g. Check offs for each completed test or test step.
h. Place for signature of person conducting tests and for the witnessing person, as applicable.

4. Owner responsibilities:
   a. Schedule Owner's staff within the constraints of their workloads.
      1) Those who will participate in this test have existing full-time work assignments, and testing is an additional assigned work task, therefore, scheduling is imperative.
      2) Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
      3) Maximum hours per week: 4.
      4) Days available: Monday to Thursday.
      5) Scheduling coordination:
      6) CC is responsible for the following:
         a) Coordinate schedule with the Owner's personnel and manufacturer's representatives (instructors).

C. Test Reports:
   1. Minimum requirements:
      a. Title.
      b. Abstract.
      c. Equipment.
      d. Procedures.
      e. Results.
         1) Complete disclosure of the calculation methodologies.
      f. Conclusions.
      g. Signature by an authorized party.
      h. Appendices.
         1) Completed test forms signed by witnesses.
   2. Water Management Plan:
      a. Requirements:
         1) Demonstrate how water will be produced, conveyed, treated, recycled, and or disposed until testing verifies specified requirements.
   3. Commissioning Schedule:
      a. Content:
         1) Comply with Attachment G – Functional Testing Requirements and provide activities organized by system and subsystem.
         2) Include the Owner Training Schedule.
         3) Comply with Attachment F - Commissioning Roles and Responsibilities Matrix.
      b. Procedures:
         1) Submit commissioning schedule as specified in Section 01_32_21 - Schedules and Reports.

1.07 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:
   1. General:
      a. Contractor tests the Work to verify it meets the Contract requirements.
      b. Contractor trains the Owner to operate and maintain the Work.

2. Contractor responsibilities:
    a. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
3. Owner responsibilities:
    a. Owner provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.

B. Source Testing:
1. As specified in the Technical Sections.
2. Source Test Plan:
    a. Engineer approval of Test Plan required prior to testing.
3. Contractor is responsible for witness trip costs associated with Owner's and Engineer's representatives.
    a. Include costs for at least the following:
        1) Transportation:
            a) Travel on commercial airline to and from site including related fees.
            b) Rental car to and from airport, hotel, and test site including related fees.
        2) Hotel/Meals:
            a) Hotel with an American Automobile Association 4-star rating or higher equivalent for single occupancy room per person per day.
            b) Meal allowance based on state government per diem guidelines per location.
    b. If Source Test is not ready when the witnesses arrive or if the Source Test fails, the witnesses will return home with Contractor responsible for costs associated with the trip costs described above.
        1) Contractor is responsible for rescheduling the Source Test and travel costs associated with repeated trips.
        2) Contractor is responsible for witnesses' costs associated with retests including costs described above.
            a) Witness labor costs:
                (1) Travel time and witness site time are included.
                (2) The greater of $200 per hour or $1,600 per day.
4. Source testing is complete after successful testing, submittal of test report, and Manufacturer's Certificate of Source Testing.
5. Engineer approval of source testing is required.

C. Installation Verification:
1. Overview:
    a. Verifying the installation of equipment in accordance with Manufacturer's Instructions.
2. Prerequisite:
    a. Engineer approval of Source Testing.
3. Submit Manufacturer's Certificate of Installation Verification.
4. Engineer approval of installation verification is required.

D. Functional Testing:
1. Overview:
    a. Testing the function of a subsystem or system.

2. Prerequisites:
    a. Engineer approval of Installation Verification.
    b. Engineer approval of Test Plan required prior to testing.
    c. Complete pipe, valve, and gate labeling as perPipe Identification requirement prior to the start of Functional Testing.
3. Witnessed.
4. Discipline checks:
    a. Verify support systems function properly, such as seal water, pipes, valves, etc.
    b. As specified in the individual Technical Sections.
5. Consecutive Day Test:
    a. Operate the Work as specified in Attachment G - Functional Testing Requirements and as specified in the individual Technical Sections.
        1) Successful completion of subsystem testing required prior to system testing.
    b. Failure response time:
        1) Be equipped and ready to provide emergency repairs, adjustments, and corrections to comply with the "Significant Interruption Duration" requirements as specified in Attachment G - Functional Testing Requirements.
    c. Duration:
        1) As specified in Attachment G - Functional Testing Requirements.
        2) Restart the consecutive day test when the system performance failures exceed the "Significant Interruption Duration" time period specified in Attachment G - Functional Testing Requirements.
            a) Individual equipment/system failures that are corrected within the "Significant Interruption Duration" time specified in Attachment G - Functional Testing Requirements shall not require the consecutive day test to be restarted unless the failure recurs.
            b) Engineer has the authority to reject the consecutive day test if individual equipment/system failures are repetitive.
6. Instrumentation and controls tests.
    a. Loop Validation Tests.
    b. Complete End-to-End Testing (CEET):
        1) Signal are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
7. Submit Manufacturer's Certificate of Functional Compliance.
8. Engineer approval of Functional Testing is required.

E. Documentation:
1. Provide records generated during Commissioning Phase of Project including but not limited to:
    a. Training documentation.
    b. Manufacturer's Certificate of Source Testing.
    c. Manufacturer's Certificate of Installation Verification.
    d. Manufacturer's Certificate of Functionality Compliance.
    e. Daily logs of equipment/system testing identifying tests conducted and outcome.
    f. Test forms and documentation.
    g. Functional Testing results.

h. Logs of time spent by manufacturer's representatives performing services on the job site.
i. Equipment lubrication records.
j. Electrical phase, voltage, and amperage measurements.
k. Insulation resistance measurements.
l. Bearing temperature measurements.
m. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.
n. Provide: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.
o. Store the data within 24 hours of the test or document creation in the project Procore system.
p. Due date: Within 14 calendar days of Substantial Completion.

2. Engineer approval of documentation is required.

F. Owner Training:
1. Overview:
a. Training Owner staff on the operation and maintenance of a subsystem.
b. Also referred to as vendor specific training.
2. Training outcomes:
a. Owner's operations, maintenance, and engineering staff have the information needed to safely operate, maintain, and repair the equipment/systems provided in the Contract.
3. Training objectives:
a. To instruct personnel in the operation and maintenance of the equipment/system. Instruction shall include step-by-step troubleshooting procedures with all necessary test equipment/system.
b. To instruct personnel in the removal, inspection, and cleaning of equipment/system as needed.
c. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
d. Provide supporting documentation, such as vendor operation and maintenance manuals.
4. Training plan:
a. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to commissioning of equipment/system.
b. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
c. Conduct classroom training at location designated by Owner.
d. Scope and sequence:
1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
2) If multiple classes are needed to meet the training objectives, they shall be included in the training plan.

5. Owner Training Schedule:
    a. Schedule Owner's staff training within the constraints of their workloads.
        1) Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative.
        2) Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
        3) Maximum training hours per week: 16.
        4) Days available for training: Monday to Thursday.
    b. Training scheduling coordination:
        1) CC is responsible for the following:
            a) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
        2) Complete Owner Training no sooner than 15 calendar days prior to Functional Testing of each system.
    c. Class logistics:
        1) Delivery time minimum: 2 hours.
        2) Delivery time maximum: 4 hours.
            a) Longer time requires Engineer approval.
        3) Class agenda:
            a) Refreshment break: One 10-minute break.
            b) Meal break: One 45-minute break, unless otherwise specified.
            c) Schedule refreshment breaks and meal breaks to meet the class needs and Owner work rules.
        4) Schedule specific sessions:
            a) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
            b) At the times requested by the Owner, within the period 7 a.m. to 7 p.m. Monday through Friday.
                (1) Times scheduled will be at Owner's discretion.
            c) Owner approval and confirmation required for session schedules.
            d) Provide minimum of 2 sessions for each class unless otherwise noted.
                (1) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner personnel working different shifts as possible.
            e) A maximum of 1 session per day for each class.
    d. Number of students:
        1) Estimated class size maximum: 5 staff.
        2) Engineer will confirm the headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.
6. Submittals:
    a. Submit Training Plan Schedule 30 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.
    b. Submit training documentation including the following:
        1) Training plan:
            a) Training modules.
            b) Scope and sequence statement.

c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
d) Instructor qualifications.

2) Training program schedule:
a) Format: Bar chart:
(1) Include in the Project Progress Schedule.
b) Contents:
(1) Training modules and classes.

7. Lesson plans:
a. Divide training into discrete modules appropriate for the equipment and trades.
b. State performance-based learning objectives in terms of what the trainees will be able to do at the end of the lesson.
c. Define student conditions of performance and criteria for evaluating instructional success.
d. Minimum requirements:
1) Hands-on demonstrations planned for the instructions.
2) Cross-reference training aids.
3) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
4) Attach handouts cross-referenced by section or topic in the lesson plan.
5) Indicate duration of outlined training segments.
e. Provide instruction lesson plans for each trade:
1) Detailed component description:
a) Identify each component function and describe in detail.
b) Identify equipment's mechanical, electrical, and electronic components and features.
c) Where applicable, group relative components into subsystems.
d) Identify and describe in detail equipment safety features, permissive and controls interlocks.
2) Equipment operation:
a) Describe equipment's operating (process) function and system theory.
b) Describe equipment's fundamental operating principles and dynamics.
c) Identify support equipment associated with the operation of subject equipment.
d) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
e) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
f) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
3) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
a) Review preventive maintenance frequency and task analysis table.

4) Define equipment Corrective Maintenance (CM) troubleshooting:
    a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
    b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
    c) Provide component specific troubleshooting checklists as they relate to specific craft problems.
    d) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
    e) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.
5) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

8. Training instruction format:
    a. The training for operations and maintenance personnel shall be provided as 1 entity.
    b. The training for operations personnel shall be provided separately from the maintenance personnel.
        1) The training for maintenance personnel shall be further subdivided into the following 4 trade groups.
            a) Mechanical maintenance.
            b) Electrical maintenance.
            c) Instrumentation and controls maintenance.
            d) Process Controls Network (PCN) maintenance.
    c. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
    d. Lecturing should be less than 30 percent of class time.
    e. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture to support training objectives.
    f. Conduct hands-on instruction according to the following descriptions:
        1) Present hands-on demonstrations of at least the following tasks:
            a) Proper start-up, shutdown, and normal and alternative operating strategies.
            b) Common corrective maintenance repairs for each group.
            c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
            d) Preventative maintenance points.
            e) Calibration, if applicable.
        2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
            a) Submit requests for supplemental assistance and facilities with the Contractor’s proposed lesson plans.
        3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner’s personnel.
    g. Training aids:
        1) Instructors shall provide needed audio-visual devices such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc. for each class.

2) Instructor to confirm with Engineer in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.

9. Training sessions:
   a. Provide training sessions for equipment/system as specified in the individual equipment/system section.
   b. Include the following information in the agenda:
      1) Instructor name.
      2) Listing of subjects to be discussed.
      3) Time estimated for each subject.
      4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
      5) List of documentation to be used or provided to support training.
   c. Owner may request that particular subjects be emphasized, and the agenda be adjusted to accommodate these requests.
   d. Digitally record audio and video of each training session.
      1) Include classroom and field instruction with question and answering periods.
      2) Engineer approval required for producer of video materials from one of the following options:
         a) Qualified, professional video production company.
         b) Contractor demonstrates satisfactory skill.
      3) Record in digital format and recording shall become property of the Owner.
      4) Media:
         a) Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
         b) Digital color video format.
         c) Provide audio portion of the composite CD sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
         d) Identification: On each copy provide a label with the following information:
            (1) Name of training.
            (2) Date video was recorded.
         e) Display continuous running time.
         f) At start of each video recording, record training class name, date, instructor's name.
         g) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
      5) The Contractor shall provide a written release from all claims to the recorded training material produced, if required.
   e. Distribute copies of the agenda to each student at the beginning of each training class.
   f. Trainees will keep training materials and documentation after the session.
   g. Distribute Training Evaluation Form following each training session.
      1) Training Evaluation Form is included in this Section.
      2) Return completed Training Evaluation Forms to Owner's designated training coordinator immediately after session is completed.

3) Revise training sessions judged "Unsatisfactory" by a majority of attendees.
    a) Conduct training sessions again until a satisfactory rating is achieved.

10. Engineer approval of Owner Training is required.

1.08 START-UP PHASE

A. Overview of Start-Up Phase:
    1. General:
        a. Confirm reliability requirements.

B. Start-Up Period:
    1. Contractor responsibilities:
        a. Support Owner to operate the Work.
    2. Owner responsibilities:
        a. Owner to operate the Work.
        b. Owner-provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.
        c. Furnish labor , power, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
    3. Prerequisites:
        a. Engineer approval of Testing and Training Phase.
    4. Witnessed.
    5. Duration: 30 calendar days.
    6. Engineer approval of Start-Up Period is required to achieve substantial completion.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT A - COMMISSIONING FLOWCHARTS

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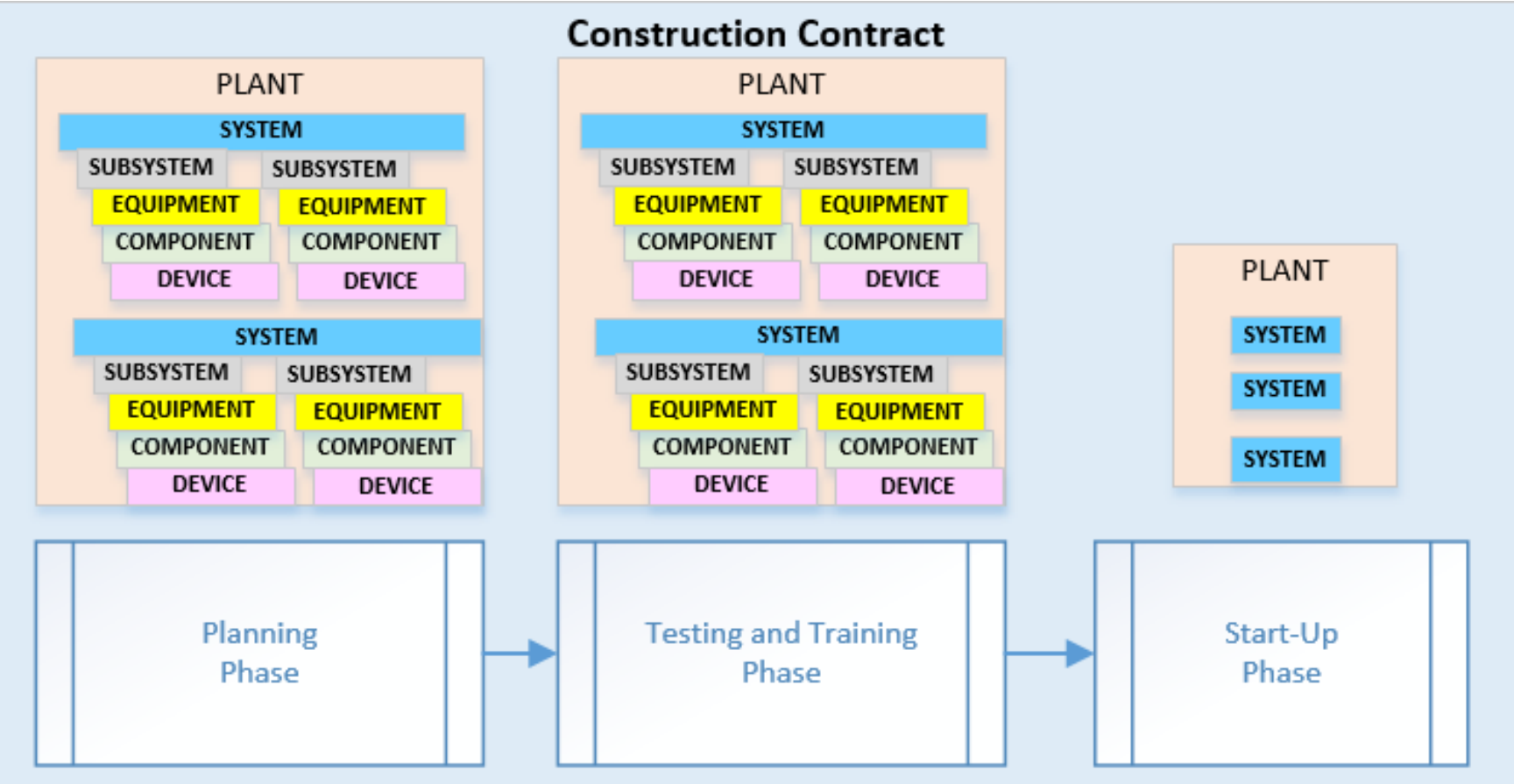
Construction Contract
PLANT
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
COMPONENT
DEVICE
DEVICE
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
COMPONENT
DEVICE
DEVICE
PLANT
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
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DEVICE
DEVICE
SYSTEM
SUBSYSTEM
SUBSYSTEM
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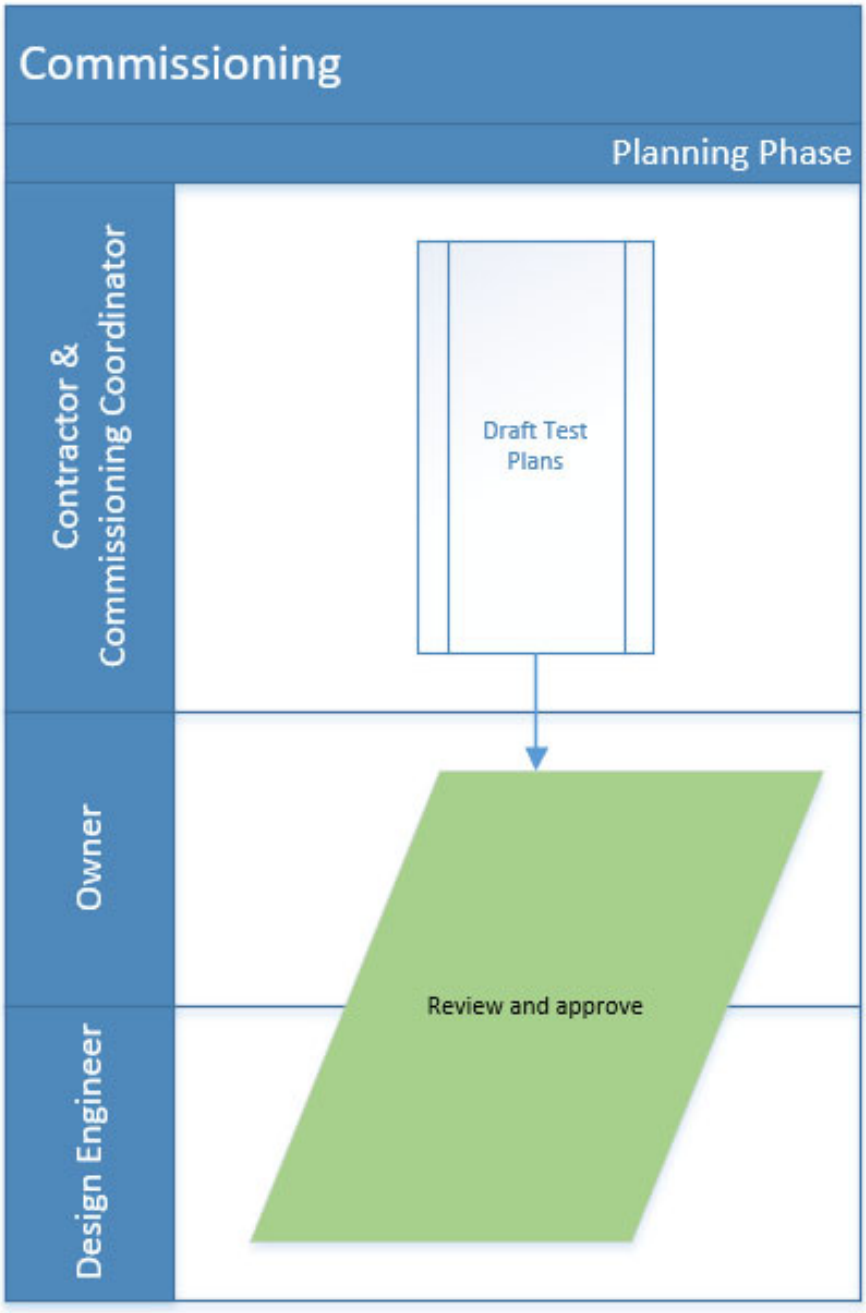
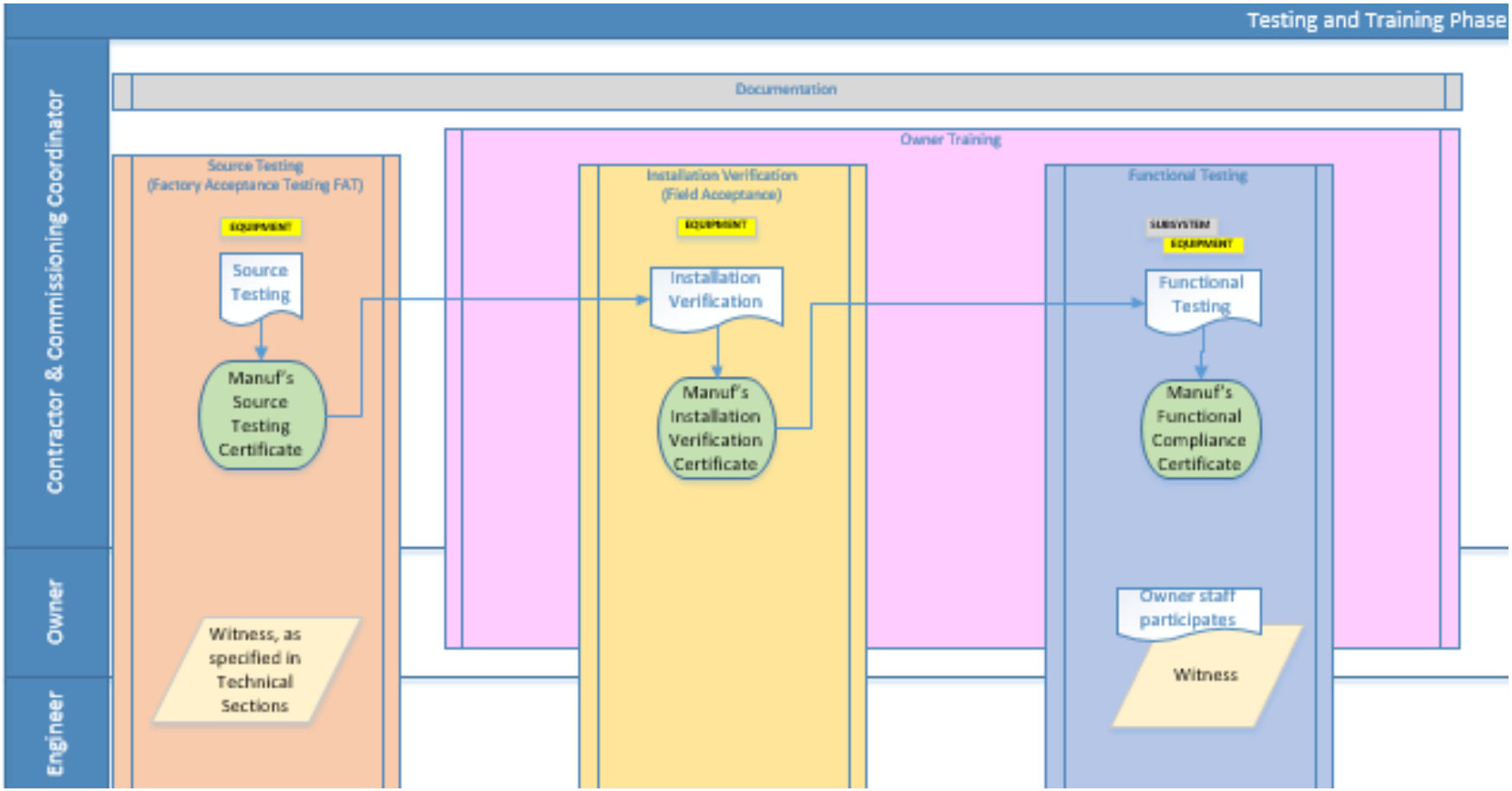
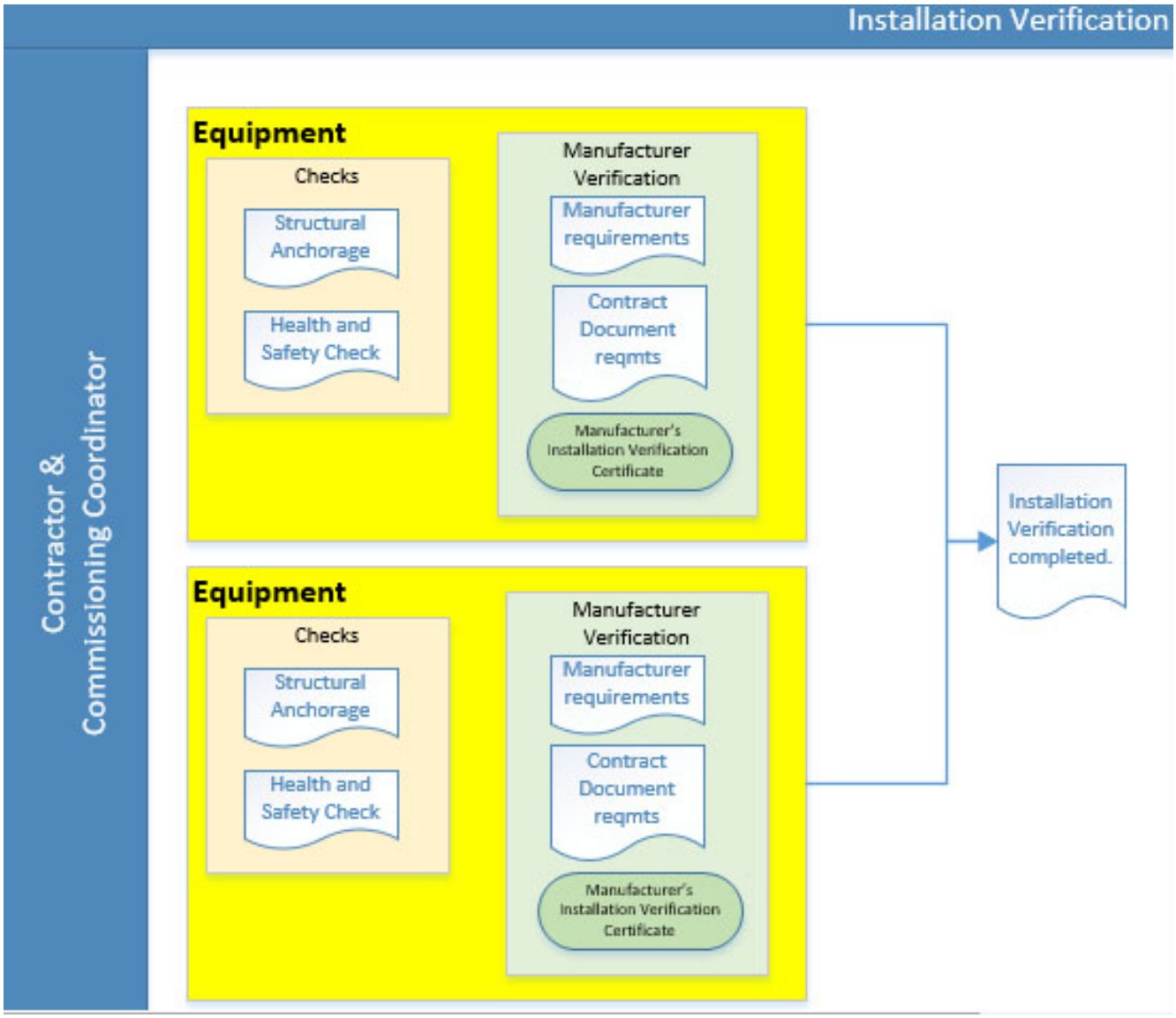
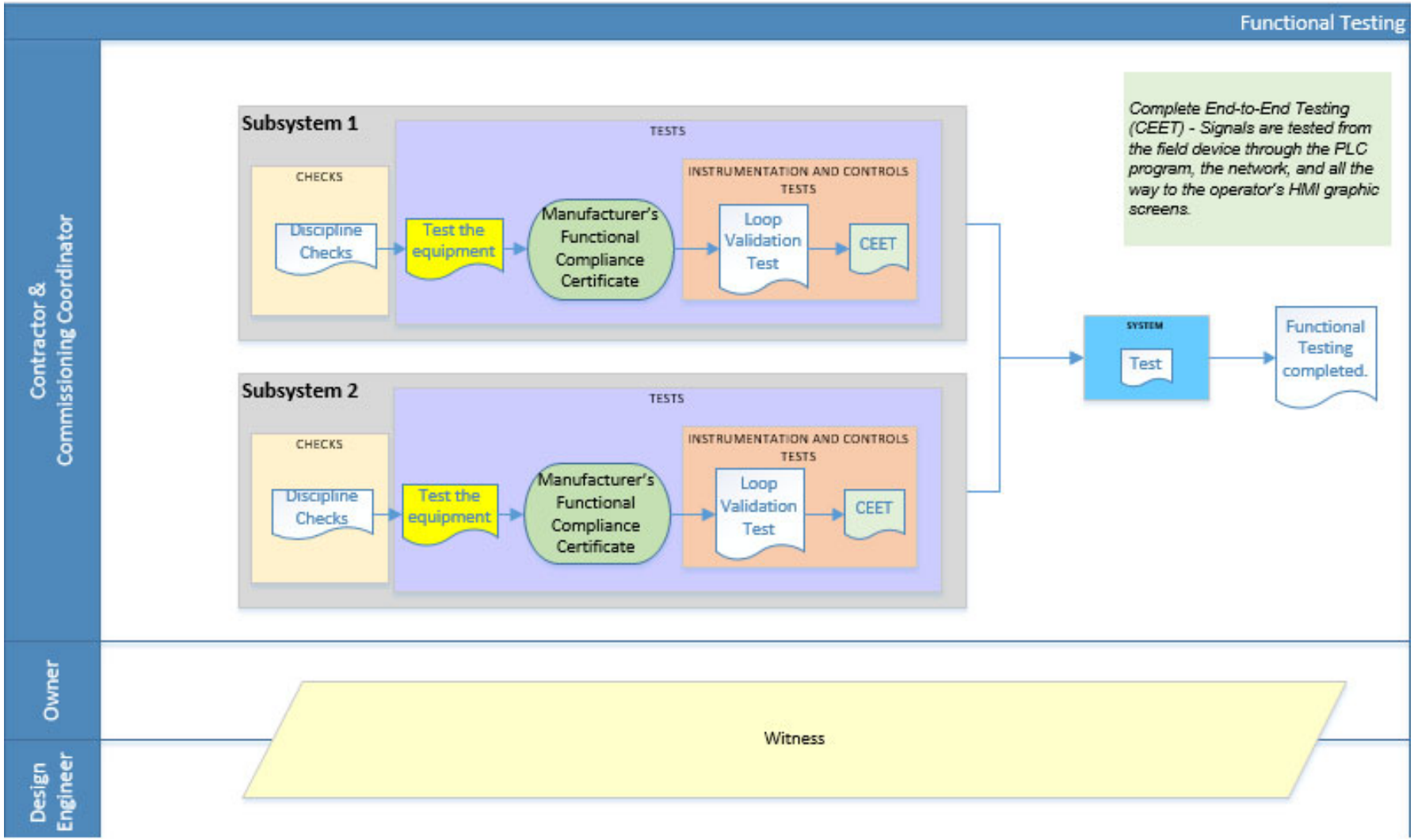
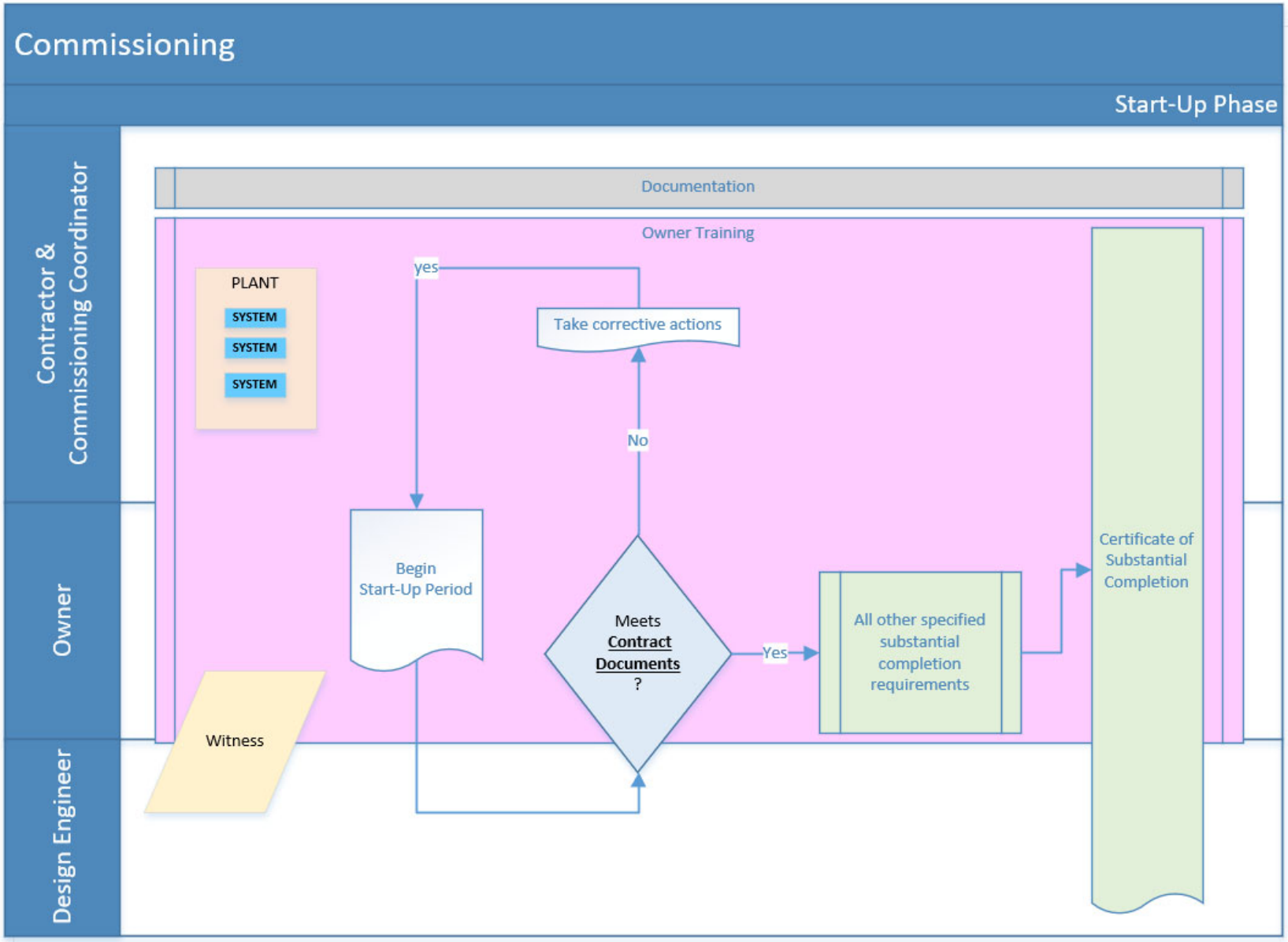
SYSTEM
SYSTEM
Planning Phase
Testing and Training Phase
Start-Up Phase


Commissioning
Planning Phase
Contractor & Commissioning Coordinator
Draft Test Plans
Owner
Review and approve
Design Engineer


Testing and Training Phase
Contractor & Commissioning Coordinator
Owner
Engineer
Documentation
Owner Training
Source Testing
(Factory Acceptance Testing FAT)
EQUIPMENT
Source Testing
Manuf's Source Testing Certificate
Witness, as specified in Technical Sections
Installation Verification
(Field Acceptance)
EQUIPMENT
Installation Verification
Manuf's Installation Verification Certificate
Functional Testing
SUBSYSTEM
EQUIPMENT
Functional Testing
Manuf's Functional Compliance Certificate
Owner staff participates
Witness


Installation Verification
Contractor & Commissioning Coordinator
Equipment
Checks
Structural Anchorage
Health and Safety Check
Manufacturer Verification
Manufacturer requirements
Contract Document reqmts
Manufacturer's Installation Verification Certificate
Equipment
Checks
Structural Anchorage
Health and Safety Check
Manufacturer Verification
Manufacturer requirements
Contract Document reqmts
Manufacturer's Installation Verification Certificate
Installation Verification completed.


Functional Testing
Contractor & Commissioning Coordinator
Owner
Design Engineer
Subsystem 1
TESTS
CHECKS
Discipline Checks
Test the equipment
Manufacturer's Functional Compliance Certificate
INSTRUMENTATION AND CONTROLS TESTS
Loop Validation Test
CEET
Subsystem 2
TESTS
CHECKS
Discipline Checks
Test the equipment
Manufacturer's Functional Compliance Certificate
INSTRUMENTATION AND CONTROLS TESTS
Loop Validation Test
CEET
Complete End-to-End Testing (CEET) - Signals are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
SYSTEM
Test
Functional Testing completed.
Witness


Commissioning
Start-Up Phase
Contractor & Commissioning Coordinator
Owner
Design Engineer
Documentation
Owner Training
PLANT
SYSTEM
SYSTEM
SYSTEM
yes
Take corrective actions
No
Begin Start-Up Period
Meets Contract Documents ?
Yes
All other specified substantial completion requirements
Certificate of Substantial Completion
Witness

ATTACHMENT B - MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

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MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____

PROJECT NAME _____ EQPT TAG NO. _____

PROJECT NO. _____ EQPT SERIAL NO. _____

SPECIFICATION NO. _____

SPECIFICATION TITLE _____

Comments: _____

_____

_____

_____

_____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

_____

(Authorized Signature)

If applicable, Witness Name *(print)*: _____

_____

(Witness Signature)

ATTACHMENT C - MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

OWNER _____ EQPT/SYSTEM _____

PROJECT NAME _____ EQPT TAG NO. _____

PROJECT NO. _____ EQPT SERIAL NO. _____

SPECIFICATION NO. _____

SPECIFICATION TITLE _____

I hereby certify the installation of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:
Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT D - MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the Functional Testing of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:
Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

WITNESSES

By Owner's Authorized Representative: _____
(Authorized Signature)

By Engineer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT E - TRAINING EVALUATION FORM

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

1.	Was representative prepared?	Acceptable	Unacceptable	or	N/A
2.	Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3.	Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4.	Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5.	Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6.	Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7.	Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8.	Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9.	Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A
10.	Comments: _____				

_____

_____

_____

11. Overall Rating: Satisfactory Unsatisfactory

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

ATTACHMENT F - COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
	Source Testing	Witness	Lead	Witness Review
	Manufacturer's Certificate of Source Testing	No Action	Lead	Review
Installation Verification				
	Structural Anchorage Check	Witness	Lead	Review
	Health and Safety Check	Witness	Lead	Review
	Manufacturer Requirements Verification	No Action	Lead	Review
	Contract Documents Verification	No Action	Lead	Review
	Manufacturer's Certificate of Installation Verification	No Action	Lead	Review
Functional Testing				
	Checks	Witness	Lead	Witness, Review
	Tests	Witness	Lead	Witness, Review
	Manufacturer's Certificate of Functional Compliance	No Action	Lead	Witness, Review
System Testing				
	System Testing	Witness	Lead	Witness, Review
Start-Up Phase				
	Start-Up	Lead	Support	Witness, Review

Legend:
Lead: Primarily responsible for organization, coordination, and execution of task work product or result.
Support: Assist the lead with organization, coordination, and execution of task work product or result.
Witness: Observe and document completion of task work product or result.
No Action: Limited or no involvement.
Review: Approve for compliance with Contract Documents or reject.

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ATTACHMENT G - FUNCTIONAL TESTING REQUIREMENTS

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FUNCTIONAL TESTING REQUIREMENTS

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
		1	2	Test Water	Contractor
	Distribution Structure Gates				
	Distribution Control Valves				
Bioreactor		5	8	Test Water	Contractor
	Anoxic/Swing Zone Mixers				
	MLR Pumps				
	MLR Channel Gates				
	Surface Wasting Gates				
	Surface Wasting Pumps				
	Aeration System Blowers Control Valves				
Secondary Clarification		3	4	Test Water	Contractor
	Mixed Liquor Gates				
	Polymer Blending				
	Clarifier Drives				
	Scum Pumping				

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
RAS		3	4	Test Water	Contractor
	RAS Suction Valves				
	RAS Pumping				
	RAS Flow Split				
Hydrocyclone		7	8	RAS	Owner
	Pump Suction Valves				
	Feed Valves				
	Feed Pumps				
	Hydrocyclone				
Polymer Blending and Feeding		3	2	Polymer	Contractor
WAS		3	2	Test Water	Contractor
	Pump Suction Valves				
	WAS Pumping				
Blowers					
Entire Liquid Process Flow Stream		5	4	Re-circulated water from a potable water source	Contractor
	Bar Screens				
	Flash Mix				
	Flocculation Basins				

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
	Filters				
	UV Disinfection System				
	Clearwell				
	Backwash Pump Station				
Entire Solids Handling Flow Stream				Solids from process	Contractor
	Sludge Hose Pumps	7	4		
	Solids Contact Clarifier	7	4	Solids from process	Contractor
Entire High Service Pump Station		4	2	Finished Water	Owner
	Pumps				
	Variable Frequency Drive(s)				
	Valves				

Notes:

1. As specified in Section 01_11_00 - Summary of Work.
2. As specified in Section Specific Control Strategies.
3. As specified in this Section under Functional Testing.
4. As specified in this Section under Functional Testing.

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SECTION 01_77_00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Contract closeout requirements.

1.02 REFERENCES

A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Substantial Completion and Final Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Clean roofs, gutters, downspouts, and drainage systems.

F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
   1. Police yards and grounds to keep clean.

G. Remove dust, cobwebs, and traces of insects and dirt.

H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

I. Remove non-permanent protection and labels.

J. Polish waxed woodwork and finish hardware.

K. Wash tile.

L. Wax and buff hard floors, as applicable.

M. Wash and polish glass, inside and outside.

N. Wash and shine mirrors.

O. Polish glossy surfaces to clear shine.

P. Vacuum carpeted and soft surfaces.

Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

R. Clean ducts, blowers, and coils when units were operated without filters during construction.

S. Clean light fixtures and replace burned-out or dim lamps.

T. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from Owner of such property.

B. Do not fill ditches, washes, or drainage ways which may create drainage problems.

C. Do not create unsightly or unsanitary nuisances during disposal operations.

D. Maintain disposal site in safe condition and good appearance.

E. Complete leveling and cleanup prior to Final Completion of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF PLANT FACILITIES

A. Clean channels, pipe, basins, reservoirs, and tanks before running of 7-day test, or before facility goes on stream when 7-day test is not required. Membranes are to be installed after the sub-system function testing and before the membrane system functional testing.

B. Wash, wherever practicable, or broom sweep channels, pipe, basins, reservoirs, and tanks.

C. Disinfect filter basins, reservoirs, clear wells, tanks, channels, and piping intended to carry potable water as follows or in accordance with AWWA Standards.

D. Provide ample sampling outlets in pipe for testing.

E. Fill pipe and other plant facilities with chlorine solution of sufficient strength to retain residual of not less than 10 parts per million at end of 24 hours.

F. When reservoirs and basins are too large to be economically disinfected by filling with chlorine solution, spray reservoirs and basins with solution containing 100 parts per million of chlorine.

G. After disinfection, rinse entire potable water system with potable water sufficient to reduce chlorine residual to not more than 0.6 parts per million throughout system before system is put into service.

1.07 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF POTABLE WATER MAINS

A. Clean interior of pipe and fittings.

B. When pipe contains dirt that cannot be removed by flushing, swab pipe interiors with solution containing not less than 500 parts per million of chlorine until clean.

C. Flush 12-inch in diameter and smaller pipe as thoroughly as available water sources will permit.

D. Fill pipe with chlorine solution of sufficient strength to provide 10 parts per million chlorine residual at end of 24 hours.

E. Flush pipes with potable water until chlorine residual is less than 0.6 parts per million before pipe are put into service.

1.08 CLOSEOUT DOCUMENTS

A. Submit the following Closeout Submittals before Substantial Completion:
   1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
   2. Evidence of Compliance with Requirements of Governing Authorities.
   3. Project Record Documents.
   4. Approved Operation and Maintenance Manuals.
   5. Approved Warranties and Bonds.
   6. Keys and Keying Schedule.
   7. Completed contract requirements for commissioning and process start-up.

B. Submit the following Closeout Submittals before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
   1. Punch list of items have been completed and Engineer and Owner are satisfied that all deficiencies are corrected.
   2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
   3. Release of claims as outlined in Conditions of the Contract.
   4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
   5. Final statement of accounting.
   6. Submit Final (As-Built) Schedule as specified in Section 01_32_21 - Schedules and Reports.

1.09 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

A. Submit the following:
   1. Certificate of Occupancy.
   2. Certificates of Inspection:
      a. Elevators.
      b. Mechanical:
         1) Form U-1 "Manufacturer's Data Report for Unfired Pressure Vessels" for each pressure vessel furnished and installed.

1.10 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
   1. Mark and record field changes and detailed information contained in submittals and change orders.
   2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
   3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
   4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
   5. Provide schedules, lists, layout drawings, and wiring diagrams.
   6. Make annotations in electronic format conforming to the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

B. Maintain documents separate from those used for construction:
   1. Label documents "RECORD DOCUMENTS."

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.
   2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.

D. Affix civil engineer's or professional land surveyor's signature and registration number to Record Drawings to certify accuracy of information shown.

E. Deliver Record Documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

F. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

G. Updated Record Documents are a condition for Engineer's recommendation for progress payment.

H. Final Schedule Submittal as specified in Section (01_32_21) - Schedules and Reports.

1.11 MAINTENANCE SERVICE

A. Maintenance service as specified in technical specifications.

1.12 SUBSTANTIAL COMPLETION

A. Obtain Certificate of Substantial Completion.

1.13 FINAL COMPLETION

A. When Contractor considers the Work is complete, submit written certification that:
   1. Work has been completed in accordance with the Contract Documents:
   2. Punch list items have been completed or corrected.
   3. Work is ready for final inspection.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness.

C. Should the Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Engineer that the Work is complete.
   3. Engineer shall re-inspect the Work.

1.14 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the Engineer at least 7 days prior to final Application for Payment.

B. Statement shall reflect all adjustments to the Contract amount.
   1. The original Contract amount.
   2. Additions and deductions resulting from:
      a. Change Orders.
      b. Units installed and unit prices.
      c. Set-offs for uncorrected or incomplete Work.
      d. Set-offs for liquidated damages.
      e. Set-offs for reinspection payments.
      f. Extended engineering and/or inspection services and inspection overtime.
      g. Excessive shop drawings review cost by the Engineer.
      h. Other adjustments.
   3. Total Contract amount, as adjusted.
   4. Previous payments.
   5. Remaining payment due.

C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.15 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

2.01 SPARE PARTS

A. Owner may request advanced delivery of spare parts, maintenance products, and special tools.
   1. Deduct the delivered items from the inventory list and provide transmittal documentation.

B. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to Owner at a location on site chosen by the Owner.
   1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
   2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_78_24

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preparation and submittal of Operation and Maintenance Manuals.

1.02 GENERAL

A. Submit Operation and Maintenance Manuals as specified in technical sections.

1.03 SUBMITTALS

A. Make approved manuals available at project site for use by construction personnel and Owner.

B. Draft Operation and Maintenance Manuals:
   1. Submit prior to shipment of equipment or system to site.
   2. Shipment will be considered incomplete without the draft Operation and Maintenance Manuals.
   3. Quantity:
      a. Hard copy: 4 sets.
      b. Electronic: 2 USB flash drive.

C. Final Operation and Maintenance Manuals:
   1. Make additions and revisions in accordance with Owner's and Engineer's review comments on draft manuals.
   2. Submit approved Operation and Maintenance Manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
   3. Quantity:
      a. Hard copy: 4 sets.
      b. Electronic: 2 USB flash drive.

1.04 PREPARATION

A. General requirements:
   1. Provide dimensions in English units.
   2. Assemble material, where possible, in the same order within each volume.
   3. Reduce drawings and diagrams to 8 1/2 by 11-inch size, if possible unless otherwise specified.
   4. Complete forms on computer, handwriting not acceptable.
   5. Delete items or options not provided in the supplied equipment or system.
   6. Provide package control system annotated ladder logic for PLC, if applicable.

B. Hard copy requirements:
   1. Binders: 3-ring with rigid covers.
      a. Break into separate binders as needed to accommodate large size.
   2. Utilize numbered tab sheets to organize information.
   3. Provide original and clear text on reproducible non-colored paper, 8 1/2 by 11-inch size, 24 pound paper.
   4. Drawings larger than 8 1/2 by 11 inch:
      a. Fold drawings separately and place in envelope bound into the manual.
      b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:
   1. File format:
      a. Entire manual in PDF format.
         1) Include text and drawing information.
         2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
         3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
            a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
            b) Hard copy record drawing requirements:
               (1) Provide a single multipage PDF file of each set of the scanned drawings.
               (2) Page 1 shall be the cover of the drawing set.
            c) At file opening, display the entire cover.
               (1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
               (2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
         4) Pagination and appearance to match hard copy.
         5) Searchable.
         6) Scanned images are not acceptable.
         7) Bookmarks:
            a) Bookmarks shall match the table of contents.
            b) Bookmark each section (tab) and heading.
            c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
            d) At file opening, display all levels of bookmarks as expanded.
         8) Thumbnails optimized for fast web viewing.
      b. Drawing requirements:
         1) Provide additional copy of drawings in most current version of AutoCAD format.
         2) Drawings shall have a white background.
         3) Drawing shapes shall not degrade when closely zoomed.
         4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
         5) Delete items or options not provided in the supplied equipment or system.
   2. Media:
      a. USB flash drive.
      b. Secure File Transfer Protocol (SFTP).

3. Label media with the following information:
    a. Operation and Maintenance Manual.
    b. Equipment name.
    c. Specification Section Number
    d. Equipment tag number.
    e. Owner's name.
    f. Project number and name.
    g. Date.
4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.05 CONTENTS

A. Label the spines:
    1. Equipment name.
    2. Tag number.
    3. Project name.
    4. Owner name.

B. Cover page:
    1. Operation and Maintenance Manual.
    2. Equipment name.
    3. Specification Section Number
    4. Equipment tag number.
    5. Owner's name.
    6. Project number and name.
    7. Date.

C. Table of Contents: General description of information provided within each tab section.

D. Complete Attachment A - Equipment Summary Form.

E. Complete Attachment B - Electric Motor Technical Data Form.

F. Description of system and components.
    1. Valves:
        a. Each type of manual valve 4 inches in nominal size and larger.
        b. Non-manual valves.
        c. Operators.

G. Description of equipment function, normal operating characteristics, and limiting conditions.

H. Manufacturer's product data sheets:
    1. Where printed material covers more than 1 specific model, indicate the model number, calibrated range, and other special features.
    2. Equipment with bearings:
        a. Include manufacturer and model number of every bearing.
        b. Include calculated ball pass frequencies of the installed equipment for both the inner and outer raceways.

I. Assembly, installation, alignment, adjustment, and checking instructions.

J. Storage instructions.

K. Control diagrams:
   1. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.
   2. Complete set of 11-inch by 17-inch drawings of the control system.
   3. Complete set of control schematics.

L. Programming: Copies of Contractor furnished programming.

M. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.

N. Operating procedures:
   1. Step-by-step instructions including but not limited to the following:
      a. Safety precautions and applicable Safety Data Sheets.
      b. Guidelines.
      c. Manual keyboard entries.
      d. Entry codes.
      e. System responses.
      f. Other information as needed for safe system operation and maintenance.
   2. Modes:
      a. Startup.
      b. Routine and normal operation.
      c. Regulation and control.
      d. Shutdown under specified modes of operation.
      e. Emergency operating shutdown.

O. Preventative maintenance procedures:
   1. Recommended steps and schedules for maintaining equipment.
   2. Troubleshooting.

P. Lubrication information: Required lubricants and lubrication schedules.

Q. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.

R. Parts list:
   1. Complete parts list for equipment including but not limited to the following information:
   2. Catalog data: Generic title and identification number of each component part of equipment.
   3. Include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
   4. Availability.
   5. Service locations.

S. Spare parts list: Recommended number of parts to be stored at the site and special storage precautions.

T. Engineering data:
   1. Drawings: Complete set of 11-inch by 17-inch equipment drawings.
   2. Exploded view or plan and section views with detailed callouts.
   3. Outline, cross-section, and assembly drawings.
   4. System drawings: Provide interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
   5. Packaged equipment system drawings: Provide instrumentation loop drawing, control schematic diagrams, interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
   6. System drawings and data sheets: Include drawings and data furnished by the Engineer and the Supplier; provide "as installed" version.
   7. Provide electrical and instrumentation schematic record drawings.

U. Test data and performance curves, when applicable.

V. Manufacturer's technical reference manuals.

W. Source (factory) Test results: Provide copies of Source Tests reports as specified in technical sections.

X. Functional Test results: After Functional Tests are completed, insert Functional Test reports as specified in technical sections.

1.06 ARCHIVAL DOCUMENTATION

A. Typically does not require updating to remain valid and should be stored in a format that preserves the document and limits one's ability to make changes.

B. Types of archival documents include the following:
   1. Record drawings.
   2. Reports.
   3. Specifications.
   4. Shop drawings.
   5. Vendor Equipment O & M Manuals.
   6. Photos.
   7. Demonstration and training videos.
   8. Other.

1.07 LIVING DOCUMENTATION

A. Requires periodic updates to remain valid and should be stored in formats that are easy to update.

B. Types of living documents include the following:
   1. Facility O&M Manuals.
   2. Standard Operating Procedures.
   3. Other.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT A - EQUIPMENT SUMMARY FORM

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EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT IDENTIFICATION NUMBER(S) _____
(maps equipment number)

4. LOCATION OF EQUIPMENT _____

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

_____

_____

_____

6. NAMEPLATE DATA -
   - Horsepower _____
   - Amperage _____
   - Voltage _____
   - Service Factor (S.F.) _____
   - Speed _____
   - ENC Type _____
   - Capacity _____
   - Other _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name _____

   Address _____

   Telephone Number _____

8. MAINTENANCE REQUIREMENTS:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

9. LUBRICANT LIST:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)

(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

10. SPARE PARTS (recommendations)_____

_____

11. COMMENTS_____

12. GENERAL INFORMATION:

Date Accepted*: _____

Expected Life*: _____

Project Name & Number: _____

Design Engineer: _____

13. WARRANTY:

Start Date: _____

Expiration Date: _____

Prorated: _____

ATTACHMENT B - ELECTRIC MOTOR TECHNICAL DATA

ELECTRIC MOTOR TECHNICAL DATA

Technical Data for Each Motor:

Application: _____

Manufacturer: _____

Frame No.: _____ Type: _____

Code Letter: _____ Design Letter: _____

Rating:

Horsepower: _____Voltage: _____ Phase: _____

Cycles: _____Full Load rpm: _____

(wound rotor secondary)

Volts: _____ Amperes: _____

Full Load Current: _____ amperes

Locked Rotor Current: _____ amperes

Locked Rotor or Starting Torque (percent of full load): _____ percent

Full Load Torque: _____ ft-lb

Breakdown Torque: _____ percent

Efficiency:		Power Factor:	
Full Load:	_____ percent	Full Load	_____ percent
3/4 Load:	_____ percent	3/4 Load:	_____ percent
1/2 Load:	_____ percent	1/2 Load:	_____ percent

Insulation:

Type: _____

Class: _____

Temperature Rise: _____ Above Ambient: _____

Enclosure: _____

Net Weight: _____ lbs

Wk^2: _____ lbs/sq ft

Type of Bearings: _____

Service Factor: _____

Noise Level in Decibels: _____

Heaters: _____ kW, _____ Phase, _____ volts

Altitude: _____

SECTION 01_78_36

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Warranty and bonds requirements.

1.02 SUBMITTALS

A. For each item of material or equipment furnished under the Contract:
   1. Submit manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
   2. Submit manufacturer's special warranty when specified.

B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion.
   1. Contents:
      a. Organize warranty and bond documents:
         1) Include Table of Contents organized by specification section number and the name of the product or work item.
      b. Include each required warranty and bond in proper form, with full information, certified by manufacturer as required, and properly executed by Contractor, or subcontractor, supplier, or manufacturer.
      c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
   2. Hardcopy format:
      a. Submit 2 copies.
      b. Assemble in 3 D-side ring binders with durable cover.
      c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
   3. Electronic copy in PDF format:
      a. Submit 1 copy.

1.03 OWNER'S RIGHTS

A. Owner reserves the right to reject warranties.

B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.

B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S WARRANTY MINIMUM REQUIREMENTS

A. Written warranty issued by item's manufacturer.

B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner.

C. Covers all costs associated with the correction of the defect, including but not limited to removal of defective parts, new parts, labor, and shipping.
   1. When correcting warranted Work that has failed, remove and replace other Work that had been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

D. Provides a timely response to correct the defect.
   1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
   2. In the case that Owner has to provide temporary equipment to replace function of warranted item requiring repair or replacement, manufacturer shall reimburse Owner for such costs associated with the temporary equipment.

E. Warranty commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.

F. Duration of Warranty: 1 year.

1.06 MANUFACTURER'S SPECIAL WARRANTY

A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements specified in the section where the item is specified.
   1. Includes Project-specific information and requirements, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Owner. Technical sections indicate Project-specific requirements that differ from the minimum warranty requirements for that item.
      a. Examples include extending the duration of manufacturer's warranty or to provide increased rights to Owner.
   2. Manufacturer's warranties commence on the date that the associated item is certified by Engineer as substantially complete.

1.07 WARRANTY WORK

A. Contractor's responsibilities:
   1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Replacement cost:
   1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
      a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.

C. Related damages and losses:
   1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

D. Owner's recourse:
   1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.

E. Reinstatement of warranty:
   1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
      a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

A. Warranty of title and intellectual rights:
   1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
   2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

A. Equipment bond and other bond requirements as specified in the technical sections.

B. Bonds commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01_81_50

DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Design criteria for use in the selection of equipment and appurtenances specified in Technical Sections of these Specifications and indicated on the Drawings.
   2. Criteria for design of systems, components and equipment fabricated off site and shipped to the Work for installation.
   3. Criteria for design of anchors to connect equipment and appurtenances to supports and structures.

B. The criteria in this Section apply throughout the Work, unless additional criteria, or more restrictive criteria, are indicated.
   1. Additional criteria and requirements relevant to specific locations, specific materials, and specific equipment are indicated on the Drawings, and in the Technical Sections.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures. (ASCE 7).

B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
   1. ASHRAE Fundamentals Handbook.

C. International Code Council (ICC):
   1. International Energy Conservation Code (IECC).
   2. International Plumbing Code (IPC).

D. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
   1. Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd edition - 2008.

1.03 SUBMITTALS

A. Submit documentation of Contractor-prepared designs as specified in Technical Sections of the Contract Documents.
   1. Calculations:
      a. Where submittal of calculations is required:
         1) Provide complete calculations, including sketches to illustrate the design concepts being evaluated, and details to fully describe proposed construction.

2. Shop drawings:
    a. Shop drawings describing components and manufacturer's requirements for connections.
        1) Include details for connections of components to structures and supports
        2) Include details for anchoring bracing to structures where required.

B. Delegated Design Submittals:
    1. As specified in Section 01_35_73 - Delegated Design Procedures.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA - SITE INFORMATION

A. Site name:
    1. Location:
        a. Street Address: As specified in Section 01_11_00 - Summary of Work.
        b. Elevation (approximate):
            1) 62 feet above mean sea level**.**

2.02 DESIGN CRITERIA - REGULATORY REQUIREMENTS

A. Requirements of authorities having jurisdiction over the project are included in Section 01_41_00 - Regulatory Requirements.

2.03 DESIGN CRITERIA - OPERATING ENVIRONMENT

A. Project conditions:
    1. Equipment and materials for the Work shall be suitable for performance in a potable water treatment plant.
    2. The Drawings and Technical Sections include additional criteria and requirements relevant to specific locations, materials, and equipment.

B. Outdoor conditions:
    1. Temperature criteria: As specified in the following Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook.
    2. Rainfall intensity:
        a. Reference: International Plumbing Code (IPC):
            1) 2.3 inches per hour (100-year, 1-hour rainfall).

C. Indoor Conditions: N/A.

2.04 DESIGN CRITERIA - STRUCTURAL

A. General:
    1. Criteria for structural design of:
        a. Equipment at locations subject to seismic events.
        b. Equipment exposed to outdoor environments.
        c. Equipment supports and bracing, and anchorage of such items to building and non-building structures.

d. Structures provided for the Work through delegated design.
e. Manufactured and prefabricated structures, and anchorage of such structures to foundations or other supporting elements.

2. Structural design criteria used by the engineer of record and required by the building code to be indicated on the Drawings, are included on the Contract Drawing titled "General Structural Notes.

B. Delegated Design:
1. Structural engineering design for the Pre-Engineered Metal Canopies shall be performed by a Civil Engineer licensed in the State of Texas.

C. Groundwater elevation:
1. For design of buried and partially buried construction:
a. Assume groundwater level at grade**.**

D. Structure risk category:
1. Determine importance factors, develop design loads, and provide detailing in accordance with the provisions of ASCE 7 and the building code specified in Section 01_41_00 - Regulatory Requirements, based on the Structure Risk Category indicated in Table: Project Structures - Risk Category and Seismic Design Information.

E. Seismic loads:
1. Seismic design parameters: Basic parameters - ASCE 7:
a. Ground motion MCE_R, 5 percent damped:
1) Short periods, Ss = 0.304 g.
2) One second period, S_1 = 0.099 g.
b. Peak ground acceleration, MCE_G:
1) Peak ground acceleration, PGA = 0.131 g.
c. Mapped long-period transition period:
1) TL = 6 seconds.
2. Structures - General:
a. Seismic Design Category (SDC): As indicated in the following Table: Project Structures - Risk Category and Seismic Design Information.

Table: Project Structures - Risk Category and Seismic Design Information

Description: Water Treatment Facility

Area	Description	Risk Category	Site Class	S_{DS}	S_{D1}	Seismic Design Category(1)
All	All	III	D	0.316	0.158	C

Notes:

(1) Seismic Design Category for delegated design, and for seismic certification of electrical and mechanical equipment as required by ASCE 7.

b. Structure response modification coefficient, R:
    1) In accordance with ASCE 7, and the requirements of the Technical Sections.

3. Structures - Tanks and vessels.
    a. Includes: Tank structures, tank supports, and anchorage to structures or foundations:
    b. Liquid storage structures (e.g.: basins and tanks)
        1) Include impulsive and convective (“sloshing”) effects.
        2) Component response modification factor - impulsive effects, Ri: In accordance with ASCE 7, Table 15.4-2.
        3) Component response modification factor - convective effects, Rc = 1.0.
    c. Dry material storage structures (e.g.: silos, hoppers):
        1) Include effects of stored materials.
        2) Component response modification factor - impulsive effects, Ri: In accordance with ASCE 7, Table 15.4-2.

4. Non-structural components - General:
    a. Includes:
        1) Mechanical and electrical equipment; anchorage of equipment to structures or supports; design of equipment supports; and anchorage of supports to structures or foundations.
        2) Distribution systems associated with mechanical and electrical equipment such as piping, ductwork, conduits, cable trays, raceways, bus ducts, and similar items; anchorage of such systems to supports and structures; and bracing or such systems.
    b. Seismic design requirements for non-structural components are based on the Seismic Design Category (SDC) of the structure or facility where the equipment is installed.
        1) See Table: Project Structures - Risk Category and Seismic Design Information for Seismic Design Categories of facilities or structures included in the Work.
    c. Design components, component anchorage, and component connections to piping and utilities in accordance with the requirements of ASCE 7, Table 13.2-1
    d. Component amplification factor (ap), response factor (Rp), and overstrength factor for anchorage to concrete (Ωo):
        1) Mechanical and electrical components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
        2) Architectural components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
    e. Component importance factor, Ip:
        1) In accordance with the following Table: Component Importance Factor for seismic design, I_p.
        2) For items not listed in Table: Component Importance Factor for seismic design, I_p, designate importance factor in accordance with the provisions of ASCE 7, Chapter 13 and submit to Engineer for review prior to developing calculations and details related to that component.

Table: Component Importance Factor for seismic design, I_p		
Structure Seismic Design Category	**Components**	**Ip**
All	Electrical: Items and distribution system components specified in Division 26 - Electrical.	1.5
All	Process Control and Instrumentation Systems: Components and distribution systems specified in Division 40 - Process Integration.	1.5
All	Equipment and components specified in Divisions 11 through 49,	1.5
Notes:		

5. Non-structural components: HVAC ductwork.
    a. Component importance factor, Ip: Determine in accordance with ASCE 7, Section 15.4.1.1.
    b. Seismic design category:
        1) See Table: Component Importance Factor for seismic design, I_p (preceding).
    c. SMACNA seismic hazard level.
        1) Seismic hazard level for design of heating, ventilating, and air conditioning ductwork, supports and equipment in accordance with SMACNA Seismic Restraint Manual:

F. Wind loads:
1. Design structures and non-structural components that are exposed to wind to withstand design wind loads.
    a. Reduction of wind loads based on shielding effects of surrounding structures or components is not allowed.
    b. Design for wind loading is not required for non-structural components and for non-building structures located inside enclosed buildings.
2. Design parameters:
    a. Basic wind speed:
        1) 112 miles per hour (33 feet, 3 second gust).
    b. Exposure category: C.
    c. Topographic factor, Kzt: 1.0.
    d. Wind pressure for design of "components and cladding."
        1) "Components and cladding" includes doors, windows, siding panels, skylights, parapets and similar architectural elements.
        2) Minimum wind pressure for components and cladding, strength level:
            a) Wall elements: NA.
            b) Roof elements: Minimum 18 pounds per square foot, pressure or vacuum.
            c) For "allowable stress level" pressures, multiply strength level pressures by 0.625.

G. Snow loads:
1. Design for snow loading is not required for non-structural components and for non-building structures located inside enclosed buildings.

2. Design parameters:
    a. Ground snow load: pg = 5 pounds per square foot.
    b. Flat roof snow load: pf = 5 pounds per square foot, minimum.
    c. Exposure factor, minimum: Ce = 1.1.
    d. Importance factor, minimum: Is = 1.2.
    e. Drifting:
        1) Consider effects of adjacent and nearby structures and equipment on drift loads.

H. Rainfall loads:
    1. Determine rainfall loads using rainfall intensity specified herein, and including effects of exposed surface slope, height above surface to discharge elevation, and deflection of ponded surfaces.

I. Operational loads:
    1. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), surge or "water hammer," and other load conditions.
    2. Design for loads indicated by equipment manufacturer.
    3. Design for loads indicated in the Technical Sections for equipment and appurtenances.

J. Serviceability considerations:
    1. Deflection, unless otherwise indicated on the Drawings, or specified:
        a. Beam deflection as fraction of span:
            1) Walkways and platforms: total load = L/240; live load = L/360.
            2) Equipment supports: L/450.

PART 3 EXECUTION

3.01 GENERAL

A. Design in accordance with the requirements of:
    1. Regulatory requirements, including but not limited to the building code specified in Section 01_41_00 - Regulatory Requirements; AND
    2. Reference standards and project-specific design criteria listed in this Section; AND
    3. Specific requirements for individual elements and components of the Work as specified in subsequent Technical Sections.

B. Designs based on criteria in this Section shall not be less than what is required to comply with the codes and standards specified in Section 01_41_00 - Regulatory Requirements.

C. In the event of conflicts between design criteria, contact Engineer for interpretation.

D. Prepare and submit designs for the following, and where Owner-delegated design is required by the Specifications.
    1. Design, detailing, and anchoring of pre-engineered structures.
    2. Design, detailing, and anchoring of pre-engineered structural components.
    3. Anchoring of equipment and components to structures.

4. Bracing of equipment and components from structures.
5. Anchoring and bracing for distribution systems attached to or braced from structures.

E. Requirements for seismic design calculations will be waived for the following:
1. Furniture and storage racks 6 feet in height or less.
2. Moveable equipment.
3. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category A or B.
4. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category C and where the component importance factor, Ip, is equal to 1.0.

F. Requirements for wind design calculations will be waived for the following:
1. Equipment and components located inside structures, and away from the effects of wind loads.

3.02 DESIGN - ANCHORS FOR EQUIPMENT, COMPONENTS, AND BRACING

A. General:
1. Complete, submit, and obtain Engineer's approval of anchor designs after approval of equipment and before placement of concrete or masonry that will support or provide bracing for the equipment.
2. Adjust equipment pad sizes and add additional anchorage confinement reinforcing to provide required strength at anchorage points.
3. Supports and bracing:
a. Design and install braces and anchors to transfer forces from equipment and components to the lateral force resisting system of the surrounding structure.
b. Anchor and brace piping, ductwork, and electrical distribution components so that lateral or vertical displacement does not result in damage to or failure of essential architectural, mechanical, or electrical equipment.
1) Provide supplementary framing where required to transfer forces.
2) Detail and locate braces and anchors to minimize differential movements between components and structure.

B. Preparation:
1. Obtain manufacturer's information:
a. Layout and location of anchors that connect to equipment base plates, sole plates, or skids.
b. Sizes of holes for anchors that will be provided in equipment bases or support frames.

C. Analysis and design:
1. Perform and submit calculations to determine anchor designs at locations where equipment and equipment supports are connected to the supporting structure.
a. Indicate number, size, type, and material for anchors.
2. In determining forces at locations where equipment is anchored to structures, include effects of:
a. Equipment self-weight and operating weight.
b. Location of equipment center of mass.

c. Forces from equipment operation including, but not limited to:
    1) Effects of internal contents including weight, sloshing, surge, and water hammer.
    2) Equipment reactions and operating torque.
    3) Equipment vibration.
    4) Thermal effects from equipment and from attached distribution systems.
    5) Other load or displacement inducing conditions.
d. Forces on equipment from piping and electrical connections.
e. Forces on equipment from loads specified in this Section.
    1) Include effects of wind, snow, and icing loads where applicable based on location of the equipment in the Work.
    2) Design for load combinations indicated in ASCE 7, unless otherwise specified or indicated on the Drawings.
    3) Seismic and wind loads: For equipment and tanks having varying weight based on the volume of contained material, determine anchor forces to accommodate the full range of filled, partially filled, and empty conditions.

3. Determine forces and overturning moments at equipment supports and at locations where supports are anchored to structures.
    a. Indicate shears and associated axial forces at each anchor.
4. Do not use friction to resist sliding resulting from seismic or wind forces. Resist only by direct application of sliding loads to fasteners as bearing, shear, tension, or compression forces.
5. Using combined shears and axial forces at each anchor, design anchors and anchor groups for ductile failure.
    a. Ductile failure: Anchor yield before failure of base material, typically concrete or masonry, at the anchor.
6. Anchor selection:
    a. Provide anchors type indicated on the Drawings.
    b. Where anchors are not specifically indicated on the Drawings, select in accordance with the following:
        1) Anchors that resist seismic and wind forces:
            a) Cast-in-place forged hex-head anchor bolt.
        2) Anchors loaded in sustained tension:
            a) Cast-in-place forged hex-head anchor bolt.
        3) Anchors for reciprocating, vibrating, and rotating equipment:
            a) Cast-in-place forged hex-head anchor bolt.
    c. Do not use post-installed anchors, mechanical or adhesive, unless:
        1) Post-installed anchors are indicated on the Drawings; or
        2) Post-installed are approved by Engineer prior to placement of the surrounding concrete or masonry.
    d. Anchor diameter:
        1) Select diameter so that hole in base plate is not greater than 125 percent of the nominal diameter of the anchor, nor greater than the diameter of the anchor plus 1/4 inch.
7. Determine number, size, layout, and minimum effective embedment for anchors.
    a. Layout includes anchor spacing and required distance(s) from anchor to edge(s) of supporting concrete or masonry.

b. Anchors in concrete: Design based on minimum specified 28-day compressive strength, f'c, as follows, unless otherwise indicated on the Drawings for the Work area:
   1) Concrete placed for this Work: f'c = 4,000 pounds per square inch.
   Anchors in masonry: N/A.

8. Prepare drawings showing construction details of anchor designs.
9. Submit design calculations and drawings prior to placement of anchors, and of the structural elements to which they will connect.

END OF SECTION

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SECTION 03_20_00

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Reinforcing bars.
      a. Carbon steel.
   2. Thread bars.
   3. Bar supports.
   4. Tie wires.
   5. Welded wire fabric.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.
   2. SP-66 - ACI Detailing Manual.

B. American Iron and Steel Institute (AISI).

C. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

D. ASTM International (ASTM):
   1. A493 - Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
   2. A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
   3. A1064 - Standard Specification of Carbon-Steel wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

E. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

1.03 DEFINITIONS

A. Architectural concrete: Concrete surfaces that will be exposed to view in the finished work.
   1. Additionally, for purposes of this Section,includes:
      a. Concrete surfaces that are designated to receive paints or coatings.
      b. Exposed concrete in open basins, channels, and similar liquid containing structures:Surfaces shall be considered exposed to view if located above a line 2 feet below the normal operating water surface elevation in that structure.

B. Bars: Reinforcement or reinforcing bars as specified in this Section.

C. Evaluation Report: Report prepared by ICC-ES , or by other testing agency acceptable to the Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and its acceptance for use under the Building Code specified in Section 01_41_00 - Regulatory Requirements.

D. Give away bars: Reinforcing bars that are not required by the Contract Documents, but are installed by the Contractor to provide support for the required reinforcing bars.

E. Wire supports: Metal reinforcing supports constructed of steel wire as specified. Includes individual high chairs, continuous high chairs, bolsters and other similar configurations and shapes.

1.04 SUBMITTALS

A. General:
   1. Submit in accordance with Section 01_33_00 - Submittal Procedures.
   2. Changes to reinforcement in Contract Documents:
      a. Indicate in a separate letter submitted with shop drawings any changes to reinforcement indicated on the Drawings or specified.
      b. Such changes will not be acceptable unless Engineer has accepted them in writing.

B. Product data:
   1. Bar supports:
      a. Wire bar supports:
         1) Schedule of support materials to be provided and locations of use.

C. Shop drawings:
   1. Reinforcement shop drawings:
      a. Submit drawings showing bending and placement of reinforcement required by the Contract Documents.
      b. Clearly indicate structures or portions of structures covered by each submittal.
         1) Submit reinforcement shop drawings for each structure as a complete package. Submittals addressing only a portion of a structure will be rejected and returned without review, unless such presentation is accepted by Engineer in advance.
      c. Shop drawings shall conform to the recommendations of the CRSI Manual of Standard Practice and ACI SP-66.
      d. Use the same bar identification marks on bending detail drawings, placement drawings, and shipping tags.
      e. Submittals consisting solely of reinforcing bar schedules, without accompanying placement drawings, will not be accepted unless accepted under prior written agreement with Engineer.
   2. Reinforcement placement drawings:
      a. Clearly show placement of each bar listed in the bill of materials, including additional reinforcement at corners and openings, and other reinforcement required by details in the Contract Documents.
      b. Clearly identify locations of reinforcement with coatings (e.g., galvanized or epoxy) and with yield strength other than ASTM A615, Grade 60.

c. Show anchor bolt locations based on anchor bolt templates for approved equipment.
d. Show splice locations.

3. Reinforcement fabrication drawings:
   a. If bend types or nomenclature differs from that recommended in the CRSI Manual of Standard Practice, provide details showing bend types and dimensional designations.
      Clearly identify reinforcement with coatings and with yield strength other than ASTM A615, Grade 60.

D. Samples (when requested by Engineer):
1. Bar supports/wire reinforcement supports: Samples of each type of chair and bolster proposed for use. Submit with letter stating where each type will be used.
2. Precast concrete bar supports: Samples of each type of precast support proposed for use. Submit with letter stating where each will be used.

E. Test reports:
1. Certified copy of mill test for each steel used. Show physical properties and chemical analysis.
   a. Mill test reports may be submitted as record documents at the time the reinforcement from that heat of steel is shipped to the site.
   b. In such cases, submit certificates under the shop drawing submittal number with the letter "R" (for record date) appended to the end (e.g., of the reinforcement was submitted as 03_20_00-002-1, deliver the associated mill certificate as submittal 03_20_00-002-1R).

F. Manufacturer's instructions:

G. Special procedures:
1. Welding procedures conforming to AWS D1.4 for reinforcement to be field welded.
   a. Procedures qualification record.

H. Qualifications statements:
1. Welder qualifications.

I. Closeout documents:
1. Field quality control and inspection reports.
2. Field quality assurance special inspection and testing reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
1. Deliver bars bundled and tagged with identifying tags.

B. Acceptance at site:
1. Reinforcing bars: Deliver reinforcing bars lacking grade identification marks with letter containing manufacturer's guarantee of grade.

1.06 SEQUENCING AND SCHEDULING

A. Bar supports:
   1. Do not place concrete until samples and product data for bar supports have been accepted by Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. The drawings contain notes describing the size and spacing of reinforcement and its placement, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete, and other related information.

2.02 MATERIALS

A. Reinforcing bars:
   1. Provide reinforcement of the grades and quality specified, fabricated from new stock, free from excessive rust or scale, and free from unintended bends or other defects affecting its usefulness.
   2. Reinforcing bars:
      a. ASTM A615 Grade 60 deformed bars, including the following requirements, .
         1) Actual yield strength based on mil tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
         2) Ratio of actual ultimate tensile strength to actual tensile yield strength shall not be less than 1.25.
   3. Reinforcing bars designated or required to be welded:
      a. Low-alloy, ASTM A706 Grade 60, deformed bars.

B. Bar supports:
   1. Wire supports:
      a. All stainless steel bar supports:
         1) Conforming to CRSI Manual of Standard Practice recommendations for types and details, but custom fabricated entirely from stainless steel wire conforming to ASTM A493, AISI Type 316.
      b. Stainless steel protected bar supports:
         1) Conforming to CRSI Manual of Standard Practice Class 2, Type B, and consisting of bright basic wire support fabricated from cold--drawn carbon steel wire with stainless steel ends attached at the bottom of each leg.
         2) Stainless steel wire ends shall conform to ASTM A493, AISI Type 316 and shall extend at least 3/4 inch inward from the formed surface of the concrete.
      c. Bright basic wire bar supports.
         1) Conforming to CRSI Manual if Standard Practice, Class 3.
   2. Plastic supports:
      a. Manufacturers: The following or equal:
         1) Aztec Concrete Accessories.

3. Deformed steel reinforcing bar supports:
    a. Fabricated of materials and to CRSI details recommended for typical reinforcement embedded in concrete and bent to dimensions required to provide specified clearances and concrete cover.
4. Precast concrete bar supports ("dobies"):
    a. Pre-manufactured, precast concrete blocks with cast-in annealed steel wires, 16-gauge or heavier.
    b. Compression strength of concrete: Equal to or exceeding the compression strength of the surrounding concrete.
    c. Block dimensions:
        1) Height to provide specified concrete cover.
        2) Footprint not less than 3 inches by 3 inches, and adequate to support the weight of the reinforcement and maintain specified concrete cover without settling into the underlying surface.

C. Tie wires:
1. General use: Black annealed steel wire, 16-gauge or heavier.

D. Welded wire fabric reinforcement:
1. Material:
    a. Carbon steel conforming to ASTM A1064.
2. Provide welded wire reinforcement in flat sheet form. Rolled wire fabric is not permitted.
3. Fabric may be used in place of reinforcing bars if accepted by Engineer:
    a. Provide welded wire fabric having cross-sectional area per linear foot not less than the cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.03 FABRICATION

A. Shop fabrication and assembly:
1. Cut and bend bars in accordance with provisions of ACI 318 and the CRSI Manual of Standard Practice.
2. Bend bars cold. Use bending collars to develop the recommended bend radius.
3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.
4. Circumferential and radiused reinforcement: Roll to the radius required for its location in the structure before installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
1. Reinforcing bars and welded wire reinforcement:
    a. Verify that reinforcement is new stock, free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings that will adversely affect bonding capacity when placed in the Work.
2. Welded wire fabric:
    a. Verify that sheets are not curled or kinked before or after installation.

3.02 PREPARATION

A. Surface preparation:
   1. Reinforcing bars - uncoated:
      a. Clean reinforcement of concrete, dirt, oil and other coatings that will adversely affect bond before embedding bars in subsequent concrete placements.
      b. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean bars having rust scale, loose mill scale, or thick rust coat.
      c. Partially embedded reinforcement: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placements.

3.03 INSTALLATION

A. Reinforcing bars: General:
   1. Field-cutting of reinforcing bars is not permitted.
   2. Field-bending of reinforcing bars, including straightening and rebending, is not permitted.

B. Placing reinforcing bars:
   1. Accurately place bars to meet position and cover requirements indicated on the Drawings and specified. Secure bars in position.
   2. Tolerances for placement and minimum concrete cover: As listed in Table 1.

Table 1 - Reinforcement Placing Tolerances

Member	Tolerance on Reinforcement Location (1)	Tolerance on Minimum Concrete Cover (1,2)
Slabs, beams, walls and columns except as noted below:		
10 inches thick and less	± 3/8 inch	- 3/8 inch
More than 10 inches thick	± 1/2 inch	- 1/2 inch
Formed soffits:	As noted above	- 1/4 inch
Longitudinal location of bends and ends of reinforcement:		
Conditions not listed below:	± 2 inches	- 1/2 inch
At discontinuous ends of brackets and corbels	± 1/2 inch	- 1/4 inch
At discontinuous ends of other members:	± 1 inch	- 1/2 inch

Notes:
(1) ± indicates "plus or minus;" - indicates "minus;" + indicates "plus."
(2) Tolerance on cover is limited as noted, but decrease in cover shall not exceed one third of the minimum cover indicated on the Drawings.

3. Spacing between bars:
    a. Minimum clear spacing between bars in a layer:
        1) As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
    b. Minimum clear spacing between bars in 2 or more parallel layers:
        1) Place bars in upper layers directly above bars in lower layers.
        2) Minimum spacing between layers: As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
    c. Limits on minimum clear spacing between bars also applies to the clear spacing between a lap splice and the adjacent bars and/or lap splices.
4. Lap splices for bars:
    a. Lap splice locations and lap splice lengths: as indicated on the Drawings. Where lap lengths are not indicated, provide in accordance with ACI 318.
    b. Unless otherwise specifically indicated on the Drawings (and noted as "non-contact lap splice"), install bars at lap splices in contact with each other and fasten together with tie wire.
    c. Where bars are to be lap spliced at concrete joints, ensure that bars project from the first concrete placement a length equal to or greater than minimum lap splice length indicated on the Drawings.
    d. Stagger lap splices where indicated on the Drawings.
    e. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318.

C. Reinforcing supports:
1. Provide supports of sufficient numbers, sizes, and locations to maintain concrete cover, to prevent sagging and shifting, and to support loads during construction without displacement and without gouging or indentation into forming surfaces.
    a. Quantities and locations of supports shall not be less than those indicated in ACI SP-66 and the CRSI Manual of Standard Practice.
2. Do not use brick, concrete masonry units, concrete spalls, rocks, wood, or similar materials for supporting reinforcement.
3. Do not use "give away bars" that have less cover than that required by the Contract Documents. Do not adjust the location of reinforcement required by the Contract Documents to provide cover for give away bars.
4. Provide bar supports of height required to maintain the clear concrete cover indicated on the Drawings.
5. Provide bar supports at formed vertical faces to maintain the clear concrete cover indicated on the Drawings.
6. Schedule of reinforcement support materials: Provide bar supports as indicated in Table 2.

Table 2 - Reinforcement Support Materials

Case	Location	Material
a.	Concrete placed over earth and concrete seal slabs ("mud mats"):	Stainless steel wire supports on stainless steel plates.
b.	Concrete placed against forms and exposed to water or wastewater process liquids (whether or not such concrete received additional linings or coatings):	All stainless steel bar supports.

Table 2 - Reinforcement Support Materials		
Case	**Location**	**Material**
c.	Concrete placed against forms and exposed to earth, weather, frequent washdown, or groundwater in the finished work	All stainless steel bar supports.
d.	Concrete placed against forms and exposed to interior equipment/piping areas in the finished work	All stainless steel bar supports.
e.	Between mats of reinforcement, and fully embedded within a concrete member	Bright basic wire bars supports, or deformed steel reinforcing bars.

D. Tying of reinforcing:
   1. Fasten reinforcement securely in place with wire ties.
   2. Tie reinforcement at spacings sufficient to prevent shifting.
      a. Provide at least 3 ties in each bar length. (Does not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity).
   3. Tie slab bars at every intersection around perimeter of slab.
   4. Tie wall bars and slab bar intersections other than around perimeter at not less than every fourth intersection, but at not more than the spacing indicated in Table 3:

Table 3 - Maximum Spacing of Tie Wires for Reinforcement		
Bar Size	**Slab Bar Spacing (inches)**	**Wall Bar Spacing (inches)**
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

   5. After tying:
      a. Bend ends of wires inward towards the center of the concrete section. Minimum concrete cover for tie wires shall be the same as cover requirements for reinforcement.
      b. Remove tie wire clippings from inside forms before placing concrete.

E. Welded wire fabric reinforcement:
   1. Install only where indicated on the Drawings or accepted in advance by Engineer.
   2. Install necessary tie wires, spacing chairs, and supports to keep welded wire fabric at its designated position in the concrete section while concrete is being placed.
   3. Straighten welded wire fabric to make sheets flat in the Work.
   4. Do not allow wire fabric to drape between supports unless such a configuration is specifically indicated on the Drawings.
      a. If fabric is displaced during placement of concrete, make provisions to restore it to the designated location using methods acceptable to Engineer.

5. Bend welded wire fabric as indicated on the Drawings or required to fit Work.
6. Lap splice welded wire fabric as indicated on the Drawings.
    a. If lap splice length is not indicated, splice in accordance with ACI 318, but not less than 1 1/2 courses of fabric or 8 inches minimum. Tie laps at ends and at not more than 12 inches on center.

F. Welding reinforcing bars:
1. Weld reinforcing bars only where indicated on the Drawings or where acceptance is received from Engineer prior to welding.
2. Perform welding in accordance with AWS D1.4 and welding procedures accepted by Engineer.
    a. Conform to requirements for minimum preheat and interpass temperatures.
3. Submit:
    a. Welding procedures specification.
    b. Procedures qualification record.
    c. Welder qualification test record.
4. Do not tack weld reinforcing bars except where specifically indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Provide quality control for the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Field inspections and testing:
1. Submit records of inspections and testing to Engineer in electronic format within 24 hours after completion.

3.05 FIELD QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 01_45_00 - Quality Control.

B. Special inspections and tests:
1. Provide as specified in Section 01_45_24 - Regulatory Quality Assurance.
2. Frequency of inspections:
    a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Building Code specified in Section 01_41_00 - Regulatory Requirements.
3. Preparation:
    a. Review Drawings and Specification for the Work to be observed.
    b. Review approved submittal sand shop drawings.
4. Inspections: Special inspection shall include, but is not limited to, the following items.
    a. Reinforcement: General:
        1) Type (material) and location of reinforcement supports.
        2) Bar material/steel grade and bar size.
        3) Location, placement, and spacing of bars.
        4) Clear concrete cover over reinforcement.
        5) Lap splice: Location and lap length. Bars within tolerances for contact (unless non-contact splice is indicated on the Drawings.)

6) Bar hooks and development lengths embedded within concrete sections as indicated on the Drawings.
7) Reinforcement tired in position and tie wire legs turned inward toward the center of the concrete section.

b. Reinforcement: Welding:
1) Inspector qualification and inspections shall be in accordance with the requirements of AWS D1.4.
2) Provide periodic inspection for:
a) Weldability of reinforcement other than ASTM A706.
b) Single pass fillet welds with thickness less than or equal to 5/16 inch.
3) Provide continuous inspection for:
a) Other welds.
b) Welds at mechanical reinforcing bar couplers and end anchors.
4) In addition to visual inspection, Owner may inspect reinforcing bar welds by other methods, including radiographic inspection.

5. Records of inspections:
a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspections.

3.06 NON-CONFORMING WORK

A. Before placing concrete, adjust or remove and re-install reinforcement to conform to the requirements of the Contract Documents.

END OF SECTION

SECTION 03_21_17

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

A. American Concrete Institute (ACI).
   1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

B. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

C. ASTM international (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

D. Concrete Reinforcing Steel Institute (CRSI).

E. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

F. Society for Protective Coatings (SSPC):
   1. SP-1 - Solvent Cleaning.

1.03 DEFINITIONS

A. Evaluation Service Report (ESR): Report prepared by ICC-ES, or other testing agency acceptable to Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and to document its acceptance for use under the Building Code specified in Section 01_41_00 - Regulatory Requirements.

1.04 SUBMITTALS

A. Product data: Technical data for adhesives, including:
   1. Manufacturer's printed installation instructions (MPII).
   2. Independent laboratory test results indicating allowable loads in tension and shear for concrete of the types included in this Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
   3. Handling and storage instructions.

B. Quality control submittals:
    1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01_41_00 - Regulatory Requirements.
    2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
    3. Installer qualifications:
        a. Submit evidence of successful completion of adhesive manufacturer's installation training program.
        b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.

C. Inspection and testing reports:
    1. Inspections: Field quality control: Reports of inspections and tests.
        a. Inspections: Field quality assurance: Reports of special inspections and tests.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Installation requirements:
        a. Have available at the site, and install anchors in accordance with, the adhesive manufacturer's printed installation instructions.
    2. Installer qualifications:
        a. Demonstrating successful completion of adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
        b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the Building Official.
            1) Organizations/certification programs deemed to be qualified are:
                a) ACI-CRSI Adhesive Anchor Installer Certification Program.
                b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the Building Official.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
    1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.
    2. Control temperature to maintain storage within manufacturer's recommended temperature range.
        a. If products have been stored at temperatures outside manufacturer's recommended range, test by methods acceptable to the Engineer to confirm acceptability before installing in the Work.
    3. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

B. Seismic Design Category (SDC) for structures: As specified in Section 01_81_50 - Design Criteria.PRODUCTS

1.08 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

B. Adhesives shall have a current Evaluation Report documenting testing and compliance with the requirements or ACI 355.4 and of ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the Seismic Design Category specified.

C. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.

1.09 EPOXY ADHESIVE

A. Materials:
   1. Meeting the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C depending on site conditions.
   2. 2-component, 100 percent solids, insensitive to moisture.
   3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

B. Packaging:
   1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
      a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
      b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.
   2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
   1. Hilti, Inc., HIT-RE 500-V3.
   2. Simpson Strong-Tie Co., Inc., SET-XP.

1.10 ALL THREAD RODS

A. Materials: As specified in Section 05_12_00 - Structural Steel Framing for rods, nuts and washers.

1.11 REINFORCING BARS

A. As specified in Section 03_20_00 - Concrete Reinforcing.

PART 2 EXECUTION

2.01 GENERAL

A. Execution of this work is restricted to installers who have personally completed the adhesive manufacturer's on-site training for the products to be installed, and who are personally certified through a qualified certification program described under Quality Assurance and accepted by the Engineer and the Building Official.
   1. Do not install holes or adhesive until training is complete.

B. Perform work in strict compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.

C. Install reinforcing bars and all thread rods to embedment depth, and at spacing and locations indicated on the Drawings.
   1. If embedment depth is not indicated, contact Engineer for requirements.

2.02 PREPARATION

A. Do not begin installation of adhesive bonded anchors until:
   1. Concrete has achieved an age of at least 21 days after placement.
   2. On-site training in installation of adhesive bonded anchors by manufacturer's technical representative is complete. Do not drill holes in concrete or install adhesive and embeds in holes.

B. Review manufacturer's printed installation instructions (MPII) and "conditions of use" stipulated in the Evaluation Report before beginning work.
   1. Bring to the attention of the adhesive manufacturer's technical representative any discrepancies between these documents and resolve before proceeding with installation.

C. Install adhesive bonded anchors in full compliance with manufacturer's printed installation instructions using personnel who have successfully completed manufacturer's on-site training for products to be used and who hold certifications specified in this Section.

D. Confirm that adhesive and substrate receiving adhesive are within manufacturer's recommended range for temperature and moisture conditions, and will remain so during the curing time for the product.

2.03 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device, and mark locations with construction crayon on the surface of the concrete.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by Engineer.

B. Hole drilling equipment:
    1. Electric or pneumatic rotary impact type with medium or light impact.
        a. Installation of anchors in cored holes is not permitted.
        b. Set drill to "rotation only" mode, or to "rotation plus hammer" mode in accordance with the manufacturer's installation instructions and the requirements of the Evaluation Report.
        c. Where edge distances are less than 2 inches and "rotation plus hammer" mode is permitted, use lighter impact equipment to prevent micro-cracking and concrete spalling during the drilling process.
    2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a "condition of use" in the Evaluation Report.
        a. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommended in the manufacturer's installation instructions and the Evaluation Report.

D. Hole depth: As recommended in the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
    1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by Engineer, stop drilling. Prepare and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth.
        a. Obtain Engineer's acceptance of distance between abandoned and relocated holes before proceeding with the relocation.
        b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.
        c. Epoxy grout may be substituted for dry-pack mortar when accepted by Engineer.
    2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the member and endanger the stability of the structure.
    3. When existing reinforcing steel is encountered during drilling and when specifically accepted by Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
    4. Bent bar reinforcing bars: Where edge distances are critical, and interference with existing reinforcing steel is likely, if acceptable to Engineer, drill hole at 10 degree (or less) angle from axis of reinforcing bar or all thread rod being installed.

F. Cleaning holes:
    1. Insert air nozzle to bottom of hole and blow out loose dust.
        a. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
        b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.

2. Using a stiff bristle brush with diameter that provides contact around the full perimeter of the hole, vigorously brush hole to dislodge compacted drilling dust.
    a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
    b. Repeat at least 4 times.
3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and in the number of cycles required by the MPII and the Evaluation Report.
4. Leave prepared holes clean and dry.
5. Protect prepared and cleaned holes from contamination and moisture until adhesive is installed.
6. Re-clean and dry previously prepared holes if, in the opinion of the Engineer, the hole has become contaminated after initial cleaning.

2.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts reinforcing bars and all thread rods:
    1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
    2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC SP-1. Provide an oil and grease free surface for bonding of adhesive to steel.

B. Fill holes with adhesive:
    1. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.
    2. Fill hole as nozzle is withdrawn without creating air voids.
    3. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
    4. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.

C. Installing reinforcing bars and all thread rods.
    1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
    2. Insert reinforcing bars and all thread rods into adhesive in accordance with manufacturer's recommended procedures.
    3. Confirm that insert has reached the designated embedment in the concrete, and that adhesive completely surrounds the embedded portion.
    4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
    5. Clean excess adhesive from the mouth of the hole.

D. Curing and loading.
    1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.

2. Do not disturb or load bonded embeds until manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

2.05 POST-INSTALLATION ACTIVITIES

A. Do not bend bars or all-thread rods after bonding to the concrete, unless accepted in advance by the Engineer.

B. Attachments to all thread rods:
   1. After assemblies to be connected are placed, install nuts and washers for threaded rods as indicated on the Drawings.

2.06 FIELD QUALITY CONTROL

A. Provide field quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Do not allow work described in this Section to be performed by individuals who do not hold the specified certifications and who have not completed the specified job site training.

C. Manufacturer's services:
   1. Before beginning installation, furnish adhesive manufacturer's technical representative to conduct on-site training in proper storage and handling of adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
      a. Provide notice of scheduled training to Engineer and to Special Inspector(s) not less than 10 working days before training occurs. Engineer and Special Inspector may attend training sessions.
   2. Submit record, signed by the manufacturer's technical representative, listing Contractor's personnel who completed the training. Only qualified personnel who have completed manufacturer's on-site training shall perform installations.

D. Field inspections and testing:
   1. Hole drilling and preparation.
   2. Results: Submit records of inspections and testing to Engineer by electronic copies within 24 hours after completion.

2.07 FIELD QUALITY ASSURANCE

A. Provide field quality assurance over the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Special inspections, special tests, and structural observation:
   1. Provide as specified in Section 01_45_24 - Regulatory Quality Assurance.
   2. Frequency of inspections:
      a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Evaluation Report for the product installed.
      b. Provide continuous inspection for the initial installation of each type and size of adhesive bonded reinforcing bar and all thread rod. Subsequent installations of the same anchor may be installed with periodic inspection as defined in subsequent paragraphs.

3. Preparation:
    a. Review Drawings and Specifications for the Work to be observed.
    b. Review adhesive manufacturer's MPII and recommended installation procedures.
    c. Review Evaluation Report "Conditions of Use" and "Special Inspection" requirements.
4. Inspection: Periodic:
    a. Initial inspection. Provide an initial inspection for each combination of concrete and reinforcing bar strength or concrete strength and all thread rod material being installed. During initial inspection, observe the following for compliance with the installation requirements.
        1) Concrete: Class (minimum specified compressive strength) and thickness.
        2) Environment: Temperature conditions at work area, and moisture conditions of concrete and drilled hole.
        3) Holes: Locations, spacing, and edge distances; verification of drill bit compliance with requirements; cleaning equipment and procedures; cleanliness of hole. Before adhesive is placed, confirm that depth and preparation of holes conforms to the requirements of the Contract Documents, the MPII, and the "conditions of use" listed in the Evaluation Report.
        4) Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedure. Note initial set times observed during installation.
        5) Reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment provided.
    b. Subsequent inspections: Subsequent installations of the same reinforcing bars or all thread rods may be performed without the presence of the special inspector, provided that:
        1) There is no change in personnel performing the installation, the general strength and characteristics of the concrete receiving the inserts, or the reinforcing bars and all thread rods being used.
        2) For ongoing installations, the special inspector visits the site at least once per day during each day of installation to observe the work for compliance with material requirements and installation procedures.
5. Inspection: Continuous.
    a. Make observations as described under "Inspection - Periodic, Initial Inspection" during all drilling, cleaning, and bonding activities for all bars and rods installed.
6. Records of inspections:
    a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
    b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspection.

END OF SECTION

SECTION 03_30_01

CONCRETE WORK

TABLE OF CONTENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete formwork; concrete accessories; concrete reinforcement; batching and mixing of concrete to be cast-in-place; concrete placement and curing: and tooled concrete finishes.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
   2. 305 - Specification for Hot Weather Concreting.
   3. 306 - Standard Specification for Cold Weather Concreting.
   4. 318 - Building Code Requirements for Structural Concrete and Commentary.
   5. SP-66 - ACI Detailing Manual.

B. ASTM International (ASTM):
   1. A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   2. A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   3. A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   4. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   5. C33 - Standard Specification for Concrete Aggregates.
   6. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   7. C94 - Standard Specification for Ready-Mixed Concrete.
   8. C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
   9. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
   10. C150 - Standard Specification for Portland Cement.
   11. C156 - Standard Test Method for Water Loss Through Liquid Membrane-Forming Curing Compounds for Concrete.
   12. C171 - Standard Specification for Sheet Materials for Curing Concrete.
   13. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   14. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
   15. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   16. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   17. C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
   18. C494 - Standard Specification for Chemical Admixtures for Concrete.
   19. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   20. C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.

21. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
22. C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
23. C1293- Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
24. C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
25. C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
26. C1260 - Standard Test Method of Potential Alkali Reactivity of Aggregates (Mortar Bar Method).
27. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
28. D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
29. D2103 - Standard Specification for Polyethylene Film and Sheeting.

C. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

1.03 DEFINITIONS

A. Alkali load: Amount of alkalies contributed by the portland cement in a concrete mixture, expressed in lb/yd^3, and calculated by multiplying the portland cement content of the concrete in lb/yd^3 by the alkali content of the portland cement; or the portland cement portion of a blended cement, divided by 100.

B. Average daily temperature: The average of the highest and lowest temperatures during a 24-hour period from midnight to midnight.

C. Cold weather: A period when, for more than 3 consecutive days, the average daily temperature drops below 40 degrees Fahrenheit.
   1. When the temperature is above 50 degrees Fahrenheit for more than half of any 24-hour duration, that period need not be regarded as cold weather.

D. Green concrete: Concrete whose current compressive strength is less than 100 percent of the minimum specified compressive strength, f'c.

E. Hand mixed concrete: Concrete mixed at or near the point of placement using shovels, hoes, or other similar manually operated tools.

F. Hot weather: A period when project conditions such as low humidity, high temperature, solar radiation, and high winds promote rapid drying of freshly placed concrete.

G. Neat cement grout: Grout made from a mixture of portland cement and water.

H. Supplementary cementitious material: inorganic material such as fly ash, natural pozzolans, silica fume, or slag cement that reacts pozzolanically or hydraulically.

1.04 SUBMITTALS

A. General:
   1. Submittal as specified in Section 01_33_00 - Submittal Procedures unless modified in this Section.

B. Product data:
   1. Formwork:
      a. Formwork facing materials. Data on facing materials for concrete exposed to view in the finished work, if different from that specified in this Section.
      b. Form release agent. Manufacturer's name and catalog data, including materials safety data sheet and documentation of suitability for use in contact with potable water.
   2. Joint materials:
      a. Preformed expansion joint material: Manufacturer's name and catalog data with documentation of conformance to materials standards specified for each type and thickness of material.
   3. Reinforcement:
      a. Mill certificates for each heat of steel provided.
      b. Reinforcement placement drawings:
         1) Show anchor bolt locations based on anchor bolt templates for approved equipment.
      c. Concrete bar supports:
         1) Precast concrete bar supports ("dobies"): Manufacturer's product data indicating compression strength of concrete supports and material used for tie wires.
         2) Wire chairs and slab bolsters: Manufacturer's product data.
   4. Concrete materials:
      a. Cement:
         1) Mill certificate in accordance with ASTM C150. Include "Type" and results of testing for alkali content measured as equivalent alkalies.
      b. Supplementary cementitious materials:
         1) Fly Ash: Identify source and provide testing results documenting compliance with ASTM C618 and any additional requirements of this Section.
      c. Aggregates:
         1) Type, pit or quarry location, and producer's name.
         2) Commercial laboratory test reports for samples of each aggregate proposed for use. Tests shall have been made not more than 24 months prior to the date of the submittal.
            a) Fine aggregate: Gradation analysis, specific gravity, reactivity, and reports of deleterious materials to document compliance with ASTM C33.
            b) Coarse aggregate: Gradation analysis, specific gravity, soundness, reactivity, and reports of deleterious materials to document compliance with ASTM C33 for each size used.
      d. Admixtures:
         1) Manufacturer's catalog cuts and product data indicating compliance with the standards specified.

5. Concrete mixes: Submit full details, including:
    a. Mix proportions measured by both weight and volume and concrete properties for each class of concrete proposed for use.
        1) Information on correction of batching for varying moisture contents of fine aggregate.
    b. Data to establish the average compressive strength:
        1) If established by field test records, submit:
            a) Product and test data for the materials actually used in the mix.
            b) Actual mix proportions used in the mix producing the record.
            c) Field test data for slump, air content, and 28-day compressive strength. Include not less than 15 tests in accordance with ACI 318 Chapter 5.
        2) If established by testing of trial batches, submit:
            a) Confirmation that the materials and proportions used in the trial batches are those that will be provided for the mix.
            b) Mix test data for slump, air content, and 28-day compressive strength.
        3) For either method, include calculations for:
            a) Standard deviation: Calculated in accordance with ACI 318 requirements.
            b) Required average compression strength (f'cr) using the standard deviation calculated in accordance with ACI 318 requirements.
            c) Statement demonstrating that the average compression strength from field test records or from trial batch testing for each mix ($f'c_{avg}$) exceeds the required average compressive strength (f'cr) for that mix.
    c. Data to establish alkali load:
        1) Determine and include the alkali load of the proposed mix.
    d. Data to establish chloride content:
        1) Submit test results showing that the concrete mix contains water-soluble chloride ion content contributed from the constituents including water, aggregates, cementitious materials, and admixtures is less than the limit specified in Table B of this Section. Test shall be performed in accordance with ASTM C1218 at age between 28 and 42 days after mixing.
6. Concrete finishing and curing materials:
    a. Manufacturer's name and product data sheets.

C. Shop drawings:
    1. Reinforcement:
        a. Submit drawings showing bending and placement of reinforcement.
            1) Drawings shall be in accordance with ACI SP-66.
            2) Clearly show placement, shapes, and dimensions of each bar listed in the bill of materials, including additional reinforcement at corners and openings required by details in the Contract Documents.
            3) Show splice locations and bar lengths reflecting Contractor's intended placement sequence.

D. Samples:
    1. Form ties: If requested by the Engineer.
    2. Concrete bar supports: If requested by the Engineer, provide samples of:
        a. Precast concrete bar supports ("dobies").

b. Wire chairs and slab bolsters.

E. Procedures:
1. Contractor's plans for production, placement, finishing, curing, protection, and temperature monitoring of concrete during the following environmental conditions:
a. Hot weather.
b. Cold weather.

F. Project record documents:
1. For the following items, note location of concrete in the structure, and include tag numbers of associated cylinders for compression strength tests.
2. Concrete delivery tickets. Submit copies of concrete delivery tickets within 24-hours after delivery.
3. Field test reports: Results of field-testing for slump, temperature, unit weight, and air entrainment.
4. Testing laboratory reports for compression strength.

G. Notifications:
1. Modifications to concrete mixes:
a. Submit notification of any adjustments to mixture proportions and any changes in materials made during the course of the Work for Engineer's review.
b. Include details of the changes and supporting documentation.
2. Joint locations:
a. Where joint locations other than those indicated on the Drawings are requested, submit proposed locations for Engineer's review.
b. Provide drawings showing proposed joint locations with joint types labeled and joint details referenced.
3. Reinforcement placement: Where necessary to move reinforcement beyond the specified placing tolerances to avoid interference, submit the proposed arrangement for Engineer's review.
4. Concrete placements: Submit notification of readiness for each concrete placement at least 24 hours in advance.
5. Concrete repairs:
a. Where concrete surfaces or sections exhibit defects after removal of forms, submit description of existing conditions and of proposed repair procedures and materials.
b. Include photos of existing conditions with submittal.

1.05 QUALITY ASSURANCE

A. Tolerances on concrete construction: In accordance with ACI 117 unless more stringent requirements are specified in the Contract Documents.

B. Concrete mixtures:
1. Ensure that concrete produced has the specified characteristics in the freshly mixed state, and that those are maintained to during transport and delivery and to the point of final placement.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle concrete materials in manner as to prevent damage and inclusion of foreign substances.

B. Deliver reinforcing steel bundled and tagged with identifying tags marked in a legible manner with waterproof markings showing the same designations as indicated on the submitted shop drawings.
   1. Store off the ground and protect from moisture, dirt, oil, and other injurious contaminants.

C. Protect concrete accessories from weather and direct exposure to sunlight before installation.

1.07 PROJECT CONDITIONS

A. Environmental requirements:
   1. Hot weather concreting: Construct in accordance with ACI 305 during conditions when the ambient air temperature is above 90 degrees Fahrenheit.
   2. Cold weather concreting: Construct in accordance with ACI 306 when ambient air temperature is below 40 degrees Fahrenheit or is 45 degrees Fahrenheit and falling.
   3. Conditions that promote rapid drying of freshly placed concrete, such as low humidity, high temperature, and wind: Take corrective action to minimize loss of water from the concrete.

1.08 SEQUENCING AND SCHEDULING

A. Schedule placing of concrete in such a manner that completes any single placing operation to a construction, or expansion joint as indicated on the Drawings or accepted by the Engineer in advance of the placement.

PART 2 PRODUCTS

2.01 FORMWORK

A. Forms:
   1. Design and performance requirements:
      a. Design and performance of formwork shall be the responsibility of the Contractor, subject to the requirements of the Contract Documents.
      b. Design, construct, and brace formwork to:
         1) Carry all loads applied or transmitted, including the pressure resulting from placement and vibration of plastic concrete.
         2) Remain tight to prevent loss of mortar.
         3) Maintain specified tolerances and provide finished surfaces as specified.
      c. Maximum deflection of facing materials and supporting members on surfaces exposed to view in the finished work: 0.0042 times the clear span (span/240).
      d. Maximum deviation from alignment (horizontal or vertical): In accordance with ACI 117.

2. Form facing materials:
    a. Surfaces exposed to view in the finished work:
        1) Facing materials shall produce a smooth, uniform texture on the concrete.
        2) Do not use materials with raised grain, tears, worn edges, patches, dents, or other similar defects.
        3) Acceptable materials: Plywood with “C” or better face; plastic-faced plywood; tempered concrete form grade hardboard; or steel.
    b. Surfaces not exposed to view in the finished work:
        1) Special form facing material not required.
3. Forms for chamfers and keyways:
    a. Uniform steel, plastic, or lumber section of dimensions shown or specified.
    b. Provide adequate stiffness and support to maintain a true line at the concrete surface.
    c. Treated to eliminate bond with the concrete if required to produce a smooth, uniform, and undamaged finish upon removal.

B. Form ties:
1. General:
    a. Provide form ties fabricated by recognized manufacturer of concrete forming equipment and suitable for use with the forming system selected.
    b. Provide ties that accurately tie, lock, and spread forms:
        1) Do not use wire ties or wood spreaders.
    c. Provide form ties manufactured such that, when forms are removed, the tie leaves no metal or other material within 1-1/2 inches of the surface of the concrete.
    d. Do not allow tie holes through forms for ties to leak during concrete placement.
2. Cone snap ties: Tie with removable plastic cone leaving a tapered depression having a minimum diameter of 1 inch at the surface of the concrete and a depth of 1-1/2 inches below the surface.

C. Dry-pack mortar for filling cone snap tie holes:
1. Proportioned mix of 1 part of portland cement to 1 part plaster sand with potable water added to provide a stiff consistency that can be driven into holes and properly compacted.
2. For repairs in concrete exposed to view in the finished work, mix repair mortar using the same cement and sand as that used for the concrete being patched.
    a. Mix a trial batch and confirm color compatibility with the surrounding material.
    b. Adjust color to match that of the surrounding concrete by adding white portland cement if necessary.
3. Admixtures or additives to mortar are not permitted.

D. Form release agent: Commercially manufactured, non-staining formwork release agent that will prevent absorption of water by the formwork and will prevent bond between the formwork and the concrete.
1. Form release agent to comply with all local air quality management regulations.

2.02 JOINT MATERIALS

A. Synthetic sponge rubber expansion joint material:
   1. Elastic sponge rubber compound in accordance with ASTM D1752, Type I.
   2. Concrete-gray color unless otherwise noted.
   3. Thickness: As indicated on the Drawings.
   4. Manufacturers: One of the following or equal:
      a. Williams Products Inc., Everlastic 1300.
      b. WR Meadows, Seal Tight Sponge Rubber Expansion Joint.

B. Bituminous fiber expansion joint material:
   1. Thickness: To match joint width indicated on the Drawings.
   2. Asphalt-impregnated fiberboard in accordance with ASTM D1751.
      a. Manufacturers: One of the following or equal:
         1) Durajoint.
         2) W.R. Meadows, SealTight Fibre Expansion Joint.

C. Sealants and caulking: As specified in Section 07_92_00 - Joint Sealants.

2.03 REINFORCEMENT

A. Materials:
   1. Deformed bars: In accordance with ASTM A615 Grade 60 .
   2. Welded wire fabric: Sheets of plain wire in accordance with ASTM A185.
   3. Bar supports:
      a. Over ground or “mud mat”:
         1) Precast concrete blocks with cast-in annealed steel tie wires, 16 gauge or heavier.
            a) Compressive strength of blocks equal to or exceeding the compressive strength of the surrounding concrete.
         2) Height as required for minimum 3 inches of clear concrete cover below reinforcement.
         3) Minimum block “footprint” of 4 square inches, or as required to supporting load from reinforcement while maintaining the required concrete cover.
      b. Wire supports: Class 2, Type B stainless steel protected wire in accordance with CRSI Manual of Standard Practice.
   4. Tie wire: Annealed steel.

B. Fabrication:
   1. Cut and cold-bend bars in accordance with provisions of ACI 315 and ACI 318.
   2. Fabricate reinforcement to the tolerances in accordance with ACI 117.
   3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

2.04 SOURCE QUALITY CONTROL

A. Submit documentation that the proposed concrete mixes will conform to the requirements of this Section and will produce concrete having the required proportions and properties specified.
   1. Do not place concrete until the design for that mix and the results of any trial batch testing have been accepted by the Engineer.

2. If the Engineer requires changes to the mix design, modify mixes within limits set forth in this Section and submit new mix design for Engineer's review.

B. After acceptance, do not change mixes or mix proportions without prior acceptance by the Engineer.
   1. Exception: At all times, adjust batching of water to compensate for free moisture content of aggregates. Total water content in the mix shall not exceed that specified.

C. If there is change in source of cement or aggregate, or if there is a significant change in the characteristics or quality of any constituent material received from a source accepted to supply materials, submit new design mixes for each class of concrete affected.

D. Testing of materials and mixes before placement to demonstrate that they comply with the requirements of this Section shall be at the Contractor's expense.

2.05 CONCRETE MIXES

A. Constituent materials:
   1. Cement:
      a. Portland cement: In accordance with ASTM C150, Type II or Type III:
         1) Cement for finishes or repairs: Provide cement from same source and of same type as concrete to be finished.
   2. Supplementary Cementitious Materials (SCM):
      a. Fly ash:
         1) In accordance with ASTM C618, Class C.
         2) Sampling and testing: In accordance with ASTM C311.
         3) Loss on ignition: Not to exceed 4 percent.
   3. Aggregates:
      a. General:
         1) Provide normal weight concrete aggregates that are sound, uniformly graded, and free of deleterious material in excess of the amounts specified.
         2) Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, or other construction waste.
         3) Obtain aggregate from source that is capable of providing uniform quality, moisture content, and grading during any single day's operations.
         4) Alkali-silica reactivity:
            a) Provide fine and coarse aggregate classified as aggregate-reactivity class of R0 in accordance with ASTM C1778 and with expansion not greater than 0.10 percent at 14 days when tested in accordance with ASTM C1260 and not greater than 0.04 percent at 1 year when tested in accordance with ASTM C1293.
      b. Fine aggregate:
         1) Provide fine aggregate consisting of clean, natural sand or of sand prepared from crushed stone or crushed gravel.
         2) In accordance with ASTM C33.

c. Coarse aggregate:
1) Provide coarse aggregate consisting of gravel or crushed stone made up of clean, hard, durable particles free from calcareous coatings, organic matter, or other foreign substances; and in accordance with ASTM C33, Class 4S.
2) Grading: Unless otherwise specified or accepted in writing by the Engineer, provide the following:
a) Aggregate for Class A, C Concrete: ASTM C33, Size Number 57.
b) Aggregate for Class CE Concrete: ASTM C33, Size Number 8.
c) Where a combination of 2 or more sizes of coarse aggregate are used, the gradation of the blend shall conform to the grading requirements in accordance with ASTM C33 for the size number specified.

4. Water:
a. Water for concrete mixes, for washing aggregate, and for curing concrete: Potable water, clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
b. Do not exceed the optional chemical limits of ASTM C1602.

5. Admixtures:
a. General:
1) Do not use admixtures, except those specified, unless written authorization has been obtained from the Engineer.
2) Admixtures shall be compatible with concrete and other admixtures. Admixtures (other than fly ash) shall be the products of a single manufacturer to ensure compatibility.
3) Do not use admixtures containing chlorides in excess of 0.5 percent by weight of cement when calculated as chloride ion.
b. Air entraining admixture: In accordance with ASTM C260.
c. Water reducing admixture:
1) In accordance with ASTM C494, Type A or Type D.
2) Not containing air-entraining agents.
d. High range water reducing admixtures/plasticizing admixtures:
1) High-range water reducing admixtures: In accordance with ASTM C494, Type F.
2) Plasticizing admixtures: In accordance with ASTM C1017, Type I.
3) Use shall produce non-segregating concrete mixture with little bleeding that remains in a plastic state for not less than 2 hours.
e. Coloring admixture:
1) To produce red-colored concrete for encasement of electrical ducts, conduits, and similar items:
a) Mix 10 pounds of coloring agent into each cubic yard of concrete, unless otherwise recommended by the manufacturer and accepted by the Engineer.
2) Manufacturers: One of the following or equal:
a) Davis Colors, #100 Utility Red.
b) I. Reiss Co., Inc., equivalent product.
c) Euclid Chemical Co., Increte Division, “Colorcrete Brick Red.”

B. Mix design and proportioning:
1. Proportion mixes to provide compression strength, workability, and durability as specified in this Section.

2. Submit documentation that the proposed mixes will conform to the requirements of this Section and will produce concrete having the required properties.
3. Compression strength:
    a. Proportion each concrete mix to provide the required average compressive strength (f'cr) determined in accordance with the provisions of ACI 318 Chapter 19.
    b. Determine required average compressive strength (f'cr) for each class of concrete using the specified compressive strength of the mix, f'c, and the standard deviation determined in accordance with ACI 318.
        1) Establish the standard deviation in accordance with ACI 318 and based on either field test records or based on trial batches.
        2) Documentation of standard deviation based on field test records:
            a) Calculate standard deviation in accordance with ACI 318 procedures using test records that:
                (1) Represent materials, quality control procedures, and conditions similar to those expected for this Work.
                (2) Do not include provisions for materials and proportions that are more restrictive than the materials proposed for use in this Work.
                (3) Represent a mix proportioned to provide a specified compressive strength (f'c) within 1,000 pounds per square inch of that specified for the corresponding mix in this Section.
        3) Documentation of standard deviation based on trial batches plus empirical code requirements:
            a) When records including at least 15 consecutive tests that span a period of at least 45 calendar days are not available, determine required average compressive strength (f'cr) from Table A:

TABLE A
Required Average Compressive Strength

Specified Compressive Strength f'_c (pounds per square inch)	**Required Average Compressive Strength f'cr (pounds per square inch)**
Less than 3,000	f'c + 1,000
3,000 to 5,000	f'c + 1,200

4. Workability:
    a. Provide concrete with workability and consistency that can be readily worked into corners and angles of forms and around reinforcement without excessive vibration and without permitting materials to segregate or free water to collect on the surface.
5. Cement content:
    a. Minimum cementitious materials content: Conform to values specified in Table B of this Section.
    b. Ratio of water to cementitious materials:
        1) Conform to values specified in Table B of this Section.
        2) Total water, including that from moisture content of aggregates and admixtures, shall not exceed that specified in Table B of this Section.

6. Supplementary Cementitious Materials:
    a. Fly ash:
        1) Maximum of 15 percent by weight of total weight of cementitious materials (cement plus fly ash).Other supplemental cementitious materials shall not be used without prior acceptance by the Engineer.
7. Aggregates:
    a. Ratio of coarse aggregate to fine aggregate: Not less than 1.0 or more than 2.0 for all concrete classes, with exception of Class CE.
8. Admixtures:
    a. Use in accordance with manufacturer's instructions.
    b. Air entraining admixture:
        1) Not required.
    c. Water reducing admixture:
        1) Required in all concrete mixes.
        2) No decrease in cementitious materials content is permitted as a result of use of water reducing admixture.
    d. High range water reducing admixture/plasticizing admixture:
        1) Not permitted.
    e. Coloring admixture:
        1) Unless otherwise recommended by the manufacturer, mix into each cubic yard of concrete 10 pounds of coloring agent.
9. Concrete mix design requirements by class:
    a. Provide concrete mixes for each "class" specified in this Section and indicated in Table B of this Section.
    b. Use each class at the locations specified in the following paragraphs or indicated on the Drawings.
        1) "Class A" Concrete: General use. Use at all locations unless otherwise indicated on the Drawings or listed in the following paragraphs.
        2) "Class C" Concrete: May be used as fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and elsewhere as indicated on the Drawings.
        3) Class CE Concrete: Use for electrical conduit and duct bank encasements.
        4) Class PM concrete: Use for concrete pavement, cart paths, curbs, gutters, and sidewalks.
    c. Pumped concrete: Provide a separate mix design and substantiation testing for each "class" to be placed by pumping.

TABLE B
Concrete Classes

Concrete Class	Minimum Specified Compressive Strength at 28 days, f'c [1]	Ratio of water to cementitious materials [2,3] (minimum - maximum).	Cementitious Materials Content [3] (pounds per cubic yard of concrete by weight)	Cement Type (ASTM C150)	Maximum Chloride Content (percent by weight of cement)	Maximum Coarse Aggregate Size [4]	Air Entrainment (percent) (N/R: not required.)	Admixtures required [5]	Slump Range (inches)
A	4,500	0.40 to 0.45	535 to 575II	II	0.30	57	N/R	WRA	2 to 4
C	2,500	0.62 max.	Minimum 423	II	No limit	57	N/R	WRA	3 to 6
CE	2,500	0.62 max.	Minimum 423	II	No limit	8	N/R	WRA CA	3 to 6
PM	5,000	0.40	535 to 575	II	0.15	57	5+1.	WRA	3 to 6

Notes:

1 At locations where concrete will not be subjected to load from other elements of the structure or from Contractor's placing operations, maximum time period for achievement of specified compressive strength may be extended to 56 days when accepted by the Contractor's Engineer.

2 W/C Ratio = Ratio of water to cementitious materials (portland cement plus supplemental cementitious material) by weight Include weight of admixtures in the water content of the mix when the quantity of the admixtures exceeds 10 ounces per 100 pounds of cement.

3 Provide mix within the range of W/C ratio and cementitious materials content indicated.

4 Size number in ASTM C33, Table 2

5 Admixtures are designated as follows:

AEA: Air entraining admixture.

CA: Coloring Admixture.

WRA: Water reducing admixture.

2.06 CONCRETE BATCHING AND MIXING EQUIPMENT

A. Provide equipment and facilities for accurate measurement and control of materials.
   1. At all times, maintain proportions of concrete mix within specified limits.
   2. Control and adjust batch weights to secure maximum yield.

B. Measuring or weighing equipment:
   1. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
   2. Devices shall bear the current and valid seal of the Sealer of Weights and Measures in the Authority having jurisdiction.
   3. Furnish devices capable of providing successive quantities of individual materials measured to within 2 percent of desired amount of that material.

C. Mixing equipment:
   1. Mixes shall be ready-mix or transit-mixed concrete in accordance with ASTM C94.
      a. Hand-measured or hand-mixed batches shall not be used.
   2. Provide equipment capable of combining aggregates, cementitious materials, water, and admixtures into a thoroughly mixed and uniform mass during the time periods specified, and capable of discharging the resulting mixture without segregation.
   3. Maintain mixing equipment in good working order. Operate at loads and speeds, and for periods of time recommended by the manufacturer or specified in this Section.

2.07 CONCRETE FINISHING AND CURING MATERIALS

A. Evaporation retardant:
   1. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterKure ER 50.
      b. Euclid Chemical Co., Eucobar.

B. Plastic membrane for curing:
   1. White polyethylene film in accordance with ASTM C171:
      a. Nominal thickness not less than 0.0040 inches when measured in accordance with ASTM D2103, and thickness at any point not less than 0.0030 inches.
      b. Loss of moisture: Not to exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C156.

C. Sprayed membrane curing compound:
   1. In accordance with ASTM C309, Type 1D. Clear with fugitive dye.

PART 3 EXECUTION

3.01 GENERAL

A. Preparation:
   1. Use construction methods and sequences that allow time for concrete to reach adequate strength to prevent damage to or overstress of the concrete structure or its elements during construction.
   2. Locations of construction and expansion joints are indicated on the Drawings.
      a. Make no other joints, except as accepted in advance by the Engineer.

b. Schedule placing of concrete to complete any single placing operation between designated joints.
c. Schedule and sequence placements to allow adequate time for concrete to achieve adequate strength before subsequent placements and loads are applied to the structure.

B. Verification of conditions:
1. Do not place concrete until:
a. Forms have been thoroughly cleaned of dirt and debris, and form release agents have been applied.
b. Forms have been thoroughly checked for alignment, level, strength, and accurate location of reinforcement, joint accessories, and mechanical and electrical inserts or other embedded items.
c. Reinforcement is secure and properly fastened in its correct position.
d. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
e. Forms are aligned and secured, and loose form ties at construction joints have been retightened.
2. Notify the Engineer in writing of readiness, not just intention, to place concrete in any portion of the work:
a. Provide this notification in advance of operations, allowing such time as the Engineer deems necessary to make final observation of preparations at location of the concrete placement.
b. Have forms, reinforcement, screeds, anchors, ties, embeds, and inserts in place before notifying Engineer of readiness for final observations.
3. Do not place concrete until Engineer has completed final observations of conditions at the placement and has given acceptance to proceed.

3.02 FORMING

A. General:
1. Do not use earth cuts as forms for vertical or sloped surfaces unless specifically required by or indicated on the Contract Documents.
2. Joints: Locate joints as indicated on the Drawings:
a. Submit joint locations other than or differing from those indicated on the Drawings for Engineer's review before construction.
3. Chamfers:
a. Permanently exposed outside corners: Provide 3/4-inch chamfer.
b. Re-entrant corners:
1) Chamfer not required.
2) Corner may be left square.
c. Edges of formed joints: Chamfer not required except where indicated on the Drawings.
4. Level strips: Install level strips at top of wall concrete placements to maintain true line at horizontal construction joints.

B. Constructing and erecting formwork:
    1. Brace and anchor formwork to ensure vertical and lateral stability and to maintain finish tolerances when subjected to uplift pressures and lateral pressures from plastic concrete.
        a. Ensure that formwork is positioned, braced, and firmly held against previously placed concrete to maintain flush surfaces and to prevent loss or leaking of mortar at construction joints.
            1) At joints with flush surfaces exposed to view, lap contact surface of form a maximum of 1-inch over the previously placed concrete.
        b. Design and construct forms with sufficient strength and stiffness that deflections resulting from loading by plastic concrete will not exceed the surface tolerance limits specified.
        c. Set forming materials in an orderly and symmetrical arrangement, keeping the number of seams to a practical minimum.
        d. Form ties: Tie forms together using cone snap ties placed at not more than 2-foot centers vertically and horizontally.
        e. Construct formwork to permit easy removal without damage to formed surfaces.
        f. Provide temporary openings at the base of column and wall formwork to allow cleaning and inspection immediately before concrete placement.
        g. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.
    2. Where forms are re-used, clean surfaces of mortar, grout, and foreign materials before coating with form release agent and setting.
    3. Cover formwork surfaces with form release agent to prevent bond with the concrete:
        a. Do not allow form release agent to puddle in the forms.
        b. Do not allow form release agent to contact reinforcement, embeds, or previously placed concrete.
    4. Provide runways supported directly on the formwork for moving equipment and supplies during preparations for concreting:
        a. Do not rest such runways on reinforcement.

C. Embeds, joints, and accessories:
    1. Position pipes, sleeves, conduits, inserts, anchors, castings, and other embedded items in the forms, and anchor to formwork to prevent displacement.
    2. Fill voids in sleeves, pipes, inserts and anchor slots with readily removable material, and seal if required to prevent entry of mortar.
    3. For pipe or conduit runs, position embeds to allow at least 3 inches of clear concrete separation between parallel runs of pipes, conduits or any combination of these items with each other or with reinforcement.

D. Removing formwork:
    1. Remove forms after the specified time for curing and protection has been provided and when operations will not damage concrete.
    2. Immediately after forms are removed, carefully examine concrete surfaces.
        a. Report any irregularities in surfaces and finishes to the Engineer.
        b. Where surface repairs are needed, contact Engineer with description of conditions and description of repair procedures before proceeding with work.

3. Immediately follow form removal with installation of specified curing materials and procedures.
4. After forms are removed from wall and curing is complete, fill tie holes as follows:
    a. Remove form ties and cones from surfaces.
    b. Roughen cone-shaped tie holes by heavy sandblasting before repair.
    c. Clean and dampen tie holes, maintaining a saturated surface for at least 2 hours before applying dry-pack mortar.
    d. Dry pack cone-shaped tie holes with dry-pack mortar as specified in this Section.

3.03 PLACING CONCRETE REINFORCEMENT, EMBEDS, AND ACCESSORIES

A. Preparation:
1. Cut and bend deformed steel reinforcement in the shop and deliver completed bars to the site for installation.
    a. Do not field-bend deformed reinforcement.
2. Surface preparation:
    a. Thoroughly clean reinforcing bars from rust scale, loose mill scale, rust coat, dirt, oil, and other coatings that adversely affect bonding capacity when placed in the work.
        1) Thin coating of red rust resulting from short exposures will not be considered objectionable.
    b. Remove concrete or other deleterious coatings on dowels and other reinforcement projecting from previous placements by wire brushing or sandblasting before the reinforcement is embedded in the subsequent placement.

B. Support of reinforcement and accessories:
1. Provide supports for deformed bars and wire fabric to maintain reinforcement position indicated on the Drawings and to provide specified minimum clear concrete cover around the reinforcement.
2. Use number of supports required to prevent reinforcement from sagging and to support loads during construction, but in no fewer quantities and locations than recommended by ACI SP-66 and CRSI Manual of Standard Practice.
3. Support wire fabric from reinforcing supports:
    Do not place wire fabric on grade or forms for subsequent lifting into plastic concrete during the concrete placement.
    a. Take care to maintain specified position of wire fabric in the concrete section and to prevent bending, draping, or kinking of the wires.
4. Do not:
    a. Use brick, broken concrete masonry units, concrete spalls, rocks, or other such material for supporting reinforcement.
    b. Support reinforcement on additional reinforcing bars installed with less cover than that required by the Contract Documents (“give away bars”).
    c. Adjust location of reinforcement indicated on the Drawings to increase cover over support bars.
5. Furnish and use templates for placing column dowels.

C. Placing reinforcement:
1. Locate reinforcement to provide minimum clear concrete cover specified:
    a. Where cover is not specified, provide cover in accordance with ACI 318.

2. Accurately place reinforcement in accordance with the tolerances of ACI 117:
    a. Where reinforcement must be moved beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embeds, submit the proposed arrangement for Engineer's review.
3. Fasten reinforcement securely in place with wire ties:
    a. After tying, bend ends of wire ties inward towards the center of the concrete to match clear concrete cover provided for reinforcement.
4. Do not weld reinforcing bars or wires.
5. Deformed reinforcing bars:
    a. Tie slab bars at every intersection around the perimeter of slabs.
    b. Tie wall bar and slab bar intersections, other than those around the perimeter, at every 4th intersection, but not more than 48 inches on center each way.
    c. Lap splices:
        1) Lap reinforcement at splices as indicated on the Drawings or specified.
        2) Unless indicated on the Drawings, install lap splices with bars in contact and fastened together with tie wire.
        3) If lap splice length is not indicated on the Drawings, provide lap splice equal to 40 times reinforcing bar diameter.
6. Welded wire fabric reinforcement:
    a. Bend fabric as indicated on the Drawings or required to fit work.
    b. Straighten fabric to make reinforcement in each face a flat, planar surface before placing in the Work.
    c. Extend welded wire fabric across concrete section to provide fabric to within 2 inches of vertical concrete edges.
    d. Lap splice welded wire fabric as indicated on the Drawings:
        1) If no splice details are indicated, lap fabric at least 12 inches, fasten with wire ties spaced not more than 24 inches on center, and lace lap with wire of the same diameter of the fabric.

3.04 BATCHING, MIXING, TRANSPORTING AND DELIVERING CONCRETE

A. General:
    1. Measure, batch, mix, transport, and deliver ready-mixed concrete in accordance with ASTM C94.

B. Measuring and batching:
    1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
        a. Weigh cementitious materials separately.
    2. Furnish satisfactory means for checking moisture content of aggregates before batching.
        a. Adjust mix water to compensate for free moisture content of aggregate.
    3. Mixing water:
        a. Measure by volume or by weight.
        b. Maximum water-to-cementitious materials ratio for each concrete class shall not exceed that specified in Table B of this Section.
    4. Admixtures:
        a. Provide admixtures as specified.

b. Batch products by means of mechanical batcher capable of accurate measurement, and in accordance with the admixture manufacturer's instructions.

C. Mixing and transporting:
1. Mixing:
a. Equip each truck mixer with device capable of counting number of drum revolutions and interlocked to prevent discharge of concrete from drum before required number of revolutions is complete.
b. Once drum revolutions commence, continuously revolve drum until it has completely discharged its batch.
c. Do not add water until drum commences revolutions.
d. Engineer may require an increase in the designated minimum number of revolutions, or a decrease in the designated maximum number of revolutions if necessary to obtain satisfactory mixing.
1) Incorporate such changes without additional costs to Owner.
2. Do not exceed the following time period for mixing and delivery:
a. Total elapsed time from addition of water at batch plant through discharging of mix: Not to exceed the lesser of 90 minutes nor 300 revolutions of the mixer drum.
b. Total elapsed time for from arrival at the project site to completing discharge of mix: Not to exceed 30 minutes.
c. Under conditions contributing to quick setting, the Engineer may reduce total elapsed time permitted.

D. On-site acceptance of concrete mixes:
1. Concrete shall possess the properties specified in this Section at the point of placement.
2. Do not place concrete:
a. Having slump outside the limits indicated in Table B of this Section.
b. That does not conform to specifications for entrained air content.
c. For which the total elapsed time of mixing or elapsed time at the site exceeds the specified maximums.

3.05 CONVEYING, DEPOSITING, AND CONSOLIDATING CONCRETE

A. Preparation:
1. General:
a. Clean construction joints and forming surfaces of dirt, sawdust, chips, and other debris after forms are built and immediately before concrete or grout placement.
1) Use vacuum cleaner if required to provide clean surfaces.
b. Remove snow, ice, frost, and standing water from surfaces of formwork, reinforcement, and embeds in contact with concrete.
c. Secure reinforcement, joint materials, anchors, embeds and other items in place.
d. During conveying, placement, consolidation, and finishing of concrete, protect surrounding construction, including concrete walls and slab surfaces, from concrete splatter.
e. Thoroughly clean surrounding construction at the completion of each placement and before splatter sets up.

2. Concrete construction on grade:
    a. Provide subgrade preparation, base materials, and compaction as required by the Contract Documents.
    b. Remove loose soils, debris, standing water, snow, or ice from subgrade.
    c. Provide moist subgrade with no standing or free water and no muddy or soft spots.
        1) When subgrade is not moist, sprinkle with water not less than 2 nor more than 6 hours in advance of placing concrete.
        2) If subgrade becomes dry prior to actual placing of concrete, sprinkle again, without forming pools of water.
3. Weather conditions:
    a. Hot weather: In hot weather conditions, make provisions in advance of placement for windbreaks, shading, fogging, sprinkling, ponding, or wet covering.
    b. Cold weather: In cold weather conditions, make provisions to maintain the required concrete temperatures without overheating or drying, and without exposing concrete to carbon dioxide from heater exhaust.
    c. Precipitation:
        1) Do not begin placements while rain, sleet, or snow is falling or anticipated, or unless adequate protection is provided.
        2) Do not allow precipitation to increase concrete water content or to damage the surface of the concrete.
    d. Wind:
        1) Do not begin placements during wind events that will blow dust or debris into the plastic concrete.
        2) Do not allow wind-blown debris to become embedded in or to damage the surface of the concrete.
        3) At all times, have sufficient coverings on hand to protect new concrete from excessive drying or blowing debris.

B. Conveying concrete:
1. Convey concrete from mixer to place of final deposit by methods that prevent segregation or loss of materials.
2. Use chutes, pumps, and conveyors of size and design that will ensure continuous flow of concrete at point of delivery without cold joints.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from the chute or conveying device.
4. Keep conveying equipment clean by thoroughly washing and scraping upon completion of any placement.

C. Depositing concrete:
1. Do not place concrete under the following conditions:
    a. After initial set has occurred.
    b. When re-tempering has occurred.
2. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
    a. Do not use vibrators to move concrete from its point of deposit.
    b. Use tremies for placing concrete where drop is over 5 feet.

3. Place concrete continuously in approximately horizontal layers not exceeding 24 inches in depth. Bring level up evenly in all parts of forms.
    a. After placement begins, continue without significant interruption and as a continuous operation until the end of that placement is reached.
    b. Do not allow “cold joints” to form between adjacent layers or areas of the placement, or initial set to form on “wet edge” of placements.
    c. Take precautions to prevent delays between placement of adjacent layers or areas from exceeding 20 minutes.
        1) If more than 20 minutes elapse after the initial surface was placed, spread a layer of neat cement grout, as specified for construction joints before depositing additional concrete.
4. Placing concrete on slopes: Commence placement at bottom of slope and work upward.
5. Placing horizontal concrete monolithically with structures below:
    a. If concrete for slabs, beams, or walkways is to be cast monolithically with walls or columns below, do not place the horizontal concrete elements until the concrete in walls or columns below has been placed, consolidated, and allowed to achieve initial set.
    b. Allow set time of not less than 1 hour.
    c. Maintain a moist surface at the top of the walls or columns during the setting period.
6. Placing a second concrete lift over hardened concrete below:
    a. Take special precautions in form work at top of old lift and bottom of new lift to prevent:
        1) Spreading and vertical or horizontal displacement of forms.
        2) Grout "bleeding" onto finished concrete surfaces.

D. Consolidating concrete:
1. Thoroughly consolidate concrete into forms and around reinforcement, pipes, and other embeds using mechanical vibrators.
    a. Take special care to place concrete solidly against forms, leaving no voids.
    b. Make concrete solid, dense, compact, and smooth.
2. Provide vibration energy sufficient to cause concrete to flow and readily settle into place, leaving no voids. Vibration should visibly affect concrete over a radius of at least 18 inches without segregation.
3. Vibrators:
    a. At all times, have sufficient vibrators on hand to consolidate concrete as it is placed.
    b. In addition to vibrators in use while concrete is being placed, have on hand at least 1 spare vibrator in serviceable condition.
    c. Place no concrete until it has been ascertained that all vibrating equipment, including spares, are in serviceable condition.

3.06 FINISHING CONCRETE

A. Provide concrete finishes indicated on the Drawings.

B. Liquid evaporation retardant:
1. Apply evaporation retardant when environmental conditions will result in rapid evaporation of moisture from the surface of the fresh concrete during finishing

operations. Such conditions include low humidity, high heat, and wind occurring alone or in combination.

2. Immediately after the concrete is screeded, coat the surface of the concrete with a liquid evaporation retardant.
3. Apply the evaporation retardant again after each work operation as necessary to prevent drying shrinkage cracks and crazing at the surface.

3.07 CURING AND PROTECTING CONCRETE

A. Curing concrete:
   1. Cure concrete by methods specified in this Section.
   2. Keep concrete continuously moist and at a temperature of at least 50 degrees Fahrenheit for at least 7 days after placement unless the details of a particular method specify a longer period.
   3. Make provisions to maintain moisture or curing membrane integrity at edges of slabs, tops of walls, and joint surfaces, and to prevent loss of protection.
   4. Schedule of curing methods:
      a. Concrete surfaces that will receive additional materials that require bond to the initial placement (including concrete; concrete repairs, coatings, paints, sealers; grout, and other materials):
         1) Water curing or plastic membrane curing.
      b. Formed surfaces:
         1) If non-absorbent forms are left in place for 7 days after placement: No additional requirements.
         2) For absorbent forms or when forms are removed during the 7 days following placement: Cure by water curing, plastic membrane curing, or sprayed membrane curing.
      c. Unformed concrete surfaces:
         1) Water curing, plastic membrane curing, or sprayed membrane curing.
   5. Water curing:
      a. Keep surfaces of concrete constantly and visibly saturated by ponding, continuous fogging, or continuous sprinkling at all times during curing period.
         1) Cover surfaces if required to maintain saturated conditions.
         2) For horizontal surfaces, pond the surface with at least 2 inches of water or cover with saturated mats or fabric kept continuously wet.
      b. Formed surfaces:
         1) Each day forms remain in place may be counted as 1 day of water curing.
         2) Do not loosen form ties while concrete is being cured by forms left in place.
         3) No further credit for curing time will be allowed after contact between the concrete surface and the forms has been broken.
   6. Plastic membrane curing:
      a. Cover concrete with plastic membrane, sealing joints and edges against displacement by wind or site operations and to prevent loss of moisture.
      b. Install plastic membrane as soon as concrete is finished and can be walked on without damage.
      c. Keep all surfaces of concrete under plastic membrane moist at all times during the curing period.

7. Sprayed membrane curing:
    a. Application of curing compound:
        1) Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
            a) If more than 1 hour elapses between removal of forms and application of curing compound, provide water curing of affected surfaces for the full curing period.
        2) Contractor is cautioned that the method of applying curing compound specified in this Section may require more compound than normally suggested by manufacturer of compound, and also more than is customary in the trade.
        3) Apply curing compound by mechanical, power-operated sprayer with mechanical agitator that will uniformly mix all pigment and compound.
        4) Apply compound in at least 2 coats, with each subsequent coat in a direction turned 90 degrees from the preceding coat.
        5) Apply curing compound in sufficient quantity that concrete has uniform appearance and that the natural color of the concrete is effectively and completely concealed immediately after spraying.
        6) Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
        7) Apply compound to a film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
        8) Take care to apply curing compound to edges of placements and over full surface profile of construction joints.
    b. Removal of curing compound:
        1) Do not remove curing compound from concrete in less than 7 days after application.
        2) Before placing fresh concrete against a surface previously coated with curing compound, remove the curing compound by heavy sandblasting, or alternate method acceptable to the Engineer.
        3) Prior to final acceptance of the work, remove any curing compound on surfaces exposed to view by sandblasting or other acceptable method. After removal, only the natural color of finished concrete shall remain visible, and such color shall be uniform over the entire surface.

B. Protecting concrete:
    1. Immediately after placement, protect concrete from hot or cold weather, and mechanical damage.
    2. Temperature:
        a. Cold weather: Protect concrete during the curing period so that the concrete temperature is maintained within the following requirements.
            1) Sections less than 12 inches thick: Minimum 55 degrees Fahrenheit.
            2) Sections 12 to 36 inches thick: Minimum 50 degrees Fahrenheit.
        b. Hot weather: Protect concrete during the curing period so that the concrete temperature does not exceed 90 degrees Fahrenheit.
        c. Remove protection against temperature gradually so that concrete surface temperature does not drop or rise by more than 40 degrees Fahrenheit during any 24-hour period.
    3. Maintain forms, shoring, and bracing in place after concrete placement for a periods after concrete placement as indicated in the following paragraphs.

Forms may be removed after these periods if the concrete has developed sufficient strength and hardness to resist surface or other damage.

a. Vertical forms:
    1) General: Minimum 24 hours after concrete placement.
    2) Sides of footings: Minimum 24 hours after concrete placement.
    3) Sides of beams, girders, and similar members: Minimum 48 hours after concrete placement.
b. Horizontal forms:
    1) Slabs, beams, and girders: Until concrete reaches specified compressive strength, f'c, or until shoring is installed.
c. Shoring for slabs, beams, and girders:
    1) Shore until concrete strength reaches specified compressive strength, f'c.
        a) Temporary shoring may be required after the specified compressive strength is reached if construction loads will exceed the designated live load capacity of the structure.
d. Wall bracing:
    1) Brace until strength of concrete beams and slabs laterally supporting the wall reaches specified compressive strength, f'c.

C. Loads against or on the concrete:
    1. Loading of green concrete, by backfilling or by placing personnel and equipment on the surface, is not permitted.
    2. Backfilling: Do not place backfill against concrete walls until the wall and all elements attached to it, including connecting slabs or beams, are fully braced by the structure, and have achieved their minimum specified compressive strength, f'c.

3.08 JOINTS AND JOINT PREPARATION

A. Joint locations and details:
    1. Construct concrete work as monolith to the extent practical.
    2. Construct joints as indicated on the Drawings and as specified.
    3. Locations of construction, expansion, and other joints are indicated on the Drawings or specified in this Section.
        a. Do not relocate, add, or delete joints without prior approval from the Engineer.

B. Construction joints:
    1. Where spacing is not indicated on the Drawings, provide construction joints in slabs and walls at intervals not greater than 35 feet.
    2. Construct as indicated on the Drawings.
    3. Before placing fresh concrete against the joint: Use heavy sandblast to thoroughly clean joint surfaces and reinforcement crossing the joint of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter.
    4. Just before placing concrete against the joint, wash surface with water to saturate joint surface and concrete surfaces within 12-inches of the joint.

5. Horizontal joints:
    a. Immediately before placing concrete, thoroughly spread bed of neat cement grout over the joint surface. Grout shall be as follows:
        1) Use same sand-to-cementitious materials ratio that is used for concrete mix.
        2) Use same materials that are used for concrete.
        3) Use water-to-cementitious materials ratio that is no more than that specified for concrete.
    b. Grout thickness: Not less than 1/2 inch, nor more than 1 inch.

C. Expansion joints:
1. Where width is not indicated on the Drawings, provide 3/4-inch wide joint.
2. Construct as indicated on the Drawings.
3. Do not extend reinforcement, conduits, or other items through expansion joints unless details for such crossings are indicated on the Drawings.
4. Preformed expansion joint material:
    a. Accurately position joint filler in the joint.
        1) Fasten to concrete or forms with adhesive.
        2) Fastening joint filler using nails, bolts, screws, or similar items is not permitted.
    b. Tape splices in joint filler to prevent intrusion of mortar.

3.09 COLD WEATHER CONCRETING

A. Preparation:
1. Remove snow, ice, and frost from surfaces, including soil subgrade, that will receive fresh concrete.
2. Do not place concrete against embedments or reinforcement at a temperature below freezing, where such items are sufficiently massive to cause adjacent concrete to freeze.

B. Placement during cold weather:
1. Placement temperature:
    a. The minimum temperature of concrete immediately after placement shall be as specified in Table C of this Section.
    b. The temperature of concrete as placed shall not exceed the values shown in Table C of this Section by more than 20 degrees Fahrenheit.
2. Protection temperature:
    a. Unless otherwise specified, the minimum temperature of concrete during the protection period shall be as shown Table C of this Section.
    b. Temperatures specified to be maintained during the protection period shall be those measured at the concrete surface, whether the surface is in contact with formwork, insulation, or air.
    c. Measure the temperature with a surface measuring device accurate to 2 degrees Fahrenheit.
    d. Measure the temperature of concrete in each placement at regular time intervals as specified in the contract documents.
3. Termination of protection:
    a. The maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the values listed in Table C of this Section.

b. Do not exceed these limits until the surface temperature of the concrete is within 20 degrees Fahrenheit of the ambient temperature of surrounding temperatures.
c. When the surface temperature of the concrete is within 20 degrees Fahrenheit of the ambient temperature, thermal protection may be removed.

TABLE C
Concrete Temperature Requirements

Least dimension of section (inches)	Minimum temperature of concrete as placed and maintained during the protection period (degrees Fahrenheit)	Maximum for gradual decrease in surface temperature during any 24 hour period after end of protection period (degrees Fahrenheit)
Less than 12	55	50
12 to less than 36	50	40
36 to 72	45	30
Greater than 72	40	20

C. Curing of concrete:
4. Prevent concrete from drying during the required curing period. If water curing is used, terminate use at least 24 hours before any anticipated exposure of the concrete to freezing temperatures.

D. Protection of concrete:
5. Combustion heaters: Vent flue gases from combustion heating units to the outside of the enclosures.
6. Overheating and drying: Place and direct heaters and ducts to avoid areas of overheating or drying of the concrete surface.
7. Maximum air temperature: During the protection period, do not expose the concrete surface to air having a temperature more than 20 degrees Fahrenheit above the values shown in Table C of this Section unless higher values are required by an accepted curing method.
8. Protection against freezing:
a. Cure and protect concrete against damage from freezing for a minimum of 3 days, unless otherwise specified.
1) Maintain the surface temperature of the concrete as specified in Table C of this Section.
b. During periods not defined as cold weather, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24 hours after placing.

3.10 TOLERANCES

A. Concrete:
1. Finished concrete: Conform to shapes, lines, grades, and dimensions indicated on the Drawings.

2. In accordance with ACI 117, except as modified in the following paragraphs:
    a. Where more restrictive tolerances to accommodate equipment are indicated on the Drawings.
    b. Slabs where slope is indicated:
        1) Uniformly slope to drain.
        2) Without depressions that puddle water.
    c. Slabs indicated to be level:
        1) Maximum deviation of 1/8 inches in 10 feet without any apparent changes in grade.
        2) Without depressions that puddle water.

B. Embeds:
1. General:
    a. Sleeves and inserts: Plus or minus 1/8 inch.
    b. Projected ends of anchor bolts: Plus 1/4 inch; minus 0 inches.
    c. Anchor bolt position: Plus or minus 1/16 inch.
2. Equipment: Set inserts to tolerances required for proper installation and operation of equipment or systems to which insert pertains.

3.11 FIELD QUALITY CONTROL BY CONTRACTOR

A. Provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Field tests:
1. During progress of construction, provide testing to determine whether the concrete, as being produced, complies with requirements specified.
2. Sampling and testing shall be performed by Contractor's testing laboratory. Requirements as specified in Section 01_45_00 - Quality Control.
    a. Cooperate in testing by allowing free access to the Work for testing laboratory to sample and test materials.
    b. Provide full access for Engineer to observe concrete sampling and testing at any time.
    c. Contractor is responsible for providing care of and curing conditions for test specimens in accordance with ASTM C31 until specimens are collected by testing laboratory.
    d. Provide firmly braced, insulated, heated, closed wooden curing boxes. Include cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication through receipt at Contractor's testing laboratory.
3. Testing shall include:
    a. Sampling of concrete in accordance with ASTM C172.
    b. Temperature of concrete at delivery in accordance with the requirements of ASTM C1064 and as specified in this Section.
    c. Slump of concrete using slump cone in accordance with the requirements of ASTM C143. Test slump at the following intervals:
        1) Test slump at the beginning of each placement.
        2) As often as necessary to keep slump within the specified range, but not less than every 6^{th} truck.
        3) When requested to do so by the Engineer.

4) Observe concrete during slump test for signs of segregation:
a) Observe concrete for mortar or moisture flow from slumped concrete.
b) Reject concrete if mortar or moisture flows out of the mix.

d. Unit weight of concrete in accordance with ASTM C138.
e. Air entrainment in accordance with ASTM C173. Test air content at the following intervals:
1) At the beginning of each placement.
2) As often as necessary to keep entrained air within the specified range, but not less than every 6th truck.
3) When requested to do so by the Engineer.
f. Compressive strength, f'c, in accordance with ASTM C39. Required number of cylinders:
1) Not less than 4 cylinder specimens, 4-inch diameter by 8-inches long, will be tested for each 150 cubic yards of each class of concrete; not less than 4 specimens for each half-day of placement.
2) One cylinder will be broken at 7 days and 3 cylinders will be broken at 28 days.

4. Contractor shall:
a. Furnish concrete for test specimens and provide manual assistance to testing lab in preparing said specimens.
b. Assume responsibility for providing care and on-site curing and protection for test specimens in accordance with ASTM C31.

3.12 FIELD QUALITY CONTROL BY OWNER

A. Provide on-site observation and field quality assurance for the Work of this Section as specified in Section 01_45_00 - Quality Control.

B. Special tests and inspections: See Section 01_45_24 - Regulatory Quality Assurance.

C. Field inspections:
1. Required inspections:
a. Observe construction for conformance to the Contract Documents and the accepted submittals.
2. Records of inspections:
a. Provide record of each inspection.
b. Submit copies to Contractor upon request.

D. Field tests:
1. Engineer may request, at any time, additional testing to confirm that materials being delivered and placed conform to the requirements of the Specifications.
a. If such additional testing shows that the materials do not conform to the specified requirements, Contractor shall pay the cost of these tests.
b. If such additional testing shows that the materials do conform to the specified requirements, Engineer will pay the cost of these tests.

3.13 NON-CONFORMING WORK

A. Enforcement of specification requirements:
1. Do not place concrete that does not conform to the requirements of these Specifications. Remove non-conforming materials from the site.

2. Strength requirements:
    a. Concrete is expected to reach higher compressive strength than the minimum specified compressive strength f'c as indicated in Table B of this Section.
    b. Concrete strength will be considered acceptable if following conditions are satisfied:
        1) Averages of all sets of 3 consecutive strength test results are greater than or equal to specified compressive strength f'c.
        2) No individual strength test (average of 2 cylinders tested at 28-days) falls below specified compressive strength f'c by more than 500 pounds per square inch.
    c. Whenever 1, or both of the conditions stated above is not satisfied, provide additional curing or testing of the affected portion as directed by the Engineer.
        1) The costs of such curing or testing shall be at the Contractor's expense.

3.14 ADJUSTING

A. Remove and replace or repair defective work as directed by the Engineer:
    1. Do not patch, repair, or cover defective work before observation by the Engineer.
    2. Make no repairs until Engineer has accepted proposed methods for preparation and repair.

END OF SECTION

SECTION 03_60_00

GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cement grout.
   2. Cement mortar.
   3. Dry-pack mortar.
   4. Epoxy grout.
   5. Grout.
   6. Non-shrink epoxy grout.
   7. Non-shrink grout.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens).
   2. C230 - Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   3. C531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   4. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
   5. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   6. C942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   7. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
   8. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

B. International Concrete Repair Institute (ICRI):
   1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.03 SUBMITTALS

A. Cement grout:
   1. Mix design.
   2. Material submittals.

B. Cement mortar:
   1. Mix design.
   2. Material submittals.

C. Non-shrink epoxy grout:
   1. Manufacturer's literature.

D. Non-shrink grout:
   1. Manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in their original, unopened packages or containers, clearly labeled with manufacturer's product identification and printed instructions.

B. Store materials in cool dry place and in accordance with manufacturer's recommendations.

C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Non-shrink epoxy grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star DP Epoxy Grout.
      b. Master Builder Solutions, MasterFlow 648.
      c. L&M Construction Chemicals, Inc., EPOGROUT.
   2. Non-shrink epoxy grout shall be 100 percent solid, premeasured, prepackaged system containing 2-component thermosetting epoxy resin and inert aggregate.
   3. Maintain flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
   4. Shrinkage or expansion: Less than 0.0006 inches per inch when tested in accordance with ASTM C531.
   5. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C579, Method B.
   6. Compressive creep: Not exceed 0.0037 inches/per inch when tested under 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C1181.
   7. Coefficient of thermal expansion: Not exceed 0.000018 inches per inch per degree Fahrenheit when tested in accordance with ASTM C531, Method B.

B. Non-shrink grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star Grout.
      b. Master Builder Solutions, MasterFlow 928.
      c. L&M Construction Chemicals, Inc., CRYSTEX.
   2. In accordance with ASTM C1107.
   3. Preportioned and prepackaged cement-based mixture.
   4. Contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
   5. Require only addition of potable water.
   6. Water for pre-soaking, mixing, and curing: Potable water.

7. Free from emergence of mixing water from within or presence of water on its surface.
8. Remain at minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C230.
    a. If at fluid consistency, verify consistency in accordance with ASTM C939.
9. Dimensional stability (height change):
    a. In accordance with ASTM C1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
    b. Have 90 percent or greater bearing area under bases.
10. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C1107 for various periods from time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C109 as modified by ASTM C1107.

2.02 MIXES

A. Cement grout:
    1. Use same sand-to-cementitious materials ratio for cement grout mix that is used for concrete mix.
    2. Use same materials for cement grout that are used for concrete.
    3. Use water-to-cementitious materials ratio that is no more than that specified for concrete.
    4. For spreading over surfaces of construction or cold joints.

B. Cement mortar:
    1. Use same sand-to-cementitious materials ratio for cement mortar mix that is used for concrete mix.
    2. Use same materials for cement mortar that are used for concrete.
    3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
    4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

C. Dry-pack mortar:
    1. Proportions by weight: 1 part portland cement to 2 parts concrete sand.
        a. Portland cement: As specified in Section 03_30_00 - Cast-in-Place Concrete.
        b. Concrete sand: As specified in Section 03_30_00 - Cast-in-Place Concrete.

D. Epoxy grout:
    1. Consist of mixture of epoxy or epoxy gel and sand.
        a. Epoxy: As specified in Section 03_63_01 - Epoxies.
        b. Epoxy gel: As specified in Section 03_63_01 - Epoxies.
        c. Sand: Clean, bagged, graded, and kiln-dried silica sand.
    2. Proportioning:
        a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
        b. For vertical or overhead work: Consist of 1 part epoxy gel with not more than 2 parts sand.

E. Grout:
    1. Mix in proportions by weight: 1 part portland cement to 4 parts concrete sand.
        a. Portland cement: As specified in Section 03_30_00 - Cast-in-Place Concrete.
        b. Concrete sand: As specified in Section 03_30_00 - Cast-in-Place Concrete.

F. Non-shrink epoxy grout:
    1. Mix in accordance with manufacturer's installation instructions.

G. Non-shrink grout:
    1. Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and loose material or foreign matter likely to reduce bond or performance of grout or mortar.

3.02 PREPARATION

A. Surface preparation for grouting other baseplates:
    1. Remove grease, oil, dirt, dust, curing compounds, laitance, and other deleterious materials that may affect bond to concrete and bottoms of baseplates.
    2. Roughen concrete surfaces in contact with grout to ICRI CSP-6 surface profile or rougher.
        a. Remove loose or broken concrete.
    3. Metal surfaces in contact with grout: Grit blast to white metal surface.

3.03 INSTALLATION

A. Mixing:
    1. Cement grout:
        a. Use mortar mixer with moving paddles.
        b. Pre-wet mixer and empty out excess water before beginning mixing.
    2. Cement mortar:
        a. Use mortar mixer with moving paddles.
        b. Pre-wet mixer and empty out excess water before beginning mixing.
    3. Dry-patch mortar:
        a. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.
    4. Non-shrink epoxy grout:
        a. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.
    5. Non-shrink grout:
        a. May be drypacked, flowed, or pumped into place. Do not overwork grout.
        b. Do not retemper by adding more water after grout stiffens.

B. Placement:
    1. Cement grout:
        a. Exercise care in placing cement grout because it is required to furnish structural strength, impermeable water seal, or both.
        b. Do not use cement grout that has not been placed within 30 minutes after mixing.
    2. Cement mortar:
        a. Use mortar mixer with moving paddles.
        b. Pre-wet mixer and empty out excess water before beginning mixing.
    3. Epoxy grouts:
        a. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
    4. Non-shrink epoxy grout:
        a. Mix in complete units. Do not vary ratio of components or add solvent to change consistency of mix.
        b. Pour hardener into resin and mix for at least 1 minute and until mixture is uniform in color. Pour epoxy into mortar mixer wheelbarrow and add aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in mix.
    5. Non-shrink grout:
        a. Add non-shrink cement grout to premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
        b. Mix in accordance with manufacturer's instructions to uniform consistency.

C. Curing:
    1. Cement based grouts and mortars:
        a. Keep continuously wet for minimum of 7 days. Use wet burlap, soaker hose, sun shading, ponding, and in extreme conditions, combination of methods.
        b. Maintain above 40 degrees Fahrenheit until it has attained compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for minimum of 24 hours to avoid damage from subsequent freezing.
    2. Epoxy based grouts:
        a. Cure grouts in accordance with manufacturers' recommendations.
            1) Do not water cure epoxy grouts.
        b. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for minimum of 48 hours after placement.

D. Grouting equipment bases, baseplates, soleplates, and skids: As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.

E. Grouting other baseplates:
    1. General:
        a. Use non-shrink grout as specified in this Section.
        b. Baseplate grouting shall take place from one side of baseplate to other in continuous flow of grout to avoid trapping air in grout.
        c. Maintain hydrostatic head pressure by keeping level of grout in headbox above bottom of baseplate. Fill headbox to maximum level and work grout down.
        d. Vibrate, rod, or chain non-shrink grout to facilitate grout flow, consolidate grout, and remove trapped air.

2. Forms and headboxes:
    a. Build forms using material with adequate strength to withstand placement of grouts.
    b. Use forms that are rigid and liquidtight. Caulk cracks and joints with elastomeric sealant.
    c. Line forms with polyethylene for easy grout release. Coating forms with 2 coats of heavy-duty paste wax is also acceptable.
    d. Headbox shall be 4 to 6 inches higher than baseplate and shall be located on one side of baseplate.
    e. After grout sets, remove forms and trim back grout at 45 degree angle from bottom edges of baseplate.

3.04 FIELD QUALITY CONTROL

A. Non-shrink epoxy grout:
    1. Test for 24-hour compressive strength in accordance with ASTM C579, Method B.

B. Non-shrink grout:
    1. Test for 24-hour compressive strength in accordance with ASTM C942.

END OF SECTION

SECTION 03_63_01

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Epoxy.
   2. Epoxy gel.
   3. Epoxy bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Systems for Concrete.
   2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01_33_00 - Submittal Procedures.

B. Product Data: Submit manufacturer's data completely describing epoxy materials:
   1. Submit evidence of conformance to ASTM C881. Include manufacturer’s designations of Type Grade, Class, and Color.
   2. Submit documentation that materials meet or exceed the specified strength and performance characteristics. Indicate test methods and test results.

C. Quality control submittals:
   1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Provide epoxy materials that are new.
   2. Store and use products within limitations set forth by manufacturer.
   3. Perform and conduct work of this Section in neat orderly manner.

2.02 MATERIALS

A. General:
   1. Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the

performance properties specified when tested in accordance with the standards specified.

B. Epoxy: Low viscosity product in accordance with ASTM C881; Types I, II and IV; Grade 1; Class C , except as modified in this Section.
   1. Manufacturers: One of the following or equal:
      a. Dayton Superior, Unitex Pro-Poxy 100.
      b. Sika Corporation, Sikadur 35 Hi-Mod LV.
   2. Required properties:

Table 1 - Material Properties - Epoxy.		
Property	**Test Method**	**Required Results ("neat")**
Tensile Strength (7-day)	ASTM D638	7,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	10,000 pounds per square inch, minimum.
Bond Strength (harded concrete to harded concrete after2-day cure)	ASTM C882	1,000 pounds per square inch, minimum. Concrete failure before failure of epoxy.
Viscosity (mixed)		250-550 centipoise
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

C. Epoxy gel: Non-sagging product in accordance with ASTM C881, Types I and IV, Grade 3, Class C.
   1. Manufacturers: One of the following or equal:
      a. Sika Corp., Sikadur 31, Hi-Mod Gel.
   2. Required properties:

Table 2 - Material Properties - Epoxy Gel.		
Property	**Test Method**	**Required Results ("neat")**
Tensile Strength (7-day)	ASTM D638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C882	1,500 pounds per square inch, minimum.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C881, Type II, Grade 2, Class C.
   1. Manufacturers: One of the following or equal:
      a. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
   2. Required properties.

Table 3 - Material Properties - Epoxy Bonding Agent		
Property	**Test Method**	**Required Results**
Tensile Strength (7-day)	ASTM D638	3,300 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C882	1,800 pounds per square inch, minimum. Concrete failure before failure of epoxy bonding agent.
Pot Life	-	AS recommended by manufacturer.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:
   1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy gel:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use for vertical or overhead work, or where high viscosity epoxy is required.
   3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy bonding agent:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

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SECTION 03_63_02

EPOXY RESIN/PORTLAND CEMENT BONDING AGENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Epoxy resin/portland cement bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
   2. C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
   3. C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   4. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

B. Federal Highway Administration (FHWA):
   1. FHWA-RD-86-193 - Highway Concrete Pavement Technology Development and Testing Volume V: Field Evaluation of SHRP C9206 Test Sites (Bridge Deck Overlays).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sika Corp., Sika Armatec 110.

B. Substitutions: The use of other than the specified product will be considered, providing the Contractor requests its use in writing to the Engineer. This request shall be accompanied by:
   1. A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds specified performance criteria, tested in accordance with the specified test standards.
   2. Documented proof that the proposed substitute product has a 1-year proven record of performance of bonding portland cement mortar/concrete to hardened portland cement mortar/concrete, confirmed by actual field tests and 5 successful installations that the Engineer can investigate.

2.02 MATERIALS

A. Epoxy resin/portland cement adhesive:
   1. Component "A" shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.
   2. Component "B" shall be primarily a water solution of a polyamine.

3. Component "C" shall be a blend of selected portland cements and sands.
4. The material shall not contain asbestos.

2.03 DESIGN AND PERFORMANCE CRITERIA

A. Properties of the mixed epoxy resin/portland cement adhesive:
   1. Pot life: 75 to 105 minutes.
   2. Contact time: 24 hours.
   3. Color: Dark gray.

B. Properties of the cured epoxy resin/portland cement adhesive:
   1. Compressive strength in accordance with ASTM C109:
      a. 3 day: 4,500 pounds per square-inch minimum.
      b. 7 days: 6,500 pounds per square-inch minimum.
      c. 28 days: 8,500 pounds per square-inch minimum.
   2. Splitting tensile strength in accordance with ASTM C496:
      a. 28 days: 600 pounds per square-inch minimum.
   3. Flexural strength:
      a. 1,100 pounds per square-inch minimum in accordance with ASTM C348.
   4. Bond strength in accordance with ASTM C882 modified at 14 days:
      a. 0 hours open time: 2,800 pounds per square-inch minimum.
      b. 24 hours open time: 2,600 pounds per square-inch minimum.
   5. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.
   6. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the FHWA Program Report Number FHWA-RD-86-193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mixing the epoxy resin: Shake contents of Component "A" and Component "B." Empty all of both components into a clean, dry mixing pail. Mix thoroughly for 30 seconds with a jiffy paddle on a low-speed with 400 to 600 revolutions per minute drill. Slowly add the entire contents of Component "C" while continuing to mix for a minimum of 3 minutes and until uniform with no lumps. Mix only the quantity that can be applied within its pot life.

B. Placement procedure:
   1. Apply to prepared surface with stiff-bristle brush, broom, or "hopper-type" spray equipment:
      a. For hand applications: Place fresh plastic concrete/mortar while the bonding bridge adhesive is wet or dry, up to 24 hours.
      b. For machine applications: Allow the bonding bridge adhesive to dry for 12 hours minimum.

C. Adhere to all limitations and cautions for the epoxy resin/portland cement adhesive in the manufacturer's current printed literature.

3.02 CLEANING

A. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

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SECTION 05_05_24

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cast-in anchors and fasteners:
      a. Anchor bolts.
      b. Anchor rods.
   2. Post-installed steel anchors and fasteners:
      a. Concrete anchors.
   3. Appurtenances for anchoring and fastening:
      a. Anchor bolt sleeves.
      b. Thread coating for threaded stainless steel fasteners.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.

B. American National Standards Institute (ANSI):
   1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.

C. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.6 - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
   4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   6. A240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   7. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   8. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   9. A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plan and Deformed, for Concrete.
   10. B633 - Standard Specification for *Electrodeposited* Coatings of Zinc on Iron and Steel.

11. B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
12. E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
13. F436 - Standard Specification for Hardened Steel Washers.
14. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
15. F594 - Standard Specification for Stainless Steel Nuts.
16. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
17. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. International Code Council Evaluation Service, Inc. (ICC-ES):
1. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 DEFINITIONS

A. Built-in anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.

B. Cast-in anchor: Headed bolt or assembly installed in position before placing plastic concrete around.

C. Overhead installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 60 degrees above a horizontal line so that the fastener resists sustained tension loads.

D. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

E. Post-installed anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.

F. Terms relating to structures or building environments as used with reference to anchors and fasteners:
1. Corrosive locations: Describes interior and exterior locations as follows:
    a. Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.
    b. Exterior and interior locations at the following treatment structures:
        1) All locations.
2. Wet and moist locations: Describes locations, other than "corrosive locations," that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
    a. Exterior portions of buildings and structures.
    b. Liquid-containing structures:
        1) Locations at and below the maximum operating liquid surface elevation.
        2) Locations above the maximum operating liquid surface elevation and:
            a) Below the top of the walls containing the liquid.

b) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams, or walkways enclosing the open top of the structure).

c. Liquid handling equipment:
   1) Bases of pumps and other equipment that handles liquids.
d. Indoor locations exposed to moisture, splashing, or routine wash down during normal operations, including floors with slopes toward drains or gutters.
e. Other locations indicated on the Drawings.

3. Other locations:
   a. Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 SUBMITTALS

A. General:
   1. Submit as specified in Section 01_33_00 - Submittal Procedures.
   2. Submit information listed for each type of anchor or fastener to be used.

B. Action submittals:
   1. Product data:
      a. Cast-in anchors:
         1) Manufacturer's data including catalog cuts showing anchor sizes and configuration, materials, and finishes.
      b. Post-installed anchors:
         1) For each anchor type, manufacturer's data including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.
   2. Samples:
      a. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.
   3. Certificates:
      a. Cast-in anchors:
         1) Mill certificates for steel anchors that will be supplied to the site.
      b. Post-installed anchors:
         1) Manufacturer's statement or certified test reports demonstrating that anchors that will be supplied to the site comply with the materials properties specified.
   4. Test reports:
      a. Post-installed anchors: For each anchor type used for the Work:
         1) Current ICC-ES Report (ESR**)** demonstrating:
            a) Acceptance of that anchor for use under the building code specified in Section 01_41_00 - Regulatory Requirements.
   5. Manufacturer's instructions:
      a. Requirements for storage and handling.
      b. Recommended installation procedures including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
      c. Requirements for inspection or observation during installation.

6. Qualification statements:
    a. Post-installed anchors: Installer qualifications:
        1) Submit list of personnel performing installations and include date of manufacturer's training for each.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Post installed anchors shall be in accordance with building code specified in Section 01_41_00 - Regulatory Requirements.

B. Special inspection:
    1. Provide special inspection of post-installed anchors as specified in Section 01_45_24 - Regulatory Quality Assurance and this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.

B. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.

C. Protect anchors from weather and moisture until installation.

1.07 PROJECT CONDITIONS

A. Seismic Design Category (SDC) for structures is C.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. General:
    1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
        a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
        b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.
    2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact Engineer for clarification.
    3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:
    1. Provide and install anchors of materials as in this Section.

2.02 CAST-IN ANCHORS AND FASTENERS

A. Anchor bolts:
   1. Description:
      a. Straight steel rod having one end with an integrally forged head, and one threaded end. Embedded into concrete with the headed end cast into concrete at the effective embedment depth indicated on the Drawings or specified, and with the threaded end left to project clear of concrete face as required for the connection to be made.
      b. Furnish anchor bolts with heavy hex forged head or equivalent acceptable to Engineer.
         1) Rods or bars with angle bend for embedment in concrete (i.e., “L” or “J” shaped anchor bolts) are not permitted in the Work.
   2. Materials:
      a. Type 316 stainless steel:
         1) Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
         2) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
         3) Washers: Type 316 stainless steel.
      b. Type 304 stainless steel:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Bolts: ASTM F593, Group 1, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
         4) Washers: Type 304 stainless steel.
      c. Galvanized steel:
         1) Hot-dip galvanized coating in accordance with ASTM F2329.
         2) Bolt: ASTM F1554, Grade 36, heavy hex, coarse thread.
         3) Nuts: ASTM A563, Grade A, heavy hex, threads to match bolt.
         4) Washers: ASTM F436, Type 1.

B. Anchor rods:
   1. Description: Straight steel rod having threads on each end. One threaded end is fitted with nuts or plates and embedded in concrete to the effective depth indicated on the Drawings, leaving the opposite threaded end to project clear of the concrete face as required for the connection to be made at that location.
   2. Materials:
      a. Stainless steel: Type 316:
         1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
         2) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
         3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of rods.
         4) Washers: Type 316 stainless steel.
         5) Plates (embedded): ASTM A240.
      b. Galvanized: steel:
         1) Hot-dip galvanized with coating in accordance with ASTM F2329.
         2) Rod: ASTM F1554, Grade 36, coarse thread.
         3) Nuts: ASTM A563, Grade A, threads to match rod.
         4) Washers: ASTM F436, Type 1.
         5) Plates (embedded): ASTM A36.

2.03 POST-INSTALLED ANCHORS AND FASTENERS - ADHESIVE

A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete: As specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

2.04 POST-INSTALLED ANCHORS AND FASTENERS - MECHANICAL

A. General:
   1. Post-installed anchors used for the Work shall hold a current ICC Evaluation Service Report demonstrating acceptance for use under the building code specified in Section 01_41_00 - Regulatory Requirements. Conditions of use: The acceptance report shall indicate acceptance of the product for use under the following conditions:
      1) In regions of concrete where cracking has occurred or may occur.
      2) To resist short-term loads due to wind forces.
      3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.
   2. Substitutions: When requesting product substitutions, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.
      a. Calculations shall be prepared by and shall bear the signature and seal of a Professional Engineer licensed in the State of Texas.
      b. Decisions regarding the acceptability of proposed substitutions shall be at the discretion of the Engineer.

B. Concrete anchors:
   1. Description. Post-installed anchor assembly consisting of a threaded stud and a surrounding wedge expansion sleeve that is forced outward by torquing the center stud to transfer loads from the stud to the concrete through bearing, friction, or both. (Sometimes referred to as “expansion anchors” or “wedge anchors.”)
      a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials to develop holding power.
   2. Concrete anchors for anchorage to concrete:
      a. Acceptance criteria:
         1) Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
         2) Concrete anchor performance in the current ICC-ES Report shall be “Category 1” as defined in ACI 355.2.
      b. Manufacturers: One of the following or equal:
         1) Hilti, Kwik Bolt TZ Expansion Anchor.
         2) DEWALT/Powers, PowerStud.
         3) Simpson Strong-Tie, Strong Bolt 2 Wedge Anchor.

c. Materials. Integrally threaded stud, wedge, washer, and nut:
1) Stainless steel: Type 316.
2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5).

C. Flush shells:
1. Description: Post-installed anchor assembly consisting of an internally threaded mandrel that is forced into a pre-drilled concrete hole with a setting tool until the top of the anchor is flush with the face of the concrete. Once installed, a removable threaded bolt is installed in the mandrel.
2. Flush shell anchors are not permitted in the Work.

2.05 APPURTENANCES FOR ANCHORING AND FASTENING

A. Anchor bolt sleeves:
1. Having inside diameter approximately 2 inches greater than bolt diameter and minimum 10-bolt diameters long.
2. Plastic sleeves:
a. High-density polyethylene, corrugated sleeve, threaded to provide adjustment of location on the anchor bolt.
b. Manufacturers: The following or equal:
1) Portland Bolt & Manufacturing Co.

B. Isolating sleeves and washers:
1. Manufacturers: One of the following or equal:
a. Central Plastics Co.
b. Allied Corrosion Industries.
2. Sleeves: Mylar, 1/32-inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending half way into both steel washers.
3. One sleeve required for each bolt.
4. Washers: The inside diameter of all washers shall fit over the isolating sleeve, and both the steel and isolating washers shall have the same inside diameter and outside diameter.
a. Proper size to fit bolts.
b. Two 1/8-inch thick steel washers for each bolt.
c. G3 Phenolic: 2 insulating washers are required for each bolt:
1) Thickness: 1/8 inch.
2) Base material: Glass.
3) Resin: Phenolic.
4) Water absorption: 2 percent.
5) Hardness (Rockwell): 100.
6) Dielectric strength: 450 volts per mil.
7) Compression strength: 50,000 pounds per square inch.
8) Tensile strength: 20,000 pounds per square inch.
9) Maximum operating temperature: 350 degrees Fahrenheit.

C. Coating for repair of galvanized surfaces:
1. Manufacturers: The following or equal:
a. Jelt, Galvinox.

D. Thread coating: For use with threaded stainless steel fasteners:
   1. Manufacturers: One of the following or equal:
      a. Bostik, Never-Seez.
      b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION: GENERAL

A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.

B. Substitution of anchor types:
   1. Post-installed anchors may not be used as an alternative to cast-in/built-in anchors at locations where the latter are indicated on the Drawings.
   2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.

C. Protect products from damage during installation. Take special care to protect threads and threaded ends.

D. Accurately locate and position anchors and fasteners:
   1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
   2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.

E. Interface with other products:
   1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), use stainless steel anchors and separate or isolate dissimilar metals using isolating sleeves and washers.
   2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION: CAST-IN ANCHORS

A. General:
   1. Accurately locate cast-in and built-in anchors.
      a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
      b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.

c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not “stab” anchors into plastic concrete, mortar, or grout.
d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.

2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.

B. Anchor bolts:
1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
Where indicated on the Drawings, set anchor bolts in plastic, galvanized steel or stainless steel sleeves to allow for adjustment. Seal top of sleeve to prevent grout from filling sleeve.
2. Anchor rods:
a. Install as specified for anchor bolts.

3.04 INSTALLATION: POST-INSTALLED ADHESIVE ANCHORS

A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete: As specified in Section 03_21_17 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

3.05 INSTALLATION: POST-INSTALLED MECHANICAL ANCHORS

A. General:
1. Install anchors in accordance with the manufacturer’s instructions, ACI 355.2, the anchor’s ICC-ES Report. Where conflict exists between the ICC-ES Report and the requirements in this Section, the requirements of the ICC-ES Report shall control.
2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
3. After anchors have been positioned and inserted into concrete or masonry, do not:
a. Remove and reuse/reinstall anchors.
b. Loosen or remove bolts or studs.

B. Holes drilled into concrete and masonry:
1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f’c or f’m).
2. Accurately locate holes:
a. Before drilling holes, use a reinforcing bar locator to identify the position of all reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.

b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.

3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry.
   a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await Engineer's instructions before proceeding.
4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
5. Drill using anchor manufacturer's recommended equipment and procedures:
   a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
      1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
      2) Drill bits: Carbide-tipped in accordance with ANSI B212-15. Hollow drills with flushing air systems are preferred.
6. Drill holes at manufacturer's recommended diameter and to depth required to provide the effective embedment indicated.
7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES Report for that anchor.
   a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
   b. Repeat cleaning process as required by the manufacturer's installation instructions.
   c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.

C. Insert and tighten (or torque) anchors in full compliance with the manufacturer's installation instructions.
   1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.

D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	**Minimum Effective Embedment Length**		**Minimum Member Thickness**
	In Concrete	**In Grouted Masonry**	
3/8 inch	2 1/2 inch	2 5/8 inch	8 inch
1/2 inch	3 1/2 inch	3 1/2 inch	8 inch
5/8 inch	4 1/2 inch	4 1/2 inch	10 inch
3/4 inch	5 inch	5 1/4 inch	12 inch

E. Flush shell anchors:
   1. Flush shell anchors are not permitted in the Work.
   2. If equipment manufacturer's installation instructions recommend the use of flush shell anchors, contact Engineer for instructions before proceeding.

3.06 FIELD QUALITY CONTROL

A. Contractor shall provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control.
   1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.

B. Post-installed anchors:
   1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service Report (hereafter referred to as "installation documents") for each anchor type and material.
   2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
   3. Certify in writing to the Engineer that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.07 FIELD QUALITY ASSURANCE

A. Owner's Representative will provide on-site observation and field quality assurance for the Work of this Section.
   1. Expenses associated with work described by the following paragraphs shall be paid by the Owner.

B. Field inspections and special inspections:
   1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted submittals, and manufacturer's installation instructions for the products used.
   2. Record of inspections:
      a. Maintain record of each inspection.
      b. Submit copies to Engineer upon request.
   3. Statement of special inspections: At the end of the project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.

C. Special inspections: Anchors cast into concrete and built into masonry.
   1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
      a. Anchor bolts.
      b. Anchor rods.
   2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents.
      a. Anchor:
         1) Type and dimensions.
         2) Material: Galvanized steel, Type 304 stainless steel, or Type 316 stainless steel as specified in this Section or indicated on the Drawings.

3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.

3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
   a. Base material (concrete or grouted masonry):
      1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
      2) Material encapsulating embedment is dense and well-consolidated.

D. Special Inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry.
   1. Provide special inspection during installation of the following anchors:
      a. Concrete anchors.
   2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torquing of anchors.
      a. Provide continuous special inspection for post-installed anchors in "overhead installations" as defined in this Section.
   3. Requirements for periodic special inspection:
      a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Report for the anchor being used. Observe the initial installation of each type and size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours.
         1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor shall require a new "initial inspection."
      b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor's rated strength.
      c. Anchor:
         1) Manufacturer, type, and dimensions (diameter and length).
         2) Material (galvanized, Type 304 stainless steel, or Type 316 stainless steel).
      d. Hole:
         1) Positioning: Spacing and edge distances.
         2) Drill bit type and diameter.
         3) Diameter, and depth.
         4) Hole cleaned in accordance with manufacturer's required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
         5) Anchor's minimum effective embedment.
         6) Anchor tightening/installation torque.
   4. Requirements for continuous special inspection:
      a. The special inspector shall observe all aspects of anchor installation, except that holes may be drilled in his/her absence provided that he/she confirms the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.

E. Field tests:
   1. Owner's Representative may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
      a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
      b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests.

3.08 NON-CONFORMING WORK

A. Remove misaligned or non-performing anchors.

B. Fill empty anchor holes and repair failed anchor locations as specified using high-strength, non-shrink, non-metallic grout.

C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.09 SCHEDULES

A. Stainless steel. Provide and install stainless steel anchors at the following locations:
   1. "Corrosive locations" as defined in this Section: Type 316 stainless steel.
   2. "Wet and moist locations" as defined in this Section: Type 316 stainless steel.
   3. "Other locations:"
      a. For connecting stainless steel members to concrete or masonry: Type 304 stainless steel.
      b. For connecting aluminum members to concrete or masonry.
      c. For connecting fiber-reinforced plastic (FRP) members to concrete or masonry.
   4. At locations indicated on the Drawings.

END OF SECTION

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SECTION 13_34_19

METAL BUILDING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Prefabricated metal building systems.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

B. American Institute of Steel Construction (AISC):
   1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
   2. 360 - Specification for Structural Steel Buildings.

C. American Iron and Steel Institute (AISI):
   1. SG02 - North American Specification for the Design of Cold-Formed Steel Structural Members.

D. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   4. A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   5. A792 - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
   6. B187 - Standard Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
   7. B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   8. D1494 - Standard Test Method for Diffuse Light Transmission Factor of Reinforced Plastics Panels.
   9. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
   10. F436 - Standard Specification for Hardened Steel Washers.
   11. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.

E. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.3 - Structural Welding Code - Sheet Steel.

F. FM Global (FM).

G. International Accreditation Service (IAS):
   1. AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems.

H. Metal Building Manufacturing Association (MBMA):
   1. Metal Building Systems Manual.

I. Occupational Safety and Health Administration (OSHA):
   1. Occupational Safety and Health Standards:
      a. 1910.23 - Guarding floor and wall openings and holes.

J. Research Council on Structural Connections (RCSC):
   1. Specification for Structural Joints Using High Strength Bolts.

K. Society for Protective Coatings (SSPC):
   1. SSPC-SP2 - Hand Tool Cleaning.

L. Steel Door Institute (SDI):
   1. A250.8 - Recommended Specifications for Standard Steel Doors and Frames.

M. Underwriters' Laboratories, Inc. (UL).
   1. 580 - Tests for Uplift Resistance of Roof Assemblies.

1.03 DEFINITIONS

A. Primary framing: An assemblage of beams and columns that support the secondary framing members, and that collects loads to transfer to the building foundation.

B. Secondary framing: Members which directly support roof, wall, or floor surfaces and convey loads to the primary framing.

1.04 SUBMITTALS

A. Product Data:
   1. Manufacturer's installation instructions.
   2. Manufacturer's standard color charts and profiles:
      a. Exterior wall and roof panels.
      b. Interior wall and roof liner panels.
      c. Gutters and downspout trim.
   3. Manufacturer's list of approved clamps that may be used to hang suspended items from roof purlins and details of acceptable methods of attachment to purlins.

B. Shop drawings:
   1. Shop drawings: Catalog cuts; design and erection drawings; and other data needed to clearly describe design, materials, construction details, fasteners, and erection.
      a. Erection drawings shall include building dimensions, required foundation footprint, anchor bolt and base plate settings, bracing, main and secondary framing, and sections and details required to fully describe construction of building.

b. Indicate quantity, size, grade, embedment, and projection, and location of anchor bolts.

2. Calculations: Submit engineering design calculations for the complete structural system, sealed and signed by a Professional Engineer licensed in the state where the project is located.
   a. Clearly indicate foundation reactions at all columns. Identify all applied loads, load factors, and load combinations used to develop the reactions.
   b. Calculations will be submitted for record information only.
      1) Engineer's review of calculations will be for general conformance to the loading requirements of this Section.
      2) The building manufacturer shall remain fully responsible for the structural design and adequacy of the metal building system.
3. Descriptive data: Submit data for the following items either on the shop drawings or separately: Accessories, each type of flashing, trim closures, caps and similar items, fasteners, doors, roof openings, gutters, and downspouts.

C. Quality control submittals:
   1. Building manufacturer:
      a. If requested by the Engineer, submit a record of manufacturer's metal building systems of similar design manufactured and erected in the 5-year period preceding the bid date for this project.
         1) Include date of installation, location of metal building, and name and address of Owner.
      b. Submit evidence of manufacturer's certification under IAS AC472 Accreditation.
         1) Certification must be valid for the facility at which the metal building will be fabricated.
      c. Confirmation of UL 580 wind uplift rating.
   2. Erector:
      a. Submit welder qualification certificates.

D. Record documents:
   1. 1 set of reproducible "Record Drawings" for the erected structure.
      a. Drawings shall bear the seal and signature of a Professional Engineer, registered in the state where the work is constructed and who provided responsible charge for the design.

E. Closeout submittals: Submit Contract Closeout Submittals as specified in Section 01_77_00 - Closeout Procedures.
   1. Operating and Maintenance Information.
   2. Warranty.
   3. Certificate of Compliance: At the completion of the metal building manufacture, the manufacturer will furnish a letter to the Engineer stating that the work was performed in accordance with the approved construction documents.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer shall have been engaged in the design, manufacture, and erection of metal building systems of the type specified for at least 5 years preceding the Bid Date of this Contract.
   1. Building manufacturer shall be certified by IAS AC472 Accreditation.

2. The manufacturer’s Engineer of Record shall hold current license as a Professional Engineer in the state where the work will be constructed.

B. Erector qualifications: Erectors shall be trained, approved, and certified by the manufacturer prior to Bidding of the Project. Erectors shall demonstrate at least 3 years of experience in successfully erecting metal building systems of the type specified in this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver materials and fabrications to the job site in manufacturer's original containers with seals unbroken and labeled with manufacturer's identification and number.

B. Delivery:
1. Deliver materials dry and undamaged, and store out of contact with ground.
2. Cover materials with weathertight coverings and keep dry.
3. Provide good air circulation and protection from surface staining for roof and wall covering sheets.

C. Storage and protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.07 WARRANTY

A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

B. Special warranty:
1. Provide Owner with warranty that exterior finish system for metal panels shall be guaranteed against blister, peeling, cracking, chipping, or material rust-through for a period of 5 years from the date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Buildings: One of the following or equal:
1. Nucor.Behlen Building Systems.
2. Butler Manufacturing Co.
3. Varco Pruden.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. System:
1. Design: Furnish metal building with vertical walls, single-sloperoof, and with column layout as indicated on the Drawings.
2. Size:
a. Furnish metal building of the size and configuration indicated on the Drawings.
b. Coordinate manufacturer's design dimensions for metal building system components, including columns, with equipment foundations, and details indicated on the Drawings.

3. Roof slope: Use a roof slope of 1 inch vertical in 12 inches horizontal or steeper.
4. Provide building with horizontal and vertical bracing where indicated on the Drawings.
5. Column reactions shall be vertical and horizontal only.
    a. No bending moments shall be transferred at column bases.
6. Building indicated on the Drawings is a roof canopy only.
    a. Wall framing and wall panels will not be provided under this contract; however, design the structural framing and report frame reactions to accommodate both the present condition, and the possibility of adding wall panels to enclose the structure at a future date.
7. The building roofing system will be listed for a UL 580, Class 60 designation.
8. Openings: Frame openings for doors, windows, louvers, equipment with structural framing to replace panels and secondary framing cut for opening.
    a. Provide curbs to suit roof-mounted equipment compatible with roof sheathing.

B. Performance requirements:
1. General:
    a. Design of the metal building structure and its appurtenances shall conform to the requirements of the IBC, the Metal Building Systems Manual, and the requirements of this Section.
        1) Where the Metal Building Systems Manual conflicts with the requirements of this Section, the more restrictive requirements will govern.
    b. Do not include collateral or auxiliary loads in load combinations where dead loads offset other load effects (for example, uplift due to wind loads).
    c. Hot-rolled structural steel sections or welded-up plate sections: Design in accordance with AISC 360.
    d. Cold-formed steel structural members: Design in accordance with the AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
2. Loading:
    a. General:
        1) Design building for dead load, live loads, and combinations of loads including unbalanced loads in accordance with the IBC and the MBMA Metal Building Systems Manual, except as modified in this Section.
        2) Reduction in wind, live, or snow loads based on tributary loaded area will not be permitted.
    b . Roof loading requirements:
        1) Live load: Minimum 20 pounds per square foot assumed to act vertically on horizontal projected area of roof.
        2) Ground snow load: Minimum 5 pounds per square foot assumed to act vertically on horizontally projected area of roof.
        3) Rain on snow surcharge load: Minimum 5 pounds per square foot assumed to act vertically on horizontally projected area of roof.
    a. Collateral loading: Uniform roof load of 10 pounds per square foot assumed to act vertically on horizontal projected area of roof to account for miscellaneous accessories supported from the structure.
        1) Collateral loading shall be considered a live load.

2) Design primary and secondary framing to support the additional weight of mechanical equipment such as fans, air conditioners, etc. shown on plans.
a) Mechanical equipment weights are in addition to collateral loading.

b. Auxiliary loading:
1) Structural members: Any single point along the secondary roof framing members shall be designed to carry a concentrated load of 200 pounds in addition to the roof live load.
2) Roof panels: Design panels to support a 200 pound load uniformly distributed over a 2 square foot area centered between supporting framing members, without exceeding a panel deflection to span ratio of 1/180 in a 2-span condition.
3) Auxiliary loading shall be considered a live load.
4) Auxiliary is to be considered concurrently with collateral loading.

c. Wind design criteria: As specified in Section 01_81_50 - Design Criteria.
1) Design roof purlins and structural frames for loads specified, but not less than 20 pounds per square foot uplift on horizontally projected roof area.

d. Seismic design criteria: As specified in Section 01_81_50 - Design Criteria.
1) Bolted joints subject to seismic loading shall be designated pretensioned joints.

4. Deflection limitations:
a. Primary frames:
1) Gravity deflection:
a) Live load deflection: L/240.
b) Snow load deflection: L/240.
c) Total load deflection: L/180.
2) Horizontal drift of rigid frames measured at eave indicated on the Drawings:
a) Wind drift limitation: H/60

b. Secondary framing:
1) Gravity deflection:
a) Live load deflection: L/180.
b) Snow load deflection: L/180.
c) Total load deflection: L/180.
2) Horizontal deflection: L/180.

c. Deflection of roof and wall panels:Span/180.
d. Deflection calculations should be based on the wind loads presented in AISC Design Guide 3.

5. Climatic conditions:
a. Gutters and downspouts: Design for a rainfall rate of 5 inches per hour.
b. Temperature: Provide for movement (expansion or contraction) caused by a range of ambient temperature of 120 degrees Fahrenheit without detrimental effects.

2.03 MATERIALS

A. Primary framing (rigid frames):
   1. Welded plates or hot-rolled steel columns and roof beams, complete with necessary splice or connector plates for bolted field assembly.
      a. Minimum nominal thickness of structural shapes or their elements shall be 1/4-inch.
   2. Welding procedures, welder qualifications, and welding quality standards shall be in accordance with AWS D1.1 and AWS D1.3.
   3. Base, cap, compression plates, and stiffener plates shall be factory-welded in place and shall have shop-fabricated connection holes.
      a. Provide minimum 4 anchor bolts per column base.
   4. Columns and roof beams shall be fabricated complete with holes in webs and flanges for attaching bracing and roof and sidewall framing.
   5. Shop finishing:
      a. Shop galvanized - hot-dipped:
         1) Hot-dip galvanize members in accordance with ASTM A123.
         2) Provide a minimum zinc coating of not less than 1.4 ounces per square foot.

B. Secondary framing (purlins, girts, framing at endwalls and openings, eave struts, bracing):
   1. Hot rolled structural steel or cold-formed members.
   2. Minimum thickness: 16-gauge.
   3. Bracing elements constructed of wire rope, stranded tendons, or other similar material is not permitted.
      a. Rolled angle sections or solid steel bar is permitted.
   4. Provide factory-punched holes for panel connections.
   5. Shop finishing - hot rolled sections:
      a. Galvanized - hot-dipped:
         1) Hot-dip galvanize members in accordance with ASTM A123.
         2) Provide a minimum zinc coating of not less than 1.4 ounces per square foot.
   6. Shop finishing (cold-formed sections):
      a. Galvanized - hot-dipped:
         1) Hot-dip galvanize members in accordance with ASTM A653 to G90 designation.

C. Roof and wall panels:
   1. Roll-formed minimum 24-gauge steel, factory-finished each side.
   2. Panels shall have interlocking side seams and shall be the manufacturer's maximum standard width Factory cut to maximum possible length to minimize end laps.
   3. Factory pre-punched for fastening.
   4. Panel finish:
      a. Factory pre-painted, pre-finished coating consisting of a UV light-resistant polyvinylidene diflouride (PVDF) resin based paint and primer system having a total thickness not less than 1.0 mil on an approximately 55 percent aluminum-43 percent zinc-1 percent silicone galvanized coating complying with ASTM A792.

b. The galvanized coating shall be deposited at a minimum rate of 0.50 ounces/square foot.
c. Furnish manufacturer's standard color chart for Owner's selection.

5. Ridge panel: 1-piece, factory-formed to match roof slope at each side, of same material as roof panels, and capable of completely sealing roof ridge.

D. Bolted joint components: High-strength steel bolts used for steel-to-steel structural connections.
1. Bolts: ASTM F3125, Grade A325, Type 1.
2. Nuts: ASTM A563, heavy hex. Grade and finish to match bolts as specified in RCSC Specification for Structural Joints Using High Strength Bolts.
3. Washers: ASTM F436; flat unless otherwise noted.
4. Load indicator devices:
a. Twist-off type tension-control bolt assemblies: ASTM F3125, Grade A1852**.**
b. Compressible washer direct tension indicators: ASTM F959, Type 325-1 for ASTM F3125, Grade A325 bolts**.**
5. Bolts furnished for the project shall be a single size and grade.

E. Anchor bolts or anchor rods: As specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry except that material shall be Type 316 stainless steel unless otherwise indicated on the Drawings.

F. Fasteners and washers:
1. Fasteners and washers used for attachment of wall and roof panels.
2. Fasteners: Vinyl-coated steel or stainless steel.
3. Washers: Neoprene or other accepted type washer capable of being used to ensure watertightness at fastening locations.

G. Gutters and downspouts:
1. 24-gauge steel.
2. Galvanized in accordance with ASTM A653 to G60 designation.
3. Field painted. Color to be selected by Owner to complement wall panels.

H. Doors and frames: N/A.

I. Windows and glazing: N/A.

J. Roof hatch: Provide roof hatch as indicated on the Drawings and as specified in Section 07_72_33 - Roof Hatches.

K. Touch-up painting materials:
1. For structural elements:
a. Shop primer: Manufacturer’s standard primer.
b. Touch-up paint: Same as shop primer.
2. For sheet metal skin:
a. Exterior finish paint: Match specified coating.
1) Color: Color as selected by the Engineer.

L. Insulation:
1. Thermal value:
a. Roof insulation: As defined in Table 502.2(2) of the IECC.
b. Wall insulation: As defined in Table 502.2(2) of the IECC.

M. Translucent panels:
   1. Exterior ribbed profile sheet plastic manufactured with light stabilized polyester resins and reinforced with glass fibers.
      a. Glass fibers shall be approximately 30 percent by weight.
   2. Panels shall be resistant to chemicals expected in or around the structure.
   3. Exterior panels shall match the configuration of the metal roofing.
   4. Color shall be as selected by the Engineer.
   5. Panels shall be classified by UL and FM with a flame spread of 25 or less and be self-extinguishing for fire.
   6. Minimum light transmittance in accordance with ASTM D1494 shall be 24 percent.

N. Caulking material: Elastomer type, manufacturer's standard.

O. Roof vents:
   1. 10-foot ridge vents with 9-inch or 12-inch throat opening at ridge. Vents shall be pre-fabricated by a recognized manufacturer and shall include necessary flashing to make them weathertight.
   2. Factory painted with color acceptable to Engineer and factory assembled units complete with bird screen and cord operated damper.
   3. Each vent shall allow a minimum of 620 cubic feet per minute air movement at a temperature differential of 10 degrees..
   4. Vents shall be fabricated by a recognized manufacturer shall include necessary flashing to make them weathertight.

P. Vent materials:
   1. Steel: Minimum 20 gauge galvanized.
   2. Screens: 1/8-inch mesh aluminum screen.

Q. Ventilator accessories:
   1. Bird Screen.
   2. Flashing.

2.04 FABRICATION

A. Shop fabrication:
   1. Structural elements:
      a. Fabricate rigid frame of hot-rolled sections or continuously welded plate sections.
      b. Field connections shall be bolted unless otherwise accepted by the Engineer.
   2. Wall panels: N/A.
   3. Roof panels:
      a. Panel splicing: Panels may be spliced with minimum end overlap of 9 inches at purlins.
      b. Ridge panel: Provide 1 piece ridge panel, factory formed to match roof slope, of same material as roof panel, and capable of completely sealing roof ridge.
      c. Expansion of roof panels: Provide means to allow expansion of roof panels.

4. Fasteners for roof and wall panels:
    a. Fasteners: Secure with fasteners that ensure maximum weathertightness, proper bearing surface, and permanent seal at point of fastening.
    b. Washers: Use washers capable of assuring watertightness at fastening locations.
5. Accessories:
    a. Gutters, downspouts, and hangers:
        1) Provide 4-inch gutters, downspouts, and hangers as indicated on the Drawings.
    b. Vents:
        1) Provide vents of size and location indicated on the Drawings.
        2) Provide louvers that are operable and that have screens.
    c. Ventilators:
        1) Provide buildings with gravity vertical turbine ventilators with 12-inch throats where indicated on the Drawings.
        2) Provide ventilators that are gravity operated with damper.
        3) Accessories: Provide hardware and accessories including bird screen and flashing, as required to properly install ventilators in roof openings.

B. Tolerances:
1. Hot-rolled sections: In accordance with AISC 303.
2. Cold-formed and Built-up sections: In accordance with MBMA Metal Building Systems Manual.

2.05 SOURCE QUALITY CONTROL

A. General.
1. Components of the metal building system fabricated in the manufacturer's shop will may be subjected to special inspection, as specified in the building code.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
1. Verify site conditions prior to start of work. Unacceptable conditions shall be reported to Engineer.
2. Starting of erection of metal building system work shall indicate acceptance of existing conditions.
    a . Manufacturer or manufacturer's trained erector shall review and examine existing site conditions, foundation, and surface preparation, and adequacy of site-prepared components prior to commencing erection of the building.

3.02 ERECTION

A. General:
1. Erect in accordance with the MBMA, Metal Building Systems Manual and manufacturer's instruction, except as modified in this Section.

2. Separate dissimilar materials with gaskets or suitable insulating coatings.
3. Keep exposed surfaces clean and free from sealant, metal cuttings, and other foreign materials.

B. Framing and structural members:
1. Set anchor rods by template and securely tie into formwork before concrete placement.
2. Provide uniform bearing under baseplates and sills by filling using a nonshrinking grout as specified in Section 03_60_00 - Grouting.

C. Walls and roof:
1. Erect a structure that will be free from water leaks and meet design requirements.
2. Direct side lap edges away from the prevailing winds at the site.
3. Do not exceed the maximum fastener spacings specified.
   a. Space fasteners uniformly not to exceed: 8 inches on center at ends of covering, 12 inches on center at intermediate supports and at roof covering side laps, and 18 inches on center at wall covering side laps.
4. Install fasteners in straight lines within a tolerance of 1/2-inch per bay.
5. Seal side laps, ends of roof, wall coverings, and joints at accessories.
   a. Drive fasteners to the surface and seat gasketed heads and washers.
6. Fasten accessories to framing members, except as otherwise accepted by the Engineer.
7. Wall panels shall be isolated from concrete floor slab and/or foundation.
8. Flashing shall be provided at the base of wall panels to prevent wind-driven rain from entering the building envelope.

D. Gutters and downspouts:
1. Attach securely to the building.
2. Install gutters sloped to drain with adequate provisions for expansion and contraction.

E. Doors and roof openings:
1. Anchor securely to the supporting construction.
2. Install doors plumb and true and adjust to provide operation.

3.03 FIELD QUALITY CONTROL

A. General:
1. Installation of metal building system will be subject to special inspection and evaluation during construction, as specified in this Section.

B. Site inspection:
1. Special inspection of the metal building system components will be performed at the time and frequency outlined in Attachment A - Metal Building System Construction Special Inspection.
2. The elements of the metal building system construction that will be subject to special inspection are as indicated in Attachment A - Metal Building System Construction Special Inspection.

3.04 ADJUSTING

A. Touch-up factory finished surfaces of roof and wall panels with the manufacturers recommended paint where damaged or abraded.

B. Where shop processes such as shearing or punching leave edges of galvanized steel unprotected by galvanization, touch up unprotected edges as specified in this Section.

C. Galvanized surfaces: Repair damaged galvanized surfaces in accordance with recommendations of the American Hot-Dip Galvanized Association and ASTM A780.

3.05 CLEANING

A. Remove excess materials, equipment, and debris incidental to this work upon completion.

3.06 PROTECTION

A. During erection, the erector shall be responsible for the protection of this and all adjacent work from damage.

END OF SECTION

ATTACHMENT A - METAL BUILDING SYSTEM CONSTRUCTION SPECIAL INSPECTION

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METAL BUILDING SYSTEM CONSTRUCTION SPECIAL INSPECTION

IBC Table 1704.3	Inspection Task	Frequency/Timing of Inspection	Criteria Reference
Prior to beginning installation of metal building, verify high-strength bolts, nuts, and washers:			
1.a.	Identification markings conform to ASTM standards required by approved design.	Periodic: Confirm from stockpile of materials delivered to site whether material furnished complies with the materials in the approved design.	
1.b.	Confirmation of manufacturer's certificate of compliance	Periodic: Confirm that manufacturer has furnished the required Certificate of Compliance.	
Inspection of high-strength bolted joints:			
2.a.	Joints designated bearing-type connections by the approved design.	Periodic: Provide continuous inspection of the initial installation of each type and size of joint. Subsequent installations of the same type and size of joint may be inspected on a periodic basis with inspections of a minimum of 20 percent of installations, or once per calendar week, whichever is more frequent.	
2.b.	Joints designated slip-critical connections by the approved design.	Continuous: Provide continuous inspection as specified in Section 01_45_24 - Regulatory Quality Assurance.	
Inspection of structural steel welding:			
5.a.1.	Complete and partial penetration groove welds.	Continuous: Provide continuous inspection as specified in Section 01_45_24 - Regulatory Quality Assurance.	
5.a.2.	Multipass fillet welds.	Continuous: Provide continuous inspection as specified in Section 01_45_24 - Regulatory Quality Assurance.	
5.a.3.	Single-pass fillet welds greater than 5/16 inch.	Continuous: Provide continuous inspection as specified in Section 01_45_24 - Regulatory Quality Assurance.	

IBC Table 1704.3	Inspection Task	Frequency/Timing of Inspection	Criteria Reference
5.a.4.	Single-pass fillet welds less than or equal to 5/16 inch.	Periodic: Provide continuous inspection of the initial production of each type and size of welded joint. Subsequent production of the same type and size of joint may be inspected on a periodic basis with inspections of a minimum of 20 percent of installations, or once per calendar week, whichever is more frequent.	
5.a.5.	Floor and roof deck welds.	Periodic: Provide continuous inspection of the initial production of each type and size of welded joint. Subsequent production of the same type and size of joint may be inspected on a periodic basis with inspections of a minimum of 20 percent of installations, or once per calendar week, whichever is more frequent.	
Inspection of steel frame joint construction for compliance with approved design.			
6.a.	Bracing and stiffening details.	Periodic: Provide periodic inspection of any bracing and stiffening details of construction. Inspection should include, as a minimum, verification of member sizes and proper orientation. A minimum of 15 percent of locations should be verified.	
6.b.	Member locations.	Periodic: Provide periodic inspection of member locations. Inspection should include, as a minimum, verification of member sizes and proper spacing/location. A minimum of 15 percent of locations should be verified.	
6.c.	Connection joint details.	Periodic: Provide periodic inspection of joint details of construction. Inspection should include, as a minimum, verification of miscellaneous steel detailing, including stiffener plates, concrete pourstops, gusset plates and similar miscellaneous steel framing. A minimum of 15 percent of locations should be verified.	

SECTION 26_05_00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. General requirements applicable to all Electrical Work.
   2. General requirements for electrical submittals.

B. General:
   1. Interfaces to equipment, instruments, and other components:
      a. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
      b. Provide all material and labor needed to install the actual equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional installation based on the actual equipment furnished:
         1) Make all changes necessary to meet the manufacturer's wiring requirements.
      c. Submit all such changes and additions to the Engineer for acceptance as specified in Section 01_33_00 – Submittal Procedures and any other relevant Sections.
      d. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appear on the Drawings or in the Specifications from another discipline in the scope of Work:
         1) If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.
   2. All electrical equipment and systems for the entire Project must comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:
      a. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections.
      b. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.
      c. Owner is not responsible for any additional costs due to the failure of Contractor to notify all subcontractors and suppliers of the Electrical Specifications requirements.

C. Contract Documents:
    1. General:
        a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.
    2. Specifications:
        a. The General and Supplementary Conditions of the Contract Documents govern the Work.
        b. These requirements are in addition to all General Requirements.
    3. Contract Drawings:
        a. The Electrical Drawings show desired locations, arrangements, and components of the Electrical Work in a diagrammatic manner.
        b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only; exercise professional judgment in executing the Work to ensure the best possible installation:
            1) The equipment locations and dimensions indicated on the Drawings are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.
            2) The Contractor has the freedom to select any of the named manufacturers identified in the individual specification sections; however, the Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.
        c. Installation details:
            1) The Contract Drawings include typical installation details the Contractor is to use to complete the Electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.
            2) Not all typical installation details are referenced within the Drawing set. Apply and use typical details where appropriate.
        d. Schematic diagrams:
            1) All controls are shown de-energized.
            2) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
            3) Add relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.
            4) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.
            5) Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

D. Alternates/Alternatives:
   1. Coordinate with Section 01_33_00 – Submittal Procedures for substitute item provisions.

E. Changes and change orders:
   1. As specified in Section 01_33_00 – Submittal Procedures.

1.02 REFERENCES

A. Code compliance:
   1. As specified in Section 01_41_00 - Regulatory Requirements.
   2. The publications are referred to in the text by the basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of the bid governs.
   3. The standards listed are hereby incorporated into this Section.
      a. American National Standards Institute (ANSI).
      b. American Society of Civil Engineers (ASCE):
         1) ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
      c. ASTM International (ASTM).
      d. Illuminating Engineering Society (IES).
      e. Institute of Electrical and Electronics Engineers (IEEE).
      f. Insulated Cable Engineers Association (ICEA).
      g. International Code Council (ICC):
         1) International Code Council Evaluation Service (ICC-ES).
            a) AC 156 - Acceptance Criteria for Seismic Certification by Shake Table Testing of Non-Structural Components (ICC-ES AC 156).
      h. International Society of Automation (ISA).
      i. National Electrical Manufacturers Association (NEMA):
         1) 250 - Enclosures for Electrical Equipment (1000 V Maximum).
      j. National Fire Protection Association (NFPA):
         1) 70 - National Electrical Code (NEC).
      k. National Institute of Standards and Technology (NIST).
      l. Underwriters' Laboratories, Inc. (UL).

B. Compliance with laws and regulations:
   1. As specified in all relevant Sections and Front End Documents.

1.03 DEFINITIONS

A. General:
   1. Definitions of terms and other electrical and instrumentation considerations as set forth by:
      a. IEEE.
      b. NETA.
      c. IES.
      d. ISA.
      e. NEC.
      f. NEMA.
      g. NFPA.
      h. NIST.

B. Specific definitions:
   1. FAT: Factory acceptance test.
   2. ICSC: Instrumentation and controls subcontractor.
   3. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
   4. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
   5. PCIS: Process control and instrumentation system.
   6. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
   7. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment, i.e., provide all standoffs, bus, and hardware, as part of the space.
   8. Spare: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that physically contains a device with no load connections to be made.
   9. USB: Universal Serial Bus is an industry standard that establishes specifications for cables, connectors, and protocols for connection, communication, and power supply interfacing between computer, peripherals, and other computers, it has largely replaced interfaces such as serial and parallel ports.
   10. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.
   11. Unequipped space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.

1.04 SYSTEM DESCRIPTION

A. General requirements:
   1. The Work includes everything necessary for and incidental to executing and completing the Electrical Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from:
      a. The Electrical Drawings are schematic in nature; use the Structural, Architectural, Mechanical, and Civil Drawings for all dimensions and scaling purposes.
   2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of equipment furnished by others as well as equipment furnished by the Contractor, whether or not specifically mentioned but which are necessary for successful operation.
   3. Provide all Electrical Work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the Work.

4. Coordinate all aspects of the Work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The Owner is not responsible for any change orders due to lack of coordination of the Work between the Contractor, the electrical subcontractor, the other subcontractors or suppliers.
5. Demolition:
    a. Where demolition is specified or indicated on the Drawings, disconnect all associated electrical equipment and render the equipment safe.
    b. Remove and dispose of all conduit, wire, electrical equipment, controls, etc. associated with the items and/or areas to be demolished as indicated on the Drawings unless otherwise indicated.
    c. Salvage electrical equipment, where required by the Owner.
    d. For each piece of equipment to be removed, remove all ancillary components (e.g. instruments, solenoid valves, disconnect switches, etc.).
    e. Conduit:
        1) Where conduit removal, other than associated with equipment to be removed, is indicated on the Drawings:
            a) Remove exposed conduit to the point of encasement or burial.
            b) Cut conduit flush and plug or cap encased or buried conduit.
        2) Where conduits are to remain in place and removal is not indicated on the Drawings:
            a) Cap conduit open ends.
            b) Re-label empty conduits as spare.
    f. Remove all wire back to the source for all conduits to be removed or abandoned in place.
    g. Provide new nameplates for modified electrical distribution equipment, motor control centers etc. to identify equipment and circuits that are no longer used as spares.
    h. Provide new typewritten schedules for all modified panelboards.
6. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment:
    a. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before starting any Work. Determine all information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.
    b. Provide and document interface with, modifications to, upgrades, or replacement of existing circuits, power systems, controls, and equipment.
7. Provide all trenching, forming, rebar, concrete, back filling, hard surface removal and replacement, for all items associated with the Electrical Work and installation:
    a. As specified in the Contract Documents.
8. Defective work:
    a. As specified in Sections 01_45_00 – Quality Control, 01_45_17 – Contractor Quality Control Plan, and all other relevant Sections or Documents.

B. Existing system:
1. The existing settling pond sluice gates (16 included in the scope) are currently actuated manually, with remote status wired to PLC1-RIO3 from limit switches.
2. All of the existing conduit and cables to the 16 sluice gates will be demolished and new conduit and wire will be installed.

C. New system:
   1. New 480V, 3-phase electric actuators and local disconnect switches will be installed for the 16 sluice gates.
   2. The electric actuators will be controlled locally via the Vendor-provided control station for each actuator. The actuator status will be wired to PLC1-RIO3, however no remote control is being provided per EPW design preferences.
   3. An LED light and a weather protected, GFCI receptacle will be installed at each of the 10 new canopies at the sluice gate structures.
   4. Two new panelboards and a dry-type transformer will be installed in the Settled Water Lift Station Lower Storage Room. The 480 Vac distribution panelboard will be powered from a new feeder breaker installed an available space in existing MCC-4.
   5. Power termination junction boxes will be used near the panelboards and near the field end devices (actuators, lights and receptacles) to transition oversized (due to voltage drop) cables to smaller cables capable of terminating at the equipment, as indicated and as required.
      a. Note that the conductors for the receptacles are sized to power EPW's portable actuator tool.
   6. Handholes and manholes will have a level switch and transmitter installed to detect the presence of water above the specified minimum level in each handhole and manhole.

D. Operating facility:
   1. As specified in Section 01_14_00 - Work Restrictions.
   2. The Jonathan Rogers Water Treatment Plant is an operating facility. Portions of this facility must remain fully functional throughout the entire construction period. In consideration of this requirement, comply with the following guidelines:
      a. All outages must be of minimal duration and fully coordinated and agreed to by the Owner. Adjust the construction schedule to meet the requirements of the Owner. All changes in schedule and any needs to reschedule are included in the Work.
      b. As weather and water demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.
      c. Coordinate the construction and power renovation, bear all costs, so that all existing facilities can continue operation throughout construction.
   3. According to individual circumstances and in compliance with the Drawings, extend or replace conduit and cable connections from existing locations.
   4. The standards of documentation, instrument tagging, cable and conductor ferruling, terminal identification and labeling that apply to the new installation apply equally to the existing installation which forms part of the modified system.

1.05 SUBMITTALS

A. General:
   1. Furnish submittals as specified in Section 01_33_00 - Submittal Procedures and this Section.
   2. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.
   3. Furnish the submittals required by each section in the Electrical Specifications.

4. Adhere to the wiring numbering scheme specified in Section 26_05_53 - Identification for Electrical Systems throughout the Project:
    a. Uniquely number each wire.
    b. Wire numbers must appear on all Equipment Drawings.
5. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

B. Seismic requirements:
1. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site seismic loads based on the seismic design criteria in Section 01_81_50 - Design Criteria.
2. For equipment installed in structures designated as seismic design category C, D, E or F, prepare and submit the following:
    a. Statement of seismic qualification, and special seismic certification:
        1) “Statement of seismic qualification:” Provide manufacturer’s statement that the equipment satisfies the seismic design requirements of the building code indicated in Section 01_41_00 - Regulatory Requirements, including the requirements of ASCE 7, Chapter 13.
        2) “Special seismic certification:” Provide manufacturer’s certification that the equipment, when subjected to shake table testing in accordance with ICC-ES AC 156, meets the “Post-Test Functional Compliance Verification” requirements of ICC-ES AC 156 for “Components with Ip = 1.5.” Compliance shall include both operability and containment of hazardous materials as appropriate to the unit being tested.
    b. Substantiating test data: With seismic qualification and special seismic certification statements, submit results of testing in accordance with ICC-ES AC 156.
    c. Anchoring design calculations and details:
        1) Submit project-specific drawings and supporting calculations, prepared and sealed by a professional engineer licensed in the state where the Project is being constructed, and showing details for anchoring electrical equipment to its supports and for anchoring supports provided with the equipment to the structure. Prepare calculations in accordance with the requirements of Section 01_81_50 - Design Criteria.
3. Exemptions: A “statement of seismic qualification” and a “special seismic certification” are not required for the following equipment:
    a. Temporary or moveable equipment.
    b. Equipment anchored to the structure and having a total weight of 20 pounds or less.
    c. Distribution equipment anchored to the structure and having a total unit weight of 3 pounds per linear foot, or less.

C. Operation and maintenance manuals:
1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.
2. Furnish the Engineer with a complete set of written operation and maintenance manuals 8 weeks before Functional Acceptance Testing.

D. Material and equipment schedules:
   1. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:
      a. Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

E. Schedule of values:
   1. In addition to completing all items referred to in the schedule of values, Section 01_29_73 - Schedule of Values, submit per unit material and labor costs used in developing the final bid for the electrical system, for the express purpose of pricing and cost justification for any proposed change orders. In addition to the items shown on the schedule of values, provide per unit material and labor costs for conduit and wire installation for specific types, sizes, and locations as indicated on the Drawings and Conduit Schedule. It is the responsibility of the electrical subcontractor to prove to the Engineer's satisfaction that said per unit costs were used in the development of the final Bid amount.

F. Record Documents:
   1. Furnish as specified in Section 01_77_00 - Closeout Procedures.

G. Test reports:
   1. As specified in Section 01_33_00 - Submittal Procedures.
   2. Additional requirements for field acceptance test reports are specified in Sections 01_75_17 - Commissioning and 26_08_50 - Field Electrical Acceptance Tests.

H. Calculations:
   1. Where required by specific Electrical Specifications:
      a. Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

1.06 QUALITY ASSURANCE

A. General:
   1. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. General:
   1. As specified in Section 01_60_00 - Product Requirements.

1.08 PROJECT OR SITE CONDITIONS

A. Site conditions:
   1. Provide an electrical, instrumentation and control system, including all equipment, raceways, and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.

2. Seismic load resistance:
    a. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site seismic loads as specified in Section 01_81_50 - Design Criteria.
3. Wind load resistance:
    a. Provide electrical equipment with construction and anchorage to supporting structures designed to resist site wind loads as specified in Section 01_81_50 - Design Criteria.
4. Altitude, temperature, and humidity:
    a. As specified in Section 01_81_50 - Design Criteria.
    b. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.
    c. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines:
        1) Provide all power conduits wiring for these devices (e.g. heaters, fans, etc.) whether indicated on the Drawings or not.
5. Site security:
    a. Abide by all security and safety rules concerning the Work on the Site, as specified in the individual specification sections, and Section 01_50_00 - Temporary Facilities and Controls.
6. Outdoor installations:
    a. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
    b. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in this Section for the equipment:
        1) Provide all wiring necessary to power these devices.

B. Enclosures:
    1. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements of NEMA Standard 250.

C. Plant area electrical work requirements:
    1. Provide all Electrical Work in accordance with the following table, unless otherwise specifically indicated on the Drawings:

PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED CONDUIT TYPE	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS
Electrical & Storage Room Interiors	12	RAC	C	316 SS
Outdoor Plant Areas	4X (316 SS)	RAC, SLT	W, X	316 SS

2. Modify exposed conduit runs as specified in Section 26_05_33 - Conduits.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING

A. General:
   1. As specified in Sections 01_31_19 - Project Meetings and 01_75_17 - Commissioning.
   2. Testing requirements are specified in Section 01_75_17 - Commissioning, 26_08_50 - Field Electrical Acceptance Tests and other sections.
   3. General scheduling requirements are specified in Section 01_32_21 - Schedules and Reports.
   4. Work restrictions and other scheduling requirements are specified in Section 01_14_00 - Work Restrictions.
   5. Commissioning requirements as specified in Section 01_75_17 - Commissioning.

B. Pre-submittal conference:
   1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire Project, equipment, control philosophy, schedules, and submittal requirements.
   2. Contractor, electrical subcontractor, all suppliers, and individual equipment manufacturers furnishing major pieces of equipment must attend.

1.11 WARRANTY

A. General:
   1. Warrant the Electrical Work as specified in Section 01_78_36 – Warranties and Bonds:
      a. Provide additional warranty as specified in the individual Electrical Specifications.

1.12 SYSTEM START-UP

A. General:
   1. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:
      a. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the Engineer.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

A. General:
   1. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.
   2. Furnish all spare parts as required by other sections of the Specifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. General:
   1. Provide similar items of same manufacturer throughout the electrical and instrumentation portion of the Project.
   2. Allowable manufacturers are specified in individual Electrical Specifications.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. General:
   1. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products and that bear all approvals and labels as required by the Specifications.
   2. Provide materials complying with the applicable industrial standard as specified in Section 01_60_00 – Product Requirements, and other relevant Sections.

B. Stainless steel:
   1. Where stainless steel is indicated or used for any portion of the Electrical Work, provide a non-magnetic, corrosion-resistant alloy, ANSI Type 316, satin finish.
   2. Provide exposed screws of the same alloys.
   3. Provide finished material free of any burrs or sharp edges.
   4. Use only stainless-steel hardware, when chemically compatible, in all areas that are or could be in contact with corrosive chemicals.

5. Use stainless steel hardware, when chemically compatible, in all chemical areas or areas requiring NEMA Type 4X construction.
6. Do not use stainless steel in any area containing chlorine, gas or solution, chlorine products or ferric chloride.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. General:
   1. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products.

PART 3 EXECUTION

3.01 EXAMINATION

A. General:
   1. The electrical subcontractor is encouraged to visit the site to examine the premises completely before bidding.
   2. It is the electrical subcontractor's responsibility to be fully familiar with the existing conditions and local requirements and regulations.
   3. Comply with pre-bid conference requirements as specified in the Front End Documents.
   4. Review the site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Equipment locations:
   1. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction:
   2. Verify all dimensions indicated on the Drawings:
      a. Actual field conditions govern all final installed locations, distances, and levels.

3. Review all Contract Documents and approved equipment shop drawings and coordinate Work as necessary to adjust to all conditions that arise due to such changes.
4. Make minor changes in location of equipment before rough in, as directed by the Owner or Engineer.
5. Provide a complete electrical system:
    a. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical system.

B. Equipment installation:
1. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. Cutting and patching:
1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:
    a. Secure the permission of the Engineer before performing any operation likely to affect the strength of a structural member such as drilling, cutting, or piercing:
        1) Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made:
            a) Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.
            b) Use tone-locate system or X-ray to ensure that area is clear of obstructions.
    b. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.
2. Perform all patching to the same quality and appearance as the original work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:
    a. 3M: CP 25WB+: Caulk.
    b. 3M: Fire Barrier: Putty.
3. Use the installation details indicated on the Drawings as a guide for acceptable sealing methods.

D. Conduits:
1. Install all conduits and equipment in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear:
    a. Install all conduits and equipment in accordance with working space requirements in accordance with the NEC.
        1) This includes any panel, disconnect switch or other equipment that can be energized while open exposing live parts regardless of whether it is likely to require examination or has serviceable parts.
    b. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.
        1) Adjust equipment locations as necessary to avoid any obstruction or interferences.

c. Where an obstruction interferes with equipment operation or safe access, relocate the equipment.
d. Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.

E. Earthwork and concrete:
1. Install all trenching, shoring, concrete, backfilling, grading, and resurfacing associated with the Electrical Work:
a. Requirements as specified in the Contract Documents.

F. Terminations:
1. Provide and terminate all conductors required to interconnect power, controls, instruments, panels, and all other equipment.

G. Miscellaneous installation requirements:
1. Location of manholes and pullboxes indicated on the Drawings are approximate.
a. Coordinate exact location of manholes and pullboxes with Mechanical and Civil Work.
2. Conductors shall not pass through equipment they are not terminating in unless indicated on the Drawings or approved by the engineer.

H. Labeling:
1. Provide all nameplates and labels as specified in Sections 26_05_53 - Identification for Electrical Systems and 26_05_74 - Electrical System Studies.

I. Equipment tie-downs:
1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing criteria, which apply to the Site.
a. All control panels must be permanently mounted and tied down to structures in accordance with the Project seismic criteria.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. General:
1. As specified in Section 01_75_17 - Commissioning.

B. Loop tests:
1. Loop tests shall be conducted as specified in Section 40_61_00 – Common Work Results for Process Control and Instrumentation Systems.
a. Electrical Contractor shall be on site and assist with troubleshooting and correcting issues found during loop testing.

C. For Owner and Engineer witnessed FAT:
1. Contractor is responsible for the Owner’s and Engineer’s costs associated with FAT as specified in Section 01_75_17 - Commissioning.

D. Owner training:
   1. As specified in Section 01_75_17 - Commissioning and in this Section.
   2. Provide source testing and owner training on electrical equipment as defined in the table below:

3.08 FIELD QUALITY CONTROL

A. Inspection:
   1. Allow for inspection of electrical system installation as specified in Section 01_45_00 - Quality Control.
   2. Provide any assistance necessary to support inspection activities.
   3. Engineer inspections may include, but are not limited to, the following:
      a. Inspect equipment and materials for physical damage.
      b. Inspect installation for compliance with the Drawings and Specifications.
      c. Inspect installation for obstructions and adequate clearances around equipment.
      d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.
      e. Inspect equipment nameplate data to verify compliance with design requirements.
      f. Inspect raceway installation for quality workmanship and adequate support.
      g. Inspect cable terminations.
   4. Inspection activities conducted during construction do not satisfy inspection or testing requirements specified in Section 26_08_50 - Field Electrical Acceptance Tests.

B. Field acceptance testing (Functional Testing):
   1. Notify the Engineer when the Electrical Work is ready for field acceptance testing.
   2. Perform the field acceptance tests as specified in Section 26_08_50 - Field Electrical Acceptance Tests.
   3. Record results of the required tests along with the date of test:
      a. Use conduit identification numbers to indicate portion of circuit tested.

C. Workmanship:
   1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
      a. Neatly coil and label spare wiring lengths.
      b. Shorten, re-terminate, and re-label excessive used as well as spare wire and cable lengths, as determined by the Engineer.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. General:
   1. As specified in Section 01_77_00 - Closeout Procedures.
   2. Remove all foreign material and restore all damaged finishes to the satisfaction of the Engineer and Owner.

3. Clean and vacuum all enclosures to remove all metal filings, surplus insulation and any visible dirt, dust, or other matter before energization of the equipment or system start-up:
    a. Use of compressors or air blowers for cleaning is not acceptable.
4. Clean luminaries that were used in the areas affected by the construction.
5. As specified in other sections of the Contract Documents.

3.11 PROTECTION

A. General:
    1. Protect all Work from damage or degradation until Substantial Completion.
    2. Maintain all surfaces to be painted in a clean and smooth condition.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_05_18

600-VOLT OR LESS WIRES AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. 600 volt class or less wire and cable.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. CSA International (CSA).

D. Insulated Cable Engineer's Association (ICEA):
   1. S-90-661 – Individually Unshielded Twisted Pair Indoor Cables for Use in Communication Wiring Systems.

E. National Electrical Code (NEC).

F. National Electrical Manufacturers Association /Insulated Cable Engineers Association (NEMA/ICEA):
   1. NEMA WC 57/ICEA S-73-532 - Standard for Control, Thermocouple Extension, and Instrumentation Cables.
   2. NEMA WC 66/ICEA S-116-732 – Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in LAN Communication Wiring Systems.
   3. NEMA WC 70/ICEA S-95-658-1999 - Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

G. National Fire Protection Association (NFPA):
   1. 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

H. Telecommunications Industry Association (TIA):
   1. 568.2-D – Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
   2. 569-B – Commercial Building Standards for Telecommunications Pathways and Spaces.

I. Underwriter's Laboratories Inc., (UL):
   1. 44 – Standard for Thermoset-Insulated Wires and Cables.
   2. 1277 - Electrical Power and Control Tray Cables with Optional-Fiber Members.

3. 1569 - Standard for Metal-Clad Cables.
4. 1666 - Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
1. AWG: American wire gauge.
2. BCCS: Bare copper-covered steel.
3. CPE: Chlorinated polyethylene.
4. FEP: Fluorinated ethylene propylene.
5. FHDPE: Foam high-density polyethylene.
6. FPE: Foam polyethylene.
7. OD: Outside diameter.
8. PVC: Polyvinyl chloride.
9. XHHW: Cross-linked high heat water resistant insulated wire.

C. Definitions of terms and other electrical considerations as set forth in the:
1. ASTM.
2. ICEA.

1.04 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
1. Manufacturer of wire and cable.
2. Insulation:
   a. Type.
   b. Voltage class.
3. AWG size.
4. Conductor material.
5. Pulling compounds.

C. Shop drawings:
1. Show splice locations.
   a. For each proposed splice location provide written justification describing why the splice is necessary.

D. Test reports:
1. Submit test reports for meg-ohm tests.

E. Calculations:
1. Submit cable pulling calculations to the Engineer for review and comment for all cables that will be installed using mechanical pulling equipment. Show that

the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:

a. Provide a table showing the manufacturer's recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.
b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

F. Cable lengths:
   1. Submit installed cable lengths using a conduit measuring tape for all 3-phase circuits including, but not limited to:
      a. 480 V circuits.
      b. 208 V circuits.
   2. Submit installed lengths of cable for the following single-phase circuits:
      a. Circuits feeding single-phase transformers.
      b. Circuits feeding single-phase panelboards.

1.06 QUALITY ASSURANCE

A. All wires and cables shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER`S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. 600 volt class wire and cable:
      a. General Cable.
      b. Okonite Co.
      c. Southwire Co.
      d. Service Wire.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Conductors:
   1. Copper in accordance with ASTM B3.

2.04 MANUFACTURED UNITS

A. General:
   1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
   2. Permanently mark each wire and cable with the following at 24-inch intervals:
      a. AWG size.
      b. Voltage rating.
      c. Insulation type.
      d. UL symbol.
      e. Month and year of manufacture.
      f. Manufacturer's name.
   3. Identify and mark wire and cable as specified in Section 26_05_53 - Identification for Electrical Systems:
      a. Use integral color insulation for #2 AWG and smaller wire.
      b. Wrap colored tape around cable larger than #2 AWG.

B. 600 volt class wire and cable:
   1. Provide AWG or kcmil sizes as indicated on the Drawings or in the Conduit Schedules:
      a. When not indicated on the Drawings, size wire as follows:
         1) In accordance with the NEC:
            a) Use 75 degree Celsius ampacity ratings.
            b) Ampacity rating after all derating factors, equal to or greater than rating of the overcurrent device.
         2) Provide #12 AWG minimum for power conductors.
         3) Provide #14 AWG minimum for control conductors.
   2. Provide Class B stranding in accordance with ASTM B8:
      a. Provide Class C stranding where extra flexibility is required.
   3. Insulation:
      a. Type XHHW-2 for conductor sizes below 250 kcmil.
      b. Type RHW-2 for conductor sizes 250 kcmil and larger.
      c. 90 degree Celsius rating.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Wire ties:
   1. One of the following or equal:
      a. T&B, "Ty-Rap" cable ties.
      b. Panduit, cable ties.

B. Wire markers:
   1. As specified in Section 26_05_53 - Identification for Electrical Systems.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall comply with the applicable requirements of NEMA WC 70/ICEA S-95-658-1999.

B. Test Type XHHW-2 in accordance with the requirements of UL 44.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Color-coding:
   1. Color-coding shall be consistent throughout the facility.
   2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Single phase system: Black for 1 hot leg, red for the other.
      e. Neutral: White.
      f. High phase or wild leg: Orange.
      g. Equipment ground: Green.
   3. The following color code shall be followed for all 480/277 volt systems:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray.
      e. Equipment ground: Green.
   4. The following color code shall be followed for all 120 VAC control wiring:
      a. Power: Red.
      b. Neutral: White.
   5. The following color code shall be followed for all general purpose DC control circuits:
      a. Grounded conductors: White with blue stripe.
      b. Ungrounded conductors: Blue.
   6. Switch legs shall be violet. 3-way switch runners shall be pink.
   7. Wires in intrinsically safe circuits shall be light blue.

8. Wire colors shall be implemented in the following methods:
    a. Wires manufactured of the desired color.
    b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
        1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

C. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:
    1. Install wires only in approved raceways.
    2. Do not install wire:
        a. In incomplete conduit runs.
        b. Until after the concrete work and plastering is completed.

D. Properly coat wires and cables with pulling compound before pulling into conduits:
    1. For all #4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
        a. Ideal Products.
        b. Polywater Products.
        c. 3M Products.
        d. Greenlee Products.
        e. Or equal as recommended by cable manufacturer.
        f. Do not use oil, grease, or similar substances.

E. Cable pulling:
    1. Prevent mechanical damage to conductors during installation.
    2. For cables #1 AWG and smaller, install cables by hand.
    3. For cables larger than #1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
    4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the Engineer may, at his discretion, require replacement of the cable.
    5. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.
    6. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer’s recommendation for the specified cable size:
        a. Make splices in manholes or pull boxes only.
        b. Leave sufficient slack to make proper connections.

F. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer’s recommendations.

G. Install and terminate all wire in accordance with manufacturer's recommendations.

H. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
    1. Do not lace wires in gutter or panel channel.
    2. Install all wire ties with a flush cutting wire tie installation tool:
        a. Use a tool with an adjustable tension setting.
    3. Do not leave sharp edges on wire ties.

I. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
   1. Use ring type lugs if box lugs are not available on the equipment.

J. Lighting circuits:
   1. Each circuit shall have a dedicated neutral.

K. Splices:
   1. Provide continuous circuits from origin to termination whenever possible:
      a. Obtain Engineer's approval prior to making any splices.
   2. Lighting and receptacle circuit conductors may be spliced without prior approval from the Engineer.
   3. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:
      a. Splice box NEMA rating requirements as specified in Section 26_05_00 - Common Work Results for Electrical.
      b. Make splices in labeled junction boxes for power conductors.
      c. Make splices for control and instrument conductors in terminal boxes:
         1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
   4. Power and control conductors routed in common raceways may be spliced in common junction boxes.
   5. Clearly label junction and terminal boxes containing splices with the word "SPLICE LOCATED WITHIN".
   6. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
   7. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
      a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
   8. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
      a. A heat shrink insulating system listed for submersible applications.
      b. Or an epoxy resin splicing kit.

L. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

M. Wiring allowances:
   1. Equipment locations may vary slightly from the drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.
   2. Locations for pull boxes, manholes, and duct banks may vary slightly from the drawings. Include an allowance for necessary conductors and related materials to provide conductors to all pull boxes, manholes and duct banks within 20 linear feet of locations indicated on the Drawings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_05_21

LOW VOLTAGE WIRE CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Wire connecting devices.
   2. Terminations.
   3. Splices.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

C. CSA International (CSA):
   1. C22.2 - No. 197-M1983 (R2208) - PVC Insulating Tape.

D. Underwriters Laboratories, Inc. (UL):
   1. 510 - Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Provide a complete system of wiring connectors, terminators, fittings, etc. for a complete wiring system suitable for the cables and conductors used.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.
   2. Installation instructions.

1.06 QUALITY ASSURANCE

A. All materials shall be UL listed.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers for each type of technology are specified with the equipment in this Section.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Control connections:
   1. Use insulated ring type wire terminators for connections to all screw terminals:
      a. With chamfered/funneled terminal barrel entry.
      b. Deep internal serrations.
      c. Long barrel design to reduce electrical resistance and increased insulator-barrel surface area to ensure that the insulator remains in contact with the barrel.
      d. Electroplated-tin copper conductor.
      e. Manufacturers: The following or equal:
         1) Thomas & Betts, Sta-Kon.
   2. For process equipment connections work from manufacturer's drawings.

B. Joints, splices, taps, and connections:
   1. 600-volt conductors:
      a. Use solderless connectors.

b. Use only plated copper alloy connectors or lugs:
    1) Aluminum connectors or lugs are not acceptable for copper conductors.
c. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.
d. For wire Number 10 AWG and smaller use compression splice caps, with insulating caps:
    1) Manufacturers: The following or equal:
        a) Buchanan, 2006S or 2011S, with 2007 or 2014 insulating caps.
e. For wire Number 8 AWG and larger, use heavy duty copper compression connectors:
    1) Manufacturers: One of the following or equal:
        a) Burndy.
        b) Thomas & Betts.
f. Heat shrink tubing:
    1) Suitable for indoors, outdoors, overhead, direct burial or submerged applications.
    2) Minimum shrink ratio: 4 to 1.
    3) Continuous operating temperature: -55 degrees Celsius to 110 degrees Celsius.
    4) Internally applied adhesive sealant.
    5) Cross-linked polyolefin:
        a) Manufacturers: One of the following or equal:
            (1) 3M, ITCSN.
            (2) Thomas & Betts, Shrink-Kon.

2. Instrumentation class cable splices:
    a. Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.
    b. Utilizing an epoxy, polyurethane, and re-enterable compounds.
    c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kilovolt.
    d. Two-part mold body with tongue and groove seams and built in spacer webbing.
    e. Manufacturers: The following or equal:
        1) 3M, Scotchcast 72-N.

C. Insulating tape:
1. General purpose insulating tape:
    a. Minimum 7 mil vinyl tape.
    b. Suitable for application in an ambient of -18 degrees Celsius (0 degrees Fahrenheit).
    c. Operating range up to 105 degrees Celsius (220 degrees Fahrenheit).
    d. Flame retardant, hot- and cold- weather resistant, UV resistant.
    e. For use as a primary insulation for wire cable splices up to 600 VAC.
    f. Meeting and complying with:
        1) ASTM D3005 Type I.
        2) UL 510.
        3) CSA C22.2.
    g. Manufacturers: The following or equal:
        1) 3M, Scotch Number Super 33+.

2. General-purpose color-coding tape:
    a. Minimum 7 mil vinyl tape.
    b. Suitable for application on PVC and polyethylene jacketed cables.
    c. For use indoors and outdoors in weather protected enclosures.
    d. Available with the following colors:
        1) Red.
        2) Yellow.
        3) Blue.
        4) Brown.
        5) Gray.
        6) White.
        7) Green.
        8) Orange.
        9) Violet.
    e. For use as phase identification, marking, insulating, and harnessing.
    f. Meeting and complying with:
        1) UL 510.
        2) CSA C22.2.
    g. Manufacturers: The following or equal:
        1) 3M, Scotch Number 35.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Load connections:
    1. Connect loads to the circuits as indicated. Color-code all branch circuits as specified in Section 26_05_18 - 600-Volt or Less Wires and Cables.

B. Zero to 600-volt systems:
    1. Make all connections with the proper tool and die as specified by the device manufacturer.
    2. Use only tooling and dies manufactured by the device manufacturer.
    3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.
    4. Number all power and control wires before termination.

C. Motor connections (600 volts and below):
   1. Terminate all leads and wires with compression type ring lugs.
   2. Terminations on all motor leads, including leads that are connected together to accommodate the motor voltage, and the machine wires entering the motor terminal box from the power source, shall have ring type compression lugs.
   3. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
      a. In damp and wet locations, use a complete kit containing mastic that shall seal out moisture and contamination.
      b. Shrink cap with low heat as recommended by manufacturer.
   4. Wire markers shall be readable after boot installation.
   5. Manufacturers: The following or equal:
      a. Raychem, MCK.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

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SECTION 26_05_26

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Grounding materials and requirements.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

D. Underwriters Laboratories, Inc. (UL):
   1. 467 - Ground and Bonding Equipment.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.

1.05 QUALITY ASSURANCE

A. All grounding components and materials shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT/SITE CONDITIONS (NOT USED)

1.08 SEQUENCING (NOT USED)

1.09 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Compression connectors: One of the following or approved equal:
   1. Erico.
   2. Harger.
   3. Burndy.
   4. Thomas & Betts.
   5. Panduit.

B. Ground rods: One of the following or approved equal:
   1. Erico.
   2. Harger.
   3. Nehring
   4. Thomas & Betts.

C. Ground cable: One of the following or approved equal:
   1. Erico.
   2. Harger
   3. Nehring.
   4. Southwire.

2.02 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:
   1. Grounding electrodes.
   2. Bonding jumpers.
   3. Ground connections.

C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors.

D. The ground system resistance (electrode to ground) of the completed installation, as determined by tests specified in Section 26_08_50 - Field Electrical Acceptance Tests, shall be:
   1. 5 ohms or less for industrial systems.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS

A. Ground rod:
   1. Minimum: 3/4-inch diameter, 10 feet long.
   2. Uniform 10 mil covering of electrolytic copper metallically bonded to a rigid steel core:
      a. The copper-to-steel bond shall be corrosion resistant.
   3. In accordance with UL 467.
   4. Sectional type joined by threaded copper alloy couplings.
   5. Fit the top of the rod with a threaded coupling and steel-driving stud.

B. Ground cable:
   1. Requirements:
      a. Soft drawn (annealed).
      b. Concentric lay, coarse stranded in accordance with ASTM B8.
      c. Bare copper in accordance with ASTM B3.
   2. Size is as indicated on the Drawings, but not less than required by the NEC.

C. Compression connectors:
   1. Manufactured of high copper alloy specifically for the particular grounding application.
   2. Suitable for direct burial in earth and concrete.
   3. Identifying compression die number inscription to be impressed on compression fitting.
   4. Barrels prefilled and sealed with oxide-inhibiting and anti-seizing compound.

D. Grounding electrode conductors:
   1. Minimum size in accordance with the NEC.

E. Main bonding jumpers and bonding jumpers:
   1. Minimum size in accordance with the NEC.

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES (NOT USED)

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Provide a separate grounding conductor for each motor and connect at motor terminal box. Do not use bolts securing motor box to frame or cover for grounding connectors:

B. Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:
   1. Individually bond these raceways to the ground bus in the equipment.

C. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

D. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

E. Interconnect the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at service entrance point or after a transformer.

F. Duct bank ground system:
   1. Provide a bare copper grounding conductor the entire length of each duct bank, embedded in the concrete of the duct bank as indicated on the Drawings and specified in the Specifications.
   2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.

G. Grounding at service (600 V or Less):
   1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

H. Ground connections:
   1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using compression type grounding connectors as indicated on the Drawings, UL listed, and labeled for the application.
   2. Make ground connections in accordance with the manufacturer's instructions.
   3. Do not conceal or cover any ground connections until the Engineer or authorized representative has established and provided written confirmation that every grounding connection is as indicated on the Drawings and specified in the Specifications.

I. Grounding electrode system:
   1. Ground ring:
      a. Provide all trenching and materials necessary to install the ground ring as indicated on the Drawings.
      b. Ground ring conductor shall be in direct contact with the earth, or where embedded, concrete, of the size as indicated on the Drawings.
      c. Minimum burial depth 36 inches or as indicated on the Drawings.
      d. Re-compact disturbed soils to original density in 6-inch lifts.
   2. Ground rods:
      a. Locations as indicated on the Drawings.
      b. Length of rods forming an individual ground array shall be equal in length.
      c. Drive ground rods and install grounding conductors before construction of concrete slabs and duct banks.
      d. Pre-crimp all ground rods, as recommended by the manufacturer, before crimping connector to ground rod.
   3. Metal underground water pipe:
      a. Bond metal underground domestic water pipe to grounding electrode system.
   4. Metal frame of building or structure:
      a. Bond metal frame of building or structure to grounding electrode system.
   5. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
   6. Where grounding conductors are exposed and subject to physical damage, install in Schedule 80 PVC conduit for protection.
   7. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

J. Shield grounding:
   1. Analog signal cables shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
   2. For communication and data line signal cable shields and drain wires should be grounded at both ends of the cable run.
   3. Insulate the shielding and exposed drain wire for each signal cable with heat-shrink tubing.
   4. Terminate the signal cable shield on a dedicated grounding terminal block.

K. Where indicated on the Drawings, install ground rods in precast ground wells.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. Measure grounding electrode system resistance to ground in accordance with IEEE 81.

3.09 ADJUSTING

A. Under the direction of the Engineer, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:
   1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_05_29

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Mounting and supporting electrical equipment and components.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   3. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Conform to the requirements of the Building Code as specified in Section 01_41_00 - Regulatory Requirements.
   2. Demonstrate the following using generally accepted engineering methods:
      a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.
      b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.
   3. Design loading and anchoring requirements:
      a. As indicated in the Building Code unless otherwise specified.
      b. Seismic loading requirements:
         1) Freestanding, suspended or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in Section 01_81_50 - Design Criteria.
      c. Wind loading requirements:
         1) All exterior equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in Section 01_81_50 - Design Criteria.

d. Minimum safety factor against overturning: 1.5.
e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:
1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
1. Supports:
a. Materials.
b. Geometry.
c. Manufacturer.
2. Hardware:
a. Materials.
b. Manufacturer.

C. Shop drawings:
1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.
2. Complete anchoring details for equipment, lighting and raceway, supporting structures, trapezes, and wall supports for all equipment:
a. For free standing supports and wall supports supporting equipment weight in excess of 200 pounds:
1) Stamped by a professional engineer licensed in the state where the Project is being constructed.
b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.
3. Include data on attachment hardware and construction methods that will satisfy the design loading and anchoring criteria.

D. Installation instructions:
1. Furnish anchorage instructions and requirements based on the seismic and wind conditions of the Site:
a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM STARTUP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Preformed channel:
      a. Thomas & Betts.
      b. Power-Strut.
      c. Unistrut.
      d. Cooper B-Line.
      e. Robroy.
      f. Tyco.

B. Nonmetallic cable rack:
   1. Underground Devices Inc.
   2. Hubbell.
   3. Unistrut.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Use materials appropriate for the area as specified in Section 26_05_00 - Common Work Results for Electrical.

B. Preformed channel:
   1. Stainless steel:
      a. Supports:
         1) In accordance with ASTM A240.
         2) ANSI Type 316 material.
      b. Hardware:
         1) ANSI Type 316 material.

C. Non-metallic cable rack:
   1. Consists of stanchions and cable support arms.
   2. Stanchions:
      a. 50 percent glass reinforced nylon or other non-metallic material.
      b. Capable of supporting multiple arms.

c. Recessed bolt mounting holes.
d. Length as required.

3. Arms:
   a. 50 percent glass reinforced nylon or other non-metallic material.
   b. Size the arms based on the length and weight of the cable to be supported.
4. Stainless steel mounting hardware.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Anchor bolts:
   1. As specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Preformed Channel:
   1. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated racks unless otherwise indicated on the Drawings.
      a. Provide the necessary sway bracing to keep trapeze type structures from swaying under seismic events or wind loading.
   2. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:
      a. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the Engineer.
   3. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:
      a. Fabricate pedestals out of welded angle, tube sections, or preformed channel.

b. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.
c. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.

4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.
    1) Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.
5. Corrosion protection:
    a. Isolate dissimilar metals, except where required for electrical continuity.
        1) Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.
6. Raceway:
    a. Furnish all racks and trapeze structures needed to support the raceway from the structure.
        1) Group raceway and position on racks to minimize crossovers.
        2) Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.
7. Anchoring methods:
    a. Solid concrete: Anchor bolts, anchor rods or post-installed anchors as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
    b. Metal surfaces: Machine screws or bolts.
    c. Hollow masonry units: Post-installed anchors as specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
8. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.
9. Recoat or seal all drilled holes, cut or scratched surfaces or with products recommended by the manufacturer.

B. Non-metallic cable rack:
1. Install the non-metallic cable rack in accordance with the manufacturer's recommendations.
2. Provide at least 2 stanchions and 2 arms at each installation.
3. Mount the cable rack so that the supported cable does not interfere with access to manhole or handhole and so that the supported cable does not lie on the floor.
4. Do not exceed the cable manufacturer's minimum bending radius.
5. Use nylon cable ties to secure the cable to the supports.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_05_33

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Metallic conduits.
   2. Nonmetallic conduits.
   3. Conduit bodies.
   4. Conduit fittings and accessories.
   5. Conduit installation.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. American National Standards Institute (ANSI):
   1. C80.1 - Electrical Rigid Steel Conduit.
   2. C80.3 - Steel Electrical Metallic Tubing.
   3. C80.5 - Electrical Rigid Aluminum Conduit.
   4. C80.6 - Electrical Intermediate Metal Conduit.

C. National Electrical Manufacturer's Association (NEMA):
   1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Steel Conduit.
   2. TC2 - Electrical Polyvinyl Chloride (PVC) Conduit.
   3. TC3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   4. TC7 - Smooth-Wall Coilable Electrical Polyethylene Conduit.
   5. TC13 - Electrical Nonmetallic Tubing.
   6. TC14 - Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

D. Underwriters Laboratories (UL):
   1. 1 - Standard for Flexible Metal Conduit.
   2. 6 - Standard for Electrical Rigid Metal Conduit - Steel.
   3. 6A - Standard for Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel.
   4. 360 - Standard for Liquidtight Flexible Steel Conduit.
   5. 651 - Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
   6. 651B - Standard for Continuous Length HDPE Conduit.
   7. 797 - Standard for Electrical Metallic Tubing - Steel.
   8. 1203 –Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
   9. 1242 - Standard for Electrical Intermediate Metal Conduit - Steel.
   10. 1653 - Standard for Electrical Nonmetallic Tubing.

11. 1660 - Standard for Liquidtight Flexible Nonmetallic Conduit.
12. 1684 - Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to, Shapes C, E, LB, T, X, etc.
2. Conduit fitting: An accessory that primarily serves a mechanical purpose. Includes, but not limited to, bushings, locknuts, hubs, couplings, reducers, etc.
3. PCS: Polyvinyl chloride (PVC) coated rigid steel conduit.
4. PVC: Polyvinyl chloride rigid nonmetallic conduit.
5. SLT: Sealtight-liquidtight flexible conduit.
6. RAC: Rigid aluminum conduit.
7. FRD: Fiberglass-reinforced duct.
8. NPT: National pipe thread.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
1. Furnish complete manufacturer’s catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.
2. Furnish complete manufacturer’s recommended special tools to be used for installation if required.
3. Certified test results for PVC-coated metallic conduit showing the adhesive bond is stronger than the tensile strength of the PVC.

C. Shop drawings:
1. Furnish conduit routing plans for conduits before the installation of any conduit.
2. Detail the intended routing of each conduit, conduit material and include supporting methods.
3. Number conduits in accordance with the Contract Documents.
    a. Provide conduit labels as specified in Section 26_05_53 - Identification for Electrical Systems.

D. Certifications:
1. Furnish PVC-coated conduit manufacturer’s valid, unexpired certification for each installer.

E. Record Documents:
1. Incorporate all changes in conduit routing on electrical plan drawings.
2. Dimension underground and concealed conduits from building lines.
3. Furnish hard copy drawings.

F. Installation drawings: Installation drawings, including individual conduit numbers, routing, sizes, cable sizes, and circuit numbers for each conduit.

1.05 QUALITY ASSURANCE

A. All conduits, conduit bodies, and fittings shall be UL listed and labeled.

B. Every installer of PVC-coated metallic conduit shall be certified by the manufacturer for installation of the conduit, and be able to present a valid, unexpired installer certification card prior to installation beginning.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not expose non-metallic conduit to direct sunlight.

B. Do not store conduit in direct contact with the ground.

C. Do not store aluminum conduit in contact with concrete.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.08 SEQUENCING

A. Before installing any conduit or locating any device box:
   1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.
   2. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

B. Duct bank construction and direct buried conduit installation have a prerequisite of fulfilling all aspects of Section 01_14_00 – Work Restrictions.

C. Before performing any trenching, the following prerequisites must be met for each underground conduit routing:
   1. Review of existing civil record drawings for recorded underground utilities.
   2. Existing underground utility horizontal and vertical location by at least 1 of the following methods:
      a. Soft excavation.
      b. Local utility location service, CALL BEFORE YOU DIG or equal.
   3. Protection of any discovered existing underground utility shall remain intact until the nearby duct bank installation is complete.

1.09 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. PVC-coated rigid steel conduit:
   1. One of the following or equal:
      a. Robroy Ind.
      b. Ocal, Inc.
      c. Calbond.
      d. Allied.
      e. NEC, Inc. BlackGuard.

B. Rigid aluminum conduit:
   1. One of the following or equal:
      a. Allied Tube and Conduit.
      b. Patriot Aluminum Products.
      c. Republic Conduit.
      d. Wheatland Tube Co.

C. Sealtight-liquidtight flexible conduit:
   1. One of the following or equal:
      a. Southwire.
      b. AFC Cable Systems.
      c. Electri-Flex Co.
      d. Anaconda.

D. Rigid nonmetallic PVC conduit:
   1. One of the following or equal:
      a. Carlon.
      b. Cantex.
      c. Triangle Conduit and Cable.

E. Fiberglass reinforced duct:
   1. One of the following or equal:
      a. Champion Fiberglass.
      b. Smith Fiberglass.
      c. FRE Composites.

F. Conduit bodies:
   1. One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
      c. O-Z/Gedney.
      d. Ocal, Inc.
      e. Robroy Ind.
      f. Calbond.
      g. Carlon.

G. Joint compound:
   1. The following or equal:
      a. Thomas & Betts.

H. PVC-coated rigid steel conduit expansion fittings:
   1. One of the following or equal:
      a. Ocal, Inc.
      b. Robroy Ind.
      c. NEC, Inc. BlackGuard.

I. Aluminum conduit expansion fittings:
   1. One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
      c. O-Z/Gedney.

J. Conduit sleeve:
   1. One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
      c. O-Z/Gedney.

K. Conduit seals:
   1. One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
      c. O-Z/Gedney.

L. Conduit hangers and supports:
   1. As specified in Section 26_05_29 - Hangers and Supports.

M. Conduit through wall and floor seals:
   1. The following or equal:
      a. O-Z/Gedney:
         1) Type "WSK."
         2) Type “CSM.”

2.02 SYSTEM DESCRIPTION

A. Provide conduits, conduit bodies, fittings, junction boxes, and all necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

B. Provide location and protection of existing underground utilities, underground conduit trenching, conduit and backfill necessary for the complete installation of underground conduits.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. PCS:
   1. The steel conduit, before PVC coating, shall be new, unused, hot-dip galvanized material, conforming to the requirements for Type GRC.
   2. Coated conduit NEMA Standard RN-1:
      a. The galvanized coating may not be disturbed or reduced in thickness during the cleaning and preparatory process.
   3. Factory-bonded PVC jacket:
      a. The exterior galvanized surfaces shall be coated with primer before PVC coating to ensure a bond between the zinc substrate and the PVC coating.
      b. Nominal thickness of the exterior PVC coating shall be 0.040 inch except where part configuration or application of the piece dictates otherwise.
      c. PVC coating on conduits and associated fittings shall have no sags, blisters, lumps, or other surface defects and shall be free of holes and holidays.
      d. The PVC adhesive bond on conduits and fittings shall be greater than the tensile strength of the PVC plastic coating:
         1) Confirm bond with certified test results.
   4. A urethane coating shall be uniformly and consistently applied to the interior of all conduits and fittings:
      a. Nominal thickness of 0.002 inch.
      b. Conduits having areas with thin or no coating are not acceptable.
      c. All threads shall be coated with urethane.
   5. The PVC exterior and urethane interior coatings applied to the conduits shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).
   6. PCS conduit bodies and fittings:
      a. Malleable iron.
      b. The conduit body, before PVC coating, shall be new, unused material and shall conform to appropriate UL standards.
      c. The PVC coating on the outside of conduit bodies shall be 0.040-inch thick and have a series of ribs to protect the coating from tool damage during installation.
      d. 0.002-inch interior urethane coating.
      e. Utilize the PVC coating as an integral part of the gasket design.
      f. Stainless steel cover screw heads shall be encapsulated with plastic to ensure corrosion protection.
      g. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.
         1) The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.
         2) The sleeve shall provide a vapor- and moisture resistant seal at every connection.
         3) Fittings shall be Form 8 and supplied with plastic encapsulated stainless steel cover screws. Fittings shall be UL Type 4X. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty.

B. RAC:
   1. Material:
      a. Extruded from 6063 Alloy in Temper Designation T-1.
      b. Maximum 1/10-percent copper content.
      c. Containing lubricating inside liners.
   2. NPT standard threads with a 3/4-inch taper per foot:
      a. Running conduit threads are not acceptable.
   3. Provide aluminum fittings and conduit bodies.

C. SLT:
   1. Temperature rated for use in the ambient temperature at the installed location but not less than the following:
      a. General purpose:
         1) Temperature range: -20 degrees Celsius to +80 degrees Celsius.
      b. Oil-resistant:
         1) Temperature range: -20 degrees Celsius to +60 degrees Celsius.
   2. Sunlight-resistant, weatherproof, and watertight.
   3. Manufactured from single strip steel, hot-dip galvanized on all 4 sides before conduit fabrication.
   4. Strip steel spiral wound resulting in an interior that is smooth and clean for easy wire pulling.
   5. Overall PVC jacket.
   6. With integral copper ground wire, built in the core, in conduit trade sizes 1/2 inch through 1-1/4 inch.

D. PVC:
   1. Extruded from virgin PVC compound:
      a. Schedule 40 unless otherwise specified.
      b. Schedule 80 extra-heavy wall where specified.
   2. Rated for 90 degrees Celsius conductors or cable.
   3. Rated for use in direct sunlight.

E. FRD:
   1. Suitable for use at -40 degrees Celsius to 110 degrees Celsius.
   2. Integral bell and spigot either glued together or assembled with an integral urethane tri-seal gasket held in place with a retainer ring.
   3. For underground use only.
   4. Conduits and fittings shall be pigmented with UV-inhibiting carbon black.

F. Conduit bodies:
   1. Material consistent with conduit type:
      a. Cast aluminum bodies and covers when used with Type RAC.
      b. PVC-coated malleable iron bodies and covers when used with Type PCS.
   2. Conduit bodies to conform to Form 8, Mark 9, or Mogul design:
      a. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire-bending space.
   3. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.08 ACCESSORIES

A. Connectors and fittings:
   1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat metallic bushings:
   1. Construction:
      a. Malleable iron or zinc-plated steel when used with steel conduit.
      b. Aluminum when used with aluminum conduit.
      c. Positive metallic conduit end stop.
      d. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
      e. Use fully insulated bushings on nonmetallic conduit system made of high-impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

C. Insulated grounding bushings:
   1. Construction:
      a. Malleable iron or steel, zinc-plated, with a positive metallic end stop.
      b. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
      c. Tin-plated copper grounding saddle for use with copper or aluminum conductors.

D. Electrical unions (Erickson Couplings):
   1. Construction:
      a. Malleable iron for use with steel conduit.
      b. Aluminum for use with aluminum conduit.
      c. PVC-coated malleable iron for use with PCS conduit.
      d. Concrete tight, 3-piece construction.
      e. Rated for Class I Division 1 Group D in hazardous areas.

E. SLT fittings:
   1. Construction:
      a. Malleable iron.
      b. Furnished with locknut and sealing ring.
      c. Liquidtight, raintight, oiltight.
      d. Insulated throat.
      e. Furnish as straight, 45-degree elbows, and 90-degree elbows.
      f. Designed to prevent sleeving:
         1) Verify complete bonding of the raceway jacket to the plastic gasket seal.
      g. Equipped with grounding device to provide ground continuity irrespective of raceway core construction. Grounding device, if inserted into raceway and directly in contact with conductors, shall have rolled-over edges for sizes under 5 inches.
      h. Where terminated into a threadless opening using a threaded hub fitting, a suitable moisture-resistant/oil-resistant synthetic rubber gasket shall be provided between the outside of the box or enclosure and the fitting shoulder. Gasket shall be adequately protected by and permanently bonded to a metallic retainer.

2. Corrosion-resistant and outdoor SLT fittings:
    a. Construction:
        1) PVC-coated liquidtight fittings with a bonded 0.040-inch thick PVC coating on the metal connector to form a seal around the SLT conduit.
        2) Insulated throat and an integral sealing ring.

F. Hubs for threaded attachment of steel conduit to sheet metal enclosures:
    1. Construction:
        a. Insulated throat.
        b. PVC-coated when used in corrosive areas.
        c. Bonding locknut.
        d. Recessed neoprene o-ring to ensure watertight and dusttight connector.
        e. 1/2-inch through 1-1/4-inch steel zinc electroplated.
        f. 1-1/2-inch through 6-inch malleable iron zinc plated.
        g. Aluminum with aluminum conduit.
    2. Usage:
        a. All conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

G. Sealing fittings:
    1. Construction:
        a. 40-percent wire fill capacity.
        b. PVC-coated when used in corrosive areas.
        c. Malleable ductile iron with steel conduit.
        d. Aluminum with aluminum conduit.
        e. Type EYDX where drains are required.
        f. Type EYSX where drains are not required.
        g. UL 1203 listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; and Class II, Divisions 1 and 2, Groups E, F, and G.
    2. Sealing compound:
        a. Fiber filler and cement as recommended by the sealing fitting manufacturer.
        b. Approved for the conditions and use.
            1) Not affected by surrounding atmosphere or liquids.
        c. Melting point shall be 200 degrees Fahrenheit minimum.

H. PVC fittings:
    1. Materials:
        a. All devices shall be made of PVC, using the same materials as used for Type PVC conduit.
        b. All metal hardware shall be stainless steel.

I. Through wall and floor seals:
    1. Materials:
        a. Body: Aluminum.
        a. Grommet: Neoprene.
        b. Pressure rings: PVC-coated steel.
        c. Disc material: PVC-coated steel.

J. Expansion/deflection couplings:
   1. Use to compensate for movement in any directions between 2 conduit ends where they connect.
   2. Shall allow movement of 3/4 inch from the normal in all directions.
   3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
   4. Constructed to maintain electrical continuity of the conduit system.
   5. Materials:
      a. End couplings: Bronze or galvanized ductile iron.
      b. Sleeve: Neoprene.
      c. Bands: Stainless steel.
      d. Bonding jumper: Tinned copper braid.

K. Expansion couplings:
   1. Shall allow for expansion and contraction of conduit:
      a. Permitting 8-inch movement, 4 inches in either direction.
   2. Constructed to maintain electrical continuity of the conduit system.
   3. Materials:
      a. Head: Malleable or ductile iron .
      b. Sleeve: Steel.
      c. Insulating bushing: Phenolic.
      d. Finish: Hot-dip galvanized.
      e. Aluminum when used with Type RAC.
      f. PVC-coated steel when used with Type PCS.

L. Conduit markers:
   1. As specified in Section 26_05_53 - Identification for Electrical Systems.

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
   1. Conduit routing:
      a. The electrical drawings are diagrammatic in nature:
         1) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.

2) Modify conduit runs to suit field conditions, as accepted by the Engineer:
    a) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.
    b) Make changes in conduit routing due to the relocation of equipment.
    c) Install conduits and equipment in such a manner as to avoid obstructions and to preserve headroom and keep openings and passageways clear.
3) Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.
4) The electrical drawings do not indicate all required junction boxes and pull boxes:
    a) Provide junction boxes and pull boxes to facilitate wire pulling as required:
        (1) To meet cable manufacturer's pulling tension requirements.
        (2) To limit total conduit bends between pull locations.
    b) Install junction boxes and pull boxes at locations acceptable to the Engineer.

b. The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:
    1) The Engineer is the sole source in determining whether the change is constituted as a deviation:
    2) Perform any changes resulting in additional conduits, or extra work from such deviations.
    3) Incorporate any deviations on the Record Documents.
c. Owner reserves the right to deduct the amount of applicable reimbursement, equivalent to the cost of the engineering effort required to show those unauthorized changes on Record/As-Built Drawings.

2. Use only tools recommended by the conduit manufacturer for assembling the conduit system.
3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:
    a. Clearance of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.
    b. Clearance of 12 inches from surfaces greater than 149 degrees Fahrenheit.
    c. Keep conduits at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings, and 12 inches from fuel lines and gas lines.
    d. Where it is necessary to route conduits close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.
4. Support conduit runs on water-bearing walls a minimum of 7/8-inch away from wall on an accepted preformed channel:
    a. Do not run conduits within water-bearing walls unless otherwise indicated on the Drawings.
5. Do not install 1-inch or larger conduits in or through structural members unless approved by the Engineer.

6. Run conduits exposed to view parallel with or at right angles to structural members, walls, or lines of the building:
    a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.
    b. Make changes in direction with long radius bends or with conduit bodies.
7. Install conduits with total conduit bends between pull locations less than or equal to 270 degrees.
8. Route all exposed conduits to preserve headroom, access space and work space, and to prevent tripping hazards and clearance problems:
    a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment-removal hatches.
    b. Route conduits to avoid drains or other gravity lines. Where conflicts occur, relocate the conduit as required.
9. When installing conduits through existing slabs or walls, make provisions for locating any possible conflicting items where the conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into the existing conduits, piping, cables, post-tensioning cables, etc.
10. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture.
11. Install conduits through wall and floor seals where indicated on the Drawings.
12. For existing and new 2-inch and larger conduit runs, snake conduits with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of the conduit:
    a. Remove and replace conduits through which mandrel will not pass.
13. Provide all sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.
14. Install complete conduit systems before conductors are installed.
15. Provide metallic conduits terminating in transformer, switchgear, motor control center, or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.
16. Underground conduits:
    a. Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:
        1) As specified in Section 26_05_44 - Duct Banks.
    b. Make underground conduit size transitions at handholes and manholes.
    c. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and handholes.
    d. Seal around conduit penetrations of below grade walls with a mechanical seal.
17. Underground conduit trenching:
    a. Perform trenching as specified in Section 31_23_35 - Trenching.
    b. Trench must be uniformly graded with the bottom, rock free and covered with select material.
    c. Damage occurring to existing ducts, conduits, cables, and other utilities during underground conduit installation shall be remediated to the satisfaction of the Owner.
    d. Whenever possible, use the walls of the trench as forms for concrete encasement:
        1) Forms are required where the soil is not self-supporting.

B. Equipment grounding conductors:
   1. Provide a separate, green insulated, grounding conductor in each raceway independent of raceway material:
      a. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.
      b. Provide a separate grounding conductor in each individual raceway for parallel feeders.
   2. Conductors shall be the same type and insulation as the circuit conductors:
      a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.
   3. Minimum size in accordance with the NEC.

C. Lighting and receptacle conduits:
   1. Provide conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:
   2. Install conduits in accordance with the requirements of this Section unless otherwise indicated.
   3. Minimum conduit size:
      a. 3/4-inch for exposed conduits.
      b. 1-inch for underground or in-slab conduits.
   4. Provide conduit materials for the installed location as specified in Section 26_05_00 - Common Work Results for Electrical.

D. Conduit usage:
   1. Exposed conduits:
      a. Rigid conduit:
         1) Install the rigid conduit type for each location as specified in Section 26_05_00 - Common Work Results for Electrical.
         2) Minimum size: 3/4-inch.
      b. Flexible conduit:
         1) Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment, or where required for equipment servicing:
            a) Use Type SLT with rigid metallic conduit.
         2) Minimum size: 3/4-inch:
            a) 1/2 when required for connection to instruments.
         3) Maximum length:
            a) Fixed equipment:

Conduit Trade Size	Flexible Conduit Length (inch)
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

b) Removable instruments or hinged equipment:
(1) As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete-encased and embedded conduits:
   a. Straight runs and bends less than 45 degrees:
      1) Type PVC Schedule 40.
   b. Bends with total deflection greater than 45 degrees;
      1) PCS or FRD.
   c. Entering and exiting duct bank, underground or embedded conduit runs a minimum 12 inches above and below grade, finished floor, or entering equipment:
      1) PCS.
   d. Minimum size:
      1) 2-inch in duct banks.
      2) 1-inch for in-slab conduits.
      3) Provide conduit fittings to enlarge the conduit from the exposed size in the conduit schedule as required.
3. PVC-coated rigid metallic conduit:
   a. Use specifically manufactured or machined threading dies to manufacturer's specifications to accommodate the PVC jacket.
   b. Repair damage to PVC coatings with manufacturer supplied touchup compound or PVC Coating Repair Kit for PVC Coated Raceway Systems.
4. RAC:
   a. Do not use aluminum conduit below grade, cast in concrete, or on concrete or masonry in contact with earth.
   b. When installing RAC on concrete surfaces, mount the RAC on the channel so that only the channel is in contact with the concrete.
   c. When penetrating concrete walls and/or floors, use O-Z/Gedney rubber-gasketed through wall and floor seals so that the aluminum conduit is completely isolated from the concrete by the rubber seal material.

E. Conduit joints and bends:
1. General:
   a. Where conduit is underground, under slabs on grade, exposed to the weather, or in NEMA Type 4 or NEMA Type 4X locations, make joints liquidtight.
   b. Keep bends and offsets in conduit runs to an absolute minimum.
   c. All bends shall be symmetrical.
   d. The following conduit systems shall use large-radius sweep elbows:
      1) Underground conduits.
   e. Provide large-radius factory-made bends for 1-1/4-inch trade size or larger.
   f. Make field bends with a radius of not less than the requirements found in the NEC:
      1) The minimum bending radius of the cable must be less than the radius of the conduit bend.
      2) Make all field bends with power bending equipment or manual benders specifically intended for the purpose:
         a) Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.
         b) For the serving utilities, make bends to meet their requirements.
   g. Replace all deformed, flattened, or kinked conduit.

2. Threaded conduit:
    a. Cut threads on rigid metallic conduit with a standard conduit-cutting die that provides a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench-tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.
    b. Thoroughly ream conduit after threads have been cut to remove burrs.
    c. Use bushings or conduit fittings at conduit terminations.
    d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing "Galvabar™," or CRC "Zinc It."
    e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:
        1) Apply to the male threads and tighten joints securely.
        2) Clean excess sealant from exposed threads after assembly.
    f. Securely tighten all threaded connections.
    g. Any exposed threaded surfaces must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.
3. PVC:
    a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray-type cement is not allowed.
    b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to ensure full inside diameter at all bends:
        1) Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

F. Conduit sealing and drainage:
1. Conduit drainage and sealing other than required for hazardous and classified areas:
    a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above-grade conduit runs at the points at which the conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.
    b. Provide seal fittings with drains in vertical drops directly above grade for exterior and above-grade conduit runs that are extended below grade.
    c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:
        1) Where portions of an interior raceway pass through walls, ceilings, or floors that separate adjacent areas having widely different temperatures.
    d. Provide conduit seals similar to O-Z/Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.
    e. Seal one end only of all underground conduits at highest point with O-Z/Gedney sealing (non-hazardous) filling, or equal.
2. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of the conduit.

G. Conduit supports:
   1. General:
      a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:
         1) As specified in Section 26_05_29 - Hangers and Supports.
         2) Provide support materials consistent with the type of conduit being installed as specified in Section 26_05_00 - Common Work Results for Electrical.
      b. Support conduit at the intervals required by the NEC.
      c. Perforated strap and plumbers tape are not acceptable for conduit supports.
   2. Conduit on concrete or masonry:
      a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.
      b. Use preset inserts in concrete when possible.
      c. Use pipe spacers (clamp backs) in wet locations.
   3. Conduit on metal decking:
      a. Use 1-hole malleable iron straps with 1-inch long cadmium-plated Type A panhead sheet-metal screws. Fully or partially hammer-driven screws are not acceptable.
   4. Suspended conduit:
      a. Use malleable-iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.
      b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2-feet long, provide rigid sway bracing.
   5. Supports at structural steel members:
      a. Use beam clamps.
      b. Drilling or welding may be used only as specified or with approval of the Engineer.
   6. PVC-coated rigid metal systems:
      a. Provide right-angle beam clamps and “U” bolts specially formed and sized to snugly fit the outside diameter of the coated conduit. Provide "U" bolts with PVC-encapsulated nuts that cover the exposed portions of the threads.
      b. Securely fasten exposed conduits with Type 316 stainless steel clamps or straps.

H. Expansion or expansion/deflection fittings:
   1. General:
      a. Align expansion coupling with the conduit run to prevent binding.
      b. Follow manufacturer’s instructions to set the piston opening.
      c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.
      d. Furnish fittings of the same material as the conduit system.
   2. For metallic conduit, provide expansion or expansion/deflection couplings, as appropriate, where:
      a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.

I. Empty conduits:
   1. Provide a pull tape in each empty conduit more than 10 feet in length.
   2. Seal ends of all conduits with approved, manufactured conduit seals, caps, or plugs immediately after installation:
      a. Keep ends sealed until immediately before pulling conductors.

J. Miscellaneous:
   1. Seal roof penetrations for raceways and other items that penetrate the roof in accordance with roofing manufacturer's instructions and as indicated on the Drawings.
   2. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:
      a. Running threads and threadless couplings are not allowed.
   3. Replace any conduits installed that the Engineer determines do not meet the requirements of this Specification.
   4. Provide conduit housekeeping curb around all embedded or below-grade conduits exiting or entering the slab, per the Typical Details.

3.04 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

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SECTION 26_05_34

BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Device boxes.
   2. Raceway system boxes.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

C. ASTM International (ASTM):
   1. A47 - Standard Specification for Ferritic Malleable Iron Castings.
   2. D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
   3. D495 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
   4. D570 - Standard Test Method for Water Absorption of Plastics.
   5. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   7. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

D. Joint Industry Conference (JIC).

E. Underwriters Laboratories, Inc. (UL):
   1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Specific definitions:
   1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
   2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 SYSTEM DESCRIPTION

A. Provide outlet boxes for wiring devices, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes as indicated on the Drawings or as needed to complete the raceway installation.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. Manufacturer.
   2. Materials.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
      e. NEMA rating.
   4. Conduit entry locations.
   5. Catalog cutsheets.
   6. Installation instructions.

C. Shop drawings:
   1. Include identification and sizes of pullboxes.

1.06 QUALITY ASSURANCE

A. Regulatory requirements:
   1. Outlet boxes shall comply with all applicable standards of:
      a. JIC.
      b. NEC.
      c. NEMA.
      d. UL.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Formed steel enclosures:
      a. Hoffman.
      b. Thomas and Betts.
      c. Stahlin.
      d. Rittal.
   2. Stainless steel enclosures:
      a. Hoffman.
      b. Stahlin.
      c. Rittal.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Formed steel enclosures:
   1. Steel:
      a. NEMA Type 12.
      b. Fabricated from 14-gauge steel, minimum.
      c. All seams continuously welded ground smooth.
      d. Door:
         1) Rolled lip around 3 sides.
         2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
      e. Neoprene door gasket to provide a watertight, dusttight, oiltight seal:
         1) Attached with an adhesive.
         2) Retained by a retaining strip.
      f. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel:
         1) With a hasp and staple for padlocking.
      g. Provide large enclosures with door and body stiffeners for extra rigidity.
      h. No holes or knockouts.
      i. Finish:
         1) ANSI-61 gray electrostatically applied polyester powder inside and out over cleaned and primed surfaces.
         2) White electrostatically applied polyester powder mounting plate.
      j. Heavy gauge steel external mounting brackets when surface mounted.

2. Stainless steel:
    a. NEMA Type 4X:
        1) Boxes in locations subject to flooding or temporary submersion:
            a) NEMA Type 6.
    b. Fabricated from 14-gauge Type 316 stainless steel.
    c. All seams continuously welded.
    d. Door:
        1) Rolled lip around 3 sides.
        2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
    e. Neoprene door gasket to provide a watertight seal:
        1) Attached with an adhesive.
        2) Retained by a retaining strip.
    f. Fabricate all external removable hardware for clamping the door to the enclosure body from heavy gauge stainless steel:
        1) With a hasp and staple for padlocking.
    g. Provide large enclosures with door and body stiffeners for extra rigidity.
    h. No holes or knockouts.
    i. Finish:
        1) Brushed.
    j. Stainless steel external mounting brackets when surface mounted.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Fasteners:
    1. Electroplated or stainless steel in boxes with wiring devices.
    2. Screws, nuts, bolts, and other threaded fasteners:
        a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:
    1. Provide internal panels where required for mounting of terminal strips or other equipment.
    2. With plated steel shoulder studs.
    3. Steel with white polyester powder finish.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
   1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 26_05_00 - Common Work Results for Electrical.
   2. Provide outlet box materials to match the conduit system:
      a. RAC - Aluminum (copper free) boxes.
      b. PCS - PVC coated cast ferrous boxes.
   3. Solid type gang boxes:
      a. For more than 2 wiring devices.
      b. For barriered outlets.
   4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:
      a. Use machined spacers to maintain air space; built-up washers are not acceptable.
      b. Use stainless steel or nylon materials for spacers.
   5. Boxes serving luminaires or wiring devices:
      a. Use as pullboxes wherever possible.
   6. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 10 percent spare terminals:
      a. Furnish wireways for discrete and analog/DC wiring.
      b. Separate analog wiring from 120 V discrete or power wiring.
   7. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.
   8. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

B. Outlet boxes:
   1. Locate outlet boxes as indicated on the Drawings:
      a. Adjust locations so as not to conflict with structural requirements or other trades.
   2. Use deep threaded-hub malleable iron or aluminum boxes:
      a. In hazardous areas.
      b. Where exposed to the weather.
      c. In unheated areas.
      d. Where subject to mechanical damage:
         1) Defined as exposed boxes less than 10 feet above the floor.
      e. To act as a pullbox for conductors in a conduit system.
      f. Accommodate wiring devices.
   3. Use deep threaded-hub plastic coated malleable iron or aluminum boxes in corrosive and NEMA Type 4X area and when the exposed conduit system is PVC coated aluminum.
   4. Outlet boxes may be used as junction boxes wherever possible.

C. Pullboxes and junction boxes:
   1. Size pullboxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.
   2. Install pullboxes such that access to them is not restricted.

D. For boxes not indicated:
   1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in Section 26_05_00 - Common Work Results for Electrical.
   2. Outlet, switch, and junction boxes where surface mounted in exposed locations:
      a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.
   3. Outlet, control station, and junction boxes for installation in corrosive locations:
      a. Fiberglass reinforced polyester, stainless steel, or plastic-coated steel to match the conduit system.
      b. Furnished with mounting lugs.
   4. Fire rated construction: Use materials and methods to comply with the listing requirements for the classified construction.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_05_44

DUCT BANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Electrical underground duct banks.
   2. Duct bank installation requirements.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Provide location and protection of existing underground utilities, duct bank, trenching, forming, rebar, spacers, conduit, concrete, backfill, and compaction necessary for the complete installation of the duct banks.

B. Provide reinforced concrete duct banks for all conduits installed below grade, on the site, below structures, or in contact with the earth, unless otherwise indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. PVC conduit spacers.
   2. Detectable underground marking tape.
   3. Pull line.

C. Shop drawings:
   1. Submit site plan drawings of duct banks including underground profiles indicating all underground utilities.
   2. Submit cross section of each duct bank with dimensions.
   3. For duct bank routings crossing under building footers or foundations alternative to designed routings indicated on the Drawings:
      a. Submit shop drawings detailing the new building footer crossing locations and plan drawings labeling all equipment to be installed on top of the new routing for approval by the project Structural Engineer.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

B. Duct bank sections indicated on the Drawings are an initial arrangement and may need to be modified due to existing site conditions, existing underground utilities, and infrastructure.
   1. Reorganize duct bank section with approval of Engineer.

C. Field conditions and related requirements:
   1. Underground water table may be near or above the location of new duct banks.
   2. Include cost for necessary dewatering, and cleaning equipment to perform work in underground duct banks, pullboxes and manholes, before installation.

1.09 SCHEDULING

A. Schedule a coordination meeting to adjust duct bank configurations and routing for each duct bank section after trenching and exposure of any underground utilities withing the vicinity of the duct bank route. The meeting shall determine the final configuration of the duct bank before installation.

1.10 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Conduit spacers:
   1. One of the following or equal:
      a. Carlon Snap-Loc.
      b. Cantex.
      c. Osburn Associates, Inc.

B. Detectable underground marking tape:
   1. One of the following or equal:
      a. Blackburn Manufacturing Co.
      b. Pro-Line Safety Products.
      c. Panduit.

C. Pull line:
   1. One of the following or equal:
      a. Arnco.
      b. Greenlee.
      c. Osburn Associates, Inc.

D. Duct seal:
   1. The following or equal:
      a. O-Z/Gedney type DUX.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Provide conduit as specified in Section 26_05_33 - Conduits.

B. Provide reinforcing steel as specified in Section 03_20_00 - Concrete Reinforcing:
   1. Provide minimum Number 4 reinforcing steel.

2.04 MANUFACTURED UNITS

A. Conduit spacers:
   1. Provide conduit spacers recommended by the conduit manufacturer or specified above.
   2. Saddle type.
   3. Non-metallic, non-corrosive, non-conductive.
   4. Interlocking type:
      a. Vertical interlocking.
      b. Horizontal interlocking.
   5. Suitable for concrete encasement.
   6. Molded-in rebar holder.
   7. Accommodates 2-inch through 6-inch conduit sizes.
   8. Relieves the conduit from both horizontal and vertical stresses.

B. Pull line:
   1. Minimum 1/4-inch wide, flat design.
   2. Polyester.
   3. Minimum pulling strength 1,200 pounds.

C. Detectable marking tape:
   1. Provide a detectable tape, locatable by a cable or metal detector from above the undisturbed grade.
   2. Aluminum core laminated between polyethylene film.
   3. 6-inch wide red tape imprinted with black lettering stating "CAUTION - BURIED ELECTRIC LINE BELOW" or equivalent.

D. Duct seal:
   1. Non-hardening sealing compound.
   2. Flexible, can be applied by hand.
   3. UL Listed for use with installed conductors.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES

A. Concrete mix requirements as specified in Section 03_30_01 – Concrete Work.

B. Provide a red-oxide conduit encasement coloring agent as specified in Section 03_30_01 – Concrete Work.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Duct banks:
   1. Install duct banks encased in concrete at least 24 inches below finish grade, unless otherwise indicated on the Drawings.
   2. Damage minimization:
      a. Conduit should not be left exposed in an open trench longer than is necessary.
      b. Protect all underground duct banks against damage during pouring of concrete or backfilling.
   3. All plastic conduit fittings to be joined should be exposed to the same temperature conditions for a reasonable length of time before assembly.
   4. Provide No. 4/0 American Wire Gauge bare copper ground wire the entire length of duct bank and bond to the grounding system at each end of the duct bank and every 20 feet to steel reinforcing bar.
   5. Install underground ducts to be self-draining:
      a. Slope duct banks away from buildings to manholes, handholes, or pullboxes.
      b. Slope duct banks uniformly from manholes, handholes, or pullboxes to manholes, handholes, or pullboxes or both ways from high points between manholes, handholes, or pullboxes.
      c. Slope a minimum of 1/4 inch per 10 feet.

6. Where new duct banks join to existing manholes, handholes, or pullboxes, make the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions, as indicated on the Drawings.
7. Install pull line in spare conduits:
    a. Provide adequate pull line at both ends of conduits to facilitate conductor pulling.
    b. Cap above ground spare conduit risers at each end with screw-on conduit caps.

B. Trenching:
1. Perform trenching as specified in Section 31_23_35 - Trenching.
2. Trench must be uniformly graded with the bottom, rock free and covered with native soil.
3. Whenever possible, use the walls of the trench as forms for concrete encasement:
    a. Forms are required where the soil is not self-supporting.
4. Damage occurring to existing ducts, conduits, cables, and other utilities during duct bank installation shall be remediated to the satisfaction of the Owner.

C. Duct spacing:
1. Separate conduits with manufactured plastic spacers using a minimum space between the outside surfaces of adjacent conduits of 2 inches, unless otherwise indicated on the Drawings:
    a. Separate medium voltage ducts a minimum of 7.5 inches on center.
2. Install spacers to maintain uniform spacing of duct assembly a minimum of 4 inches above the bottom of the trench during concrete pour. Install spacers on 8-foot maximum intervals:
    a. Due to some distortion of conduit from heat, and other means, it may be necessary to install extra spacers within the duct bank:
        1) Install the intermediate set of spacers within normal required spacing to maintain the proper horizontal clearance:
            a) Clearance is required to allow the proper amount of concrete to infiltrate vertically among the duct to ensure proper protection.
3. Spacers shall not be located at the center of a bend:
    a. Locate spacer in the tangent, free of the coupling on fabricated bends.
    b. Locate spacers midway between the tangent and the center bend on trench formed sweeps.

D. Terminating:
1. Use bell ends in duct at entrances into cable vaults.
2. Make conduit entrances into cable vaults tangential to walls of cable vault.
3. Form trapezoidal transitions between duct bank and cable vaults as needed in order to ensure adequate cable bending radius for the duct bank-to-vault transition.
4. Install duct seal in all conduits including spare conduits, at , building/equipment stub-ups. Form by hand to conduit and around cables to develop moisture barrier.
5. New manhole or handhole applications, provide a single opening or "window" per duct bank, sized to accommodate the duct bank envelope.

E. Concrete:
   1. Install concrete as specified in Section 03_30_01 – Concrete Work.
   2. Provide tie wires in accordance with Section 03_20_00 - Concrete Reinforcing to prevent displacement of the conduits during pouring of concrete:
      a. Tie wire shall not act as a substitute for spacers.
   3. Install minimum 3-inch cover around conduit and rebar.
   4. Consolidation of encasement concrete around duct banks shall be by hand puddling. Mechanical vibrators are acceptable for use outside of the rebar cage.
   5. Conduit is subject to temperature rise. As concrete cures, allow the free end to expand by pouring the concrete from the center of the run or from one tie in point.

F. Marking tape:
   1. Install a detectable marking tape 12 inches above the duct bank the entire length of the duct bank.

G. Restore all surfaces to their original condition as specified in Section 32_01_15 - Pavement Restoration and Rehabilitation, unless otherwise specified.

H. Marking piers:
   1. Provide permanent concrete cylinder marking piers, on grade, centered on duct bank and located at every bend in duct bank or wherever duct bank enters a building, vault, or other structure:
      a. Provide a cylinder, 6 inches in diameter:
         1) Top of cylinder 1/2 inch below the top of finished grade.
      b. Provide a 3-inch high "E" embossed in top of cylinder:
         1) Minimum of 2 inches deep.
      c. Provide 2-inch arrows embossed in top of cylinder showing the direction of the duct bank:
         1) Minimum of 2 inches deep.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. Clean conduits of dirt and debris by use of an appropriately sized steel mandrel no less than 1/2 inch smaller than the inside diameter of the conduit.

3.11 PROTECTION

A. Provide shoring and pumping to protect the excavation and safety of workers.

B. Protect excavations with barricades as required by applicable safety regulations.

3.12 SCHEDULES (NOT USED)

END OF SECTION

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SECTION 26_05_53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Identification of electrical equipment, devices and components.
   2. Material, manufacturing and installation requirements for identification devices.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

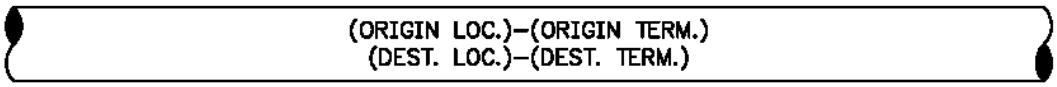
1.04 SYSTEM DESCRIPTION

A. Nameplates:
   1. Provide a nameplate for each piece of electrical equipment and devices, control panel and control panel components.
   2. Provide all nameplates of identical style, color, and material throughout the facility.
   3. Device nameplates information:
      a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.

B. Wire numbers:
   1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:
      a. Wire numbers shall correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.
      b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.
      c. Internal panel wires on a common terminal shall have the same wire number.
      d. Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations beneath freestanding equipment. All multi-conductor and instrumentation cables shall be identified at pull points as described above:
         1) Label armored multi-conductor cable using the conduit number as indicated on the Drawings, following the requirements for conduit markers in Section 26_05_33 - Conduits.

2. Provide the following wiring numbering schemes throughout the project for field wires between process control module, (PCM), vendor control panels, (VCP), motor control centers, (MCC), field starters, field instruments, etc.

OR



Where:

ORIGIN LOC .= Designation for originating panel or device
ORIGIN TERM. = Terminal designation at originating panel or device
DEST. LOC. = Designation for destination panel or device
DEST. TERM. = Terminal designation at destination panel or device or PLC I/O address at destination panel:

a. Identify equipment and field instruments as the origin.
b. PCMs are always identified as the destination.
c. Location is the panel designation for VCP, LCP, or PCM. For connections to MCCs, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.
d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multi-conductor cables, all terminal numbers shall be shown, separated by commas.
e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (e.g. T1, T2, T3, etc.).
f. Terminal designations at PCMs where the field conductor connects to field terminal blocks for a PLC input or output shall be the PLC address (Note: the following PLC I/O numbering scheme is typical for Allen-Bradley, the numbering scheme should be modified to match that of the actual PLC manufacturer used for the project):
    1) Discrete Point: W:X:Y/Z.
       Analog Point: W:X:Y.Z.
       Where:
       W= I for input, O for output
       X= PLC number (1, 2, 3…)
       Y= Slot number (01, 02, 03…)
       Z= Terminal number (00, 01, 02…) for a discrete point or a word number for an analog point (1, 2, 3…)
g. Terminal designations at PCMs where the conductor does not connect to a PLC I/O point shall be the terminal number with a "C" prefix (e.g. C0010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with "A" (e.g. C0010A).

3. **Case 1**: Vendor control panel (VCP) to process control module (PCM):
   Field wire number/label: A-B/C-D
   A = Vendor control panel number without hyphen (VCP#)
   B = Terminal number within VCP (manufacturer's or vendor's standard terminal number)
   C = Process control module number without hyphen (PCM#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)

   Examples: VCP#-10/PCM#-I: 1:01/01
   VCP#-10/PCM#-O: 1:10/07
   VCP#-10/PCM#-C0100

4. **Case 2**: Field instrument to process control module (PCM):
   Field wire number/label: E-F/C-D
   C = Process control module number without hyphen (PCM#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
   E = Field mounted instrument tag and loop numbers without hyphen (EDV#)
   F = Manufacturer's standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma

   Examples: TIT#-2,3/PCM#-I: 1:01.1
   TSH#-1/PCM#-I: 2:01/00

5. **Case 3**: Motor control center (MCC) to process control module (PCM):
   Field wire number/label: G-B/C-D
   B =Terminal number within Motor Control Center (manufacturer's or vendor's standard terminal number)
   C = Process control module without hyphen (PCM#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
   G = Actual starter designation in the motor control center without hyphen (MMS#)

   Examples: MMS#-10/PCM#-I: 1:01/01
   MMS#-10/PCM#-O: 1:10/07
   MMS#-10/PCM#-C0100

6. **Case 4**: Motor control center (MCC) to vendor control panel (VCP):
   Field wire number/label: G-B/A-B
   A = Vendor control panel number without hyphen (VCP#)
   B = Terminal number within motor control center or vendor control panel (manufacturer's or vendors standard terminal number)
   G = Actual starter designation in the motor control center without hyphen (MMS#)

   Example: MMS#-X2/VCP#-10

7. **Case 5**: Motor leads to a motor control center (MCC):
   Field wire number/label: H-I/G-B
   B = Terminal number within motor control center (manufacturer's standard terminal number)
   G = Actual starter designation in the motor control center without hyphen (MMS#)
   H = Equipment tag and loop number without hyphen (PMP#)
   I = Motor manufacturer's standard motor lead identification (e.g. T1, T2, T3, etc.)

   Example: PMP-#-T3/MMS#-T3

8. **Case 6**: Remote or separately mounted starter or variable frequency drive (VFD) to process control module (PCM):
   Field wire number/label: J-B/C-D
   B = Terminal number within starter or variable frequency drive (manufacturer's standard terminal number)
   C = Process control module number without hyphen (VCP#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
   J = Starter or variable frequency drive tag and loop number without hyphen (MMS#)

   Examples: MMS#-10/PCM#-I: 1:01/01
   MMS#-10/PCM#-O: 2: 10/07
   MMS#-10/PCM#-C0010

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. Nameplates:
      a. Color.
      b. Size:
         1) Outside dimensions.
         2) Lettering.
      c. Material.
      d. Mounting means.
   2. Nameplate schedule:
      a. Show exact wording for each nameplate.
      b. Include nameplate and letter sizes.
   3. Wire numbers:
      a. Manufacturer's catalog data for wire labels and label printer.

C. Record documents:
   1. Update the conduit schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nameplates and signs:
   1. One of the following or equal:
      a. Brady.
      b. Seton.

B. Conductor and cable markers:
   1. Heat-shrinkable tubing:
      a. One of the following or equal:
         1) Raychem.
         2) Brady.
         3) Thomas & Betts.
         4) Kroy.
         5) Panduit.

C. Conduit and raceway markers:
   1. Stainless steel, one of the following or equal:
      a. Panduit.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Nameplates:
   1. Colors:
      a. Warning nameplates: White-center, red face.
      b. Other nameplates: Black-center, white face.
   2. Laminated plastic engraving stock:
      a. 3/32-inch thick material.

b. 2-ply.
3. With chamfered edges.
4. Lettering:
    a. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:
    b. Minimum letter height: 1/8-inch.

B. Signs:
1. Automatic equipment and high voltage signs:
    a. Suitable for exterior use.
    b. In accordance with OSHA regulations.

C. Conductor and cable markers:
1. Lettering:
    a. Machine printed black characters on white tubing.
    b. Minimum letter height: 10 point type or larger.

D. Conduit and raceway markers:
1. Stainless steel:
    a. Type 304 or 316.
    b. Minimum letter height: 3/16-inch.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Nameplates:
1. Provide all nameplates for control panel operator devices (e.g. pushbuttons, selector switches, pilot lights, etc.):
    a. Same material and same color and appearance as the device nameplates, in order to achieve an aesthetically consistent and coordinated system.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Nameplates:
   1. Attach nameplates to equipment with rivets, bolts or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
   2. Provide a nameplate for each disconnecting means with the following:
      a. Equipment served, voltage, and fuse size as required.
      b. Identification of the circuit source that supplies the disconnecting means.
   3. On NEMA Type 4, NEMA Type 4X, or NEMA Type 7 enclosures, use epoxy-based cement to attach nameplates.
   4. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:
      a. Misaligned or crooked nameplates shall be remounted or provide new enclosures at the discretion of the Engineer.

B. Conductor and cable markers:
   1. Apply all conductor and cable markers before termination.
   2. Heat-shrinkable tubing:
      a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.
      b. Tubing shall be tight on the wire after it has been heated.
      c. Characters shall face the open panel and shall read from left to right or top to bottom.
      d. Marker shall start within 1/32 inch of the end of the stripped insulation point.

C. Conduit markers:
   1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
      a. Conduit markings shall match the conduit schedule.
   2. Mark conduits at the following locations:
      a. Each end of conduits that are greater than 10 feet in length.
      b. The middle of conduits that are 10 feet or less in length.
      c. Where the conduit penetrates a wall or structure.
      d. Where the conduit emerges from the ground, slab, etc.
   3. Mark conduits after the conduits have been fully painted.
   4. Position conduit markers so that they are easily read from the floor.
   5. Attach stainless steel tags with stainless steel cable ties.
   6. Mark conduits before construction review by Engineer for punch list purposes.
   7. Label intrinsically safe conduits in accordance with the requirements of the NEC.

D. Signs and labeling:
   1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
      a. Fasten warning signs with round head stainless steel screws or bolts.
      b. Locate and mount in a manner to be clearly legible to operations personnel.
   2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc. where the voltage exceeds 600 volts.

3. Furnish and install warning signs on equipment that has more than one source of power.
    a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.
4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.
    a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.
5. Label service entrance equipment, switchgear, switchboards, MCCs, panelboards, and transfer switches with the available short circuit current, equipment label, and date of application in accordance with NEC. Coordinate with Section 26_05_74 - Electrical System Studies and Owner for available fault current data.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. Replace any nameplates, signs, conductor markers, cable markers or raceway labels that in the sole opinion of the Engineer do not meet the Engineer’s aesthetic requirements.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_05_74

ELECTRICAL SYSTEM STUDIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Short-circuit fault analysis study.
   2. Protective device coordination study.
   3. Arc-flash hazard study.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 1584 - IEEE Guide for Specification of Scope and Deliverable Requirements for an Arc-Flash Hazard Calculations Study in Accordance with IEEE Std 1584(TM).

C. National Fire Protection Association (NFPA).

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. General study requirements:
   1. Scope:
      a. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall include all new and modified equipment in the power distribution system including, but not limited to:
         1) Utility equipment.
         2) All electrical equipment including:
            a) Dry-type transformers.
            b) 240 and 208 volt panelboards.
         3) Generators.
         4) Motors.
         5) Vendor control panels.
         6) HVAC equipment.
      b. Study scenarios:
         1) The studies shall include all possible electrical system configurations, for example:
            a) Operation on normal (utility) source.
            b) Operation on generator source.
            c) Main-breakers closed, tie-breaker open.
            d) Either main-breaker open, tie-breaker closed.

2. Obtain, for all equipment, the required data for preparation of the study including, but not limited to:
    a. Transformer kilovolt-ampere (kVA) and impedances.
    b. Generator impedances.
    c. Generator decrement curves.
    d. Bus withstand ratings.
    e. Cable and bus data.
    f. Protective device taps, time dials, instantaneous pickups, and time-delay settings.
    g. As-built lengths for all new wire and cable installations covered by the studies.
3. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:
    a. Utility tolerances and voltage variations.
4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.
5. Obtain equipment layouts and configurations from the manufacturer's final submittal requirements and project layout drawings as required.
6. Bus and conductor data:
    a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
    b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.
    c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
    d. Use bus withstand values for all equipment having buses.
    e. Use medium-voltage cable reactance based on typical dimensions of shielded cables with 133-percent insulation levels, unless otherwise indicated.
7. Motors:
    a. Each motor shall be individually modeled:
        1) Grouping of motors for fault contribution current is not acceptable.
    b. Motors with variable frequency drives (VFDs) may be assumed to have no contribution to fault current. , unless VFDs are equipped with Bypass Contactors.
        1) If VFDs are equipped with bypass contactors, perform the fault current and arc flash study assuming 1 of the bypass contactors are in the closed position.
8. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.

B. Short-circuit fault analysis study additional requirements:
    1. The short-circuit fault analysis shall be performed and submitted in 2 phases:
        a. Initial short-circuit fault analysis:
            1) Based on the Contract Documents and Electric Utility information.

2) The initial short-circuit fault analysis study shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
a) Measure conductor lengths from the Drawings. Use of arbitrary short conductor lengths is not allowed.
3) Provide a list of assumptions used in the initial study.
b. Final short-circuit fault analysis:
1) The final short-circuit fault analysis shall modify the initial analysis as follows:
a) Utilize the actual equipment provided on the project.
b) Utilize conductor lengths based on installation.
2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 to 4 cycle interrupting symmetrical RMS, and 30-cycle steady-state short-circuit current values at each piece of equipment in the distribution system.
3. Evaluate bus bracing, short-circuit ratings, fuse interrupting capacity and circuit-breaker-adjusted interrupting capacities against the fault currents, and calculate X/R values:
a. Identify and document all devices and equipment as either inadequate or acceptable.
4. Calculate line-to-ground and double line-to-ground momentary short-circuit values at all buses having ground-fault devices.
5. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including utility X/R ratios, typical values, recommendations, and areas of concern.

C. Protective device coordination study additional requirements:
1. Furnish protective device settings for all functions indicated on the Drawings including, but not limited to:
a. Current.
b. Voltage:
1) Provide settings for all voltage relays based upon actual utility and generator tolerances and specifications.
c. Frequency:
1) Provide settings for all frequency relays based upon actual utility and generator tolerances and specifications.
d. Negative sequence.
e. Reverse power.
f. Machine protection functions:
1) Provide settings for all motor and generator protective relays based on the manufacturer’s recommended protection requirements.
2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
1) Typical TCCs for identical portions of the system, such as motor circuits, are acceptable as allowed by the Engineer.
b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:
1) These details can be included on the TCC.

c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
1) These details can be included on the TCC.

3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include utility relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:
   a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards, and fused disconnect switches.
   b. Provide ground fault TCCs with all adjustable settings for ground fault protective devices.
   c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
   d. On the TCCs, show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and transformer damage curves.
   e. Cable damage curves.
   f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
   g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream devices to avoid nuisance tripping.
4. Site generation: When site generation (including cogeneration, standby, and emergency generators) is part of the electrical system, include phase and ground coordination of the generator protective devices:
   a. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices.
5. Suggest modifications or additions to equipment rating or settings in a tabulated form.

D. Arc-flash hazard study additional requirements:
1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
   a. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.
   b. Perform arc-flash calculations at minimum and maximum utility and generator fault contributions.
   c. Perform arc-flash calculations for both the line side and load side of the switchgear, switchboard, motor control center, and panelboard main breakers.
   d. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.
2. Provide executive summary of the study results:
   a. Provide summary based upon worst case results.
3. Provide a detailed written discussion and explanation of the tabulated outputs:
   a. Include all scenarios.

4. Provide alternative device settings to allow the Owner to select the desired functionality of the system:
    a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes.
    b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.

E. Electrical system study meetings:
1. The individual conducting the short-circuit fault analysis, protective device coordination, and the arc-flash hazard studies shall meet with the Owner and Engineer 3 times.
2. The purpose of the 3 meetings is as follows:
    a. Initial meeting:
        1) Meet with the Owner and Engineer to discuss the scope of the studies.
            a) Confirm assumptions to be used in the electrical system study with the Owner including but not limited to:
                (1) Maximum protective device fault clearing time.
        2) Discuss the Owner's operational requirements for both normal operation and maintenance.
    b. Preliminary results meeting:
        1) This meeting will be held after the studies have been completed, reviewed, and accepted by the Engineer.
        2) The purpose of this meeting is to inform the Owner of the results of the study and impacts on normal operation and maintenance including:
            a) Protective device coordination problems and recommended solutions.
            b) Explanation of the arc-flash hazard study results and its potential impact on operations.
            c) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.
    c. Final meeting:
        1) Discuss changes to the studies based on the previous meeting.
        2) Discuss with the Owner how changes to the electrical system may change the arc-flash hazard category.
    d. Deliver the final report after substantial completion.
3. The meetings will be at the Owner's facility:
    a. Provide a minimum of 3-weeks' notice to the Owner and Engineer in advance of the projected meeting date.
    b. Submit a draft of the meeting agenda when each meeting is requested.
4. Meeting materials:
    a. Prepare and provide the following materials:
        1) Meeting agenda. Include, at a minimum, the scope of the meeting, estimated time length for the meeting, and meeting goals.
        2) 6 copies of the project one-line diagrams for the initial meeting.
        3) 6 copies of the submitted studies.

F. Owner training:
1. Training shall include, but is not limited to:
    a. Introduction and basics of NFPA 70E: At least 1 hour.

b. Detailed review of the electrical system study for at least 2 hours.
c. Questions and Answers period: 0.5 hours.

G. By virtue of the fact that this is a professional study, the Owner reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash hazard study shall be modified based on the results of the meetings with the Owner.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Initial studies and reports:
1. Include the following in the initial short-circuit current report:
a. List of all devices included in the studies.
b. A description of all operating scenarios.
c. Form and format of arc-flash labels.

C. Final studies and reports:
1. Format and quantity:
a. Provide 6 bound copies of all final reports.
b. Provide 3 complete sets of electronic files on CD or DVD media, including the electrical system model(s), configuration files, custom libraries, and any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
c. Provide the number of copies specified in Section 01_33_00 - Submittal Procedures.
2. Include the sections below in the final report:
a. Copies of correspondence and data obtained from the electric utility company.
b. Letter certifying the inspection and verification of existing equipment.
c. One-line diagrams:
1) The following information shall be included at a minimum:
a) Motor horsepower.
b) Transformer data:
(1) kVA.
(2) Configuration.
c) Cable data:
(1) Insulation.
(2) Size.
(3) Length.
2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.
d. Include in the short-circuit fault analysis study:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) Normal system connections and those that result in maximum fault conditions.
3) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.
4) Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.

e. Protective device coordination study shall include:
    1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
    2) List all requirements used in the selection and setting criteria for any protective devices.
    3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
    4) TCCs graphically indicating the coordination proposed for the system on log-log graphs:
        a) All TCCs shall be in color.
    5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.
    6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.

f. Include in the arc-flash hazard study:
    1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
    2) Normal system connections and those that result in maximum arc-flash conditions.
    3) Arc-flash raw data, calculations, and assumptions.
    4) Arc-flash label data:
        a) Identifying the content of each label.
        b) Identifying the location of each label.

D. Certification:
    1. Submit written certification, sealed and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.

F. The Engineer will review all studies and reports. After review, the Engineer will make recommendations and/or require changes to be made to the short-circuit fault analysis, protective device coordination, or arc-flash hazard studies. These changes shall be provided as part of the scope of work.

G. Submit course outline for Owner's training.

1.06 QUALITY ASSURANCE

A. Qualifications of the entity responsible for electrical system studies:
    1. The studies shall be performed, stamped, and signed by a professional engineer registered in the state where the project is located.
    2. A minimum of 5 years of experience in power system analysis is required for the individual in responsible charge of the studies.
    3. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:
        a. Point-to-point calculations are not acceptable.

B. The study shall be performed by an independent firm.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT/SITE CONDITIONS (NOT USED)

1.09 SEQUENCING

A. Below is an outline of the typical work sequence. Proposed changes to the work sequence may be reviewed and approved by the Engineer.
   1. Site visit to gather data on the existing facility systems for all studies:
      a. Make multiple trips as required to obtain all data for the short-circuit fault analysis, protection device coordination, and arc flash hazard studies.
   2. Initial electrical system study meeting.
   3. Submit the initial short-circuit fault analysis study before submittal of any electrical equipment.
      a. Only the initial short-circuit results will be reviewed.
   4. Submit the preliminary short-circuit fault analysis, protective device coordination, and arc-flash hazard studies after the approval of all electrical equipment.
   5. Second electrical system study meeting for preliminary results.
   6. Update the model with all changes to the electrical system made during start-up and commissioning.
   7. Final arc-flash meeting and final short-circuit fault analysis, protective device coordination, and arc-flash hazard studies.
   8. Submit the final electrical system studies.
   9. Label equipment with approved arc-flash labels.
   10. Owner’s training.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Update the Owner’s existing electrical system studies and match the software used for the existing studies.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Arc-flash hazard labels:
   1. Dimensions:
      a. Minimum 5 inches by 3.5 inches.
   2. Materials:
      a. Polyester with polyvinyl polymer over-laminate.
      b. Self-adhesive.
      c. Resistant to:
         1) UV.
         2) Chemicals and common cleaning solvents.
         3) Scuffing.
         4) Wide temperature changes.
   3. Contents:
      a. Short-circuit bus identification.
      b. Calculated incident energy (calories/square centimeter) range:
         1) Based on worst-case study results.
      c. Arc-flash protection boundary.
      d. Shock hazard boundary:
         1) The Contractor may provide separate labels for indication of the shock hazard boundary.
      e. Fed from:
         1) Identify the tag number of the upstream equipment providing power.
   4. Color scheme:
      a. For locations above 40 calories/square centimeter:
         1) White label with red “DANGER” strip across the top.
         2) Black lettering.
      b. For locations below 40 calories/square centimeter:
         1) White label with orange “WARNING” strip across the top.
         2) Black lettering.

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. After review and acceptance of the arc-flash hazard study by the Engineer, install all arc-flash hazard labels:
   1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.
   2. At a minimum, install labels in the following locations:
      a. The front of each main or incoming service compartment.
      b. The front of each low-voltage switchgear section.
      c. The front of each medium-voltage circuit breaker door.
      d. The front of each accessible auxiliary or conductor compartment.
      e. Each accessible rear or side vertical section.
      f. Each motor control center vertical section.
      g. Each panelboard covered by the study.
      h. Each control panel, individual starter or VFD, or other equipment covered by the scope of the study.

B. After review and acceptance of the draft arc-flash hazard study and protective device coordination study by the Engineer, adjust protective device settings per final study prior to equipment energization.
   1. Devices that require power for configuration may be set during energization, but before any subfed loads are energized.
   2. Ensure that settings for upstream equipment are set prior to energizing downstream devices.

3.04 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:
   1. Remove and replace any improperly applied labels.
   2. Repair the equipment finish damaged by removal of any label.
   3. Install labels level or plumb across the entire dimension of the label.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_06_01A

CONDUIT SCHEDULE
AREA 1

PART 1 GENERAL

1.01 SUMMARY

A. Conduit requirements:
   1. As defined in Section 26_05_00 and Section 26_05_33.

B. Cable requirements and definitions:
   1. As defined in Section 26_05_00 and Section 26_05_18.
   2. PULL: Pull Rope.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONDUIT SCHEDULE

A. Conduit Schedule is presented on the following pages.

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
C-01-002	01E03	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-120	C-01-003
									TO: PB-120C	
									4 #14 >> GAT-120 CONTROL	
									2 #14 >> GAT-120 SPARE CONTROL	
C-01-003	01E03 02E01	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR: PB-120C	C-01-652
									TO: MH-04	
									4 #14 >> GAT-120 CONTROL	C-01-002
									2 #14 >> GAT-120 SPARE CONTROL	C-01-002
									4 #14 >> GAT-124 CONTROL	C-01-103
									2 #14 >> GAT-124 SPARE CONTROL	C-01-103
C-01-100		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: LIT-291	C-01-742
									TO: HANDHOLE CONDUIT	
									2 #14 >> LIT-291 CONTROL	
									2 #14 >> LIT-291 CONTROL POWER	
C-01-102	01E03	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-124	C-01-103
									TO: PB-124C	
									4 #14 >> GAT-124 CONTROL	
									2 #14 >> GAT-124 SPARE CONTROL	
C-01-103	01E03	2"	6	#14	XHHW-2	1	#14	XHHW-2	FR: PB-124C	C-01-003
									TO: PB-120C	
									4 #14 >> GAT-124 CONTROL	C-01-102
									2 #14 >> GAT-124 SPARE CONTROL	C-01-102
C-01-200		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: LIT-292	C-01-923
									TO: MANHOLE CONDUIT	
									2 #14 >> LIT-292 CONTROL	
									2 #14 >> LIT-292 CONTROL POWER	
C-01-212	01E04	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-122A	C-01-231
									TO: CONDUIT TEE	
									4 #14 >> GAT-122A CONTROL	
									2 #14 >> GAT-122A SPARE CONTROL	
C-01-222	01E04	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-122B	C-01-231
									TO: CONDUIT TEE	
									4 #14 >> GAT-122B CONTROL	
									2 #14 >> GAT-122B SPARE CONTROL	
C-01-231	01E04	1"	12	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-01-232
									TO: PB-122C	
									4 #14 >> GAT-122A CONTROL	C-01-212
									2 #14 >> GAT-122A SPARE CONTROL	C-01-212
									4 #14 >> GAT-122B CONTROL	C-01-222
									2 #14 >> GAT-122B SPARE CONTROL	C-01-222
C-01-232	01E04 02E01	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR: PB-122C	C-01-442
									TO: MH-05	
									4 #14 >> GAT-122A CONTROL	C-01-231
									2 #14 >> GAT-122A SPARE CONTROL	C-01-231
									4 #14 >> GAT-122B CONTROL	C-01-231
									2 #14 >> GAT-122B SPARE CONTROL	C-01-231
C-01-300		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: LIT-293	C-01-991
									TO: HANDHOLE CONDUIT	
									2 #14 >> LIT-293 CONTROL	
									2 #14 >> LIT-293 CONTROL POWER	
C-01-302	01E03	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-123	C-01-303
									TO: PB-123C	
									4 #14 >> GAT-123 CONTROL	
									2 #14 >> GAT-123 SPARE CONTROL	
C-01-303	01E03	2"	6	#14	XHHW-2	1	#14	XHHW-2	FR: PB-123C	C-01-903
									TO: PB-119C	
									4 #14 >> GAT-123 CONTROL	C-01-302
									2 #14 >> GAT-123 SPARE CONTROL	C-01-302
C-01-400		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: LIT-294	C-01-652
									TO: MANHOLE CONDUIT	
									2 #14 >> LIT-294 CONTROL	
									2 #14 >> LIT-294 CONTROL POWER	
C-01-412	01E04	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-114A	C-01-431
									TO: CONDUIT TEE	
									4 #14 >> GAT-114A CONTROL	
									2 #14 >> GAT-114A SPARE CONTROL	
C-01-422	01E04	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: GAT-114B	C-01-431
									TO: CONDUIT TEE	
									4 #14 >> GAT-114B CONTROL	
									2 #14 >> GAT-114B SPARE CONTROL	

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND							
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**			**DESCRIPTION**		**CONNECTING SEGMENTS**
C-01-431	01E04	1"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		CONDUIT TEE		C-01-432
									TO:		PB-114C		
										4 #14	>> GAT-114A CONTROL		C-01-412
										2 #14	>> GAT-114A SPARE CONTROL		C-01-412
										4 #14	>> GAT-114B CONTROL		C-01-422
										2 #14	>> GAT-114B SPARE CONTROL		C-01-422
C-01-432	01E04 02E01	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-114C		C-01-442
									TO:		MH-05		
										4 #14	>> GAT-114A CONTROL		C-01-431
										2 #14	>> GAT-114A SPARE CONTROL		C-01-431
										4 #14	>> GAT-114B CONTROL		C-01-431
										2 #14	>> GAT-114B SPARE CONTROL		C-01-431
C-01-442	02E01	2"	28	#14	XHHW-2	1	#14	XHHW-2	FR:		MH-05		C-01-913
									TO:		MH-04		
										4 #14	>> GAT-122A CONTROL		C-01-232
										2 #14	>> GAT-122A SPARE CONTROL		C-01-232
										4 #14	>> GAT-122B CONTROL		C-01-232
										2 #14	>> GAT-122B SPARE CONTROL		C-01-232
										4 #14	>> GAT-114A CONTROL		C-01-432
										2 #14	>> GAT-114A SPARE CONTROL		C-01-432
										4 #14	>> GAT-114B CONTROL		C-01-432
										2 #14	>> GAT-114B SPARE CONTROL		C-01-432
										2 #14	>> LIT-295 CONTROL		C-01-500
										2 #14	>> LIT-295 CONTROL POWER		C-01-500
C-01-500		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		LIT-295		C-01-442
									TO:		MANHOLE CONDUIT		
										2 #14	>> LIT-295 CONTROL		
										2 #14	>> LIT-295 CONTROL POWER		
C-01-512	01E02	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-115A		C-01-531
									TO:		CONDUIT TEE		
										4 #14	>> GAT-115A CONTROL		
										2 #14	>> GAT-115A SPARE CONTROL		
C-01-522	01E02	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-115B		C-01-531
									TO:		CONDUIT TEE		
										4 #14	>> GAT-115B CONTROL		
										2 #14	>> GAT-115B SPARE CONTROL		
C-01-531	01E02	1"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		CONDUIT TEE		C-01-532
									TO:		PB-115C		
										4 #14	>> GAT-115A CONTROL		C-01-512
										2 #14	>> GAT-115A SPARE CONTROL		C-01-512
										4 #14	>> GAT-115B CONTROL		C-01-522
										2 #14	>> GAT-115B SPARE CONTROL		C-01-522
C-01-532	01E02 02E02	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-115C		C-01-923
									TO:		MH-02		
										4 #14	>> GAT-115A CONTROL		C-01-531
										2 #14	>> GAT-115A SPARE CONTROL		C-01-531
										4 #14	>> GAT-115B CONTROL		C-01-531
										2 #14	>> GAT-115B SPARE CONTROL		C-01-531
C-01-600		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		LIT-296		C-01-642
									TO:		HANDHOLE CONDUIT		
										2 #14	>> LIT-296 CONTROL		
										2 #14	>> LIT-296 CONTROL POWER		
C-01-612	01E05	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-116A		C-01-631
									TO:		CONDUIT TEE		
										4 #14	>> GAT-116A CONTROL		
										2 #14	>> GAT-116A SPARE CONTROL		
C-01-622	01E05	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-116B		C-01-631
									TO:		CONDUIT TEE		
										4 #14	>> GAT-116B CONTROL		
										2 #14	>> GAT-116B SPARE CONTROL		
C-01-631	01E05	1"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		CONDUIT TEE		C-01-632
									TO:		PB-116C		
										4 #14	>> GAT-116A CONTROL		C-01-612
										2 #14	>> GAT-116A SPARE CONTROL		C-01-612
										4 #14	>> GAT-116B CONTROL		C-01-622
										2 #14	>> GAT-116B SPARE CONTROL		C-01-622

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND						
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**			**CONNECTING SEGMENTS**
C-01-632	01E05 02E01	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-116C	C-01-642
									TO:		MH-04 VIA HH-06	
										4 #14	>> GAT-116A CONTROL	C-01-631
										2 #14	>> GAT-116A SPARE CONTROL	C-01-631
										4 #14	>> GAT-116B CONTROL	C-01-631
										2 #14	>> GAT-116B SPARE CONTROL	C-01-631
C-01-642	02E01	2"	16	#14	XHHW-2	1	#14	XHHW-2	FR:		HH-06	C-01-652
									TO:		MH-04	
										4 #14	>> GAT-116A CONTROL	C-01-632
										2 #14	>> GAT-116A SPARE CONTROL	C-01-632
										4 #14	>> GAT-116B CONTROL	C-01-632
										2 #14	>> GAT-116B SPARE CONTROL	C-01-632
										2 #14	>> LIT-296 CONTROL	C-01-600
										2 #14	>> LIT-296 CONTROL POWER	C-01-600
C-01-652	02E01	2"	32	#14	XHHW-2	1	#14	XHHW-2	FR:		MH-04	C-01-742
									TO:		MH-02	
										4 #14	>> GAT-116A CONTROL	C-01-642
										2 #14	>> GAT-116A SPARE CONTROL	C-01-642
										4 #14	>> GAT-116B CONTROL	C-01-642
										2 #14	>> GAT-116B SPARE CONTROL	C-01-642
										2 #14	>> LIT-296 CONTROL	C-01-642
										2 #14	>> LIT-296 CONTROL POWER	C-01-642
										4 #14	>> GAT-120 CONTROL	C-01-003
										2 #14	>> GAT-120 SPARE CONTROL	C-01-003
										4 #14	>> GAT-124 CONTROL	C-01-003
										2 #14	>> GAT-124 SPARE CONTROL	C-01-003
										2 #14	>> LIT-294 CONTROL	C-01-400
										2 #14	>> LIT-294 CONTROL POWER	C-01-400
C-01-712	01E02	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-117A	C-01-731
									TO:		CONDUIT TEE	
										4 #14	>> GAT-117A CONTROL	
										2 #14	>> GAT-117A SPARE CONTROL	
C-01-722	01E02	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-117B	C-01-731
									TO:		CONDUIT TEE	
										4 #14	>> GAT-117B CONTROL	
										2 #14	>> GAT-117B SPARE CONTROL	
C-01-731	01E02	1"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		CONDUIT TEE	C-01-732
									TO:		PB-117C	
										4 #14	>> GAT-117A CONTROL	C-01-712
										2 #14	>> GAT-117A SPARE CONTROL	C-01-712
										4 #14	>> GAT-117B CONTROL	C-01-722
										2 #14	>> GAT-117B SPARE CONTROL	C-01-722
C-01-732	01E02 02E02	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-117C	C-01-742
									TO:		MH-02 VIA HH-01	
										4 #14	>> GAT-117A CONTROL	C-01-731
										2 #14	>> GAT-117A SPARE CONTROL	C-01-731
										4 #14	>> GAT-117B CONTROL	C-01-731
										2 #14	>> GAT-117B SPARE CONTROL	C-01-731
C-01-742	02E02	2"	48	#14	XHHW-2	1	#14	XHHW-2	FR:		MH-02	C-01-992
									TO:		HH-03	
										4 #14	>> GAT-117A CONTROL	C-01-732
										2 #14	>> GAT-117A SPARE CONTROL	C-01-732
										4 #14	>> GAT-117B CONTROL	C-01-732
										2 #14	>> GAT-117B SPARE CONTROL	C-01-732
										2 #14	>> LIT-291 CONTROL	C-01-100
										2 #14	>> LIT-291 CONTROL POWER	C-01-100
										4 #14	>> GAT-116A CONTROL	C-01-652
										2 #14	>> GAT-116A SPARE CONTROL	C-01-652
										4 #14	>> GAT-116B CONTROL	C-01-652
										2 #14	>> GAT-116B SPARE CONTROL	C-01-652
										2 #14	>> LIT-296 CONTROL	C-01-652
										2 #14	>> LIT-296 CONTROL POWER	C-01-652
										4 #14	>> GAT-120 CONTROL	C-01-652
										2 #14	>> GAT-120 SPARE CONTROL	C-01-652
										4 #14	>> GAT-124 CONTROL	C-01-652
										2 #14	>> GAT-124 SPARE CONTROL	C-01-652
										2 #14	>> LIT-294 CONTROL	C-01-652
										2 #14	>> LIT-294 CONTROL POWER	C-01-652
C-01-812	01E02	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-118A	C-01-831
									TO:		CONDUIT TEE	
										4 #14	>> GAT-118A CONTROL	
										2 #14	>> GAT-118A SPARE CONTROL	

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND						
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**			**CONNECTING SEGMENTS**
C-01-822	01E02	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-118B	C-01-831
									TO:		CONDUIT TEE	
										4 #14	>> GAT-118B CONTROL	
										2 #14	>> GAT-118B SPARE CONTROL	
C-01-831	01E02	1"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		CONDUIT TEE	C-01-832
									TO:		PB-118C	
										4 #14	>> GAT-118A CONTROL	C-01-812
										2 #14	>> GAT-118A SPARE CONTROL	C-01-812
										4 #14	>> GAT-118B CONTROL	C-01-822
										2 #14	>> GAT-118B SPARE CONTROL	C-01-822
C-01-832	01E02 02E02	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-118C	C-01-992
									TO:		HH-03	
										4 #14	>> GAT-118A CONTROL	C-01-831
										2 #14	>> GAT-118A SPARE CONTROL	C-01-831
										4 #14	>> GAT-118B CONTROL	C-01-831
										2 #14	>> GAT-118B SPARE CONTROL	C-01-831
C-01-902	01E03	0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR:		GAT-119	C-01-903
									TO:		PB-119C	
										4 #14	>> GAT-119 CONTROL	
										2 #14	>> GAT-119 SPARE CONTROL	
C-01-903	01E03 02E01	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-119C	C-01-913
									TO:		MH-04	
										4 #14	>> GAT-119 CONTROL	C-01-902
										2 #14	>> GAT-119 SPARE CONTROL	C-01-902
										4 #14	>> GAT-123 CONTROL	C-01-303
										2 #14	>> GAT-123 SPARE CONTROL	C-01-303
C-01-913	02E01	2"	40	#14	XHHW-2	1	#14	XHHW-2	FR:		MH-04	C-01-923
									TO:		MH-02	
										4 #14	>> GAT-122A CONTROL	C-01-442
										2 #14	>> GAT-122A SPARE CONTROL	C-01-442
										4 #14	>> GAT-122B CONTROL	C-01-442
										2 #14	>> GAT-122B SPARE CONTROL	C-01-442
										4 #14	>> GAT-114A CONTROL	C-01-442
										2 #14	>> GAT-114A SPARE CONTROL	C-01-442
										4 #14	>> GAT-114B CONTROL	C-01-442
										2 #14	>> GAT-114B SPARE CONTROL	C-01-442
										2 #14	>> LIT-295 CONTROL	C-01-442
										2 #14	>> LIT-295 CONTROL POWER	C-01-442
										4 #14	>> GAT-119 CONTROL	C-01-903
										2 #14	>> GAT-119 SPARE CONTROL	C-01-903
										4 #14	>> GAT-123 CONTROL	C-01-903
										2 #14	>> GAT-123 SPARE CONTROL	C-01-903
C-01-923	02E02	2"	56	#14	XHHW-2	1	#14	XHHW-2	FR:		MH-02	C-01-991
									TO:		HH-03	
										4 #14	>> GAT-115A CONTROL	C-01-532
										2 #14	>> GAT-115A SPARE CONTROL	C-01-532
										4 #14	>> GAT-115B CONTROL	C-01-532
										2 #14	>> GAT-115B SPARE CONTROL	C-01-532
										4 #14	>> GAT-122A CONTROL	C-01-913
										2 #14	>> GAT-122A SPARE CONTROL	C-01-913
										4 #14	>> GAT-122B CONTROL	C-01-913
										2 #14	>> GAT-122B SPARE CONTROL	C-01-913
										4 #14	>> GAT-114A CONTROL	C-01-913
										2 #14	>> GAT-114A SPARE CONTROL	C-01-913
										4 #14	>> GAT-114B CONTROL	C-01-913
										2 #14	>> GAT-114B SPARE CONTROL	C-01-913
										2 #14	>> LIT-295 CONTROL	C-01-913
										2 #14	>> LIT-295 CONTROL POWER	C-01-913
										4 #14	>> GAT-119 CONTROL	C-01-913
										2 #14	>> GAT-119 SPARE CONTROL	C-01-913
										4 #14	>> GAT-123 CONTROL	C-01-913
										2 #14	>> GAT-123 SPARE CONTROL	C-01-913
										2 #14	>> LIT-292 CONTROL	C-01-200
										2 #14	>> LIT-292 CONTROL POWER	C-01-200

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND						
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**			**CONNECTING SEGMENTS**
C-01-991	01E02 02E02	2"	60	#14	XHHW-2	1	#14	XHHW-2	FR:		HH-03	C-01-993
									TO:		PB-101C	
										4 #14	>> GAT-115A CONTROL	C-01-923
										2 #14	>> GAT-115A SPARE CONTROL	C-01-923
										4 #14	>> GAT-115B CONTROL	C-01-923
										2 #14	>> GAT-115B SPARE CONTROL	C-01-923
										4 #14	>> GAT-122A CONTROL	C-01-923
										2 #14	>> GAT-122A SPARE CONTROL	C-01-923
										4 #14	>> GAT-122B CONTROL	C-01-923
										2 #14	>> GAT-122B SPARE CONTROL	C-01-923
										4 #14	>> GAT-114A CONTROL	C-01-923
										2 #14	>> GAT-114A SPARE CONTROL	C-01-923
										4 #14	>> GAT-114B CONTROL	C-01-923
										2 #14	>> GAT-114B SPARE CONTROL	C-01-923
										2 #14	>> LIT-295 CONTROL	C-01-923
										2 #14	>> LIT-295 CONTROL POWER	C-01-923
										4 #14	>> GAT-119 CONTROL	C-01-923
										2 #14	>> GAT-119 SPARE CONTROL	C-01-923
										4 #14	>> GAT-123 CONTROL	C-01-923
										2 #14	>> GAT-123 SPARE CONTROL	C-01-923
										2 #14	>> LIT-292 CONTROL	C-01-923
										2 #14	>> LIT-292 CONTROL POWER	C-01-923
										2 #14	>> LIT-293 CONTROL	C-01-300
										2 #14	>> LIT-293 CONTROL POWER	C-01-300
C-01-992	01E02 02E02	2"	60	#14	XHHW-2	1	#14	XHHW-2	FR:		HH-03	C-01-994
									TO:		PB-101C	
										4 #14	>> GAT-117A CONTROL	C-01-742
										2 #14	>> GAT-117A SPARE CONTROL	C-01-742
										4 #14	>> GAT-117B CONTROL	C-01-742
										2 #14	>> GAT-117B SPARE CONTROL	C-01-742
										2 #14	>> LIT-291 CONTROL	C-01-742
										2 #14	>> LIT-291 CONTROL POWER	C-01-742
										4 #14	>> GAT-116A CONTROL	C-01-742
										2 #14	>> GAT-116A SPARE CONTROL	C-01-742
										4 #14	>> GAT-116B CONTROL	C-01-742
										2 #14	>> GAT-116B SPARE CONTROL	C-01-742
										2 #14	>> LIT-296 CONTROL	C-01-742
										2 #14	>> LIT-296 CONTROL POWER	C-01-742
										4 #14	>> GAT-120 CONTROL	C-01-742
										2 #14	>> GAT-120 SPARE CONTROL	C-01-742
										4 #14	>> GAT-124 CONTROL	C-01-742
										2 #14	>> GAT-124 SPARE CONTROL	C-01-742
										2 #14	>> LIT-294 CONTROL	C-01-742
										2 #14	>> LIT-294 CONTROL POWER	C-01-742
										4 #14	>> GAT-118A CONTROL	C-01-832
										2 #14	>> GAT-118A SPARE CONTROL	C-01-832
										4 #14	>> GAT-118B CONTROL	C-01-832
										2 #14	>> GAT-118B SPARE CONTROL	C-01-832
C-01-993	01E02	2"	60	#14	XHHW-2	1	#14	XHHW-2	FR:		PB-101C	
									TO:		PLC1-RIO3	
										4 #14	>> GAT-115A CONTROL	C-01-991
										2 #14	>> GAT-115A SPARE CONTROL	C-01-991
										4 #14	>> GAT-115B CONTROL	C-01-991
										2 #14	>> GAT-115B SPARE CONTROL	C-01-991
										4 #14	>> GAT-122A CONTROL	C-01-991
										2 #14	>> GAT-122A SPARE CONTROL	C-01-991
										4 #14	>> GAT-122B CONTROL	C-01-991
										2 #14	>> GAT-122B SPARE CONTROL	C-01-991
										4 #14	>> GAT-114A CONTROL	C-01-991
										2 #14	>> GAT-114A SPARE CONTROL	C-01-991
										4 #14	>> GAT-114B CONTROL	C-01-991
										2 #14	>> GAT-114B SPARE CONTROL	C-01-991
										2 #14	>> LIT-295 CONTROL	C-01-991
										2 #14	>> LIT-295 CONTROL POWER	C-01-991
										4 #14	>> GAT-119 CONTROL	C-01-991
										2 #14	>> GAT-119 SPARE CONTROL	C-01-991
										4 #14	>> GAT-123 CONTROL	C-01-991
										2 #14	>> GAT-123 SPARE CONTROL	C-01-991
										2 #14	>> LIT-292 CONTROL	C-01-991
										2 #14	>> LIT-292 CONTROL POWER	C-01-991
										2 #14	>> LIT-293 CONTROL	C-01-991
										2 #14	>> LIT-293 CONTROL POWER	C-01-991

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND							
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**				**CONNECTING SEGMENTS**
C-01-994	01E02	2"	60	#14	XHHW-2	1	#14	XHHW-2	FR:			PB-101C	
									TO:			PLC1-RIO3	
										4	#14	>> GAT-117A CONTROL	C-01-992
										2	#14	>> GAT-117A SPARE CONTROL	C-01-992
										4	#14	>> GAT-117B CONTROL	C-01-992
										2	#14	>> GAT-117B SPARE CONTROL	C-01-992
										2	#14	>> LIT-291 CONTROL	C-01-992
										2	#14	>> LIT-291 CONTROL POWER	C-01-992
										4	#14	>> GAT-116A CONTROL	C-01-992
										2	#14	>> GAT-116A SPARE CONTROL	C-01-992
										4	#14	>> GAT-116B CONTROL	C-01-992
										2	#14	>> GAT-116B SPARE CONTROL	C-01-992
										2	#14	>> LIT-296 CONTROL	C-01-992
										2	#14	>> LIT-296 CONTROL POWER	C-01-992
										4	#14	>> GAT-120 CONTROL	C-01-992
										2	#14	>> GAT-120 SPARE CONTROL	C-01-992
										4	#14	>> GAT-124 CONTROL	C-01-992
										2	#14	>> GAT-124 SPARE CONTROL	C-01-992
										2	#14	>> LIT-294 CONTROL	C-01-992
										2	#14	>> LIT-294 CONTROL POWER	C-01-992
										4	#14	>> GAT-118A CONTROL	C-01-992
										2	#14	>> GAT-118A SPARE CONTROL	C-01-992
										4	#14	>> GAT-118B CONTROL	C-01-992
										2	#14	>> GAT-118B SPARE CONTROL	C-01-992
L-01-001	01E03	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PLATFORM 120 RECEPTACLE & LIGHTING	
									TO:			TJB-120L	
										2	#12	>> PLATFORM 120 RECEPTACLE	
										2	#12	>> PLATFORM 120 LIGHTING	
L-01-002	01E03	2.5"	2	250	XHHW-2	1	250	XHHW-2	FR:			TJB-120L	L-01-012
	02E01		2	#8	XHHW-2	1	#8	XHHW-2	TO:			PB-101P VIA MH-04, MH-02, AND HH-01	
	02E02									2	250	>> TJB-120L REC CKT	
	10E01									2	#8	>> TJB-120L LTG CKT	
L-01-012	10E01	2.5"	2	250	XHHW-2	1	250	RHW-2	FR:			PB-102P	
			2	#8	XHHW-2	1	#8	XHHW-2	TO:			TJB-101L	
										2	250	>> TJB-120L REC CKT	L-01-002
										2	#8	>> TJB-120L LTG CKT	L-01-002
L-01-101	01E03	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PLATFORM 124 RECEPTACLE & LIGHTING	L-01-102
									TO:			PB-124P	
										2	#12	>> PLATFORM 124 RECEPTACLE	
										2	#12	>> PLATFORM 124 LIGHTING	
L-01-102	01E03	2"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PB-124P	
									TO:			TJB-120L	
										2	#12	>> PLATFORM 124 RECEPTACLE	L-01-101
										2	#12	>> PLATFORM 124 LIGHTING	L-01-101
L-01-201	01E04	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PLATFORM 122 RECEPTACLE & LIGHTING	
									TO:			TJB-122L	
										2	#12	>> PLATFORM 122 RECEPTACLE	
										2	#12	>> PLATFORM 122 LIGHTING	
L-01-202	01E04	3"	2	350	XHHW-2	1	350	RHW-2	FR:			TJB-122L	
	02E01		2	#6	XHHW-2	1	#6	XHHW-2	TO:			TJB-114L	
										2	350	>> TJB-122L REC CKT	
										2	#6	>> TJB-122L LTG CKT	
L-01-301	01E03	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PLATFORM 123 RECEPTACLE & LIGHTING	L-01-302
									TO:			PB-123P	
										2	#12	>> PLATFORM 123 RECEPTACLE	
										2	#12	>> PLATFORM 123 LIGHTING	
L-01-302	01E03	2"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PB-123P	
									TO:			TJB-119L	
										2	#12	>> PLATFORM 123 RECEPTACLE	L-01-301
										2	#12	>> PLATFORM 123 LIGHTING	L-01-301
L-01-401	01E04	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR:			PLATFORM 114 RECEPTACLE & LIGHTING	
									TO:			TJB-114L	
										2	#12	>> PLATFORM 114 RECEPTACLE	
										2	#12	>> PLATFORM 114 LIGHTING	
L-01-402	01E03	3"	2	350	XHHW-2	1	350	RHW-2	FR:			TJB-114L	
	01E04		2	#6	XHHW-2	1	#6	XHHW-2	TO:			TJB-119L	
	02E01									2	350	>> TJB-114L REC CKT	
										2	#6	>> TJB-114L LTG CKT	

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
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DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
L-01-501	01E02	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR: PLATFORM 115 RECEPTACLE & LIGHTING	
									TO: TJB-115L	
									2 #12 >> PLATFORM 115 RECEPTACLE	
									2 #12 >> PLATFORM 115 LIGHTING	
L-01-502	01E02	2"	2	#2	XHHW-2	1	#2	XHHW-2	FR: TJB-115L	L-01-702
	02E02		2	#10	XHHW-2	1	#10	XHHW-2	TO: HH-01 VIA MH-02	
									2 #2 >> TJB-115L REC CKT	
									2 #10 >> TJB-115L LTG CKT	
L-01-601	01E05	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR: PLATFORM 116 RECEPTACLE & LIGHTING	
									TO: TJB-116L	
									2 #12 >> PLATFORM 116 RECEPTACLE	
									2 #12 >> PLATFORM 116 LIGHTING	
L-01-602	01E03	2.5"	2	250	XHHW-2	1	250	XHHW-2	FR: TJB-116L	
	01E05		2	#8	XHHW-2	1	#8	XHHW-2	TO: TJB-120L VIA HH-06	
	02E01								2 250 >> TJB-116L REC CKT	
									2 #8 >> TJB-116L LTG CKT	
L-01-701	01E02	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR: PLATFORM 117 RECEPTACLE & LIGHTING	
									TO: TJB-117L	
									2 #12 >> PLATFORM 117 RECEPTACLE	
									2 #12 >> PLATFORM 117 LIGHTING	
L-01-702	01E02	2"	4	#2	XHHW-2	1	#2	XHHW-2	FR: TJB-117L	
	02E02		4	#10	XHHW-2	1	#10	XHHW-2	TO: HH-01	
									2 #2 >> TJB-117L REC CKT	
									2 #10 >> TJB-117L LTG CKT	
									2 #2 >> TJB-115L REC CKT	L-01-502
									2 #10 >> TJB-115L LTG CKT	L-01-502
L-01-801		0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR: PLATFORM 118 RECEPTACLE & LIGHTING	
									TO: TJB-118L	
									2 #12 >> PLATFORM 118 RECEPTACLE	
									2 #12 >> PLATFORM 118 LIGHTING	
L-01-802	01E02	2"	2	#2	XHHW-2	1	#2	XHHW-2	FR: TJB-118L	L-01-812
	02E02		2	#10	XHHW-2	1	#10	XHHW-2	TO: HH-01 VIA MH-02, HH-03	
									2 #2 >> TJB-118L REC CKT	
									2 #10 >> TJB-118L LTG CKT	
L-01-812	02E02	2"	4	#2	XHHW-2	1	#2	XHHW-2	FR: HH-01	L-01-822
	10E01		4	#10	XHHW-2	1	#10	XHHW-2	TO: PB-101P	
									2 #2 >> TJB-117L REC CKT	
									2 #10 >> TJB-117L LTG CKT	
									2 #2 >> TJB-118L REC CKT	L-01-802
									2 #10 >> TJB-118L LTG CKT	L-01-802
L-01-822	10E01	2"	4	#2	XHHW-2	1	#2	XHHW-2	FR: PB-102P	
			4	#10	XHHW-2	1	#10	XHHW-2	TO: TJB-101L	
									2 #2 >> TJB-117L REC CKT	L-01-812
									2 #10 >> TJB-117L LTG CKT	L-01-812
									2 #2 >> TJB-118L REC CKT	L-01-812
									2 #10 >> TJB-118L LTG CKT	L-01-812
L-01-901	01E03	0.75"	4	#12	XHHW-2	1	#12	XHHW-2	FR: PLATFORM 119 RECEPTACLE & LIGHTING	
									TO: TJB-119L	
									2 #12 >> PLATFORM 119 RECEPTACLE	
									2 #12 >> PLATFORM 119 LIGHTING	
L-01-902	01E03	3"	2	350	XHHW-2	1	350	RHW-2	FR: TJB-119L	L-01-912
	02E01		2	#6	XHHW-2	1	#6	XHHW-2	TO: PB-101P VIA MH-04, MH-02, AND HH-01	
	02E02								2 350 >> TJB-119L REC CKT	
	10E01								2 #6 >> TJB-119L LTG CKT	
L-01-912	10E01	3"	2	350	XHHW-2	1	350	RHW-2	FR: PB-102P	
			2	#6	XHHW-2	1	#6	XHHW-2	TO: TJB-101L	
									2 350 >> TJB-119L REC CKT	L-01-902
									2 #6 >> TJB-119L LTG CKT	L-01-902
L-01-995	10E01	1"	4	#8	XHHW-2	1	#8	XHHW-2	FR: LP-35	
									TO: T-35	
									4 #8 >> LP-35 POWER	
L-01-996	10E01	1"	8	#10	XHHW-2	1	#10	XHHW-2	FR: TJB-101L	
									TO: LP-35	
									8 #10 >> PLATFORM RECEPTACLE CKTS	
L-01-997	10E01	1"	8	#10	XHHW-2	1	#10	XHHW-2	FR: TJB-101L	
									TO: LP-35	
									8 #10 >> PLATFORM LIGHTING CKTS	

CONDUIT SCHEDULE AREA 01

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ENGINEER	**MJG**
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DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
P-01-001	01E03	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-120 TO: DISCONNECT SWITCH 3 #12 >> GAT-120 POWER	
P-01-002	01E03	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: TJB-120P 3 #10 >> GAT-120 DISCONNECT POWER	
P-01-003	01E03 02E01	2"	3	#8	XHHW-2	1	#8	XHHW-2	FR: TJB-120P TO: MH-04 3 #8 >> GAT-120 & 124 POWER	P-01-642
P-01-101	01E03	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-124 TO: DISCONNECT SWITCH 3 #12 >> GAT-124 POWER	
P-01-102	01E03	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: PB-124P 3 #10 >> GAT-124 DISCONNECT POWER	P-01-103
P-01-103	01E03	2"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-124P TO: TJB-120P 3 #10 >> GAT-124 DISCONNECT POWER	P-01-102
P-01-211	01E04	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-122A TO: DISCONNECT SWITCH 3 #12 >> GAT-122A POWER	
P-01-212	01E04	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-122A DISCONNECT POWER	P-01-231
P-01-221	01E04	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-122B TO: DISCONNECT SWITCH 3 #12 >> GAT-122B POWER	
P-01-222	01E04	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-122B DISCONNECT POWER	P-01-231
P-01-231	01E04	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: TJB-122P 3 #10 >> GAT-122A DISCONNECT POWER 3 #10 >> GAT-122B DISCONNECT POWER	P-01-212 P-01-222
P-01-232	01E04 02E01	2"	3	#4	XHHW-2	1	#4	XHHW-2	FR: TJB-122P TO: MH-05 3 #4 >> GAT-122A & 122B POWER	P-01-442
P-01-301	01E03	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-123 TO: DISCONNECT SWITCH 3 #12 >> GAT-123 POWER	
P-01-302	01E03	0.75"	3	#10	XHHW-2	1	#8	XHHW-2	FR: DISCONNECT SWITCH TO: PB-123P 3 #10 >> GAT-123 DISCONNECT POWER	P-01-303
P-01-303	01E03	2"	3	#10	XHHW-2	1	#8	XHHW-2	FR: PB-123P TO: TJB-119P 3 #10 >> GAT-123 DISCONNECT POWER	P-01-302
P-01-411	01E04	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-114A TO: DISCONNECT SWITCH 3 #12 >> GAT-114A POWER	
P-01-412	01E04	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-114A DISCONNECT POWER	P-01-431
P-01-421	01E04	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-114B TO: DISCONNECT SWITCH 3 #12 >> GAT-114B POWER	
P-01-422	01E04	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-114B DISCONNECT POWER	P-01-431
P-01-431	01E04	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: TJB-114P 3 #10 >> GAT-114A DISCONNECT POWER 3 #10 >> GAT-114B DISCONNECT POWER	P-01-412 P-01-422

CONDUIT SCHEDULE AREA 01

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SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
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DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
P-01-432	01E04 02E01	2"	3	#4	XHHW-2	1	#4	XHHW-2	FR: TJB-114P TO: MH-05 3 #4 >> GAT-114A & 114B POWER	P-01-442
P-01-442	02E01	2"	6	#4	XHHW-2	1	#4	XHHW-2	FR: MH-05 TO: MH-04 3 #4 >> GAT-114A & 114B POWER 3 #4 >> GAT-122A & 122B POWER	P-01-913 P-01-432 P-01-232
P-01-511	01E02	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-115A TO: DISCONNECT SWITCH 3 #12 >> GAT-115A POWER	
P-01-512	01E02	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-115A DISCONNECT POWER	P-01-531
P-01-521	01E02	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-115B TO: DISCONNECT SWITCH 3 #12 >> GAT-115B POWER	
P-01-522	01E02	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-115B DISCONNECT POWER	P-01-531
P-01-531	01E02	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: TJB-115P 3 #10 >> GAT-115A DISCONNECT POWER 3 #10 >> GAT-115B DISCONNECT POWER	P-01-512 P-01-522
P-01-532	01E02 02E02	2"	3	#10	XHHW-2	1	#10	XHHW-2	FR: TJB-115P TO: MH-02 3 #10 >> GAT-115A & 115B POWER	P-01-842
P-01-611	01E05	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-116A TO: DISCONNECT SWITCH 3 #12 >> GAT-116A POWER	
P-01-612	01E05	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-116A DISCONNECT POWER	P-01-631
P-01-621	01E05	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-116B TO: DISCONNECT SWITCH 3 #12 >> GAT-116B POWER	
P-01-622	01E05	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-116B DISCONNECT POWER	P-01-631
P-01-631	01E05	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: TJB-116P 3 #10 >> GAT-116A DISCONNECT POWER 3 #10 >> GAT-116B DISCONNECT POWER	P-01-612 P-01-622
P-01-632	01E05 02E01	2"	3	#4	XHHW-2	1	#4	XHHW-2	FR: TJB-116P TO: MH-04 VIA HH-06 3 #4 >> GAT-116A & 116B POWER	P-01-642
P-01-642	02E01 02E02	2"	3 3	#4 #8	XHHW-2 XHHW-2	1 1	#4 #8	XHHW-2 XHHW-2	FR: MH-04 TO: HH-01 VIA MH-02 3 #4 >> GAT-116A & 116B POWER 3 #8 >> GAT-120 & 124 POWER	P-01-742 P-01-632 P-01-003
P-01-711	01E02	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-117A TO: DISCONNECT SWITCH 3 #12 >> GAT-117A POWER	
P-01-712	01E02	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-117A DISCONNECT POWER	P-01-731
P-01-721	01E02	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: GAT-117B TO: DISCONNECT SWITCH 3 #12 >> GAT-117B POWER	
P-01-722	01E02	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISCONNECT SWITCH TO: CONDUIT TEE 3 #10 >> GAT-117B DISCONNECT POWER	P-01-731

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CONDUIT			CONDUCTORS			GROUND							
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**			**DESCRIPTION**		**CONNECTING SEGMENTS**
P-01-731	01E02	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR:		CONDUIT TEE		
									TO:		TJB-117P		
										3 #10	>> GAT-117A DISCONNECT POWER		P-01-712
										3 #10	>> GAT-117B DISCONNECT POWER		P-01-722
P-01-732	01E02 02E02	2"	3	#8	XHHW-2	1	#8	XHHW-2	FR:		TJB-117P		P-01-742
									TO:		HH-01		
										3 #8	>> GAT-117A & 117B POWER		
P-01-742	02E02 10E01	2"	3 6	#4 #8	XHHW-2 XHHW-2	1 1	#4 #8	XHHW-2 XHHW-2	FR:		HH-01		P-01-752
									TO:		PB-101P		
										3 #4	>> GAT-116A & 116B POWER		P-01-642
										3 #8	>> GAT-120 & 124 POWER		P-01-642
										3 #8	>> GAT-117A & 117B POWER		P-01-732
P-01-752	10E01	1.5"	3 6	#4 #8	XHHW-2 XHHW-2	1 1	#4 #8	XHHW-2 XHHW-2	FR:		PB-102P		
									TO:		PP-PA2		
										3 #4	>> GAT-116A & 116B POWER		P-01-742
										3 #8	>> GAT-120 & 124 POWER		P-01-742
										3 #8	>> GAT-117A & 117B POWER		P-01-742
P-01-811	01E02	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR:		GAT-118A		
									TO:		DISCONNECT SWITCH		
										3 #12	>> GAT-118A POWER		
P-01-812	01E02	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		DISCONNECT SWITCH		P-01-831
									TO:		CONDUIT TEE		
										3 #10	>> GAT-118A DISCONNECT POWER		
P-01-821	01E02	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR:		GAT-118B		
									TO:		DISCONNECT SWITCH		
										3 #12	>> GAT-118B POWER		
P-01-822	01E02	0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		DISCONNECT SWITCH		P-01-831
									TO:		CONDUIT TEE		
										3 #10	>> GAT-118B DISCONNECT POWER		
P-01-831	01E02	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR:		CONDUIT TEE		
									TO:		TJB-118P		
										3 #10	>> GAT-118A DISCONNECT POWER		P-01-812
										3 #10	>> GAT-118B DISCONNECT POWER		P-01-822
P-01-832	01E02 02E02	2"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		TJB-118P		P-01-842
									TO:		MH-02 VIA HH-03		
										3 #10	>> GAT-118A & 118B POWER		
P-01-842	02E02 10E01	2"	6	#10	XHHW-2	1	#10	XHHW-2	FR:		MH-02		P-01-852
									TO:		PB-101P VIA HH-01		
										3 #10	>> GAT-115A & 115B POWER		P-01-532
										3 #10	>> GAT-118A & 118B POWER		P-01-832
P-01-852	10E01	0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR:		PB-102P		
									TO:		PP-PA2		
										3 #10	>> GAT-115A & 115B POWER		P-01-842
										3 #10	>> GAT-118A & 118B POWER		P-01-842
P-01-901	01E03	0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR:		GAT-119		
									TO:		DISCONNECT SWITCH		
										3 #12	>> GAT-119 POWER		
P-01-902	01E03	0.75"	3	#10	XHHW-2	1	#8	XHHW-2	FR:		DISCONNECT SWITCH		
									TO:		TJB-119P		
										3 #10	>> GAT-119 DISCONNECT POWER		
P-01-903	01E03 02E01	2"	3	#8	XHHW-2	1	#8	XHHW-2	FR:		TJB-119P		P-01-913
									TO:		MH-04		
										3 #8	>> GAT-119 & 123 POWER		
P-01-913	02E01 02E02 10E01	2"	6 3	#4 #8	XHHW-2 XHHW-2	1 1	#4 #8	XHHW-2 XHHW-2	FR:		MH-04		P-01-923
									TO:		PB-101P VIA HH-01		
										3 #4	>> GAT-114A & 114B POWER		P-01-442
										3 #4	>> GAT-122A & 122B POWER		P-01-442
										3 #8	>> GAT-119 & 123 POWER		P-01-903
P-01-923	10E01	2"	6 3	#4 #8	XHHW-2 XHHW-2	1 1	#4 #8	XHHW-2 XHHW-2	FR:		PB-102P		
									TO:		PP-PA2		
										3 #4	>> GAT-114A & 114B POWER		P-01-913
										3 #4	>> GAT-122A & 122B POWER		P-01-913
										3 #8	>> GAT-119 & 123 POWER		P-01-913
P-01-990	10E01	1.5"	3	#2	XHHW-2	1	#8	XHHW-2	FR:		PP-PA2		P-01-991
									TO:		PB-102P		
										3 #2	>> PP-PA2 POWER		

CONDUIT SCHEDULE AREA 01

JRWTP POND IMPROVEMENTS

SETTLING PONDS AND SETTLED WATER PUMP STATION STRUCTURES

ENGINEER	**MJG**
REVISION	**0**
DATE	7/25/22

CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
P-01-991	02E01 10E01	2"	3	#2	XHHW-2	1	#8	XHHW-2	FR: PB-101P TO: STUB-UP 3 #2 >> PP-PA2 POWER	P-01-992 P-01-990
P-01-992	01E02	1.5"	3	#2	XHHW-2	1	#8	XHHW-2	FR: STUB-UP TO: MCC-4 3 #2 >> PP-PA2 POWER	 P-01-991
P-01-995	10E01	0.75"	3	#8	XHHW-2	1	#10	XHHW-2	FR: T-35 TO: PP-PA2 3 #8 >> T-35 POWER	
X-01-001	01E03 02E01	2"	1	PULL	ROPE				FR: PB-120C TO: MH-04 1 PULL >> SPARE	
X-01-011	01E02 02E01 02E02	2"	1	PULL	ROPE				FR: MH-04 TO: PB-101C VIA MH-02, HH-03 1 PULL >> SPARE	
X-01-201	01E04 02E01	2"	1	PULL	ROPE				FR: PB-122C TO: MH-05 1 PULL >> SPARE	
X-01-401	01E04 02E01	2"	1	PULL	ROPE				FR: PB-114C TO: MH-05 1 PULL >> SPARE	
X-01-411	02E01	2"	1	PULL	ROPE				FR: MH-05 TO: MH-04 1 PULL >> SPARE	
X-01-501	01E02 02E02	2"	1	PULL	ROPE				FR: PB-115C TO: MH-02 1 PULL >> SPARE	
X-01-601	01E05 02E01	2"	1	PULL	ROPE				FR: PB-116C TO: MH-04 VIA HH-06 1 PULL >> SPARE	
X-01-701	01E02 02E02	2"	1	PULL	ROPE				FR: PB-117C TO: MH-02 VIA HH-01 1 PULL >> SPARE	
X-01-801	01E02 02E02	2"	1	PULL	ROPE				FR: PB-118C TO: MH-02 VIA HH-03 1 PULL >> SPARE	
X-01-901	01E03 02E01	2"	1	PULL	ROPE				FR: PB-119C TO: MH-04 1 PULL >> SPARE	
X-01-911	01E02 02E01 02E02	2"	1	PULL	ROPE				FR: MH-04 TO: PB-101C VIA MH-02, HH-03 1 PULL >> SPARE	
X-01-991	02E02 10E01	2"	1	PULL	ROPE				FR: HH-01 TO: PB-101P 1 PULL >> SPARE	
X-01-992	02E02 10E01	2"	1	PULL	ROPE				FR: HH-01 TO: PB-101P 1 PULL >> SPARE	

END OF CONDUIT SCHEDULE

END OF SECTION

SECTION 26_08_50

FIELD ELECTRICAL ACCEPTANCE TESTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Responsibilities for testing the electrical installation.
   2. Adjusting and calibration.
   3. Acceptance tests.

B. Copyright information:
   1. Some portions of this Section are copyrighted by the InterNational Electrical Testing Association, Inc. (NETA). See NETA publication ATS for details.

1.02 REFERENCES

A. General standards:
   1. As specified in Section 26_05_00 - Common Work Results for Electrical.
   2. Specification sections for the electrical equipment being tested.
   3. Shop drawings.

B. National standards:
   1. American National Standards Institute (ANSI).
   2. ASTM International (ASTM):
      a. D877 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
      b. D923 - Standard Practices for Sampling Electrical Insulating Liquids.
      c. D924 - Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
      d. D971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
      e. D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration.
      f. D1298 - Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
      g. D1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
      h. D1524 - Standard Test Method for Visual Examination of Used Electrical Insulating Liquids in the Field.
      i. D1816 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.
      j. D2285 - Standard Test Method for Interfacial Tension of Electrical Insulating Oils of Petroleum Origin Against Water by the Drop Weight Method.
      k. D3612 - Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography.

3. Institute of Electrical and Electronics Engineers (IEEE):
    a. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
    b. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
    c. 95 - IEEE Recommended Practice for Insulation Testing of AC Electric Machinery (2300 V and Above) With High Direct Voltage.
    d. 421.3 - IEEE Standard for High-Potential Test Requirement for Excitation Systems for Synchronous Machines.
    e. 450 - IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
    f. 1106 - IEEE Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications.
    g. 1188 - IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.
    h. C57.13 - IEEE Standard Requirements for Instrument Transformers.
    i. C57.13.1 - IEEE Guide for Field Testing of Relaying Current Transformers.
    j. C57.13.3 - IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.
    k. C57.104 - IEEE Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers.
4. Insulated Cable Engineer's Association (ICEA).
5. InterNational Electrical Testing Association (NETA).
    a. ATS- Standard for Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
6. International Electrotechnical Commission (IEC).
7. Manufacturer's testing recommendations and instruction manuals.
8. National Fire Protection Association (NFPA):
    a. 70 - National Electrical Code (NEC).
    b. 110 - Standard for Emergency and Standby Power Systems.
9. National Institute of Standards and Technology (NIST).

1.03 DEFINITIONS

A. Project definitions:
    1. As specified in Sections 01_75_17 - Commissioning and 26_05_00 - Common Work Results for Electrical.

B. Specific definitions:
    1. Testing laboratory: The organization performing acceptance tests.

1.04 SYSTEM DESCRIPTION

A. General requirements:
    1. Testing of all electrical equipment installed under this Contract in accordance with the manufacturer's requirements and as specified in this Section.

2. Conduct all tests in the presence of the Engineer or the Engineer's representative:
    a. Engineer will witness all visual, mechanical, and electrical tests, and inspections.
3. The testing and inspections shall verify that the equipment is operational within the tolerances required and expected by the manufacturer, and these Specifications.

B. Responsibilities:
1. Contractor responsibilities:
    a. Ensure that all resources are made available for testing, and that all testing requirements are met.
2. Electrical subcontractor responsibilities:
    a. Perform routine tests during installation.
    b. Demonstrate operation of electrical equipment.
    c. Commission the electrical installation.
    d. Provide the necessary services during testing, and provide these services to the testing laboratory, Contractor, and other subcontractors, including but not limited to:
        1) Providing electrical power as required.
        2) Operating of electrical equipment in conjunction with testing of other equipment.
        3) Activating and shutting down electrical circuits.
        4) Making and recording electrical measurements.
        5) Replacing blown fuses.
        6) Installing temporary jumpers.
3. Testing laboratory responsibilities:
    a. Perform all acceptance tests specified in this Section.
    b. Provide all required equipment, materials, labor, and technical support during acceptance tests.

1.05 SUBMITTALS

A. General submittal requirements:
1. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Copper Ethernet test form:
1. Cable test reports:
    a. Submit 3 copies of test reports showing the results of all tests specified in this Section:
        1) Test type.
        2) Test location.
        3) Test date.
        4) Cable number.
        5) Cable length.
        6) Certification that the cable meets or exceeds the specified standard.
    b. Furnish hard copy and electronic copy for all traces.

C. Manufacturers' testing procedures:
1. Submit manufacturers' recommended testing procedures and acceptable test results for review by the Engineer prior to beginning testing.

D. Test report:
   1. Include the following:
      a. Summary of Project.
      b. Description of equipment tested.
      c. Description of tests performed.
      d. Test results.
      e. Conclusions and recommendations.
      f. Completed test forms.
      g. List of test equipment used and calibration dates.
      h. LAN cable test reports.

E. Test data records:
   1. Include the following:
      a. Identification of the testing organization.
      b. Equipment identification.
      c. Nameplate data.
      d. Humidity, temperature and or other conditions that may affect the results of the tests and or calibrations.
      e. Dates of inspections, tests, maintenance and or calibrations.
      f. Indication of the inspections, tests, maintenance, and or calibrations to be performed and recorded.
      g. Expected results when calibrations are to be performed.
      h. Indication of as-found and as-left results as applicable.
      i. Indication of all test results outside specified tolerances.

F. Testing laboratory qualifications:
   1. Submit a complete resume and statement of qualifications from the proposed testing laboratory detailing their experiences in performing the tests specified:
      a. This statement will be used to determine whether the laboratory is acceptable, and shall include:
         1) Corporate history and references.
         2) Resume of individual performing test.
         3) Equipment list and test calibration data.

G. Division of responsibilities:
   1. Submit a list identifying who is responsible for performing each portion of the testing.

1.06 QUALITY ASSURANCE

A. Testing laboratory qualifications:
   1. The testing laboratory may be qualified testing personnel from the electrical subcontractor's staff or an independent testing company.
   2. NETA certification required.
   3. Selection of the testing laboratory and testing personnel is subject to approval by the Engineer based on testing experience and certifications of the individuals and testing capabilities of the organization.

1.07 DELIVERY, STORAGE, AND PROTECTION (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. General site and project conditions:
   1. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING

A. Prior to testing:
   1. At least 30 days before commencement of the acceptance tests, submit the manufacturer's complete field testing procedures to the Engineer and to the testing laboratory, complete with expected test results and tolerances for all equipment to be tested.

B. Perform testing in the following sequence:
   1. Perform routine tests as the equipment is installed including:
      a. Insulation-resistance tests.
      b. Continuity tests.
      c. Rotational tests.
   2. Adjusting and preliminary calibration.
   3. Acceptance tests.
   4. Demonstration.
   5. Commissioning and plant start-up.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

A. Test instrument calibration:
   1. Utilize a testing laboratory with a calibration program which maintains all applicable test instrumentation within rated accuracy.
      a. The calibrating standard shall be of better accuracy than that of the equipment tested.
   2. The accuracy shall be traceable to the NIST in an unbroken chain.
   3. Calibrate instruments in accordance with the following frequency schedule:
      a. Field instruments: 6 months maximum.

b. Laboratory instruments: 12 months maximum.
c. Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.

4. Dated calibration labels shall be visible on all test equipment.
5. Maintain an up-to-date instrument calibration record for each test instrument:
   a. The records shall show the date and results of each calibration or test.
6. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.

B. Requirements prior to testing:
1. Do not begin testing until the following conditions have been met:
   a. All instruments required are available and in proper operating condition.
   b. All required dispensable materials such as solvents, rags, and brushes are available.
   c. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment are available or scheduled.
   d. All instruction books, calibration curves, or other printed material to cover the electrical devices are available.
   e. Data sheets to record all test results are available.

C. Engine generator tests:
1. The following individuals must be present and remain at the site during the entire field testing of the engine generator:
   a. Manufacturer's field engineer for the voltage regulator.
   b. Manufacturer's field engineer for the governor and governor controller.
   c. Manufacturer's field engineer for the switchgear.
   d. Load bank operator.
   e. Electrical contractor.

3.03 INSTALLATION

A. Test decal:
1. The testing laboratory shall affix a test decal on the exterior of equipment or equipment enclosure of protective devices after performing electrical tests.
2. The test decal shall be color coded to communicate the condition of maintenance of the protective. The color scheme for condition of maintenance of overcurrent protective devices shall be:
   a. White: electrically and mechanically acceptable.
   b. Yellow; minor deficiency not affecting fault detection and operation, but minor electrical or mechanical condition exists.
3. The decal shall include the following information at a minimum:
   a. Testing organization.
   b. Project identifier.
   c. Test date.
   d. Technician identifier.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. General commissioning requirements:
   1. As specified in Section 01_75_17 - Commissioning.

B. Testing and Training Phase: Installation Testing:
   1. Also called "Field Acceptance Testing".

C. Panelboards:
   1. Cleaning:
      a. Visually inspect panelboard for evidence of discoloration, abnormal dust accumulation, metal shards, or any other indication of overheating, wear, or other abnormal conditions prior to cleaning.
      b. Clean cabinet with a brush, vacuum cleaner, or clean, dry, lint-free rags to remove any accumulation of dust, dirt, or other foreign matter. Do not use liquids, solvents or detergents when cleaning panelboards or components.
      c. Avoid blowing dust into panelboards. Do not use a blower or compressed air.
      d. Clean Supports, terminals, and other major insulating surfaces with clean, dry, lint-free rags or soft bristled brushes.
      e. Remove dust, soot, grease, moisture, and foreign material from surface of circuit breakers.
   2. General:
      a. Compare equipment nameplate data with the Contract Documents.
      b. Check panelboard circuit schedule for accuracy.
      c. Verify appropriate anchorage, required area clearances, and correct alignment.
      d. Inspect overall general condition for physical damage. Check for broken studs and loose or damaged wires, connector, terminations, etc. Check all bolts, nuts, washer, and pins for tightness. Tighten or use manufacture’s replacement parts as required.
      e. Inspect cabinets for signs of rust, corrosion, or deteriorating paint. Inspect cabinets for evidence of localized heat damage to the paint. Investigate sources of heat. Repair painted surfaces.
      f. Check that covers are in place and fastened. Plug any open unused knockouts.
      g. Inspect panelboard for moisture. Seal off any cracks or openings which have allowed moisture to enter the cabinet. Inspect all component devices. Replace any components that show evidence of damage from moisture.
      h. Look for any recent changes in sprinklers or other plumbing that might expose indoor panelboards to a source of liquids. Eliminate sources of water, moisture, or liquids, or provide adequate barriers to protect panelboards from sources of water, moisture, or liquids.
      i. Inspect panelboards and internal components for evidence of overheating, arc spatter, sooty deposits, and tracking. Investigate and correct sources of arcing or overheating. Consult the panelboard manufacturer for recommendations.
      j. Verify that fuse and/or circuit breaker sizes and types correspond to record drawings, if available, as well as to the circuit breaker’s address for microprocessor communications packages, if equipped.

3. Terminations, Connections, and Lugs:
    a. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections:
                (1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
        2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    b. Inspect terminations, connection, and lugs for alignment, physical damage, burns, corrosion, discoloration, flaking, heat damage, arcing, pitting, melting, deterioration, carbonization, cracks, chips, breaks, partial discharge, or moisture. Investigate and eliminate sources of any damage.
    c. Follow manufacturer recommendations for cleaning, repairing, and replacing damaged parts.
    d. Replace overheated connections. Tighten connections to proper to proper torque levels as specified above.
4. Conductors and raceways:
    a. Inspect supply conductors and terminations for overheating, discoloration, and oxidation. Investigate and correct any deficiencies.
    b. Ensure the conductors are protected within their ampacities.
    c. Visually check panelboard, cables, and raceways for proper bonding and grounding. Correct improper bonding and grounding.
    d. Inspect conductors for discoloration, arcing, pitting, melting, flaking of insulation and/or metal parts. Repair or replace damaged components in accordance with manufacturer's recommendations.
    e. Inspect for frayed or broken wires. Replace or repair damaged components in accordance with manufacturer recommendations.
    f. Inspect for frayed or broken wires. Replace or repair conductors as necessary.
    g. Inspect conduits for moisture. Seal conduits which are a source of moisture and provide means to drain moisture away from the panelboard.
5. Circuit breakers:
    a. Breakers rated less than 100 A:
        1) Operate circuit breakers several times in order to exercise the mechanisms and the contacts, and to ensure smooth operation. Do not oil or grease parts of molded case circuit breakers.
        2) Visually check circuit breakers for evidence of overheating and thermal damage. Investigate and eliminate sources of overheating.
        3) Check circuit breakers for visual defects, chipping, cracks, breaks, burns, and deterioration. Replace damaged circuit breakers.
        4) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
        5) Inspect interchangeable trip-unit circuit breakers for tightness of trip units.
        6) Check circuit breaker terminals and connections for tightness as specified above.

b. Breakers rated 100 A and higher:
    1) Perform visual and mechanical inspection as specified in this Section.
    2) Perform electrical tests as specified in this Section.

D. Dry type transformers:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate data with the Contract Documents.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, and grounding.
    d. Verify that resilient mounts are free and that any shipping brackets have been removed.
    e. Inspect equipment for cleanliness.
    f. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    g. Verify that as-left tap connections are as specified.
2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:
        1) Apply voltage in accordance with manufacturer's published data.
            a) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Calculate dielectric absorption ration or polarization index.
    d. Perform turns ratio tests at all tap positions.
    e. Verify correct secondary voltage, phase-to-phase and phase-to-neutral after energization and before loading.
3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Tap connections are left as found unless otherwise specified.
    d. Minimum insulation-resistance values of transformer insulation shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
        2) Investigate insulation values less than the allowable minimum.
    e. The dielectric absorption ratio or polarization index shall not be less than 1.0.

f. Turns-ratio results should not deviate more than 1/2 percent from either the adjacent coils or calculated ratio.
g. Phase-to-phase and phase-to-neutral secondary voltages shall be in agreement with nameplate data.

E. Low voltage cables, 600 volt maximum:
1. Visual and mechanical inspection:
a. Compare cable data with the Drawings and Specifications.
b. Inspect exposed sections of cable for physical damage and correct connection as indicated on the Drawings.
c. Inspect bolted electrical connections for high resistance by one of the following methods:
1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
d. Inspect compression applied connectors for correct cable match and indentation.
e. Inspect for correct identification and arrangement.
f. Inspect cable jacket insulation and condition.
2. Electrical tests:
a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
b. Perform insulation resistance test on each conductor sized #8 AWG or larger with respect to ground and adjacent conductors:
1) Applied potential shall be 500 volts dc for 300 volt rated cable and 1,000 volts dc for 600 volt rated cable.
2) Test duration shall be 1 minute.
c. Perform polarization index tests on low voltage cables to confirm suitable insulation resistance after cable pulling. Polarization index value shall not be less than 2.0.
d. Perform continuity tests on all power and control conductors to insure correct cable connection.
e. Verify uniform resistance of parallel conductors.
3. Test values:
a. Compare bolted connection resistance values to values of similar connections:
1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Insulation-resistance values shall be in accordance with manufacturer's published data:
1) Refer to NETA ATS tables in the absence of manufacturer's published data.
2) Investigate values of insulation-resistance less than the allowable minimum.
c. Cable shall exhibit continuity.
d. Deviations in resistance between parallel conductors shall be investigated.

F. Low voltage molded case and insulated case circuit breakers:
   1. Visual and mechanical inspection:
      a. Compare equipment nameplate data with the Contract Documents.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage and alignment.
      d. Verify the unit is clean.
      e. Operate the circuit breaker to ensure smooth operation.
      f. Inspect bolted electrical connections for high resistance by one of the following methods:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
      g. Perform adjustments for final protective device settings in accordance with the coordination study.
   2. Electrical tests:
      a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
      b. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed and across each open pole:
         1) Apply voltage in accordance with manufacturer's published data.
         2) Refer to NETA ATS tables in the absence of manufacturer's published data.
      c. Perform a contact/pole-resistance test.
      d. Determine long-time pickup and delay by primary current injection.
      e. Determine short-time pickup and delay by primary current injection.
      f. Determine ground-fault pickup and delay by primary current injection.
      g. Determine instantaneous pickup value by primary current injection.
      h. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
      i. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function and trip unit battery condition:
         1) Reset all trip logs and indicators.
      j. Verify operation of charging mechanism.
   3. Test values:
      a. Compare bolted connection resistance values to values of similar connections:
         1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      b. Bolt-torque levels shall be in accordance with manufacturer's published data:
         1) Refer to NETA ATS tables in the absence of manufacturer's published data.
      c. Insulation-resistance values shall be in accordance with manufacturer's published data:
         1) Refer to NETA ATS tables in the absence of manufacturer's published data.
         2) Investigate values of insulation-resistance less than the allowable minimum.

d. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
    1) If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.
e. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band including adjustment factors:
    1) If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.
f. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
g. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
h. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances:
    1) Refer to NETA ATS tables in the absence of manufacturer's published data.
i. Pickup values and trip characteristics shall be within manufacturer's published tolerances.
j. Determine energy reducing maintenance switch pickup value by primary current injection.
k. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.
l. The charging mechanism shall operate in accordance with manufacturer's published data.

G. Grounding systems:
1. Visual and mechanical inspection:
    a. Inspect ground system for compliance with the Contract Documents, and the NEC.
    b. Inspect physical and mechanical condition.
    c. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    d. Inspect anchorage.
2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform fall of potential test or alternative test in accordance with IEEE 81 on the main grounding electrode or system.
    c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, the system neutral and any derived neutral points.

3. Test values:
    a. Grounding system electrical and mechanical connections shall be free of corrosion.
    b. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    c. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    d. The resistance between the main grounding electrode and ground shall be as specified in Section 26_05_26 - Grounding and Bonding.
    e. Investigate point-to-point resistance values that exceed 0.5 ohm.

H. Motor control centers, low voltage:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate data with the Contract Documents.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding and required clearances.
    d. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
    e. Verify that circuit breaker/fuse sizes and types correspond to the approved submittals and the coordination study.
    f. Verify that current and voltage transformer ratios correspond to those indicated on the Drawings.
    g. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
    h. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    i. Verify operation and sequencing of interlocking systems:
        1) Attempt closure on locked-open devices.
        2) Attempt to open locked-closed devices.
        3) Make/attempt key-exchanges in all positions.
    j. Lubrication requirements:
        1) Verify appropriate lubrication on moving current-carrying parts.
        2) Verify appropriate lubrication on moving and sliding surfaces.
    k. Inspect insulators for evidence of physical damage or contaminated surfaces.
    l. Verify correct barrier and shutter installation and operation.
    m. Exercise all active components.
    n. Inspect all indicating devices for correct operation.
    o. Verify that filters are in place and/or vents are clear.
    p. Perform visual and mechanical inspection of instrument transformers as specified in this Section.

q. Perform visual and mechanical inspection of surge arresters as specified in this Section.
r. Inspect control power transformers:
    1) Inspect for physical damage, cracked insulation, broken leads, and tightness of connections, defective wiring, and overall general condition.
    2) Verify that primary and secondary fuse/circuit breaker ratings match the submittal drawings.
    3) Verify correction functioning of grounding contacts.
s. Perform visual and mechanical inspection of all motor control center components as specified in this Section.

2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute:
        1) Perform test in accordance with NETA ATS tables.
    c. Perform a dielectric withstand test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data or NETA ATS tables. Apply the test voltage for 1 minute.
    d. Perform ground-resistance tests:
        1) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral and derived neutral points.
    e. Control power transformers:
        1) Perform insulation-resistance tests, winding-to-winding and winding-to-ground:
            a) Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.
        2) Perform secondary wiring integrity test:
            a) Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:
                (1) Verify correct potential at all devices.
        3) Verify correct secondary voltage by energizing primary winding with system voltage:
            a) Measure secondary voltage with the secondary wiring disconnected.
    f. Verify operation of space heaters.
    g. Perform electrical tests of all motor control center components as specified in this Section.

3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Insulation-resistance values for bus and control power transformers shall be in accordance with manufacturer's published data:
    1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    2) Investigate insulation values less than the allowable minimum.
    3) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
d. Bus insulation shall withstand the over potential test voltage applied.
e. Instrument transformer test values shall be as specified in this Section.
f. Investigate grounding system point-to-point resistance values that exceed 0.5 ohm.
g. Meter accuracy shall be in accordance with manufacturer's published data.
h. Control power transformers:
    1) Insulation-resistance values of control power transformers shall be in accordance with manufacturer's published data:
        a) Refer to NETA ATS tables in the absence of manufacturer's published data.
        b) Investigate insulation values less than the allowable minimum.
        c) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
    2) Secondary wiring shall be as indicated on the Drawings and specified in the Specifications.
    3) Secondary voltage shall be as indicated on the Drawings.
i. Heaters shall be operational.
j. Test values for motor control center components shall be as specified in this Section.

l. Surge arresters, low-voltage:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate data with the Contract Documents.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding, and clearances.
    d. Verify the arresters are clean.
    e. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
    g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.
    h. Record stroke counter reading.
2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform an insulation-resistance test on each arrester, phase terminal- to- ground:
    1) Apply voltage in accordance with manufacturers published data.
    2) Refer to NETA ATS tables in the absence of manufacturer's published data.
c. Test grounding connection as specified in this Section.

3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Insulation-resistance values shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
        2) Investigate insulation values less than the allowable minimum.
    d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.

J. Switches, air, low-voltage:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate data with the Contract Document.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding, and required clearances.
    d. Verify the unit is clean.
    e. Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
    f. Verify that fuse sizes and types as indicated on the Drawings, short-circuit studies, and coordination study.
    g. Verify that each fuse has adequate mechanical support and contact integrity.
    h. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of a low resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    i. Verify operation and sequencing of interlocking systems.
    j. Verify correct phase barrier installation.
    k. Verify correct operation of all indicating and control devices.
    l. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Measure contact resistance across each switchblade and fuseholder.
c. Perform insulation-resistance tests for 1 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:
    1) In the absence of manufacturer's published data, use NETA ATS requirements.
d. Measure fuse resistance.
e. Verify cubicle space heater operation.
f. Perform ground fault test as specified in this Section, if applicable.
g. Perform tests on other protective devices as specified in this Section, if applicable.

3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connection by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
4. Test values - electrical:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
        1) If manufacturer's published data is not available, investigate values which deviate from those of similar bus connections and sections by more than 50 percent of the lowest value.
    c. Insulation-resistance values shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
        2) Investigate insulation values less than the allowable minimum.
    d. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
    e. Heaters shall be operational.
    f. Ground fault tests shall be as specified in this Section.
    g. Results of protective device tests shall be as specified in this Section.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. After the acceptance tests have been completed, dispose of all testing expendables, vacuum all cabinets, and sweep clean all surrounding areas.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_22_14

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Enclosed dry-type transformers:
      a. Rated 1 to 1,000 kilovolt-amperes, single and 3-phase.
      b. Primary voltage 600 volts and below.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 389 - IEEE Recommended Practice for Testing Electronics Transformers and Inductors.
   2. C57.12.01 - IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin Encapsulated Windings.
   3. C57.96 - IEEE Guide for Loading Dry-Type Distribution and Power Transformers.

C. Underwriters Laboratory (UL):
   1. 1561 - Standard for Dry-Type General Purpose and Power Transformers.

D. U.S. Department of Energy (DOE):
   1. 10 CFR Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTIONS

A. Provide 3-phase or 1-phase, 60 hertz dry-type with voltage ratings, kilovolt-ampere capacities, and connections as indicated on the Drawings:
   1. Transformers shall provide full capacity at the Project elevation and environmental conditions as specified in Section 26_05_00 - Common Work Results for Electrical after all derating factors have been applied.
   2. Suitable for continuous operation at full rating with normal life expectancy in accordance with IEEE C57.96.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures and 26_05_00 - Common Work Results for Electrical.

B. Product data:
   1. Catalog cutsheets.
   2. Nameplate data.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
   4. Inrush current.
   5. Insulation system and temperature constraints.
   6. Number and rating of taps.
   7. Sound levels.
   8. Connection diagrams:
      a. Primary.
      b. Secondary.
   9. BIL rating.
   10. Required clearances.
   11. Percent impedance.
   12. Efficiency.
   13. Certification of full capacity capability at the Project elevation and ambient conditions.
   14. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 26_05_00 - Common Work Results for Electrical:
      a. Manufacturer's statement of seismic qualification with substantiating test data.
      b. Manufacturer's special seismic certification with substantiating test data.

C. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. For equipment installed in structures designated as seismic design category A or B:
      a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
   3. For equipment installed in structures designated as seismic design category C, D, E, or F:
      a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 26_05_00 - Common Work Results for Electrical.
      b. Submit anchoring drawings with supporting calculations.
      c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. GE by ABB.
   2. Jefferson.
   3. Schneider Electric.
   4. Eaton.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Cores:
   1. Non-aging, grain-oriented silicon steel.
   2. Magnetic flux densities below the saturation point.

B. Windings:
   1. High-grade magnet wire.
   2. Impregnated assembly with non-hydroscopic, thermo-setting varnish:
      a. Cured to reduce hot-spots and seal out moisture.
   3. Material electrical grade:
      a. Copper.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. General:
   1. 10 kilovolts BIL for 600-volt class windings.

2. Sound levels, in accordance with IEEE 389 test conditions, not to exceed:

Kilovolt-Amperes Range	Audible Sound Level (db)
1-9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-700	62
701-1000	64

3. Taps:
   a. 15 kilovolt-amperes and less:
      1) Two 5 percent full capacity primary taps below rated voltage.
   b. 25 kilovolt-amperes and larger:
      1) Four 2.5 percent full capacity primary taps below rated voltage.
      2) Two 2.5 percent full capacity primary taps above rated voltage.
   c. Operated by a tap changer handle or tap jumpers accessible through a panel.
4. Terminals:
   a. UL listed for either copper or aluminum conductors.
   b. Rated for 75 degrees Celsius.
5. Daily overload capacities, at rated voltage and without reduction in life, in accordance with IEEE C57.96.

B. Transformers less than 15 kilovolt-amperes:
   1. Insulation class: 185 degrees Celsius.
   2. Temperature rise: 115 degrees Celsius.

C. Energy efficient transformers 15 kilovolt-amperes and larger:
   1. Insulation class: 220 degrees Celsius.
   2. Temperature rise: 80 degrees Celsius, except as noted below:
      a. 150-degree Celsius rise for dry-type transformers located in motor control centers.
   3. Efficiency:
      a. In accordance with DOE 10 CFR Part 431.

D. Enclosures:
   1. Heavy gauge steel:
      a. Outdoor: Moisture and water resistant with rodent screens over all openings and in a weather-protected enclosure, NEMA Type 3R.
      b. Indoor: NEMA Type 2.
   2. Louvers to limit coil temperature rise to the value stated above, and case temperature rise to 50 degrees Celsius.
   3. Built-in vibration dampeners to isolate the core and coils from the enclosure:
      a. Neoprene vibration pads and sleeves.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Nameplates:
   1. Non-corrosive metal or UL listed non-metallic:
      a. Stamped, engraved or printed with the following information:
         1) Phases.
         2) Frequency.
         3) Kilovolt-ampere rating.
         4) Voltage ratings.
         5) Temperature rise.
         6) Impedance.
         7) Insulation class.
         8) BIL rating.
         9) Connection diagram.
         10) Weight.
         11) Manufacturer.
         12) The identification “transformer”.
         13) Classes of cooling.
         14) Tap voltage(s).
         15) Vector diagram.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Finish to consist of de-greasing, phosphate cleaning, and an electrodeposited manufacturer’s standard gray enamel rust-inhibiting paint.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Mounted as indicated on the Drawings.
   2. Install where not in direct contact with building structure.
   3. Install on single layer vibration pad under the entire mounting surface.
      a. Manufacturers: The following or equal:
         1) Korfund.

4. Make any necessary connections to the enclosure with liquidtight flexible conduit having neoprene gaskets and insulated ground bushings.
5. Ground the enclosure:
    a. To an equipment ground conductor in the conduit.
    b. To the facility grounding electrode system.
6. Floor mounted transformers:
    a. Install transformers on a housekeeping pads.
    b. Install transformers with adequate space from walls or other enclosures for proper ventilation in accordance with the manufacturer's recommendations.

3.04 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

B. Factory tests:
    1. Applied voltage test to each winding and from each winding to the core:
        a. 600-volt class winding 4.5 kilovolt.
    2. Induced voltage test at 2 times normal voltage and 400 hertz for 1,080 cycles.
    3. Voltage ratio and polarity.
    4. Sound level, performed in a test room with ambient sound level not exceeding 24 db.
    5. Perform all tests in accordance with UL 1561.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.09 ADJUSTING

A. Set the transformer taps as required to obtain nominal output voltage on the secondary terminals.

3.10 CLEANING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.11 PROTECTION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_24_16

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Panelboards serving feeder circuits and branch circuits.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Underwriter's Laboratories, Inc. (UL):
   1. 67 - Standard for Panelboards.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Circuit breaker panelboards as indicated in the panelboard schedules, one-lines, and where indicated on the Drawings:
   1. Service voltage and configuration as indicated on the panel schedules.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures and 26_05_00 - Common Work Results for Electrical.

B. Product data:
   1. Manufacturer of panelboard.
   2. Bill of material.
   3. Assembly ratings including:
      a. Voltage.
      b. Phase.
      c. Continuous current.
      d. Short circuit interrupting rating.
   4. NEMA enclosure type.
   5. Cable terminal sizes based upon actual feeder and sub-feeder conductors used.
   6. Furnish circuit breaker submittals as specified in Section 26_28_01 - Low Voltage Molded Case Circuit Breakers.
   7. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 26_05_00 - Common Work Results for Electrical:
      a. Manufacturer’s statement of seismic qualification with substantiating test data.

b. Manufacturer's special seismic certification with substantiating test data.

C. Shop drawings:
1. Drawings to contain:
a. Overall panelboard dimensions, interior panel dimensions, and wiring gutter dimensions:
1) Height.
2) Length.
3) Width.
b. Weight.
c. Anchoring locations.
d. Breaker layout drawing with dimensions:
1) Location of the main, branches, solid neutral, and ground.
e. Conduit entry/exit locations:
1) Identify all conduit entry/exit locations and restrictions.
f. Individual panel schedules identifying breaker locations, ratings, and nameplate designations within the panelboard, for every panelboard.

D. Installation instructions:
1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
2. For equipment installed in structures designated as seismic design category A or B:
a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
3. For equipment installed in structures designated as seismic design category C, D, E, or F:
a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 26_05_00 - Common Work Results for Electrical.
b. Submit anchoring drawings with supporting calculations.
c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operations and maintenance manual:
1. Provide a complete manual for the operation and maintenance of the panelboard, circuit breakers, devices, and accessories:
a. Including but not limited to:
1) Instruction narratives and bulletins.
2) Renewal parts lists.
3) Time-current curves for all devices.

F. Calculations:
1. Detailed calculations or details of the actual physical testing performed on the panelboard to prove the panelboard is suitable for the seismic requirements at the Project Site.

1.06 QUALITY ASSURANCE

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Panelboards shall be UL listed and labeled.
   1. Where indicated as service entrance equipment, panelboards shall be UL labeled and listed “Suitable for Service Entrance.”

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.13 OWNER’S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Eaton.
   2. GE by ABB.
   3. Schneider Electric.

B. Circuit breakers:
   1. Same manufacturer as the panelboard.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Provide panelboards with:
   1. Molded-case circuit breakers with trip ratings as shown on the panel schedules.

2. Spares and spaces for future circuit breakers in panels as shown on the panel schedules.

B. Short circuit rating:
   1. Provide panelboards with short-circuit ratings as indicated on the Drawings:
   2. Testing method in accordance with UL 67.
   3. Mark each panelboard with its maximum short circuit rating at the supply voltage.
   4. Panelboards shall be fully rated.

2.06 COMPONENTS

A. Enclosure:
   1. NEMA enclosure type as indicated on the Drawings.
      a. Where not indicated on the Drawings, as specified in Section 26_05_00 - Common Work Results for Electrical for the installed location.
   2. Minimum width: 20 inches.
   3. Gutter space in accordance with the NEC:
      a. Minimum of 4 inches of gutter space.
   4. Dead-front, no live parts when the panelboard is in service.
   5. Enclose entire panelboard bus assembly in a corrosion resistant galvanized steel cabinet.
   6. 4-piece front to provide ease of wiring access.
   7. Lockable, hinged door over the protective devices with a flush, cylinder tumbler-type lock with catch and door pull.
      a. Minimum 2 keys per panelboard.
      b. Key all panelboard locks alike.
         1) Match locks on existing panelboards to the extent possible.
   8. Circuit directory frame and card on the inside of the door.
   9. Door-in-door construction consists of a one-piece front with 2 doors:
      a. The smaller door provides access to all device handles and rating labels and shall be lockable.
      b. The larger door provides access to all conductors and wiring terminals.
   10. Interior design such that replacement of circuit breakers does not require disturbing adjacent units or removal of the main bus connectors.
   11. Outdoor locations: Provide NEMA Type 4X enclosures with a NEMA Type 4X stainless steel outer enclosure (with a hinged door) and a NEMA Type 1 interior panelboard, unless otherwise indicated.

B. Bus:
   1. General:
      a. Tin-plated copper.
   2. Phase bus:
      a. Full size and height without reduction.
      b. Dimensions and temperature rise in accordance with UL 67:
         1) Limit current density to less than 1,000 amps per square inch.
      c. Insulate all current carrying parts from ground and phase-to-phase with a high dielectric strength insulator.
   3. Ground bus:
      a. Copper, solidly bonded.
   4. Neutral bus:
      a. Provide where indicated on the Drawings.

b. 100 percent rated.
c. Provide lugs for each outgoing feeder requiring a neutral connection.

5. Provide insulation barriers over the vertical bus behind the dead front shield to provide increased safety during field service.

C. Lugs:
1. UL listed for copper and aluminum wire:
a. Provide lugs rated for 75-degree Celsius terminations.
b. Provide bolted or compression main lug terminations as required for the incoming cable size.

D. Circuit breakers: As specified in Section 26_28_01 - Low Voltage Molded Case Circuit Breakers and as indicated on the Drawings:
1. Provide all circuit breakers with bolt-on connections:
a. Plug-in circuit breakers are not allowed.

2.07 ACCESSORIES

A. Surge protective devices:
1. Furnish panelboards with surge protective devices as indicated on the Drawings.
2. As specified in Section 26_43_14 - Surge Protective Devices.

B. Nameplates:
1. As specified in Section 26_05_53 - Identification for Electrical Systems.
2. Install on outside of door.
3. Indicating:
a. Panel designation.
b. Voltage.
c. Number of phases and configuration.

C. Circuit identification labels:
1. Provide index cards behind heavy clear plastic in cardholders on the inside of the doors.
2. Type all information on the cards using designations in the panel schedules.
3. Laminated on both sides.

D. Pad locking mechanism:
1. Provide a pad locking attachment to allow circuit breakers to be locked in the off position.
2. At a minimum, provide 1 mechanism per panelboard:
a. Provide multiple mechanisms if required to accommodate all circuit breaker frame sizes in the panelboard.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Finish stand-alone panelboards with a primer, rust-resistant phosphate undercoat, and 2 coats of oven-baked enamel with manufacturer’s standard gray.

B. Finish panelboards mounted in motor control centers to match the motor control center finish and color.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Mounted as indicated on the Drawings.
   2. Mount rigidly to structural members with exposed surfaces plumb and level to within 1/32 inch.
   3. Perform work in accordance with the manufacturer's instructions and shop drawings.
   4. Provide all brackets, hangers, supports, and hardware for mounting as required.
   5. In all NEMA Type 4 and NEMA Type 4X locations, mount panelboards on 7/8-inch deep stainless steel preformed channel, with channel running vertically from top to bottom of panelboard:
      a. Use only stainless steel mounting hardware.
   6. Mount panelboard so that top operating handle is not more than 6 feet-7 inches above the operating floor.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

B. Factory testing:
   1. Perform standard factory tests on the panelboards:
   2. Test in accordance with the latest version of NEMA and UL standards.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.11 PROTECTION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.12 SCHEDULES

A. Circuiting within the panelboard shall match the panel schedules as indicated on the Drawings.

B. Provide typewritten schedule in each panelboard.

END OF SECTION

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SECTION 26_28_01

LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Low voltage molded case circuit breakers.
   2. Low voltage molded case circuit breaker MCC feeder breaker units for installation in existing motor control centers.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Underwriter's Laboratories (UL):
   1. 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. In accordance with UL 489.

1.04 SYSTEM DESCRIPTION

A. Molded case thermal magnetic, solid-state, or motor circuit protector type circuit breakers as indicated on the Drawings and connected to form a completed system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures and 26_05_00 - Common Work Results for Electrical.

B. Product data:
   1. Catalog cutsheets.
   2. Manufacturer's time-current curves for all molded case circuit breakers furnished.

1.06 QUALITY ASSURANCE

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Low voltage molded case circuit breakers shall be UL listed and labeled.

1.07 DELIVERY, STORAGE AND HANDLING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal for breakers installed in new equipment:
   1. Eaton.
   2. GE by ABB.
   3. Schneider Electric.
   4. ABB.

2.02 EXISTING PRODUCTS

A. Existing motor control centers:
   1. Provide complete motor control center feeder breaker units to be added to existing motor control centers as specified in this Section and as indicated on the Drawings.
   2. Provide additions that are of the same manufacturer, type, and electrical ratings as the existing motor control centers:
      a. Provide all hardware necessary to connect the busses of the new and existing motor control centers.
   3. Provide enclosures (including doors) to match the NEMA ratings and colors of the existing motor control centers.

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. General:
   1. Conforming to UL 489.
   2. Operating mechanism:
      a. Quick-make, quick-break, non-welding silver alloy contacts.

b. Common Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.
c. Mechanically trip free from the handle.
d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped.
e. Lockable in the "OFF" position.

3. Arc extinction:
   a. In arc chutes.
4. Voltage and current ratings:
   a. Minimum ratings as indicated on the Drawings.
   b. Minimum frame size 100A.
5. Interrupting ratings:
   a. Minimum ratings as indicated on the Drawings.
   b. Modify as required to meet requirements of the short circuit fault analysis - as specified in Section 26_05_74 - Electrical System Studies.
   c. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.).

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Terminals:
   1. Line and load terminals suitable for the conductor type, size, and number of conductors in accordance with UL 489.

B. Case:
   1. Molded polyester glass reinforced.
   2. Ratings clearly marked.

C. Trip units:
   1. Provide thermal magnetic trip units as indicated on the Drawings.
   2. Thermal magnetic:
      a. Instantaneous short circuit protection.
      b. Inverse time delay overload.
      c. Ambient or enclosure compensated by means of a bimetallic element.

D. Provide ground fault trip devices as indicated on the Drawings.

E. Molded case circuit breakers for use in panelboards:
   1. Bolt-on type:
      a. Plug-in type breakers are not acceptable.
   2. Ground fault trip devices as indicated on the Drawings.

2.07 ACCESSORIES

A. Lockable handle:
   1. Provide assembly to lock operating handle in ‘OPEN’ position.
   2. Where a molded case circuit breaker is located in a dedicated enclosure, provide a lockable handle. Reference the Electrical Specifications for additional locking requirements associated with other mounting installations.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Test breakers in accordance with:
   1. UL 489.
   2. Manufacturer's standard testing procedures.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install breakers to correspond to the accepted shop drawings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.09 ADJUSTING

A. Adjust trip settings in accordance with Protective Device Coordination Study as accepted by the Engineer and in accordance with manufacturer's recommendations.

B. Adjust motor circuit protectors in accordance with NEC and the manufacturer's recommendation based on the nameplate values of the installed motor.

3.10 CLEANING (NOT USED)

3.11 PROTECTION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_28_14

LOW VOLTAGE FUSES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fuses: 600-volt class and lower.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Fuses for overcurrent protection and/or current limiting applications as indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. Catalog cut sheets.
   2. Complete fuse schedule.
   3. Manufacturer original 11-inch by 17-inch, time current curves for all fuses furnished.

C. Shop drawings:
   1. Include drawings of spare fuse cabinets.

1.06 QUALITY ASSURANCE

A. All low voltage fuses shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

A. Spare parts:
   1. Provide 3 spare fuses for each size and type used or supplied under any Section of the Contract Documents.
   2. Provide spare fuse cabinet(s):
      a. Metal cabinet with hinged door and shelves or fuse holders.
      b. Gray enamel finish.
      c. Mount near equipment and label "Spare Fuses" on face of cabinet.
      d. Suitable pocket inside door of each cabinet with typewritten spare fuse inventory in clear plastic protective insert.
      e. Provide as many cabinets as required to hold entire spare fuse inventory.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Ferraz Shawmut.
   2. Littelfuse.
   3. Bussmann.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. General:
   1. Provide durable, readily visible label inside each fuse enclosure, clearly indicating the correct type, size, and ratings of replacement fuse:
      a. Label shall not cover or interfere with equipment manufacturer's instructions.
   2. Affix a label indicating recommended torque for fuse mounting bolts or studs to the inside of fuse access doors.
   3. To ensure selective coordination of protective devices:
      a. Provide fuses for new facilities by the same manufacturer.
      b. Provide fuses for renovations of the same manufacturer as existing fuses.
   4. Provide fuses rated for the voltage and available short circuit current at which they are applied.

B. Fuses for services, switchboard mains, feeders, and branch circuits:
   1. 600 amperes and less:
      a. Provide UL listed RK1 dual-element, time-delay fuses with ampere ratings as indicated on the Drawings except as may be modified by the Contract Documents.
   2. 601 to 6,000 amperes:
      a. Provide UL listed Class L fuses.

C. Fuses for motor branch circuits:
   1. Ampere ratings shall not exceed motor controller manufacturer's recommended values:
      a. If manufacturer does not have such standards, provide fuses as specified in this Section.
   2. Provide Class RK1 fuses or fuses as indicated on the Drawings and as specified in the Contract Documents, rated in accordance with the fuse manufacturer's recommendations for backup running protection of motor circuits containing overload relays.
   3. Determine fuse ratings for overload protection of motor branch circuits by actual full-load currents of motors provided.
   4. Fuses in motor control centers may be time-delay Class J or Class CC fuses, if MCC manufacturer's standard designs use these fuse types:
      a. Time-delay Class J fuse ratings shall not exceed 150 percent of motor full load current except as permitted.
      b. Follow fuse manufacturer's recommendations for Class CC fuses.
      c. A motor having starting duty or other special characteristics requiring larger fuses than specified above, may have branch circuit fuse ratings increased as necessary to meet motor's requirements, but no larger than maximum permitted by the NEC.
         1) Increased requirements for an individual motor shall not be cause for increasing size of all fuses.
   5. Provide Class L fuses for motor branch circuits requiring fuses over 600 amperes, sized at 150 percent of motor full load current except as permitted below:
      a. A motor having starting duty or other special characteristics requiring larger fuses than specified above, may have branch circuit fuse ratings increased as necessary to meet motor's requirements, but no larger than maximum permitted by the NEC.
         1) Increased requirements for an individual motor shall not be cause for increasing size of all fuses.

D. Fusing of control circuits:
   1. Provide:
      a. Type RK1 or Time-delay Class CC fuses installed in UL listed Class CC fuse blocks as specified in the Contract Documents and as required for the equipment.
   2. Provide minimum protection for control circuits in accordance with the latest revision of UL Standard 508 for Industrial Control.
   3. Fuse both the primary and secondary circuit of control power transformers:
      a. Fuse ratings shall be in accordance with NEC requirements.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
   1. Install fuses properly aligned, electrically and mechanically secure.
   2. Evenly torque mounting bolts and nuts to ASTM recommendations for type and diameter of mounting bolts or studs provided.
   3. Paralleling of fuses is not permitted.
   4. Install fuses so that the fuse nameplate and rating are easily readable in the equipment.

B. Replace fuses, on all phases, for any fuses that opened during start-up and testing.

C. After completion of testing, deliver spare fuses in quantities specified:
   1. Fuses shall be new, in manufacturer's original packaging, and stored in a clean, dry location.

D. Install spare fuse cabinets where instructed by the Owner.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING (NOT USED)

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

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SECTION 26_28_17

DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fusible and non-fusible disconnect switches.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. National Electric Manufacturer's Association (NEMA):
   1. KS 1-2001 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. Underwriters Laboratories Inc. (UL):
   1. 20 - General-Use Snap Switches.
   2. 98 - Enclosed and Dead-Front Switches.
   3. 508 - Standard for Industrial Control Equipment.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Specific definitions:
   1. Safety switches and disconnect switches are to be considered synonymous.

1.04 SYSTEM DESCRIPTION

A. Provide heavy-duty type disconnect switches as indicated on the Drawings and specified in the Contract Documents.

B. Provide disconnect switches with the number of poles, voltage, current, short circuit, and horsepower ratings as required by the load and the power system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures and 26_05_00 - Common Work Results for Electrical.

B. Product data:
   1. Manufacturer.
   2. Manufacturer's specifications and description.
   3. Ratings:
      a. Voltage.
      b. Current.

c. Horsepower.
d. Short circuit rating.
4. Fused or non-fused.
5. NEMA enclosure type.
6. Dimensions:
a. Height.
b. Width.
c. Depth.
7. Weight.
8. Cross-referenced to the disconnect schedule indicated on the Drawings.

C. Shop drawings:
1. Manufacturer's installation instructions:
a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance, Regulatory Requirements below.
b. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
2. For each switch, indicate nameplate inscription, including voltage, circuit, fuse size (if applicable), and equipment served.

D. Installation instructions:
1. Provide anchorage instructions and requirement based on the seismic requirements at the Project Site as specified in Section 26_05_00 - Common Work Results for Electrical and calculations:
a. Stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Regulatory requirements:
1. NEMA Type KS1- Enclosed and Miscellaneous Distribution Switches (600 V Maximum).
2. UL 98 - Enclosed and Dead-Front Switches.

C. Disconnect switches shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 26_05_74 - Electrical System Studies and submit results for Engineer’s review.

B. After successful review of the initial fault current study, submit complete equipment submittal.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.12 SYSTEM START-UP

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Schneider Electric.
   2. Eaton.
   3. GE by ABB.
   4. Siemens.
   5. Appleton.
   6. Crouse-Hinds.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Switch mechanism:
   1. Quick-make, quick-break heavy-duty operating mechanisms:
      a. Provisions for padlocking the switch in the Off position.
      b. A minimum of 90-degree handle travel position between Off and On positions:
         1) Provide handle position indicators to identify the handle position.
      c. Full cover interlock to prevent opening of the switch door in the On position and to prevent closing the switch mechanism with the door open:
         1) With an externally operated override.

B. Switch interior:
   1. Switch blades visible when the switch is Off and the cover is open.
   2. Lugs:
      a. Front accessible.

b. Removable.
c. UL listed for 60/75-degree Celsius copper conductors.

3. Current carrying parts completely plated to resist corrosion.
4. Removable arc suppressors to facilitate easy access to line side lugs.
5. Furnish equipment ground kits for every switch.

C. Fused switches:
1. Furnish with fuses as indicated on the Drawings:
a. Provide fuses as specified in Section 26_28_14 - Low Voltage Fuses.
2. UL approved for field conversion from standard Class H fuse spacing to Class J fuse spacing:
a. Ratings 100 amperes through 600 amperes at 240 volts.
b. Ratings 30 amperes through 600 amperes at 600 volts.
c. Provide spring reinforced and plated fuse clips.

D. Ratings:
1. UL horsepower rated for AC or DC with the rating not less than the load served.
2. Current:
a. 30 to 1,200 amperes.
3. Voltage:
a. 250 volts AC, DC.
b. 600 volts (30 A to 200 A, 600 volts DC).
4. Poles:
a. 2, 3, 4, and 6 poles.
5. UL listed short circuit ratings:
a. 10,000 RMS symmetrical amperes when used with or protected by Class H or K fuses (30-600 amperes).
b. 200,000 RMS symmetrical amperes when used with or protected by Class R or J fuses (30-600 amperes employing appropriate fuse rejection).
c. 200,000 RMS symmetrical amperes when used with or protected by Class L fuses (800-1,200 amperes).
6. Where not indicated on the Drawings, provide switches with the NEMA ratings specified in Section 26_05_00 - Common Work Results for Electrical for the installed location.

E. Size, fusing and number poles as indicated on the Drawings or as required:
1. Provide solid neutral where indicated on the Drawings.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Disconnect switches to have provisions for a field installable “B” type electrical interlock for position indication as indicated on the Drawings.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

C. General:
   1. Use Myers hubs or bolt-on hubs for all conduit penetrations on NEMA Type 12, Type 4, and Type 4X enclosures.
   2. Provide all mounting brackets, stands, supports and hardware as required:
      a. Match finish and materials for all brackets, stands, and hardware with the switch installed.
      b. Provide adequate supporting pillar(s) for disconnect switches in accordance with the approved seismic calculations, and locate aboveground or above decks, where there is no structural wall or surface for box.
   3. When possible, mount switches rigidly to exposed building structure or equipment structural members:
      a. For NEMA Type 4 and Type 4X locations, maintain a minimum of 7/8 inch air space between the enclosure and supporting surface.
      b. When mounting on preformed channel, position channel vertically so that water may freely run behind the enclosure.
   4. Provide a nameplate for each disconnect switch:
      a. Provide per requirements specified in Section 26_05_53 - Identification for Electrical Systems.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.11 PROTECTION

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 26_43_14

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. High-energy surge protective devices.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. C62.41.1 - Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   2. C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
   3. C62.45 - Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
   4. C62.62- Standard Test Specifications for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 V and less) AC Power Circuits.

C. National Fire Protection Agency (NFPA):
   1. 20 - Standard for the Installation of Stationary Pumps for Fire Protection.
   2. 75 - Standard for the Fire Protection of Information Technology Equipment.
   3. 780 - Standard for the Installation of Lightning Protection Systems.

D. Underwriters Laboratory (UL):
   1. 1283 - Standard for Electromagnetic Interference Filters.
   2. 1449 - Standard for Surge Protective Devices.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Specific definitions:
   1. SPD: Surge protective device.
   2. SAD: Silicon avalanche diode.
   3. MOV: Metal oxide varistor.
   4. MCOV: Maximum continuous operating voltage.
   5. I_n: Nominal discharge current.
   6. VPR: Voltage protection rating.
   7. SCCR: Short circuit current rating.

1.04 SYSTEM DESCRIPTION

A. Surge protection as indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. Furnish complete product data confirming detailed compliance or exception statements to all provisions of this Section.
   2. Manufacturer's catalog cutsheets indicating:
      a. Manufacturer and model numbers.
      b. Ratings of each SPD including but not limited to:
         1) Short circuit current rating.
         2) Nominal discharge current.
         3) Maximum continuous operating voltage.
         4) Voltage protection rating.
         5) System voltage.
         6) System frequency.
         7) Surge current capacity.
   3. Submit independent test data from a nationally recognized testing laboratory verifying the following:
      a. Overcurrent protection.
      b. UL 1449.

C. Shop drawings:
   1. Provide electrical and mechanical drawings by the manufacturer that detail:
      a. Unit dimensions.
      b. Weights.
      c. Components.
      d. Field connection locations.
      e. Mounting provisions.
      f. Connection details.
      g. Wiring diagram.

D. Operation and maintenance manuals:
   1. Provide the manufacturer's manual with installation, start-up, spare parts lists, and operating instructions for the specified system.

1.06 QUALITY ASSURANCE

A. Provide SPD units that are designed, manufactured, tested and installed in compliance with the following codes and standards:
   1. Institute of Electrical and Electronics Engineers (IEEE C62.41.1, C62.41.2, C62.45, C62.62).
   2. Federal Information Processing Standards Publication 94 (FIBS PUB 94).
   3. National Electrical Manufacturers Association (NEMA).
   4. National Fire Protection Association (NFPA 20, 75 and 780).
   5. National Electric Code (NFPA 70).
   6. Underwriters Laboratories (UL 1449 4th Edition and UL 1283).
   7. International Electrotechnical Commission (IEC 801).

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.09 SEQUENCING

A. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

B. Extended warranty:
   1. Furnish a manufacturer’s full 5-year parts and labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national, state, or local electrical codes.
   2. Warranty shall include:
      a. Direct, factory trained employees must be available within 48 hours for assessment of the problem.
      b. A 24-hour toll-free 800-number for warranty support.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Southern Tier Technologies.
   2. Eaton.
   3. Schneider Electric.
   4. GE by ABB.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Provide Type 1 or Type 2 SPD units as required for the locations indicated on the Drawings.

B. Electrical requirements:
   1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.
   2. MCOV:
      a. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.
   3. Operating frequency:
      a. 47 to 63 hertz.
   4. SCCR:
      a. 65 kAIC minimum, but not less than the equipment it is connected to as indicated on the Drawings.
      b. The SCCR shall be marked on the SPD in accordance with UL 1449 and the NEC.
   5. Nominal discharge current I_n:
      a. 20 kA.
   6. Maximum VPR:

Modes	240/120 3W	208Y/120	480Y/277	480V
L-N, L-G, N-G	700	700	1,200	1,800
L-L	1,200	1,200	1,800	1,800

   7. Peak surge current:
      a. Service entrance locations:
         1) 240 kA per phase minimum.
         2) 120 kA per mode minimum.
      b. Branch locations:
         1) 120 kA per phase, minimum.
         2) 60 kA per mode minimum.

C. Protection modes:
   1. Provide SPD protection modes as follows:
      a. Line to Neutral (L-N) where applicable.
      b. Line to Ground (L-G).
      c. Neutral to Ground (N-G), where applicable.

D. Environmental requirements:
   1. Storage temperature:
      a. -40 degrees to 122 degrees Fahrenheit.
   2. Operating temperature:
      a. 32 degrees to 140 Fahrenheit.
   3. Relative humidity:
      a. 5 percent to 95 percent.
   4. Audible noise:
      a. Less than 45 dBa at 5 feet (1.5 m).
   5. Operating altitude:
      a. Zero to 12,000 feet above sea level.

E. Provide surge protective devices that are suitable for application in IEEE C62.41.1, C62.41.2 Category A, B and C3 environments, as tested to IEEE C62.45.

2.06 COMPONENTS

A. Enclosure:
   1. Located in electrical equipment as indicated on the Drawings.

B. Internal connections:
   1. Provide low impedance copper plates for intra-unit connections:
      a. Attach surge modules using bolted connections to the plates for low impedance connections.
   2. Size all connections, conductors, and terminals for the specified surge current capacity.

C. Surge diversion modules:
   1. MOV:
      a. Where multiple MOVs are used in parallel, utilize computer matched MOVs to within 1 volt variance and tested for manufacturer's defects.

D. Overcurrent protection:
   1. Individually fuse all components, including suppression, filtering, and monitoring components:
      a. Rated to allow maximum specified nominal discharge current capacity.
      b. Overcurrent protection that limits specified surge currents is not acceptable.

E. Connections:
   1. Provide terminals to accommodate wire sizes up to #2 AWG.

2.07 ACCESSORIES

A. Unit status indicators:
   1. Provide red and green solid-state indicators, with printed labels, on the front cover to redundantly indicate on-line unit status:
      a. The absence of the green light and the presence of the red light indicate that surge protection is reduced and service is needed to restore full operation.
      b. Indicates the status of protection on each mode or phase.

B. Dry contacts for remote monitoring:
   1. Electrically isolated Form C dry contacts (1 A/125 VAC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.

C. Provide an audible alarm which activates under any fault condition.
   1. Provide an alarm On/Off switch to silence the alarm.
   2. A visible LED will confirm whether alarm is On or Disabled.
   3. Locate both switches and the audible alarm on the unit’s front cover.

D. Provide transient counter to count transient voltage surges:
   1. LCD readout located on the unit’s front cover.
   2. Counter to utilize batteries with a 10-year nominal life or non-volatile memory to maintain accurate counts in the event of power loss.

2.08 MIXES (NOT USED)

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL

A. Permanently affix surge rating to the SPD.

B. Perform manufacturer's standard factory test:
   1. Perform testing in accordance with UL 1449.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Follow the manufacturer's recommended installation practices and comply with all applicable codes.

B. Special techniques:
   1. Install SPDs internal to equipment with as short and straight conductors including ground conductor as practically possible:
      a. Twist the input conductors together to reduce input conductor inductance.
   2. Do not subject SPD to insulation resistance testing.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 26_08_50 - Field Electrical Acceptance Tests.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

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SECTION 26_50_10

LIGHTING: LED LUMINAIRES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: LED luminaires, drivers, and accessories.

1.02 REFERENCES

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Illuminating Engineering Society (IES):
   1. LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
   2. LM-80 - Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
   3. TM-21 - Projecting Long Term Lumen, Photon, and Radiant Flux Maintenance of LED Light Sources.
   4. RP-7 – Recommended Practice for Lighting Industrial Facilities.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

D. National Electrical Manufacturers Association (NEMA):
   1. 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

E. Underwriters Laboratories (UL):
   1. 1598 - Luminaires.
   2. 8750 - Light Emitting Diode (LED) Equipment For Use In Lighting Products.

1.03 DEFINITIONS

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
   1. CCT: Correlated color temperature - Scientific scale to describe how “warm” or how “cool” the light source is, measured in Kelvin. The lower the Kelvin temperature, the warmer the light feels, or appears.
   2. CRI: Color Rendering Index - A quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.
   3. Driver - Device that manages power and controls the current flow from AC to DC for an LED lighting product.
   4. Efficacy - Lumen output of a light source per unit of power supplied to that source (lumens per watt).

5. EMI: Electromagnetic Interference - Electrical interference (noise) generated by electrical and electronic devices.
6. FC: Foot Candles - Measure of light level on a surface being illuminated.
7. L70 - The extrapolated life in hours of the luminaire when the luminous output depreciates 30 percent from initial values.
8. LED: Light emitting diode - A solid-state semiconductor device that produces light when electrical current flows through it.
9. LED light source - See LED luminaire.
10. LED luminaire - A complete lighting unit consisting of LED-based light emitting elements and a matched driver together with parts to distribute light, to position and protect the light emitting elements, and to connect the unit to a branch circuit.
11. Lumen - The international (SI) unit of luminous flux or quantity of light. The amount of light that is spread over a square foot of surface by one candle power when all parts of the surface are exactly one foot from the light source.
12. Lumen ambient temperature multiplier - LED light source relative lumen output when compared to a standard ambient temperature.
13. Lumen maintenance factor - How well an LED light source is able to retain its intensity when compared to new.
14. Luminaire - Lighting unit.
15. THD: Total harmonic distortion - The combined effect of harmonic Distortion on the AC waveform produced by a driver or other device.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01_33_00 - Submittal Procedures.

B. Product data:
   1. LED Luminaires:
      a. Catalog literature for each luminaire specified, cross-referenced to the luminaire type on the Luminaire Schedule in the Drawings.
      b. Provide for each luminaire type:
         1) Materials.
         2) Type of diffuser.
         3) Hardware.
         4) Gasketing.
         5) Reflector.
         6) Chassis.
         7) Finish and color.
         8) Driver type and protection.
         9) LED luminaire:
            a) Initial lumen output at 40 degrees Celsius ambient.
            b) Correlated color temperature.
            c) Lumen maintenance factors.
            d) Lumen ambient temperature multipliers.
            e) Drive current.
            f) Efficacy.
         10) Picture of luminaire.
         11) IES optical distributions.
         12) Dimensioned drawings:
            a) Effective projected area rating for pole mounted luminaires.
         13) Weight.

14) Photometric data:
    a) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
    b) Luminaire dirt depreciation factor.
    c) Candlepower distribution curves.
    d) Average luminaire brightness.
    e) Lumen output charts.
15) Furnish support method for interior luminaires weighing more than 30 pounds and all wall-mounted luminaires:
    a) Support methods shall be based on seismic requirements at the project site as specified in Section 01_81_50 - Design Criteria.

c. Luminaire substitutions:
    1) Provide complete literature for each luminaire substitution:
    2) Submittals for substituted luminaires shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire:
        a) Photometric data:
            (1) IES file in standard IES format.
            (2) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
            (3) Candlepower distribution curves.
            (4) Average luminaire brightness.
            (5) Lumen output charts.
            (6) Power requirements in watts and volt-amperes.
        b) Calculations:
            (1) Provide software generated calculations showing illuminance levels in footcandles and power usage in watts per square foot for each of the areas in which substitutions are proposed:
                (a) Use surface reflectance values in accordance with IES RP-7.
                (b) Use manufacturer Projected Lumen Maintenance factor for minimum of 60,000 hours to perform all calculations.
        c) Specification sheets:
            (1) If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L70 life rating, and any modifications necessary to meet the requirements of the contract documents.
    3) Substitutions for specified luminaires will be evaluated upon quality of construction, light distribution, energy use, appearance, and maintenance.
    4) Substitutions shall comply with all applicable building and energy codes.

2. Driver: Provide for each driver type:
    a. Catalog number.
    b. Type of driver.
    c. Output wattage.

d. Input voltage.
e. Operating voltage range.
f. Maximum input power.
g. Efficiency.
h. Operating line current.
i. Power factor.
j. Operating temperature range.
k. Current output range in ambient temperatures of 30 to 55 degrees Celsius.
l. Surge suppression data.

3. Photocell:
   a. Provide for each photocell type:
      1) Switching capacity.
      2) Life expectancy when used on LED sources.
      3) The means of adjusting the lighting pickup level.
      4) Enclosure type.
      5) Mounting method.

C. Calculations:
   1. Provide complete design calculations and installation documents for pole mounting piers and poles mounted from structures:
      a. Include in the calculations the wind and seismic requirements at the project site.
      b. Calculations and design shall be performed by and signed by a Professional Engineer registered in the state where the project is being constructed:

D. Record documents:
   1. Update the Luminaire Schedule in the Drawings to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

1.05 QUALITY ASSURANCE

A. Luminaires shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01_81_50 - Design Criteria.

1.08 SEQUENCING (NOT USED)

1.09 SCHEDULING

A. Exterior and outdoor lighting system operation shall be demonstrated during the hours of darkness.

B. Lighting demonstration shall occur within 2 weeks before substantial completion.

1.10 WARRANTY

A. As specified in Section 01_78_36 - Warranties and Bonds.

B. LED luminaire:
   1. 5 year warranty from the date of installation including material, workmanship, photometrics, driver, and LED modules.

1.11 SYSTEM START-UP

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE

A. Furnish 1 complete spare LED luminaire, with driver, of each type used.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Luminaires:
   1. The following or equal:
      a. As noted on the Luminaire Schedule.

B. Drivers:
   1. One of the following or equal:
      a. Philips Advance.
      b. Thomas Research.
      c. eldoLED.

C. Photo-electric cells:
   1. One of the following or equal:
      a. Cooper.
      b. Tork.
      c. Intermatic.

D. Substitutions:
   1. The lighting design and luminaire selection has been based upon the photometric data of the identified luminaire. It is the Contractor's responsibility to ensure and prove to the Engineer at time of submittal the substitutions meet the quality and photometric requirements of the original design.

2.02 SYSTEM DESCRIPTION

A. Provide luminaires, and accessories for all lighting systems, complete and operable, in accordance with the requirements of the Contract Documents.

B. Individual luminaire types are indicated on the Drawings and on the Luminaire Schedule.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

A. LED Luminaires:
   1. General:
      a. Pre-wired with leads of 18-AWG, minimum, for connection to building circuits.
      b. Provide the luminaires furnished per the Luminaire Schedule in the Drawings:
         1) The Specifications noted in this Section are an addition or supplement to the Luminaire Schedule.
      c. Individual LEDs connected such that a catastrophic loss or the failure of 1 LED will not result in the loss of the entire luminaire.
      d. Furnished with integral surge protection.
   2. Minimum ambient temperature range of 0 degrees Celsius to 40 degrees Celsius.
   3. Minimum rated life:
      a. Office Areas: 70,000 hours when operated at 25 degrees Celsius.
      b. Process Areas: 100,000 hours when operated at 40 degrees Celsius.
      c. Hazardous Areas: 100,000 hours when operated at 40 degrees Celsius.
   4. Minimum efficacy of 70 lumens/watt.
      a. Hazardous Areas: Minimum 60 lumens/watt.
   5. Minimum Color Rendering Index of 70.
   6. Tested according to IES LM-79 and LM-80.
   7. Lumen maintenance projection in accordance with IES TM-21.
   8. RoHS compliant.
   9. Integral driver.
   10. Suitable for dry, damp, or wet locations as indicated on the Drawings or on the Luminaire Schedule.
      a. Wet or damp locations: UL 1598 listed.
   11. Designed as a complete LED assembly. Retrofit LED lamps in luminaires not designed specifically for LED light sources shall not be used.
   12. Exterior/outdoor luminaires:
      a. Luminaires in combination with their mounting pole and bracket shall be capable of withstanding:
         1) Wind levels at the project site without damage.
         2) Seismic levels at the project site.
      b. Corrosion-resistant hardware and hinged doors or lens retainer.
      c. Luminaires furnished with integral photoelectrical control shall be of the luminaire manufacturer's standard design.

B. Photo-electric cells:
   1. Photoelectric cells for control of multiple luminaires:
      a. Self-contained.
      b. Weatherproof.

c. Provided with time-delay features.
d. Sized to meet switching capacity of the circuit:
1) Based on luminaire VA as indicated on the Drawings.
2. Photoelectric cell for control of a single luminaire:
a. Integral to the luminaire.

C. Drivers:
1. Dimmable, with dimming signal protocol of 0-10 VDC or DALI.
2. Input power source:
a. As indicated on the Drawings.
3. Drive current:
a. As indicated in the Luminaire Schedule.
4. Power factor: greater than 0.90.
5. Efficiency: greater than 80 percent.
6. Total harmonic distortion (THD) of the input current less than 20 percent.
7. Rated life of 60,000 hours in an LED luminaire operated at an ambient temperature of 40 degrees Celsius.
8. Minimum operating temperature of -25 degrees Celsius.
9. Sound rating: Class A+ or quieter.
10. UL listed Class 2 Outdoor in accordance with UL 8750.
11. In accordance with IEEE C62.41 Category A for transient protection.
12. Driver must limit inrush current:
a. Meet or exceed NEMA 410 driver inrush standard:
1) 230 Amps per 10 Amp load with a maximum of 106 Amps squared-seconds at 120V.
2) 430 Amps per 10 Amp load with a maximum of 370 Amps squared-seconds at 277V.

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES (NOT USED)

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install luminaires per the manufacturer’s guidelines and submitted installation calculations to meet seismic and wind requirements at the project site.

B. Special techniques:
    1. Support luminaires from structural elements capable of carrying the total weight.
    2. Install luminaires plumb and square with building and wall intersections:
        a. Suspend pendant-mounted luminaries that are mounted from sloping ceilings with ball hangers, unless otherwise indicated on the Drawings.
        b. Install luminaires in machinery rooms after machines have been installed, so as to ensure no conflict with machinery, piping, or ductwork.
    3. In all cases, coordinate luminaire locations with work of other trades to prevent obstruction of light from the fixtures:
        a. Locate bottom of luminaire approximately at the bottom of ductwork, unless otherwise specified or indicated on the Drawings.
    4. Support luminaires weighing more than 25 pounds independently of the outlet box and the conduit.
    5. Provide ceiling or pendent mounted luminaires with a safety chain connecting the lens, driver, and other components to the building structure.
    6. Provide recessed luminaires with auxiliary safety supports attached directly to the building structure:
        a. The safety supports shall consist of number 12 AWG soft drawn galvanized wires.
    7. Install luminaires in accordance with the architectural reflected ceiling Drawings:
        a. Center luminaires on ceiling tiles unless otherwise indicated.
    8. Support luminaires installed in suspended grid ceilings, independently of the grid:
        a. Provide seismic restraint clips for all luminaires installed in suspended grid ceilings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning.

3.08 FIELD QUALITY CONTROL

3.09 ADJUSTING

A. Aim and verify all exterior and outdoor luminaires alignment, during dark evening hours, as directed by Owner or the Engineer.

3.10 CLEANING

A. Clean all lenses, diffusers, and reflectors.

B. Refinish all luminaires' trim and support brackets, where finish has been damaged.

C. Clean all LED luminaires (new and old), used during construction for construction lighting, before substantial completion.

D. Clean and re-lamp all existing fluorescent and HID luminaires used during construction for construction lighting, before substantial completion.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES

A. Refer to the Luminaire Schedule in the Drawings.

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SECTION 31_00_00

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for buildings, basins, reservoirs, boxes, roads, and other facilities.
   2. Backfilling and compacting under and around structures.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. ASTM International (ASTM):
   1. D698-Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
   2. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   3. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
   4. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 DEFINITIONS

A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.

B. Embankments: Dikes, levees, berms, and similar facilities.

C. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, roads, and such other purposes as are indicated on the Drawings.

1.04 SUBMITTALS

A. Copy of Property Owner’s Agreement allowing placement of surplus soil material on their property.

B. Excavation plan.

C. Testing lab: Submit Contractor's proposed testing laboratory capabilities and equipment.

D. Test reports:
   1. Submit certified test reports of tests specified to be performed by the Contractor.
   2. Sign and seal test reports by a registered Geotechnical Engineer in Texas.

1.05 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 50 cubic yards of backfill adjacent to structures.
      b. 100 cubic yards of embankment work.
      c. 100 cubic yards of fill.
      d. 50 cubic yards of roadway base material.
      e. 100 cubic yards of road fill.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

B. Contractor shall perform work related to this Section in accordance with the approved Stormwater Pollution Prevention Plan (SWPPP).

1.06 SEQUENCING AND SCHEDULING

A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.

B. If necessary, stockpile excavated material in order to use it at specified locations.

C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Where mud or other soft or unstable material is encountered, remove such material and refill space with stabilization material. Wrap stabilization material with stabilization fabric.
   2. Obtain acceptable import material from other sources if surplus or borrow materials obtained within Project site does not conform to specified requirements or are not sufficient in quantity.
   3. No extra compensation will be made for hauling of fill materials nor for water required for compaction.

2.02 MATERIALS

A. Water for compacting: Use water from source acceptable to Engineer.

B. Soil and rock materials:
   1. General:
      a. Provide aggregate base course, Class 2 permeable, controlled low-strength material, drain rock, gravel, lightweight material, native material, sand, select material, and stabilization material where specified or indicated on the Drawings.
      b. If suitable surplus materials are available, obtain native material and select material from cut sections or excavations or from borrow areas or imported materials.
   2. Aggregate base course materials: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   3. Class 2 permeable: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   4. Drain rock: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   5. Gravel: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   6. Lightweight material: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   7. Native material: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   8. Sand: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   9. Select material: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   10. Stabilization material: As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.

C. Controlled low-strength material: As specified in Section 31_23_24 - Controlled Low Strength Materials (CLSM).

D. Geotextile fabrics:
   1. Filter fabric
   2. Stabilization fabric

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Character and quantity of material:
      a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
      b. Determine gradation, shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.

c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations or borrow areas or imported materials. Include in cost of work to be performed.
d. Include wasting of excess material, if required, in cost of work to be performed.

3.02 PREPARATION

A. Backfills:
1. After clearing and excavation are completed, scarify entire areas that underlie backfills or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
2. Recompact scarified areas to density specified before placing backfill material or concrete.
3. If foundation areas have soft soils, do not scarify the top 6 inches prior to compaction. Remove loose material using hand equipment or with a flat-edged backhoe bucket. Do not remold and weaken the remaining soil by operating heavy equipment on final bottom elevation of excavation.
4. If foundation areas have cemented rock, cobbles, or boulders, do not scarify the top 6 inches prior to compaction. Moisten the native soil and compact the coarse fill as specified in this Section.
5. Do not place backfill against walls until:
   a. Walls have been cast full height of structure and concrete has reached the specified strength.
   b. Connecting slabs and beams have been cast, and concrete has reached the specified strength.
6. Do not place backfill on top of buried structures until:
   a. Concrete has reached full strength.
7. Prior to backfilling:
   a. Remove forms.
   b. Clean trash and debris from the excavation site.
8. After inspection of foundation, walls, and pipes, place backfill symmetrically around structures to prevent eccentric loading of structures.
9. Place material on top of structure to prevent excessive point loading that exceeds the loading capacity of the structure.
   a. Contractor is responsible for damage to structures due to improper backfilling and compaction.

B. Embankments:
1. After clearing is completed, scarify entire areas that underlie embankments to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
2. Recompact scarified areas to density specified for embankments before placing of embankment material.
3. If embankment areas have cemented rock, cobbles, or boulders, do not scarify the top 6 inches prior to compaction. Moisten the native soil and compact the coarse fill as specified in this Section.

C. Fills:
   1. After clearing is completed, scarify entire areas that underlie fill sections or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for compacted fills before placing of fill material or concrete.
   3. If fill areas have cemented rock, cobbles, or boulders, do not scarify the top 6 inches prior to compaction. Moisten the native soil and compact the coarse fill as specified in this Section.

D. Roadway fills:
   1. After clearing is completed, scarify entire areas that underlie roadway fills to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for roadway fills before placing of roadway fill material.
   3. If roadway fill areas have cemented rock, cobbles, or boulders, do not scarify the top 6 inches prior to compaction. Moisten the native soil and compact the coarse fill as specified in this Section.

E. Sloped surfaces for fill or foundations:
   1. Foundations for fill having slopes in excess of 1 vertical to 4 horizontal:
      a. Bench or terrace to adequately key existing ground and fill built thereon.
   2. Slopes of original hillsides and old fills: Bench minimum of 10 feet horizontally as fill is placed.
   3. Provision of new benches:
      a. Start new bench wherever vertical cut of next lower bench intersects existing grade.
      b. Recompact material thus cut out along with new embankment material at no additional cost to the Owner.

3.03 INSTALLATION

A. General:
   1. Dispose of excavated materials that are not required or are unsuitable for fill and backfill in lawful manner.
   2. Dispose of surplus material on private property only when written permission agreement is furnished by owner of property. Submit copies of such agreements.
   3. Obtain material required in excess of suitable material produced by cuts and excavation, from borrow areas subject to the material requirements specified.
   4. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to the Owner.
   5. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads that may be placed upon it by Contractor's equipment.

B. Borrow area: There is no borrow area on Project site.
   1. Where material is required, import material from source located off Project site selected by the Contractor and subject to acceptance by the Engineer.

2. There will be no additional cost to the Owner for use of imported material.

C. Compaction:
   1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork.
   2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
   3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D1556, or with ASTM D6938.
   4. Maximum density, laboratory compaction: Soil maximum density and optimum water content when tested in accordance with ASTM D1557 or ASTM D698.
   5. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed AASHTO Standard Specifications for Highway Bridges, H-20 vehicle loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.
   6. Compact to percentage of maximum density as follows:
      a. Backfill adjacent to structures: 95 percent.
      b. Backfilling voids: 95 percent.
      c. Bottom of sludge beds: 90 percent.
      d. Embankments: 95 percent.
      e. Intermediate dikes : 90 percent.
      f. Loose fill:
         1) No compaction other than by hauling vehicles will be required.
         2) Uniformly distribute travel of vehicles over fill area as required to provide uniformly compacted surface.
      g. Other areas: 85 percent.
      h. Under present and future structures: 95 percent.
      i. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.
      j. Upper 6 inches of cuts: 95 percent.
      k. Fills: 95 percent.

D. Dewatering: As per required.

E. Excavation:
   1. Blasting: Not permitted.

   2. Excavations for trenching: As specified in Section **31_23_35** - Trenching.
   3. Excavations for structures:
      a. Provide excavations conforming to dimensions and elevations indicated on the Drawings for each structure.
      b. After clearing is complete, excavate for the structure, down to the elevation indicated on the Drawings. Unless directed by Engineer, do not carry excavations below elevation indicated on the Drawings.
      c. Where soil is encountered having unsuitable bearing value, Engineer may direct in writing that excavation be carried to elevations below those indicated on the Drawings.

d. Where excavations are made below elevations indicated on the Drawings, adjust elevations of excavations in accordance with the following requirements:
    1) Under slabs: Restore to proper elevation in accordance with procedure specified for backfill in this Section.
    2) Under footings: Restore to the proper elevation using one of the following:
        a) Aggregate base course.
        b) Controlled low-strength material.
e. Excavation width:
    1) Extend excavations at least 2 feet clear from walls and foundations of structures to allow for placing and removal of forms, installation of services, and inspection.
    2) Do not undercut slopes.
f. Difficulty of excavation: No extra compensation will be made for removal of rock or any other material due to difficulty of excavation.

4. Excavation of lined channels:
    a. Excavations in open cut for lined channels may be made so as to place concrete directly against excavated surfaces providing faces of excavations are:
        1) Firm and unyielding.
        2) Will stand or can be made to stand without sloughing.
    b. Excavations to provide subgrade for lined channel or subdrainage material: Excavate to lines and grades indicated on the Drawings.
5. Excavation of unlined channels and basins:
    a. Excavate to lines and grades indicated on the Drawings.
    b. Perform excavation and grading so that finish surfaces are in uniform planes with no abrupt breaks in surface.
6. Excavation of ditches and gutters:
    a. Cut ditches and gutters accurately to cross sections and grades indicated on the Drawings.
    b. Take care not to excavate ditches and gutters below grades indicated on the Drawings.
    c. Backfill excessive ditch and gutter excavations to grade with suitable material acceptable to the Engineer.
    d. Do not deposit any material within 3 feet of edge of ditch unless otherwise indicated on the Drawings.
7. Necessary over excavation:
    a. Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, backfill voids remaining after removal as specified in backfilling of voids below, or as acceptable to the Engineer.
    b. Backfill voids with material acceptable to the Engineer:
        1) With acceptance of the Engineer, backfill with one of the following:
            a) Aggregate base course.
            b) Controlled low-strength material.

F. Materials for backfills, embankments, fills, and roadway fills:
1. General:
    a. Obtain import material from other sources if surplus materials from cuts and excavations obtained from within Project site or borrow areas do not

conform to specified requirements or are not sufficient in quantity for construction of Project.

2. Backfills:
   a. Backfill adjacent to structures, slabs, or walls: Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
   b. Backfill material under concrete structures: Aggregate base course material, except in areas where controlled low-strength material or concrete encasement are indicated on the Drawings.
   c. Extend backfill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
3. Embankments:
   a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
4. Fills:
   a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
   b. Extend fill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
5. Roadway fills: One of the following, unless otherwise specified or indicated on the Drawings:
   a. Aggregate base course material.
   b. Native material or imported material meeting the requirements of native material.

G. Placement:
1. General:
   a. Lines and grades:
      1) Construct backfills, embankments, fills, and road fills, at locations and to lines and grades indicated on the Drawings.
      2) Overbuild permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.
2. Backfills:
   a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
   b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
   c. Defective compacted backfills: Remove and recompact.
3. Fills:
   a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
   b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
   c. Defective compacted fills: Remove and recompact.
4. Lightweight materials:
   a. When excavations extend into soft soils, backfill consists of lightweight material from base of excavation to the top of the soft soil. Above soft soil, native material may be used.
   b. Where lightweight material is used for backfill: Separated from adjacent soils by the use of filter fabric.

5. Coarse fill:
    a. When materials are coarsely graded so that performance of field density tests are impossible:
        1) Placement and compaction: Place material in lifts so as to obtain compacted thickness of 6 inches and roll with pneumatic roller or power roller.
        2) Moisture content: Provide moisture content of fraction of material passing 3/4-inch sieve within plus or minus 2.0 percent of optimum moisture as determined in accordance with ASTM D1557, Method C.
6. Embankments:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted embankments: Remove and recompact.
7. Roadway fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted roadway fills: Remove and recompact.
8. Loose fill:
    a. In disposal areas: In disposal areas as indicated on the Drawings, bring fill up in an essentially level layer over entire spoil area indicated:
        1) Continue filling spoil area until disposal of surplus excavated material is completed.
        2) Slope edges of fill area at between 1 and 2 horizontal to 1 vertical to the intersection with existing grade.
        3) Provide slopes that are smooth and uniform.
        4) Level finished surface of disposal area to within 4 inches of elevation indicated on the Drawings.
    b. In disposal areas: In disposal areas indicated on the Drawings, start fill at contour line indicated as finish grade:
        1) Continue filling of spoil area until disposal of surplus excavated material is completed.
        2) Slope edges of finished fill area off at between 1-1/2 and 2 horizontal to 1 vertical to natural ground.
        3) Provide slopes that are smooth and uniform.
        4) Level finish surface of disposal area to within 4 inches of elevation indicated on the Drawings.
    c. Clods or hard lumps of earth of 6 inches in greatest dimension: Break up before compacting material in embankments, except as provided as follows:
        1) When fill material includes large rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, distribute such material throughout fill.
        2) Place sufficient earth or other fine material around larger material as it is deposited so as to fill interstices and produce dense, compact fill. Do not place such material within 2 feet of finish grade of fill.

3.04 FIELD QUALITY CONTROL

A. Confirmation tests:
   1. Contractor's responsibilities:
      a. Adequacy of compaction equipment and procedures:
         1) Demonstrate adequacy of compaction equipment and procedures.
         2) At each test location include tests for each type or class of backfill from bedding to finish grade.
      b. Compaction sequence requirements:
         1) Do not perform additional earthwork of the same kind until specified degree of compaction has been demonstrated.
      c. Cost of confirmation tests: Paid for by the Contractor.
      d. Qualifications of Contractor's testing laboratory: Acceptable to Engineer.
      e. Copies of confirmation test reports: Submit promptly to the Engineer.
   2. Frequency of confirmation testing:
      a. Maximum dry density versus moisture:
         1) Backfill: 2,500 square feet of compacted area or for every 100 linear feet of backfill. For small areas, a minimum of three tests should be provided for each lift.
         2) Cuts: 20 cubic yards.
         3) Embankments: 20 cubic yards.
         4) Fills: 20 cubic yards.
         5) Roadway fills: 20 cubic yards.
      b. Cost of confirmation tests:
         1) Paid for by the Contractor.
      c. Qualifications of Contractor's testing laboratory:
         1) Perform confirmation testing by soils testing laboratory acceptable to the Engineer. Copies of confirmation test reports: Submit promptly to the Engineer.

B. Tolerances:
   1. Finish grading of backfills, cuts, embankments, fills, and roadway fills:
      a. Perform fine grading under concrete structures such that finish surfaces are never above the grade or cross section indicated on the Drawings and are never more than 0.10 feet below.
      b. Provide finish surface for areas outside of structures that are within 0.10 feet of grade or cross section indicated on the Drawings.
   2. Unlined channels and basins:
      a. In both cut and fill, and levee and access road side slopes in cut: Vertical tolerance of none above and 3 inches below grade indicated on the Drawings on bottom and side slopes.
      b. On top surface of levee and access road in both cut and fill, and levee and access road side slopes in fill: Vertical tolerance of none below and 3 inches above grade indicated on the Drawings.
   3. Areas which are not under structures, concrete, asphalt, roads, pavements, sidewalks, dikes, and similar facilities:
      a. Provide finish graded surfaces of either undisturbed soil, or cohesive material not less than 6 inches deep.
      b. Intent of proceeding is to avoid sandy or gravelly areas.
   4. Finish grading of surfaces:
      a. Reasonably smooth, compacted, and free from irregular surface changes.

b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.
c. Uniformly grade areas that are not under concrete.
d. Finish ditches and gutters so that they drain readily.

C. Compliance tests:
1. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.

3.05 ADJUSTING

A. Finish grades of excavations, backfills, and fills:
1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.06 PROTECTION

A. Finish grades of backfills, cuts, excavations, and fills:
1. Protect newly graded areas from erosion and deterioration by action of the elements.

B. Ditches and gutters:
1. Maintain ditches and gutters free from detrimental quantities of debris that might inhibit drainage until final acceptance.

END OF SECTION

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SECTION 31_05_15

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Material requirements for soils and aggregates.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   3. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   4. C535 - Standard Test Method for Resistance to Degradation of Larger-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   5. D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   6. D2844 - Standard Test Method for Resistance R-Value and Expansion Pressure of Compacted Soils.
   7. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   8. D4829 - Standard Test Method for Expansion Index of Soils.
   9. D5821 - Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate.

B. Texas Department of Transportation (TXDOT):
   1. Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (Standard Specifications).

1.03 SUBMITTALS

A. Product data:
   1. Material source.
   2. Gradation.
   3. Testing data.

B. Quality control for aggregate base course:
   1. Test reports: Reports for tests required by Sections of Standard Specifications.
   2. Certificates of Compliance: Certificates as required by Sections of Standard Specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

B. Comply with Standard Specifications storage requirements, if applicable.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

A. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.

B. Materials derived from processing demolished or removed asphalt concrete are not acceptable.

C. Comply with soil and aggregate material requirements in the Standard Specifications., unless specified otherwise.

2.02 NATIVE MATERIAL

A. Native soil-select:
   1. Sound earthen material.
   2. Sum of plasticity index when tested in accordance with ASTM D4318 and the percent of material by weight passing a Number 200 sieve shall not exceed 23 when tested in accordance with ASTM C136.
   3. Organic content not be greater than 3 percent by volume.
   4. Corrosion resistance requirements:
      a. Resistivity minimum (wet aggregates): 5,000 ohm-cm.
      b. pH: 5.0 to 12.0.
      c. Chlorides maximum: 100 parts per million.
      d. Sulfates maximum: 200 parts per million.

2.03 AGGREGATE BASE COURSE (CRUSHED ROCK SUBGRADE)

A. Provide TXDOT Standard Specification for construction of pavement, Item 347 Type A, Grade 1 or 2, Type D Flexible Base Aggregate Base Course.

B. Compacted to 95% maximum dry density at optimum moisture content.

C. Moisture requirement: -2% to +2%

D. Aggregate shall meet the following corrosion resistance requirements:

Resistivity (Wet Aggregates)	3,000 ohm-centimeters (min)
pH	5.0-10.0
Chlorides	100 ppm (max)
Sulfates	200 ppm (max)

2.04 SAND

A. Clean, coarse, natural sand.

B. Non-plastic when tested in accordance with ASTM D4318.

C. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and C136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1/2 inch	100
Number 200	0 - 20

2.05 SOURCE QUALITY CONTROL

A. The contractor shall obtain a written, notarized certification from the landowner of each proposed off-site soil borrow source stating that to the best of the landowner's knowledge and belief there has never been contamination of the borrow source site with hazardous or toxic materials.

B. .Soil materials derived from the excavation of underground petroleum storage tanks shall not be used as fill on this project

PART 3 EXECUTION

Not used.

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SECTION 31_23_24

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Controlled low strength material (CLSM), also known as "flowable fill."

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 229R - Report on Controlled Low-Strength Materials.
   2. 301 - Specifications for Structural Concrete.

B. ASTM International (ASTM):
   1. C94 - Standard Specification for Ready Mix Concrete.
   2. C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
   3. C150 - Standard Specification for Portland Cement.
   4. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   5. C494 - Standard Specification for Chemical Admixtures for Concrete.
   6. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   7. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3)).
   8. D4832 - Standard Test Method of Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
   9. D5971 - Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material.
   10. D6023 - Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material.

1.03 SUBMITTALS

A. Product data: Submit data completely describing materials in the mix and demonstrating compliance with the requirements of this Section.
   1. Cement: Mill tests. Indicate alkali content representative of each shipment.
   2. Fly ash: Identify source and type of fly ash.
   3. Water: Identify source and quality if not from a municipal treatment source.
   4. Admixtures: Manufacturer’s product data indicating suitability for use in CLSM mixes and recommended dosage rates.
   5. Aggregate:
      a. Submit source, type, and sieve analyses.
      b. Resubmit at any time there is a significant change in grading of materials.

B. Mix design:
   1. Submit full details, including mix design calculations for mix proposed for use.

2. Trial batch test data:
    a. Submit data for each test cylinder.
    b. Submit data that identifies mix and slump for each test cylinder.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store or stockpile cement, fly ash, and aggregate in accordance with ACI 301.

B. Store admixtures in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Mixture of portland cement, water, pozzolan, fine aggregate and admixtures, proportioned in accordance with the recommendations of ACI 229 to produce a homogeneous mixture that is flowable, that will readily work into corners and angles; that will not segregate in the plastic state; and that is self-compacting at the time of placement without the use of mechanical vibration.

B. Performance requirements:
    1. Air content, total calculated in accordance with ASTM D6023: Not less than 8.0 percent, nor greater than 12.0 percent.
    2. Compressive strength, measured in accordance with ASTM D4832 at 28 days: Not less than 50 pounds per square inch, nor greater than 150 pounds per square inch.
    3. Wet density: Not greater than 132 pounds per cubic foot.
    4. Slump, measured in accordance with ASTM C143 at the point of placement: Greater than 9 inches and that allows CLSM to flow freely and to be self-compacting during placement.

2.02 MATERIALS

A. Cement:
    1. Portland cement in accordance with ASTM C150, Type I or Type II.
    2. Having total alkali content not more than 0.60 percent.

B. Fly ash: Class C or Class F fly ash in accordance with ASTM C618.

C. Water:
    1. Potable water: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.

D. Admixtures: Products of a single manufacturer, specifically manufactured or recommended by that manufacturer for use in CLSM.
    1. Air entraining admixture: In accordance with ASTM C260.
    2.

E. Aggregate:
    1. Non-expansive, non-reactive, inert natural sand conforming to the following requirements:
        a. Not more than 12 percent passing a No. 200 sieve.

b. No plastic fines present.
c. Including pea gravel no larger than 3/8 inch.

2.03 MIXES

A. See System Description for performance requirements of the plastic and hardened mix.

2.04 SOURCE QUALITY CONTROL

A. 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 Engineer.
2. Prepare trial batches using the specific cement, fly ash, admixtures, aggregates, and water proposed for the Work.
3. Prepare trial batch with quantity sufficient to determine slump, workability, and consistency; and to provide test cylinders as indicated in this Section.

B. Trial batch testing:
1. Determine slump in accordance with ASTM C143, with the following modifications:
   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.
2. Prepare and test trial batch specimens in accordance with ASTM D4832, with the following modifications:
   a. Provide cylindrical test specimens, each 6-inches in diameter by 12-inch high.
   b. Provide a minimum of 8 cylinders for testing of each trial batch.
   c. Fill the molds to overflowing and tap sides lightly to settle the mix.
   d. Do not rod the mix for consolidation in the cylinder.
   e. Strike off the excess material.
3. 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.
4. Do not remove the test cylinder from mold until that cylinder is to be capped and tested.
   a. Perform the capping carefully to prevent premature fractures.
   b. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.
5. Provide compressive strength tests:
   a. Test 4 test cylinders at 7 days after casting, and another 4 cylinders at 28 days after casting.
   b. 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.

C. If the trial batch tests do not meet the Specifications for strength or density, revise and re-submit the mix design, prepare additional trial batch(es), and complete

additional trial batch tests. Repeat until an acceptable trial batch is that conforms to the Specifications is produced.

1. All the trial batches and acceptability of materials shall be paid by the Contractor.
2. After acceptance, do not change the mix design without submitting a new mix design, trail batches, and test information.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not place CLSM until preparation and condition of surfaces receiving the fill have been observed and accepted by the Engineer.

B. Remove debris foreign matter, and standing or running water from excavations and areas receiving CLSM before placement.

3.02 INSTALLATION

A. Pipes and trenches.
   1. Install cellular concrete as indicated on the Drawings and specified.
   2. Where CLSM is placed around and over pipes, secure pipes in place, or place CLSM in lifts to prevent pipe flotation.
   3. Where CLSM is placed in long, open trenches, confine material using bulkheads of sandbags, earth dams, or stiffer concrete at open ends of placement.

B. Soil preparation:
   1. Prior to placement of CLSM, prepare underlying soils as follows:
      a. Scarify surface to a depth of 8 inches.
      b. Adjust moisture content to or slightly above the optimum in accordance with ASTM D1557 or ASTM D698.
      c. Re-compact scarified surface to a minimum of 95 percent relative density in accordance with ASTM D1557 or ASTM D698.

3.03 MEASURING, BATCHING, MIXING AND TRANSPORTING

A. Measure, batch, mix and transport CLSM in accordance with the requirements of ASTM C94 and this Section.

B. Mix until there is uniform distribution of materials.

C. Discharge mixer completely prior to recharging.

D. After trial batch testing and mix acceptance, maintain slump during construction within plus or minus 1 inch of the design slump.

3.04 PLACING

A. Place controlled low strength material by method that preserves the quality of the material in terms of compressive strength and density.

B. Maintain fluid properties of the mix during placement.
   1. At point of placement, provide material that flows easily around, beneath, or through walls, pipes, conduits, or other structures.
   2. Do not place CLSM that has partially hardened or that has been contaminated by foreign materials.
   3. Handle and place CLSM using methods that minimize segregation of the mix.
   4. Deposit mix as near its final position as possible to avoid segregation due to rehandling or flowing.
   5. Contain and confine mix while it is fluid. Design containment structures and bracing at walls and forms to withstand lateral pressures of wet mix.

C. Lifts:
   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 3 feet or the lift height indicated on the Drawings.
   2. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent additional lateral load against the forms or structure due to the weight of the next lift of CLSM.

D. Water conditions:
   1. Do not place CLSM in standing or flowing water.
   2. Do not permit water to flow over the surface of freshly placed or un-hardened CLSM.
   3. Do not submerge CLSM in water within 24 hours after placement.

E. Manage CLSM bleed water.
   1. Grade top surface of CLSM to drain away from the fill.
   2. Provide side containment that permits bleed water to drain to a contained management area away from the fill.

3.05 CURING AND PROTECTION

A. Curing:
   1. Prior to and during curing, install barriers to prevent equipment or personnel from falling into or becoming entrapped in CLSM.

B. Protect CLSM from:
   1. Damage from the elements.
   2. Damage of any nature during surrounding construction operations.

3.06 FIELD QUALITY CONTROL

A. Provide quality control over the Work of this Section as specified in Section 01_45_00 - Quality Control and Section 01_45_17 - Contractor Quality Control Plan and as specified in this Section.

B. General:
   1. Engineer inspection and acceptance required prior to placement.
   2. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the Owner's Testing Laboratory in preparing said specimens.

3.07 FIELD QUALITY ASSURANCE

A. Provide quality control over the work of this Section as specified in Section 01_45_00 - Quality Control and Section 01_45_17 - Contractor Quality Control Plan.

B. Field inspections:
   1. Engineer shall provide on-site inspection for the Work of this Section.
   2. Advise Engineer of readiness to proceed at least 24 hours prior to each placement of CLSM.
   3. Required inspections:
      a. Engineer will observe the prepared areas. Do not place CLSM until Engineer has observed and accepted preparations.
   4. Record of inspections.

C. Field sampling and testing:
   1. During construction, Owner and Contractor shall provide sampling and testing to determine whether the CLSM, as produced and placed, complies with the requirements specified.
      a. Make provisions for and furnish material for test specimens. Cooperate by allowing free access for Owner's independent testing firm to sample and test materials. Provide assistance in obtaining and preparing said specimens.
   2. Sample CLSM for testing in accordance with ASTM D5971.
   3. Required tests:
      a. Air content: Prepare sample and test in accordance with ASTM D6023.
      b. Compressive strength: Prepare and test cylinder specimens in accordance with ASTM D4832.
         1) Prepare 6-inch diameter by 12-inch high specimens for testing.
            a) Provide one set of specimens for each 150 cubic yards of CLSM placed, but not less than 1 set for each half day's placement.
            b) Prepare and test not less than 3 cylinders for each set.
            c) Place CLSM in the molds in accordance with ASTM D4832. Do not rod or otherwise consolidate the material in the mold.
            d) In accordance with ASTM D4832 recommendations for displacing bleed water at the top of the molds and refilling the molds before covering with a lid. Do not use air-tight lids.
         2) Place the cylinders in a safe location away from construction activities.
            a) Protect cylinders from bumping and impact.
            b) Maintain temperature surrounding cylinders between 60 and 80 degrees Fahrenheit until delivery to the laboratory for testing.
            c) After the first day, surround molds with a high humidity environment by covering with wet burlap, or equivalent highly absorptive material. Maintain saturation of the cover. Do not sprinkle water directly on the cylinders.
         3) After 4 days, place the cylinders in a protective container for transport to the laboratory for testing.
            a) Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.

b) Transport container may be a box with a Styrofoam or similar lining that will limit jarring and bumping of the cylinders.

4) Upon receipt at the testing laboratory, place test cylinders in a moist curing room until dates for testing.
5) Do not remove test cylinders from molds until the day that cylinders is to be capped and tested.
6) Cap and test for compressive strength in accordance with ASTM D4832.
   a) Do not perform initial compression test until the cylinders reach an age of at least 4 days.
   b) Test 1 cylinder at 7 days and 2 at 28 days.
7) Compressive 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 specified.

3.08 NON-CONFORMING WORK

A. When testing or observation indicates CLSM with properties outside the specified and accepted range, Engineer will issue instructions regarding disposition of nonconforming materials.

B. Engineer may:
   1. Reject CLSM represented by those test specimens and require its removal and replacement.
   2. Require modification of the mix design to provide CLSM with the properties specified.

C. Make such modifications at no additional expense to the Owner and with no adjustment to the schedule.

END OF SECTION

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SECTION 31_23_35

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Trench excavation and trench backfill for pipelines, manholes, vaults, and appurtenances.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D698-Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
   2. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   3. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
   4. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

A. As specified in Section 01_33_00 - Submittal Procedures.

B. Product data on soils and aggregates.
   1. Material source.
   2. Gradation.
   3. Test data to demonstrate compliance with requirements as specified in this Section.

C. Samples:
   1. Provide 50-pound sample of materials when requested by the Engineer.

D. Confirmation testing:
   1. Certification of Contractor's testing laboratory.
   2. Record copy report for tests performed by Contractor's testing laboratory.

1.04 DEFINITIONS

A. Backfill: Material placed in trench above the pipe embedment zone.

B. Bedding: Material placed under, around, and over pipes or ducts in trenches.

C. Fine grading: bedding material placed directly below pipes or ducts to provide support at the bottom of the trench and to bring those elements to required grades and elevations.

D. Pipe foundation: Stabilization material placed at the bottom of trench to provide support when the trench bottom is not firm, dry or uniform.

E. Pipe embedment zone: Includes bedding, fine grading, and haunch zone.

F. Haunch zone: Material placed below and beside the pipe up to the pipe springline.

G. Pipe springline: A horizontal reference line located at mid-height, or halfway point, of a circular conduit, pipe, or tunnel. It is the maximum horizontal dimension or diameter of a circular conduit, pipe, or tunnel.

H. Rigid pipe: Includes reinforced non-cylinder concrete, reinforced concrete cylinder, prestressed concrete cylinder, vitrified clay, polymer concrete, cast iron, asbestos cement and cast-in-place pipes.

I. Flexible pipe: Includes steel, ductile iron, thermoplastics such as polyvinyl chloride (PVC) and high-density polyethylene (HDPE), thermosetting plastics such as fiberglass-reinforced polymer (FRP), bar-wrapped concrete cylinder pipe, and corrugated steel pipes.

J. Haunch zone: Material placed below and beside the pipe up to the pipe springline.

K. Lift: A layer of soil or aggregate material, measured before compaction.

L. Maximum density, laboratory compaction: Soil maximum density and optimum water content when tested in accordance with ASTM D1557 or ASTM D6938.

M. Maximum density, field compaction: Soil density and water content when tested in accordance with ASTM D1556 **or** ASTM D6938.

N. Pavement section: Includes pavement plus underlying courses such as base course and subgrade.

O. Pipe embedment zone: Includes bedding, fine grading, and haunch zone.

P. Pipe foundation: Material placed at the bottom of trench to provide support.

PART 2 PRODUCTS

2.01 MATERIALS

A. As specified in Section 31_05_15 - Soils and Aggregates for Earthwork.

B. Class C concrete: As specified in Section 03_30_01 - Concrete Work.

C. Controlled low-strength material: As specified in Section 31_23_24 - Controlled Low Strength Material (CLSM).

PART 3 EXECUTION

3.01 PREPARATION

A. Stabilize excavations.

B. Perform subsurface utility engineering (SUE) for utility locating and verification prior to any excavation work.

3.02 DEWATERING (NOT USED)

3.03 TRENCH EXCAVATION

A. Excavate bottom of trench to depth indicated on the Drawings.

B. Areas of new fill or embankment:
   1. Prior to laying pipes or electrical service, place fill and compact as specified to not less than 2 feet above top of pipe, conduit, or duct bank.
   2. Excavate through fill for pipe trench.

C. Trench widths as specified in the following table:

Buried Pipe Or Accessory	Minimum Trench Width	Maximum Trench Width
Nominal Pipe Diameter: 4 inch to 24 inch	OD + 18 inches	OD + 24 inches
Nominal Pipe Diameter: Greater than 24 inch	OD + 24 inches	OD + 36 inches
Manholes, vaults, valves, or other accessories	12 inches between outer surface and trench side or shoring	Not applicable

D. Potable water pipe and appurtenances:
   1. Lay in trenches separate from those used for sewers and recycled water.
   2. Unless otherwise specified or indicated on the Drawings, lay in trenches having cover of not less than 3 feet below surface of ground located at distance of not less than 10 feet clear horizontally from any parallel sewer and 1 foot clear vertically above any parallel sewer.

E. At road crossings or existing driveways:
   1. Provide notification, vehicular access, and traffic control as required by permits and special conditions.
   2. Provide temporary asphalt or plating for traffic or access at the end of each work day unless approved in writing by Engineer.
   3. If unexpected utility conflicts or changed site conditions require trenchless technologies or temporary bridges, immediately notify the Engineer in writing. Approval is required before proceeding with construction.
   4. When trench width at top of pipe is increased beyond width specified in this Section because of soil conditions, safety requirements, or other reasons, Engineer approval for remedy is required without additional cost to Owner.
      a. Remedy may include upgrade laying conditions or install stronger pipe designed in accordance with Specifications.

3.04 TRENCH BACKFILL - GENERAL

A. Trench area terminology and locations as indicated on the Drawings.

B. Place material, except CLSM and concrete, in maximum 6 inch lifts, measured before compaction.

C. Backfilling of manhole excavation: Conform to backfilling requirements for trenches as specified in this Section.

3.05 PIPE FOUNDATION

A. Provide trench bottom with firm, dry, uniform bearing surface at the grade indicated on the Drawings.

B. Excess excavation below elevation indicated on the Drawings will require installation of pipe foundation material to bring the trench bottom back to the elevation indicated on the Drawings at no additional cost to Owner.

C. If bottom of trench excavation consists of soil:
   1. Scarify bottom of trench to a depth of 6 inches below the grade indicated on the Drawings.
   2. Materials and placement:
      a. Recompact scarified material to 95 percent of maximum density.

D. If bottom of trench excavation consists of rock or any material that, by reason of its hardness, cannot be excavated to provide uniform bearing surface:
   1. Remove such rock or other material to a depth of not less than 4 inches below pipe embedment zone.
   2. Materials:
      a. CLSM.
      b. Class C concrete.

E. If bottom of trench excavation consists of mud or other soft unstable material:
   1. Remove such unacceptable material to a depth of not less than 18 inches below pipe embedment zone.
   2. Material and placement:
      a. Lightweight material.
      b. Stabilization material

3.06 PIPE EMBEDMENT ZONE

A. Pipe displacement:
   1. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.
   2. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.

B. Fine grading:
   1. Place 6-inches of approved haunch zone bedding material from the trench bottom to the bottom of the pipe or duct to provide support at the bottom of the trench and to bring those elements to required line and grade.

C. Depressions for joints or couplings:
   1. Excavate holes in the fine grading material at the bottom of the trench.
   2. Provide holes of sufficient width to provide ample room for grouting, banding, or welding as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.

D. Rigid pipe:
   1. Pipe embedment zone: Below pipe springline:
      a. Materials and placement:
         1) Aggregate base course compacted to 95 percent maximum dry density.
         2) Select material compacted to 95 percent maximum dry density.
   2. Pipe embedment zone: Above pipe springline:
      a. Compacted to a depth above pipe: 12-inch minimum.
      b. Materials and placement:
         1) Aggregate base course compacted to 95 percent maximum dry density.
         2) Select material compacted to 95 percent maximum dry density.
         3) Native material compacted to 95 percent maximum dry density.

E. Flexible pipe:
   1. Pipe embedment zone:
      a. Compacted to a depth above pipe: 12-inch minimum.
      b. Materials and placement:
         1) Aggregate base course compacted to 95 percent maximum dry density.
         2) CLSM. Place gravel bags to support and set pipe to line and grade prior to CLSM placement. Place CLSM in lifts as necessary to prevent floatation.
         3) Sand.

3.07 BACKFILL

A. Trenches:
   1. Materials and placement:
      a. Native soil compacted to 95 percent maximum dry density.
      b. Imported fill compacted to 95 percent maximum dry density.
      c. Aggregate base course compacted to 95 percent maximum dry density.
      d. CLSM.

B. Trenches in rock:
   1. Backfill to top of rock.
      a. Materials and placement:
         1) CLSM.
         2) Class C concrete.
   2. Backfill from top of rock to grade, if applicable:
      a. Materials and placement:
         1) Aggregate base course compacted to 95 percent of maximum density.

C. Trenches below or within 10 feet of the outside perimeter of structures:
   1. Backfill to underside of structural fill below structure, as specified in Section 31_00_00 - Earthwork.
   2. Materials and placement:
      a. Aggregate base course compacted to 95 percent of maximum density.
      b. CLSM.

D. Trenches in roadways and paved areas:
   1. Backfill trench to underside of pavement.
   2. Materials and placement:
      a. Aggregate base course compacted to 95 percent of maximum density.
      b. CLSM.

E. Trenches in areas outside the improved section of roadways or in open country:
   1. Backfill to underside of topsoil layer.
   2. Materials and placement:
      a. Native soil, native soil - select, imported material, or aggregate base course compacted to 90 percent of maximum density.

F. Trenches under existing intersecting pipes, duct banks, or conduits larger than 3 inches in diameter:
   1. Backfill from above top of new pipe embedment zone to springline of intersecting pipe or conduit.
      a. Extend backfill at least 2 feet on either side of intersecting pipe or conduit to ensure backfill material remains in place while other backfill is being placed.
      b. Materials and placement:
         1) CLSM, unless otherwise indicated on the Drawings.
   2. Backfill remainder of trench:
      a. Materials and placement:
         1) CLSM.
         2) Class C concrete.

3.08 EXCESS MATERIAL

A. Remove excess excavated material from the Project site as specified in Section 31_00_00 - Earthwork.

3.09 FIELD QUALITY CONTROL

A. Provide field quality control for the Work as specified in Section 01_45_00 - Quality Control.

B. Confirmation tests: As specified in Section 31_00_00 - Earthwork.
   1. Minimum frequency of confirmation testing:
      a. At each test location include tests for each type or class of backfill from bedding to finished grade.
      b. For trenches: 1 location every 200 linear feet.
      c. In open fields: 2 locations every 1,000 linear feet or 1 location every 200 cubic yards.
      d. Along dirt or gravel road or off traveled right-of-way: 1 location at every 500 linear feet.

e. Crossing paved roads: 1 location at each crossing.
f. Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.

C. Compliance tests:
1. Make periodic compliance tests to verify that compaction is meeting requirements as specified in this Section.
2. Perform remedial work if compaction test fails to meet specified requirements using one of the following methods:
a. Remove and replace backfill at the proper density.
b. Other means acceptable to the Engineer.
3. Retesting:
a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
b. Contractor's confirmation tests during performance of remedial work:
1) Performance: Perform tests in manner acceptable to the Engineer.
2) Frequency: Double amount specified for initial confirmation tests.

END OF SECTION

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SECTION 32_01_15

PAVEMENT RESTORATION AND REHABILITATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Resurfacing roads and paved surfaces in which surface is removed or damaged by installation of new work.

1.02 SUBMITTALS

A. Mix designs:
   1. Prior to placement of asphalt concrete, submit full details, including design and calculations for the asphalt concrete mix proposed.
   2. Submit gradation of aggregate base.
   3. Submit proposed mix design of portland cement concrete.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Limiting dimensions:
      a. Determine the exact lengths and dimensions of such roads, pavements, parking areas, and walks that will require removal and replacement for new work.
      b. Join existing surfaces to terminals of new surfacing in smooth juncture.

2.02 MATERIALS

A. Aggregate base course: As specified in Section 31_05_15 – Soil and for Earthwork.

B. Asphalt pavement: As specified in Section 32_12_15 - Asphaltic Concrete Paving.

C. Portland cement concrete replacement material: Class A concrete as specified in Section 03_30_01 - Concrete Work.

2.03 EQUIPMENT

A. Roads, pavements, parking areas, and walks:
   1. Equipment requirements: Good condition, capable of performing work intended in satisfactory manner.

2.04 ACCESSORIES

A. Material for painting asphalt concrete pavement: Tack coat as specified in Section 32_12_15 - Asphaltic Concrete Paving.

PART 3 EXECUTION

3.01 INSTALLATION

A. Aggregate surface removal replacement:
   1. When trench cut is in aggregate surfaced areas, replace aggregate base course material with material matching existing material compacted to 95 percent of its maximum density.

B. Pavement removal and temporary asphalt replacement:
   1. Install temporary asphalt pavement or first course of permanent pavement replacement immediately following backfilling and compaction of trenches that have been cut through existing pavement.
   2. Except as otherwise provided, maintain this temporary pavement in safe and reasonably smooth condition until required permanent pavement is installed.
   3. Remove and dispose of temporary paving from project site.
   4. Where longitudinal trench is partly in pavement, replace pavement to original pavement edge, on a straight line, parallel to centerline of roadway.
   5. Where no part of longitudinal trench is in pavement, surfacing replacement shall only be required where existing surfacing materials have been removed.

C. Asphalt pavement replacement:
   1. Replace asphalt pavement to same thickness as adjacent pavement and match as nearly as possible adjacent pavement in texture, unless otherwise indicated on the Drawings.
   2. Cut existing asphalt pavements to be removed for trenches or other underground construction by wheel cutter, clay spade, or other device capable of making neat, reasonably straight and smooth cut without damaging adjacent pavement. Cutting device operation shall be subject to acceptance of Engineer.
   3. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement replacement, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt pavements. No extra payment will be made for these items, and costs incurred in performing this work shall be incidental to pipe laying or pavement replacement.
   4. Conform replacement of asphalt pavement to contour of original pavement.

D. Portland cement concrete pavement replacement:
   1. Where trenches lie within portland cement concrete section of streets, alleys, sidewalks, and similar concrete construction, saw cut such concrete (to a depth of not less than 1-1/2 inches) to neat, vertical, true lines in such manner adjoining surfaces are not damaged.
   2. Place portland cement concrete replacement material to dimension as indicated on the Drawings.
   3. Provide expansion joints that match existing.
   4. Before placing replacement concrete, thoroughly clean edges of existing pavement and wash with neat cement and water.
   5. Surface finish: Wood float finish.

E. Curb, gutter, and sidewalk replacement:
   1. Where any concrete curb, gutter, or sidewalk has been removed or displaced, replace to nearest construction joints with new Class A curb, gutter, or sidewalk to same dimensions and finish as original construction that was removed:
      a. Provide expansion joints of same spacing and thickness as original construction.

F. Asphalt pavements:
   1. Trim existing asphalt pavements which are to be matched by pavement widening or pavement extension to neat true line with straight vertical edges free from irregularities with saw specifically designed for this purpose. Minimum allowable depth of cut shall be 1-1/2 inches.
   2. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement widening or extension, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt concrete pavements.
   3. No extra payment will be made for these items and costs incurred in performing this work shall be incidental to widening or pavement extension.

3.02 FIELD QUALITY CONTROL

A. Tests:
   1. Asphalt concrete as specified in Section 32_12_15 - Asphaltic Concrete Paving.
   2. Concrete as specified in Section 03_30_01 - Concrete Work.

B. Inspection:
   1. Asphalt concrete:
      a. Lay 10-foot straightedge parallel to centerline of trench when the trenches run parallel to street, and across pavement replacement when trench crosses street at angle.
      b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.
   2. Portland cement concrete replacement pavement:
      a. Lay 10-foot straightedge either across pavement replacement or longitudinal with centerline of gutter or ditch.
      b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.

END OF SECTION

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SECTION 32_12_15

ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Asphalt concrete pavement on prepared subgrade or aggregate base course, and on existing pavement, to lines, grades, compacted thicknesses, and cross sections indicated on the Drawings.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Transportation Materials and Methods of Sampling and Testing:
      a. MP1: Specification for Performance Graded Asphalt Binder.

B. ASTM International (ASTM):
   1. C117 - Standard Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   3. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   4. D977 - Standard Specification for Emulsified Asphalt.
   5. D2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures.
   6. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

C. Texas Department of Transportation (TXDOT):
   1. Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (Standard Specifications).

1.03 DEFINITIONS

A. Bituminous prime coat: Consist of application of hot bituminous material on previously prepared base course.

1.04 SUBMITTALS

A. Proposed mix design and gradation of materials.

B. Quality control submittals:
   1. Certificate of Compliance.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Asphalt concrete delivery:
   1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of foreign materials.
   2. Treat bodies as necessary to prevent material from sticking to the bodies.
   3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.

B. Comply with Standard Specifications storage requirements, if applicable.

1.06 PROJECT CONDITIONS

A. Environmental requirements:
   1. Asphalt concrete:
      a. Place asphalt concrete only when surface is dry, and when atmospheric temperature in the shade is 40 degrees Fahrenheit and rising, or above 50 degrees Fahrenheit if falling.
      b. Do not place asphalt concrete when weather is foggy or rainy or when base on which material is to be placed is in wet or frozen condition.
   2. Prime coat:
      a. Do not apply prime coat when atmospheric temperature is below 60 degrees Fahrenheit.
      b. Apply prime coat only when base course is dry or contains moisture not in excess of that which will permit uniform distribution and desired penetration.

1.07 SEQUENCING AND SCHEDULING

A. Prime coat:
   1. Prior to requesting Engineer's acceptance for application, inspect area to be coated to determine its fitness to receive bituminous priming material.
   2. Do not begin application before area to be coated has been accepted for application by the Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Compact the asphalt concrete to at least 95 percent of the density of the theoretical maximum density in accordance with ASTM D2041.

2.02 MATERIALS

A. Subgrade material: Stabilization material as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   1. Thickness: As indicated on the Drawings**.**
   2. Maximum lift thickness: 4 inches.
   3. Compaction: As indicated on Drawings.

B. Base material: Aggregate base course, limerock, or shell-rock material as specified in Section 31_05_15 - Soils and Aggregates for Earthwork.
   1. Thickness: As indicated on the Drawings**.**
      a. Maximum lift thickness: 4 inches.
   2. Compaction: As indicated on Drawings. Minimum 98 percent of the AASHTO T-180 maximum dry density**.**

C. Prime coat:
   1. Use bituminous material for prime coat in accordance with Standard Specifications**.**

D. Sand: Acceptable to the Engineer.

E. Tack coat: Use bituminous material in accordance with Standard Specifications.

F. Asphalt concrete materials:
   1. Asphalt cement: Conform to requirements for asphalt cement, PG 64-10 AASHTO MP1.
   2. Mineral aggregate:
      a. Consist of coarse aggregate of crushed stone or gravel composed of hard, durable particles, sand, and filler as follows:
         1) Coarse aggregate: Portion of material retained on Number 8 sieve. Fine aggregate: That portion passing Number 8 sieve.
      b. Provide composite material that is uniformly graded from coarse to fine and that complies with requirements of one of following gradings when tested in accordance with ASTM C136.
      c. Asphalt concrete: As indicated on the Drawings, 2-course plant mix for asphalt concrete having an overall thickness of 2 1/2 inches or more if not indicated. If less than 2-1/2 inches of asphalt concrete, use single-course plant mix.

Plant Mix, Two Course				**Plant Mix, Single Course**	
Seal, 3/4 inch Thick Minimum		**Base, 1-3/4 inch Thick Minimum**		**1-1/2 inch Thick Minimum**	
Sieve Size	**Percent Passing**	**Sieve Size**	**Percent Passing**	**Sieve Size**	**Percent Passing**
1/2"	100	1-1/4"	100	3/4"	100
3/8"	95 - 100	1"	87 - 100	1/2"	75 - 95
No. 4	50 - 70	3/4"	75 - 90	3/8"	65 - 85
No. 8	35 - 55	3/8"	55 - 72	No. 4	50 - 65
No. 30	15 - 30	No. 4	40 - 60	No. 8	35 - 50
No. 100	5 - 15	No. 8	30 - 50	No. 30	15 - 30
No. 200	3 - 8	No. 30	15 - 30	No. 100	5 - 15
		No. 100	5 - 15	No. 200	3 - 8
		No. 200	3 - 8		

3. Coarse aggregate:
    a. Consist of at least 70 percent by weight of each size aggregate and consist of particles that have at least 1 rough, angular surface produced by crushing:
        1) Have percentage of wear of not more than 50 at 500 revolutions, in accordance with ASTM C131.
    b. Aggregate plasticity index: Not more than 2 in accordance with ASTM D4318.
    c. Sand may be added to crusher or pit-run product to supply any deficiency in Number 8 sieve and filler may be added to supply any deficiency in Number 200 sieve material. If aggregate contains an excess of sand, wasting will be required.
    d. Filler:
        1) Use finely powdered limestone, portland cement, or other artificially or naturally powdered mineral dust acceptable to the Engineer.
        2) Weigh filler and add separately to each batch at time of proportioning.
        3) Use filler that is free from deleterious matter of any kind.
        4) Fineness that meet the following requirements:
            a) Passing Number 50 sieve: 100 percent.
            b) Passing Number 200 sieve: At least 75 percent.
        5) Determine amount of material passing the Number 200 sieve in accordance with ASTM C117.
    e. Provide composite aggregate that is free from vegetable matter, lumps or balls of clay, adherent films of clay, or other matter which would prevent thorough coating of asphalt cement.
    f. Materials derived from processing demolished, or removed asphalt concrete, are not acceptable.

G. Fog sealing: Asphalt emulsion, Grade SS-1h.

2.03 EQUIPMENT

A. Bituminous distributor: Designed and equipped so as to distribute bituminous material uniformly at even heat on variable widths of surface at readily determined and controlled rate with pressure range of 25 to 75 pounds per square inch.

B. Liquid asphalt distributor:
1. Designed and operated to distribute asphaltic material in uniform spray without atomization.
2. Equipped with bitumeter having dial registering feet of travel per minute.
    a. Locate dial so that it is visible to truck driver so that he can maintain constant speed required for application at specified rate.
3. Equip pump with tachometer having dial registering gallons per minute passing through nozzles.
    a. Locate dial so that it is readily visible to operator.
4. Provide means for accurately indicating temperature of asphaltic material in distributor at all times.
    a. Locate thermometer well so that it is not in contact with, or close to, heating tube.
5. Have spray bar having normal width of application of not less than 12 feet and capable of providing for application of lesser width when necessary.

6. Provided with hose and spray nozzle attachment for applying asphaltic material to patches and areas inaccessible to spray bar.
7. Equipped with heating attachments and capable of circulating asphaltic material through spray bar during entire heating process.

C. Asphalt concrete mixing plants:
   1. Equipment:
      a. Use screen and storage bins at plant of sufficient capacity to furnish the necessary amount of aggregates, when operating at the maximum capacity of the plant, with no periods of undue waiting for material.
         1) Use bins consisting of at least 2 compartments, so proportioned as to ensure adequate storage of appropriate fractions of the aggregate.
         2) Provide each compartment with an overflow pipe of such size and at such location as to prevent any backing up of material into other compartments.
      b. Dryer:
         1) Designed to heat and dry the aggregate to Specification requirements and to agitate it continuously during the heating.
         2) Capable of preparing aggregates at a rate equal to the full-rated capacity of the plant.
      c. Dust collector:
         1) So constructed as to waste or return uniformly to the hot elevator all or any part of the material collected.
      d. Mixer:
         1) Adequate capacity, with twin shafts.
      e. Thermometers:
         1) Furnished for determining the temperature of the mix.
      f. Weighing and measuring equipment:
         1) Weighing or volumetric measuring equipment of sufficient capacity.
         2) Devices to permit easy readjustment of any working part needing readjustment, so that the equipment will function properly and accurately.
         3) Attach scales for weighing to the bucket.
         4) Test and seal weighing equipment by a representative of the Inspector of Weights and Measures having jurisdiction, as often as the Engineer may deem necessary to ensure accuracy.
      g. Tanks for storage of bituminous material:
         1) Capable of heating the material under effective and positive control at all times to temperatures within the range stipulated.
   2. Asphalt concrete plant operation:
      a. Mineral aggregate:
         1) Dry and heat mineral and then screen into at least 2 fractions and conveyed into separate compartments ready for proportioning and mixing.
         2) When combined with asphalt cement:
      b. Aggregate:
         1) Contain not more than 2 percent moisture by weight.
         2) Be at a temperature within the range of that specified for the asphalt cement but not more than 25 degrees Fahrenheit above the temperature of the asphalt cement.

c. Combine dry aggregate in the plant in the proportionate amounts of each fraction of aggregate required to meet the specified grading.
    1) Introduce the asphalt cement into the mixer in the amount and at the temperature for the particular material being used.
    2) Continue mixing for at least 30 seconds, and for such longer period as may be necessary to coat the particles.
d. When a continuous mixer is used, determine the mixing time by weight method using the following formula:
    1) Mixing time in seconds = Pugmill dead capacity in pounds.
    2) Pugmill output in pounds per second.

D. Asphalt-concrete-placing equipment:
1. Use equipment for placing, spreading, shaping, and finishing asphalt concrete consisting of a self-contained power machine operating in such manner that no supplemental spreading, shaping, or finishing is required to provide surface that complies with requirements for smoothness contained in this Section.
    a. In areas inaccessible to the machine, hand spreading may be permitted.
2. Furnish 1 self-propelled, pneumatic-tired roller, and one 8-ton (minimum), smooth-wheel tandem roller.
    a. When spreading is in excess of 100 tons per hour, furnish 1 additional roller of either type for each additional 100 tons, or fraction thereof, spread per hour.

2.04 MIXES

A. Asphalt cement:
1. Do not mix at temperatures lower than 275 degrees Fahrenheit or higher than 325 degrees Fahrenheit.
2. Usual amount of asphalt cement, by weight, to be added to aggregate be 5.4 to 5.8 percent of weight of mixture.

B. Asphalt concrete:
1. Before being delivered to the site, mix aggregate with asphalt cement at the central mixing plant.
2. Use mixing plants that are in good working order with no excessively worn parts and so equipped that:
    a. Temperatures of aggregates leaving dryer, of asphalt cement entering mixer, and of mix leaving mixer can be readily determined and positively controlled within Specification limits at all times.
    b. Weights of different sizes of aggregates and of asphalt cement as set by the Engineer can be consistently introduced into the mixer.
    c. Asphalt cement can be uniformly distributed throughout the mixture with aggregate completely coated.
    d. Mixing time can be positively controlled to minimum specified.
    e. Bin samples of aggregate can be readily obtained.
    f. Provide means of calibrating weighing devices.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection:
   1. Prime-coated surfaces:
      a. Maintain surfaces until succeeding layer of pavement has been placed.
      b. During this interval, protect primed surfaces against damage and repair any broken spots.

B. Surface preparation:
   1. Prime coat:
      a. Where portions of base course prepared for immediate treatment are excessively dry, sprinkle such portions lightly with water immediately in advance of prime coat application.
      b. Immediately following preparation of base course, apply bituminous material by means of bituminous distributor at the temperature previously specified.
      c. Apply priming material in manner that results in uniform distribution being obtained at all points of surface to be primed.
      d. Following the application of prime material, allow the surface to dry for a period of not less than 48 hours without being disturbed, or for such additional period of time as may be necessary to obtain penetration into the base course and drying out or evaporation of the volatiles from prime material.
      e. Spread sufficient sand on areas that show an excess of bituminous material to effectively blot up and cure the excess.
   2. Base courses:
      a. Thoroughly clean base and apply prime coat before placing asphalt concrete.
      b. Thoroughly clean any existing base, surfacing, or pavement prior to placing plant-mixed surfacing.
      c. Where existing pavement is being widened or extended, cut to straight vertical face and treat with asphalt paint binder prior to paving operations.
      d. When asphalt concrete is to be applied over existing pavement and local irregularities in existing surface would result in course of more than specified thickness, bring surface of existing pavement to uniform contour by patching with asphalt concrete thoroughly tamped or rolled until it conforms with surrounding surface, and then apply tack coat.

3.02 APPLICATION

A. At existing asphalt to be paved over: Apply tack coat at minimum rate of 0.10 gallons per square yard.

B. Placing and compacting asphalt concrete:
   1. Placing and compacting asphalt mixture: Progress in sections generally not more than 750 linear feet in length.
   2. Spreading of mixture:
      a. Spread, shape, and finish by specified equipment.
      b. Spread each successive strip adjacent to previously spread strip.

c. Do not compact minimum 6-inch width of each strip adjacent to new strip until after new strip has been placed.
d. Spread as nearly continuous as possible.
e. Laying against vertical surfaces such as gutters: Roughen and clean face of vertical surfaces as required for proper bonding and then paint with light coating of asphalt cement or emulsified asphalt.
f. At terminations of new surface courses: Feather asphalt mixture into existing surface over such distance as may be required to produce smooth riding transition.
g. Base-course and single-course construction: Joined by vertical butt joints, finished and rolled to smooth surface.
h. Rolling:
1) Perform initial or "breakdown" rolling with tandem power roller and follow spreading operation when mixture has reached temperature where it does not "pick up" on rolls.
2) Keep rolls properly moistened but do not use surplus of water.
3) Follow initial rolling with pneumatic roller when mixture is in proper condition and when rolling does not cause undue displacement, cracking, or shoving.
4) Begin rolling at sides and progress gradually to center, lapping each preceding track until entire surface has been rolled.
5) Terminate alternate trips of roller in stops at least three feet distant from any preceding stop.
6) At any place not accessible to roller, thoroughly compact mixture with tampers and finish, if necessary, with hot iron to provide uniform layer over entire width being paved.

3. Provide finish surface having uniform texture.

C. Fog sealing:
1. Fog seal asphalt pavement after compaction with fog sealing material applied at rate of 0.05 gallons per square yard at the following locations:
a. At locations indicated on the Drawings.
b. All asphalt pavement.

D. Full-depth asphalt pavement:
1. Contractor's option:
a. Install either full-depth asphalt pavement or asphalt over 6 inch aggregate base course where reservoir bottoms are indicated on the Drawings.
b. Not permitted to use one system in one location and another system elsewhere.
c. Install either asphalt and aggregate base material or full-depth asphalt pavement in areas where paving is indicated on the Drawings or specified to be 2 inches of asphalt concrete over aggregate base course.
d. If option is selected to install full-depth asphalt pavement, prepare subgrade as previously specified in this Section.
e. Substitute asphalt concrete for aggregate base at ratio of 1 inch of asphalt concrete to 2-1/2 inches of aggregate base material. Use full-depth asphalt pavement not less than 4 inches in thickness after compaction.
f. Place asphalt concrete in courses of not more than 4 inches.

g. Use compaction equipment in accordance with following course thicknesses:
    1) 1- to 2-inch thickness: Minimum 8-ton roller.
    2) 2- to 3-inch thickness: Minimum 10-ton roller.
    3) 3- to 4-inch thickness: Minimum 12-ton roller.

2. Pneumatic rollers used for initial or secondary rolling: Use 12 to 15 tons with tires capable of 90-pounds-per-square-inch inflation pressure.
3. Asphalt concrete for full-depth asphalt pavement:
    a. Asphalt concrete as previously specified in this Section.
    b. Apply bituminous prime coats where full-depth asphalt pavement is installed.
    c. Contractor's option: If Contractor elects to use full-depth asphalt pavement, at road shoulders reduce aggregate base course to minimum aggregate thickness of 4 inches.
4. Except for asphalt thickness, aggregate base course thickness, and prime coating, full-depth asphalt pavement shall comply with requirements of this Section.

3.03 FIELD QUALITY CONTROL

A. Base course density tests:
1. Density tests shall be taken at locations suitable to confirm compliance with compaction requirements.
2. Take a minimum of 1 test per 1,000 square yards, for each lift.

B. Placement:
1. Place the mixture on the roads, pavements, or walks at a temperature not less than 225 degrees Fahrenheit.

C. Curing time:
1. Allow asphalt concrete to cure for the following time periods:
    a. Minimum 24 hours before foot traffic is allowed.
    b. Minimum 5 days before vehicle traffic is allowed.
    c. Minimum 10 days before overnight parking is allowed.
    d. Minimum 20 days before heavy construction vehicle traffic is allowed.
2. Contractor shall provide barricades and signs as required to enforce curing time.

D. Asphalt tests:
1. Provide sampling and control testing for the asphalt concrete.
    a. Location, type, and size of the samples: Suitable to determine conformance with stability, density, thickness, compaction, and other specified requirements.
    b. Use an approved power saw or core drill for cutting samples.
    c. Furnish tools, labor, and materials for cutting samples, testing, and replacing the pavement where samples were removed.
    d. Take a minimum of 1 sample per 200 tons of asphalt concrete placed.

E. Inspection:
   1. Asphalt concrete:
      a. Test with a 10-foot straightedge laid on the surface parallel with the centerline of the road. Variation of the surface from the testing edge of the straightedge not to exceed 1/4 inch.
      b. Test each course with running water applied on the surface of the pavement. Water shall flow in the direction indicated on the Drawings. After stopping the water, the pavement surface shall have no areas with standing water.

END OF SECTION

SECTION 33_71_21

PRECAST ELECTRICAL HANDHOLES AND ELECTRICAL MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. Design, fabricate, and install precast electrical handholes and precast electrical manholes of the size and type indicated on the Drawings and specified.
   1. Construction of cast-in-place concrete electrical structures, including handholes and manholes, are specified in other sections.

B. Section includes:
   1. Precast portland cement concrete handholes and accessories.

C. Alternates:
   1. Contractor may propose to construct cast-in-place structures in lieu of the precast structures specified.
      a. Obtain Engineer's acceptance of this alternative before submitting, providing, or installing.
      b. Submit full information on design and detailing of proposed alternatives including design details and drawings of the same types required by this Section for precast structures.

1.02 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

C. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   3. C858 - Standard Specification for Underground Precast Concrete Utility Structures.
   4. C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
   5. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   6. C1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

D. Code of Federal Regulations (CFR):
   1. Title 29, Chapter XVII, Part 1910 - Occupational Safety and Health Standards (OSHA).

E. National Fire Protection Association (NFPA):
   1. National Electrical Code (NEC).

F. National Precast Concrete Association (NPCA).

G. Society of Cable Telecommunications Engineers (SCTE):
   1. 77 - Specification for Underground Enclosure Integrity.

H. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Handhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to reach into, but not enter, the enclosure to install, operate, or maintain equipment or wiring or both. (Reference: NEC, Article 100)
   1. As used in this Section, “handhole” will refer to a precast electrical handhole.

B. Manhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to enter the enclosure to install, operate, or maintain equipment or wiring or both.
   1. As used in this Section, “manhole” will refer to a precast electrical manhole.

C. Portland cement concrete: A composite material consisting of a portland cement binder, water, admixtures, and a combination of fine and coarse mineral aggregates.
   1. Abbreviated “PCC” as in “PCC HANDHOLE” or “PCC MANHOLE.”

D. Precast concrete: A concrete fabrication designed by a qualified engineer and subsequently fabricated at a qualified fabrication site, which is usually located some distance from the site where the fabrication will be installed.

1.04 SUBMITTALS

A. Product data: Manufacturer’s catalog data, details, and warranties for the following items.
   1. Portland cement concrete handholes and manholes:
      a. Materials of construction.
      b. Joint details and joint-sealing materials.
      c. Data for hatches or covers and rings.
      d. Preformed channels and accessories for cable racking.
      e. Drain and sump details, including removable covers.
      f. Pulling iron details.

B. Shop drawings:
   1. Portland cement concrete handholes and manholes:
      a. Shop drawings for each structure shall bear the seal and signature of a professional engineer licensed in the state where the structures will be installed.
      b. Dimensioned and “to-scale” plans, sections, and details for each structure including:
         1) Layout plan for that structure.
         2) Sizes, locations, and vertical positions of duct bank windows and knockout panels.

3) Locations and details for access openings, pulling irons, embedded cable supports and racks, and sumps.
4) Details of structural reinforcement showing bar size and spacing; true position of reinforcement in structural members with clear concrete cover at both inside and outside faces; location, bar size, and spacing of added reinforcement around openings; and other details relevant to design and fabrication of the structure.
5) Details of joints between adjacent precast sections, including provisions for overlap and for placement of sealants.

C. Samples:
1. Portland cement concrete handholes and manholes:

D. Design data:
1. Portland cement concrete handholes and manholes:
a. Structural calculations:
1) Submit complete structural calculations for each structure.
2) Provide calculations bearing the seal and signature of a professional engineer licensed in the state where the structures will be installed.
b. Manufacturer's statement of materials used for fabrication and construction, in accordance with ASTM C858, for record. Include the following:
1) Concrete mix design: For each concrete mix design to be used for the structures, include data describing:
a) Source and type of cement.
b) Sources, grading, and specific gravities of aggregates.
c) Aggregate reactivity data.
d) Concrete mix proportions and design strength.
e) Type, name, and dosage of admixtures included in the concrete mix.
2) Reinforcing steel: Mill certificates.

E. Test reports:
1. Portland cement concrete handholes and manholes:
a. Fabricator's tests for compressive strength of concrete used in structures, made in accordance with recommendations of ASTM C858.

F. Certificates:
1. Portland cement concrete handholes and manholes:
a. Manufacturer's current plant certification under NPCA for the structures to be supplied.
1) Certification shall be current and in-effect at the time structures are manufactured.
b. Manufacturer's certification that handholes and manholes are in accordance with the requirements of ASTM C858.

G. Manufacturer's instructions:
1. Instructions for handling and setting structures in place.
2. Portland cement concrete handholes and manholes:
a. Instructions for operation and maintenance of hatches.

H. Manufacturer's field reports:
    1. Portland cement concrete handholes and manholes:
        a. Manufacturer's inspection reports in accordance with ASTM C1037.

I. Closeout documents:
    1. Project record documents:
        a. Portland cement concrete handholes and manholes:
            1) Final, revised plans and details of as-constructed precast handholes and manholes if requested for record by the Engineer.
    2. Warranties:
        a. Manufacturer's standard warranty for:
            1) Portland concrete handholes and manholes and accessories.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Designer:
        a. Portland cement concrete handholes and manholes:
            1) Professional engineer qualified in the design of concrete structures and holding a current license in the state where the structures will be installed.
    2. Manufacturer:
        a. Portland cement concrete handholes and manholes:
            1) Holding current NPCA plant certification for the products produced.
            2) Demonstrating at least 5 years of experience in the design, production, and installation of products of the type required for this Work.
            3) Capable of providing structural designs prepared by a professional engineer licensed in the state where the structures will be installed.
            4) Providing inspection during fabrication and handling in accordance with the requirements of ASTM C1037.
    3. Installer:
        a. Capable of providing equipment of adequate capacity and mobility to handle and set units with proper bearing on the subgrade and without damage to the unit.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, handling, and unloading:
    1. Package and brace structures to avoid damage during shipping and handling.
    2. Furnish crane or forklift for unloading and setting of portland cement concrete handholes and manholes.

B. Acceptance at site:
    1. Structures delivered to the site with cracks, damage, and damaged or missing accessories shall be removed from the site and replaced at no additional cost to the Owner.

C. Storage and protection:
    1. Store handholes and manholes and their appurtenances in areas protected from damage due to weather and site operations.
    2. Portland cement handholes and manholes.

1.07 PROJECT CONDITIONS

A. Operating environment: As specified in Section 01_81_50 - Design Criteria.

1.08 SEQUENCING

A. Coordinate installation of precast electrical handholes and manholes with duct banks specified in Section 26_05_44 - Duct Banks.

1.09 WARRANTY

A. Provide manufacturer's standard warranty for precast handhole and manhole structures and accessories.

1.10 SYSTEM START-UP

A. As specified in Section 26_05_00 - Common Work Results for Electrical.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Portland cement concrete handholes and manholes.

2.02 MANUFACTURED UNITS - POLYMER CONCRETE HANDHOLES (NOT USED)

2.03 MANUFACTURED UNITS - PORTLAND CEMENT CONCRETE HANDHOLES AND MANHOLES

A. General:
   1. Provide portland cement concrete handholes and manholes configured and designed as indicated on the Drawings and specified.
   2. In accordance with ASTM C858 unless otherwise noted.
      a. Concrete: Provide units with minimum specified compressive strength (f'c) of 4,500 pounds per square inch and using Type II cement.

B. Manufacturers: One of the following, or equal:
   1. Oldcastle Precast.
   2. Jensen Precast.

C. Components:
   1. Floor:
      a. Construct floors as a monolith.
      b. Where sump or low-point drain is included, slope floor to that point.
   2. Roof, walls, and base:
      a. Designed and rated to support vehicle and pedestrian loads at the spans indicated.
      b. See the Electrical Handhole and Manhole Schedule indicated on the Drawings for required load rating by structure location.

3. Access covers:
    a. Handholes: Aluminum plate hinged floor access door (hatch) as specified in Section 08_31_14 - Floor Access Doors.
        1) Load rating:
            a) “Heavy Duty” for covers at locations designated for “Roadway” loads.
            b) “Medium Duty” or stronger for covers at locations designated for “Sidewalk” loads.
        2) Minimum access door size not less than 36 inches square, unless otherwise indicated on the Drawings.
        3) Provide bearing surface with pre-installed continuous elastomeric gasket to minimize water infiltration at lid.
        4) Provide skid-resistant lid with cast-in or machined-in grid pattern and the word “ELECTRICAL” in block letters at least 1.5 inches high.
    b. Manholes: Cast iron frame and cover:
        1) Manhole rings and covers:
            a) Gray cast iron in accordance with ASTM A48, Class 30B with ring and cover machined to fit with flat bearing surfaces.
            b) Cover with word “ELECTRICAL” cast into the top exposed face for electrical manholes.
            c) Manhole riser access:
                (1) Heavy-duty bottom flange frame with solid cover for placement on grade adjustment rings above top slab.
                (2) 36-inch diameter nominal opening.
                (3) Manufacturers: The following or equal.
                    (a) Neenah Foundry Co., R1640-D.
            d) Embedded in top slab of structure:
                (1) Heavy-duty top flange frame with solid cover for embedment in top slab of a structure.
                (2) 36-inch diameter nominal opening.
                (3) Manufacturers: The following or equal.
                    (a) Neenah Foundry Co., R6095.

D. Accessories:
    1. Provide accessories as indicated on the Drawings and specified.
    2. Materials at duct bank penetrations:
        a. Joint filler as specified in Section 03_15_00 - Concrete Accessories.
        b. Backer rod and sealant as specified in Section 07_92_00 - Joint Sealants.
    3. Pulling irons:
        a. Provide non-corroding cable pulling irons located for use with each current duct bank location and additional irons for use with duct banks that may be installed through future knockout panels.
        b. Pulling irons may not be located on the floor.
        c. Where pulling irons are installed on the wall, any pockets surrounding the irons shall have bottom surfaces sloped to drain.
        d. Secure pulling eyes to structure reinforcement.
    4. Cable racks and racking hardware:
        a. Materials: Stainless steel or Non-metallic as specified in Section 26_05_29 - Hangers and Supports, and as required.
        b. Embedded slots: Maximum depth of 1.5 inches.

5. Sumps and drains:
    a. Fiberglass or HDPE fabrications including removable lids to prevent tripping hazards.
6. Exterior dampproofing:
    a. As specified in Section 07_11_00 - Dampproofing.
    b. Field applied to wall and roof surfaces exposed to soil.

E. Fabrication:
1. Embeds:
    a. Install embedded items with provisions for drainage to remove dripping or standing water, and to minimize corrosion.
        1) Pulling irons may not be placed on the floor or in pockets that will collect water.
        2) Detail bottom of cable rack channels to provide a downward sloping “sill” at the bottom of each vertical channel, so that the channel slot drains toward the floor.
    b. Concrete cover:
        1) Provide minimum 0.75-inch clear concrete cover between embeds and surrounding reinforcement.
        2) Provide minimum 1.25-inch clear concrete cover between embed and exterior face of wall.

F. Tests and inspections:
1. Test and inspect structures in accordance with ASTM C858 and ASTM C1037.

2.04 DESIGN AND PERFORMANCE CRITERIA

A. General requirements for handholes and manholes:
1. As specified in Section 26_05_00 - Common Work Results for Electrical for general requirements for electrical work.
2. Provide structures of the sizes and shapes indicated on the Drawings, with layouts, dimensions, and details as indicated on the Drawings and as specified.
3. Conform to the requirements of:
    a. NEC.
    b. Project regulatory requirements as specified in Section 01_41_00 - Regulatory Requirements.

B. Portland cement concrete handholes and manholes:
1. Load resistance of boxes and covers.
2. Design requirements: Loads on structures:
    a. In accordance with ASTM C857, except as modified in this Section.
    b. Loads at the ground surface:
        1) See “Electrical Handhole and Manhole Schedule” indicated on the Drawings for minimum surface loading requirements at each structure. Loads are designated as “sidewalk,” or ”roadway”.
        2) The vehicle and pedestrian loadings in the following paragraphs need not be additive; however, structures designated for “roadway” loading shall also support “sidewalk” loads.

3) “Sidewalk”: Load from regular pedestrian traffic with considerations for occasional non-deliberate vehicular traffic:
    a) Designation "A-0.3" in ASTM C857 Table 1 (300-psf uniform load).
4) ”Roadway”: Load from heavy, frequently repeated vehicle traffic:
    a) Designation "A-16" in ASTM C857 Table 1 (AASHTO HS20-44).

c. Lateral earth pressure loads:
    1) Determine in accordance with the following requirements. Include effects of groundwater on lateral earth pressures.
        a) Equivalent lateral pressure: 60 pounds per square foot per foot of depth (triangular distribution).
        b) Surface surcharge load:
            (1) Backfill-induced live load surcharge of 250 pounds per square foot (rectangular distribution).
            (2) In accordance with ASTM C857 Vehicle Load Designation "A-16" for "Roadway" or "A-0.3" for "Sidewalk" where such surcharge exceeds backfill loads described in the preceding paragraph.
        c) Groundwater effects:
            (1) Include effects from groundwater and soils saturated by flooding to site finished grade elevation .
            (2) Use equivalent lateral pressure of 95 pounds per square foot per foot of depth (triangular distribution) for soil below the design groundwater elevation.

d. Groundwater and flood loads - buoyancy effects:
    1) Design for site groundwater elevation taken at the level of finished grade around the structure.Buoyancy: For groundwater and flood conditions, provide factor of safety against flotation of at least 1.20.
        a) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 30 pounds per cubic foot.
        b) Concrete fill may be provided in the bottom section of precast portland cement concrete structures to add weight. Submit proposed details.

e. Soil-bearing pressure at base:
    1) Maximum 1,000 pounds per square foot total pressure on prepared subgrade soils.

f. Lifting and handling loads:
    1) Make provision in the design for the effects of loads or stresses that may be imposed on structures during fabrication, transportation, or erection.

g. Load combinations:
    1) Design structures to sustain the specified loads individually or in combination.

3. Design requirements: Structural analysis, design, and detailing:
    a. General:
        1) Analyze and design structures including the effects of 2-way action (“plate action”) and of load transfer around current and future openings.
        2) Where structures include panels designed for future removal (“knockout panels”), design structures for loads and stresses with any combination of any or all such panels in place or removed.

b. Precast portland cement concrete handholes and manholes:
    1) Design structures in accordance with the requirements of ACI 318 and this Section.
    2) Provide reinforcement at areas subject to tensile stress when loaded with the specified loads and combinations thereof.
    3) Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in concrete sections.
    4) Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of members in accordance with the following:
        a) Handholes: 1.25 inches.
    5) Reinforcement details:
        a) Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.
        b) Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.
        c) Structures with wall or slab thicknesses exceeding these limits shall have a reinforcement at each face of the member.
    6) Joints:
        a) Provide structures with watertight joints between sections and detailed to minimize water infiltration at duct bank and conduit penetrations.
        b) Provide structures with non-skid, shiplap or tongue and groove joints between sections.

4. Design requirements: Materials:
    a. Portland cement concrete handholes and manholes:
        1) In accordance with ASTM C858.

2.05 MATERIALS

A. Cast-in-place concrete for fill at base sections of portland cement concrete manholes with deep sumps or ballast to resist buoyancy shall be “Class A” concrete as specified in Section 03_30_01 – Concrete Work.

2.06 SOURCE QUALITY CONTROL

A. Portland cement concrete handholes and manholes.

PART 3 EXECUTION

3.01 GENERAL

A. Furnish and install precast electrical handholes and manholes as indicated on the Drawings and specified.

B. Install additional handholes and manholes required so installation procedures will conform to cable manufacturer’s pulling tension requirements.
    1. Include proposed locations and details of such additional handholes and manholes with the submittals under this Section.

3.02 EXAMINATION

3.03 PREPARATION

A. Design:
   1. Prepare detailed and scalable layouts for each manhole structure showing locations of conduit or duct bank penetrations, clearances, locations, and sizes of access openings and major accessories.

B. Protection:
   1. Where handhole and manhole structures are installed adjacent to existing site structures or utilities, provide excavation support or other protection as required to maintain those facilities in service and to prevent damage to both existing and new facilities.

C. Site preparation:
   1. Excavate and prepare exposed subgrade as indicated on the Drawings and as specified.
   2. Level foundation materials so that structures will be set plumb, and duct banks will be at proper grade and alignment.
      a. Install with uniform bearing on foundation materials.
      b. Wedging or blocking of base sections for leveling over the foundation materials will not be permitted.

3.04 INSTALLATION

A. General:
   1. Protect handholes and manholes from displacement, flooding, or flotation.

B. Portland cement concrete handholes and manholes:
   1. Install structures in accordance with ASTM C891 and the provisions of this Section.
      a. In the event of conflicts, the more restrictive provisions shall apply.
   2. Clean and prime joints between adjacent precast sections.
      a. Install sealing compound between sections and provide watertight joints.
   3. Set covers and hatches at elevations indicated on the Drawings.
      a. Securely attach frames to top of precast structures and grade adjustment rings.
   4. Penetrations:
      a. Holes for duct banks and other penetrations may not be cut into precast handholes and manholes unless they are located at designated locations shown on the shop drawings or at knockout panels cast into the structure during manufacturing.
      b. Carefully remove concrete from knockout panel areas with saws.
         1) Ensure that break-back does not extend beyond the designated limits of the knockout panel.
      c. Coat any reinforcement cut or exposed during removal of knockout panel sections with minimum 2 coats of high solids epoxy as specified in Section 09_96_01 - High-Performance Coatings.
         1) Apply epoxy coating applied over and at least 1-inch past the perimeter of the reinforcement.

5. Install duct banks and conduit penetrations in accordance with the penetration details indicated on the Drawings.
    a. Place joint fillers, caulks, and sealants before coating exterior concrete surface with bituminous dampproofing.
6. Fill holes that were provided for handling or other temporary purposes with non-shrink cement grout using procedures as specified in Section 03_30_00 - Cast-in-Place Concrete unless otherwise detailed by the manufacturer.
7. After structures are set and before backfilling, coat exterior below-grade surfaces (around the sidewalls, over the top slab, and around any vertical risers to grade) with 2 heavy coats of bituminous dampproofing as specified in Section 07_11_00 - Dampproofing.
    a. Apply dampproofing in accordance with the coating manufacturer's instructions and at a rate of 40 to 60 square feet per gallon per coat.
    b. Mask over at least 1 inch back from joint caulks or sealants and prevent dampproofing from coming in contact with those materials.
8. Backfill handholes and manholes in accordance with ASTM C891, except that "jetting" is not allowed.

C. Site tolerances:
1. Set electrical handholes and manholes plumb and true at locations indicated on the Drawings.
2. Tolerances on placing:
    a. Horizontal location: Plus or minus 1 inch.
    b. Vertical elevation: Plus or minus 1/2 inch.
    c. Plumb: Plus or minus 1/8 inch over 10 feet.

3.05 REPAIR/RESTORATION

A. Repair cracks or blemishes in concrete by methods acceptable to the Engineer. Submit proposed repairs for acceptance before commencing work.

3.06 FIELD QUALITY CONTROL

A. Site test and inspection.

B. Manufacturer's field service.

C. Special inspections.

3.07 ADJUSTING

A. After final grading is complete, adjust access covers to grade.

3.08 CLEANING

A. Before installation of cables in any duct banks and handholes or manholes, remove concrete spoil, forms, debris, silt, dust, and other foreign material.

3.09 PROTECTION

3.10 SCHEDULES

A. See Drawings for Electrical Handhole and Electrical Manhole Schedule.

END OF SECTION

SECTION 40_05_57.24

ELECTRIC ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Electric motor-driven actuators for valves and gates.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C504 - Standard for Rubber-Seated Butterfly Valves.
   2. C542 - Standard for Electric Motor Actuators for Valves and Slide Gates.

B. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 DEFINITIONS

A. NEMA:
   1. Type 4X enclosure in accordance with NEMA 250.
   2. Type 6P enclosure in accordance with NEMA 250.
   3. Type 7 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

A. Submit as specified in Section 01_33_00 - Submittal Procedures and Section 46_05_10 - Common Work Results for Mechanical Equipment.

B. Provide a complete list/schedule of all actuators being provided with their associated tag names as indicated on the design drawings and/or specifications, service process area and the size of the valve they are actuating.

C. Product data:
   1. Electrical ratings:
      a. Voltage and number of phases.
      b. Starting and running current.
      c. Voltage levels and source for control and status.
   2. Description of integral control interface.
   3. Remote control station components (If applicable).
   4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
   5. Gear ratios for both manual and motorized actuation.
   6. Opening and closing directions.
   7. Allowable starts per hour.
   8. List of all included options and accessories.
   9. Full travel times.
   10. Gearbox data including gear ratio, and gearbox efficiency.

D. Shop drawings:
    1. Wiring diagrams:
        a. Include all options and expansion cards furnished with each actuator.
    2. Dimensioned drawings of each valve and actuator combination.
    3. Dimensioned drawings of each valve gearbox.
    4. Electric motor data.

E. Calculations:
    1. Operating torque.
    2. Maximum torque calculations for seating and unseating.
    3. Maximum operating torque at starting and normal operation.
    4. Signed by Professional Engineer licensed in the State where project is located.

F. Provide draft vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals:
    1. Include a list of all configurable parameters, and the final values for each.
    2. Include a troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.

G. Commissioning submittals:
    1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
        a. Affidavit in accordance with AWWA C542.
    2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01_75_17 - Commissioning.

H. Project closeout documents:
    1. Provide final vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals.

1.05 WARRANTY

A. Provide warranty as specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers for lines 4 inch and larger:
    1. One of following or equal:
        a. EIM :
            1) 3KRK-3 for multi-turn applications
        b. Auma:
            1) SA (multi-turn) with Aumatic AC controls.
            2) SQ (quarter-turn) with Aumatic AC controls.
        c. Limitorque Corp.:
            1) Accutronix MX for multi-turn applications.
            2) Accutronix QX quarter-turn applications.

2.02 CHARACTERISTICS FOR ACTUATORS ON LINES 4 INCHES AND LARGER

A. Provide actuators complete and operable with all components and accessories required for operation.

B. Power supply:
   1. Voltage and phases as indicated in the Motorized Actuator Schedule.
   2. Valve or gate motion independent of power supply phase rotation.
   3. Provide an internal backup power source or mechanical indicator to maintain settings and track valve position when main power is off.
   4. The actuators shall incorporate all major components such as the motor, starter, local controls, terminals, etc. housed within a self-contained, sealed enclosure.

C. Size actuator to move gates or valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
   1. If an operating time is not indicated on the Motorized Actuator Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
   2. Size actuators so that gear boxes are not required where possible.

D. Control interface:
   1. Configuration:
      a. Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
         1) Configurable from a handheld configuring tool or input devices on the actuator.
   2. Local interface, integral to actuator:
      a. Non-intrusive, non-contacting selector switches:
         1) LOCAL-STOP-REMOTE:
            a) Motor actuator operation is prevented with the switch in STOP.
         2) OPEN-CLOSE:
            a) Controls the valve when LOCAL-STOP-REMOTE is in LOCAL.
            b) Spring return to center.
            c) Configurable between maintained (actuator runs until end of travel, high torque, or a LOCAL-STOP-REMOTE is switched to STOP) and momentary (actuator stops when lever is released).
      b. Local display:
         1) Valve fully open and fully closed indicators.
         2) Numerical display showing actual valve or gate position in percent of travel.
   3. Coatings:
      a. Material requirements:
         1) Factory prime and coat with an ISO 12944 classification coating of C5M (Marine, offshore estuaries with high salinity) coating with 15-year durability.
         2) Touch-up damaged coatings with manufacturer provided coating repair kit.
      b. Application requirements:
         1) Painting shall commence within four hours of blast cleaning.

2) Each paint coat within the system is to be applied in accordance with the paint manufacturer's instructions.
3) Paint thickness shall be checked for each coat on each actuator.

c. Qualification requirements:
1) Operators shall be experienced and proficient in surface preparation and coating application techniques.
2) Personnel shall have relevant knowledge of health and safety hazard, use of protective equipment, coating materials, mixing and thinning coatings, coating pot life, surface requirements etc.
3) Personnel carrying out inspection or verification shall be certified as NACE coating inspector or equivalent such as ICorr.

4. Control inputs:
a. Capable of using discrete 24 VDC.
b. Controls the valve when LOCAL-STOP-REMOTE is in REMOTE.
c. Isolated inputs capable of operating from external control voltage source or internal power supply:
d. Provide the following inputs:
1) OPEN.
2) CLOSE.
3) STOP.
e. OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed).

5. Status outputs:
a. Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
b. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
1) Fully closed.
2) Fully open.
c. All output contacts rated for 5 amps, 120 VAC, and 24 VDC.

E. Features:
1. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.
2. Data logging:
a. Store diagnostic data and reference data.
b. Time-stamped historical operating data, including number of operations and most recent operations.
c. Starting torque, maximum running torque, and end of travel torque.
1) Store reference data (recorded during commissioning) and data from last operation.
3. Provide display of logged data on the actuator, or provisions to download to a personal computer.

F. Materials:
1. Construct motorized actuators of materials suitable for the environment in which actuator is to be installed.
a. Enclosure ratings:
1) As scheduled with the following requirements.

a) All actuators will be double sealed for corrosion protection rated at ip68.
2) NEMA 4X for all actuators located outside of Class I areas.
3) All others shall be rated FM - Class I Groups B,C & D and Class II E, F, & G.

G. Components:
1. Motors:
a. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
b. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
1) Design requirements for rubber-seated AWWA butterfly valves:
a) Design actuators for maximum gate or valve operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542.
(1) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
(2) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
2) Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
a) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.
b) Design for the maximum torque and thrust running load over the full cycle.
c) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.
c. Capable of being removed and replaced without draining the actuator gear case.
d. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
e. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
1) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
2) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
f. Provide the following motor protection features:
1) Jammed valve (no valve motion detected through a time delay).
2) High motor temperature (sensed by an embedded thermostats).
3) High torque.
4) Single phasing protection.

H. Enclosures:
    1. Actuator housing ratings as indicated in the Motorized Actuator Schedule.
    2. Stainless steel external fasteners.
    3. Provide o-ring seals for each of the following areas:
        a. Between the terminal compartment and the internal electrical elements.
        b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
    4. Provide actuators with the following minimum enclosure ratings as scheduled:
        a. NEMA Type 4X enclosure for general applications.
        b. NEMA Type 6P rated for actuators in underground vaults or where possible submergence is indicated in the Drawings.
            1) Suitable for a minimum of 48 hours submerged under 3 meters of water.
        c. NEMA Type 7 certified by FM for Class I, Division 1, Groups C, D, E, F, and G, for actuators installed in Class I, Division 1 and 2 areas.

I. Position sensing:
    1. Electronic and adjustable using a solid-state encoder wheel.
        a. Mechanical limit switches and potentiometers are not acceptable.
    2. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
    3. Valve range and position switch outputs field adjustable.

J. Torque sensing:
    1. Torque shutdown setting: 40 percent to 100 percent rated torque:
        a. Adjustable in 1 percent increments.
    2. Torque display: 0 to 100 percent-rated torque.
    3. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
    4. Electrical or electronic torque sensing:
        a. Extrapolating torque from mechanically measured motor speed is not acceptable due to response time.
    5. Independent of variations in frequency, voltage, or temperature.
    6. The actuator shall store actual operational torque curves for retrieval by plant maintenance staff.
    7. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
    8. Provide visible verification of torque switch status without any housing disassembly.

K. Manual actuators:
    1. Hand wheel for manual operation.
        a. Maximum 80-pound pull on rim when operating gate or valve under maximum load.
        b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
            1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.
            2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.

3) Provide Type 316 stainless steel.

2. Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.

L. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set.
1. Accurately cut to ensure minimum backlash.

M. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
2. Sealed-for-life type thrust bearings housed in a separate thrust base.

N. Drive bushing:
1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
2. Positioned in a detachable base of the actuator.

O. Lubrication:
1. Provide totally enclosed actuator gearing with oil or grease filled gear case suitable for operation at any angle.
2. Actuators requiring special or exotic lubricants are not acceptable.

2.03 ACCESSORIES

A. Software:
1. Furnish PC-based diagnostic and configuration software to display diagnostic data and configure actuators.
a. Provide all accessories and drivers required for operation and communications with a standard personal computer running Microsoft Windows.

B. Termination module cover:
1. For actuators on a valve network, provide a means to keep the valve network in service, in the event where the actuator must be removed.
2. Provide sunshades for all outdoor installations of remote control stations that use an LCD or similar screen. Regular pushbutton, sector switches, and pilot light control stations will not require a sunshade.

2.04 SPARE PARTS AND SPECIAL TOOLS

A. As specified in Section 01_60_00 - Product Requirements.

B. Spare parts:
1. Provide the following (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
a. Stem nut.
b. Worm shaft subassembly.
c. Drive sleeve subassembly.
d. Complete actuator seal kit.
e. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
f. Encoder.
g. Control module.
2. Provide 1 spare motor for each size motor furnished.

C. Setting tool:
    1. If required for setting or configuring the actuator, provide a handheld setting tool. Provide a handheld setting tool capable of non-intrusive calibration and interrogation of the actuator.
        a. Furnish 1 setting tool for every 10 actuators.
        b. Capable of communicating with PC-based configuration software and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator.
        c. Actuator configurations:
            1) Capable of storing up to 10 different configurations.
        d. Diagnostic data:
            1) Capable of storing 4 complete sets of diagnostic data.

D. Gate Modification :
    1. Performance Criteria
        a. Stem : Select stem diameter, stem guide quantity and stem guide spacing based on following criteria:
            1) Slenderness ratio (l/r): Shall not exceed 200.
            2) Maximum diameter: Provide stem guides at a spacing to maintain stem diameter of 2.5 inches or less.
            3) Tensile strength: Suitable to withstand the force generated by the operator with the application of a 200 pound force applied to the crank or handwheel or a 250 foot-pound torque applied to the wrench nut.
            4) Compressive strength:
                a) Suitable to withstand buckling due to the force generated by the operator with the application of an 80 pound force applied to the crank or handwheel or a 100 foot-pound torque applied to the wrench nut.
                b) Determine buckling load using Euler Column formula in accordance with AWWA C561, where C = 2.
            5) Design force for power actuators:
                a) Electric motor operators: 1.25 times the output thrust in the stalled-motor condition.
        b. Thrust nut: Suitable to withstand thrust developed by operator with the application of a 40 pound force on the crank or handwheel with safety factor of 5. Base design on ultimate strength of material used.
    2. Components
        a. Stem :
            1) Type 304 stainless steel.
            2) Machine cut or rolled full depth ACME threads.
            3) Diameter: Capable of withstanding anticipated opening and closing thrusts .Minimum stem diameter: 1-1/2 inch at the threads
            4) Length: Capable of permitting easy installation and removal.
            5) Stem couplings:
                a) Silicon bronze or Type 304 stainless steel.
                b) Threaded and keyed to stem or threaded and bolted to stem.
            6) Stem guides:
                a) Type 304 stainless steel.
                b) Split collar.
                c) Adjustable in 2 directions.
                d) Ultra-high molecular weight polyethylene bushing.

7) Provide manganese bronze stop collar on stem above actuator.
8) Drill and connect stem to slide structural sections with Type 304 stainless steel bolts.
9) Coordinate the selection of the gate stem configuration with the gate operator and operating speed.
10) The selected gate stem configuration shall provide the most efficient combination of stem diameter/pitch/lead and keep the operating temperature at the stem nut to a minimum during operation.

b. For motorized applications, if the proposed gate stem configuration would result in any deviation from the operating rise rate specified in Section 40_05_57.24 - Electric Actuators, submit proposed deviation for approval by the Engineer. Operating nut:
1) Locate at operator level.
2) Material: Manganese bronze.

c. Coordination with motorized operator supplier:
1) Sizes and model numbers of motorized operators for gates are estimated in Section 40_05_57.24 - Electric Actuators. Gate manufacturer's responsibility shall extend to confirming these sizes and model numbers for each gate based on:
a) Design seating and unseating head.
b) Open/close speed specified in Section 40_05_57.24 - Electric Actuators.
c) Torque safety factor of 1.4, minimum, applied to the maximum torque requirement, including breakaway from seat.
2) Verify, in writing, that the motorized operators are adequately sized.
3) If the motorized operators are not properly sized for each furnished gate, notify the Engineer immediately.
4) In the event that a different size or model is required for any gate, gate manufacturer shall advise Contractor of the proper selection and Contractor shall provide, at no additional cost, the proper operator.
5) The gate supplier shall machine the stem nuts, provide proper mounting adaptation, and adaptation hardware to ensure adequate interface between the motorized operators and the slide gates.

d. Bolts, nuts, and fittings: Type 304 stainless steel.

e. Anchor bolts: Type 304 stainless steel of sufficient quantity and length to anchor the gate.
1) Quantity, size, and location of anchor bolts shall be determined by the gate manufacturer in accordance with requirements of Section 46_05_10 - Common Work Results for Mechanical Equipment.

f. Height of actuator shall be typical operator height of 3 feet 6 inches if not otherwise shown.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 46_05_10 - Common Work Results for Mechanical Equipment.

B. Position visual indicators so that they are most easily visible.

3.02 COMMISSIONING

A. As specified in Section 01_75_17 - Commissioning, Section 46_05_94 - Mechanical Equipment Testing, and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Source Testing:
         1) Proof-of-Design and Performance Test Reports in accordance with AWWA C542.
      b. Manufacturer's Certificate of Installation and Functionality Compliance.
   2. Manufacturer's Representative on-site requirements:
      a. Installation: 2 trips, 2-day minimum each.
      b. Functional testing: 2 trips, 2-day minimum each.
   3. Training:
      a. Maintenance: 4 hours per session, 2 sessions.
      b. Operation: 2 hours per session, 2 sessions.

C. Source testing:
   1. Design and Performance Test Reports in accordance with AWWA C542.
   2. Test each actuator with a simulated load.
      a. Simulate a typical valve load.
   3. Electrical Instrumentation and Controls:
      a. Test witnessing: not witnessed.
      b. Provide necessary electric actuator training to the operators, minimum of 2 hours, as part of the testing and commissioning phase of this project

D. Functional testing:
   1. Installed actuator:
      a. Test witnessing: Witnessed.
      b. Conduct Level 1 General Equipment Performance Test s.
      c. Conduct Level 1 Vibration Test s.
      d. Conduct Level 1 Noise Test s.
   2. Electrical Instrumentation and Controls:
      a. Test witnessing: Witnessed.
      b. Provide necessary electric actuator training to the operators, minimum of 2 hours, as part of the testing and commissioning phase of this project.

3.03 INTELLIGENT ACTUATOR SCHEDULE

A. Provide actuators indicated on the Drawings:
   1. Major process actuators are listed in the Intelligent Actuator Schedule shown in Attachment A - Intelligent Actuator Schedule.
      a. Attachment A - Intelligent Actuator Schedule does not include all number and types of actuators required for the Project.

END OF SECTION

ATTACHMENT A - INTELLIGENT ACTUATOR SCHEDULE

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INTELLIGENT ACTUATOR SCHEDULE

Item	Reference DWG	Gate Manufacturer	Type	Size	Duty	NEMA Rating	Voltage/ Phase	Notes	Service	Controls
GATE NO. 114A	01E04	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 114B	01E04	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 115A	01E02	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 115B	01E02	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 116A	01E05	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 116B	01E05	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 117A	01E02	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 117B	01E02	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 118A	01E02	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 118B	01E02	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 119	01E03	RH	SG		STD	4X	480/3	1, 2,3	O/C	
GATE NO. 120	01E03	RH	SG		STD	4X	480/3	1, 2,3	O/C	

Item	Reference DWG	Gate Manufacturer	Type	Size	Duty	NEMA Rating	Voltage/ Phase	Notes	Service	Controls
GATE NO. 122A	01E04	HG	SG		STD	4X	480/3	1, 2	O/C	
GATE NO. 122B	01E04	HG	SG		STD	4X	480/3	1, 2	O/C	
GATE NO. 123	01E03	HG	SG		STD	4X	480/3	1, 2	O/C	
GATE NO. 124	01E03	HG	SG		STD	4X	480/3	1, 2	O/C	

Notes:
(1) Provide actuators with local control station.
(2) New motorized actuator to be installed on existing equipment. Field verify characteristics prior to sizing motor actuator.
(3) Stem assembly modifications, pedestal and stem guide, gear box, actuator, and other necessary modifications for a functioning gate shall be provided by the original gate manufacturer. Both original gate manufacturers shall furnish actuators from the same actuator manufacturer.

Abbreviations:

Gate Manufacturer:
RH=Rodney Hunt
HG=Hydro Gate

Types:
BFV = Butterfly Valve.
BV = Ball Valve.
PV = Plug Valve.
SG = Slide Gate.

Duty:
ST = Standard service (0-60 starts/hr) duty.
MD = Modulating duty (~1000 starts/hr).

Item	Reference DWG	Gate Manufacturer	Type	Size	Duty	NEMA Rating	Voltage/ Phase	Notes	Service	Controls
Service: O/C = Open/Close. MOD = Modulating.										
Controls: PA = Profibus PA. DP = Profibus DP. DN = DeviceNet. E-IP = Ethernet/IP. E-TCP = Ethernet TCP or TCP/IP. FF = Foundation Fieldbus H1. MB = Modbus RTU (RS-485). NET = Manufacturer's proprietary network. A = Analog (4-20 mA) control, modulating. D O/C = Discrete open/close. D JOD = Position control using discrete jumps.										

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SECTION 40_61_00

COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Process control and instrumentation systems requirements for common components including installation.
   2. Loop drawings:
      a. Provide complete loop drawings for all systems, including packaged equipment furnished as part of a vendor furnished package, and pre-purchased equipment.
      b. The form, minimum level of detail, and format for the loop drawings must match that of the sample loop drawings included in the Contract Documents.
      c. The Owner and Engineer are not responsible for providing detailed loop diagrams for Contractor furnished equipment.
   3. The requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in Technical Sections, including packaged mechanical systems, LCPs, VCPs, etc.

B. Contract Documents:
   1. Contract drawings:
      a. Schematic diagrams:
         1) Use schematic diagrams in conjunction with the descriptive operating sequence in the Technical Sections to furnish a coordinated and fully-functional control system.
         2) Schematic diagrams show control function only.
            a) Incorporate other necessary functions for proper operation and protection of the system.
         3) Controls are indicated on the Drawings as de-energized.
         4) Mount devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated on the Drawings.

1.02 REFERENCES

A. Code compliance:
   1. As specified in Section 01_41_00 - Regulatory Requirements:
   2. The publications are referenced in this Section by basic designation only without a specified publish date.

B. American Petroleum Institute (API):
   1. RP 550 - Manual on Installation of Refinery Instruments and Control Systems; Part II-Process Stream Analyzers; Section 5-Oxygen Analyzers.
   2. RP 551 - Process Measurement Instrumentation.

C. International Organization for Standardization (ISO):
   1. 9001 - Quality Management Systems - Requirements.

D. International Society of Automation (ISA):
   1. 5.1 - Instrumentation Symbols and Identification.
   2. 5.4 - Instrument Loop Diagrams.

E. National Electrical Code (NEC).

F. National Electrical Manufacturers Association (NEMA).

G. Underwriters Laboratories, Inc. (UL):
   1. 508 - Standard of Safety for Industrial Control Equipment.
   2. 508A - Standard of Safety for Industrial Control Panels.

1.03 DEFINITIONS

A. Control circuit: Any circuit operating at 120 volts alternating current (VAC) or direct current (VDC) or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.

B. Digital bus: A communication network, such as PROFIBUS, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions, and diagnostic information.

C. Modifications: Changing, extending, interfacing to, removing, or altering an existing circuit.

D. Panel: An instrument support system that may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems.

E. Power circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.

F. Powered transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Section, the produced signal may be a 4 to 20 mA 24 VDC signal, a digital bus communications signal, or both.

G. RS-232: RS-232 is also known as TIA-232 or EIA-232, is a standard for serial communication transmission of data. When compared to RS-485 it has lower transmission speed, short maximum cable length, large voltage swing, large standard connectors and no multipoint capability. USB has displaced RS-232 from most of its peripheral interface roles.

H. RS-485: RS-485 is also known as TIA-485 or EIA-485, is a standard defining the electrical characteristics of drivers and receivers for use in serial communications system. Electrical signaling is balanced, and multipoint systems are supported, can be used with data rates up to 10 Mbit/s or at lower speeds distances up to 1,000 m (4,000 ft).

I. Signal circuit: Any circuit operating at less than 50 VAC or VDC, which conveys analog information or digital communications information.

J. 2-Wire transmitter (loop powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Section, 2-wire transmitter refers to a transmitter that provides a signal such as 4 to 20 mA 24 VDC regulation of a signal in a series circuit with an external 24 VDC driving potential:
   1. Fieldbus communications signal or both.

K. USB: Universal Serial Bus is an industry standard that establishes specifications for cables, connectors, and protocols for connection, communication, and power supply interfacing between computer, peripherals, and other computers, it has largely replaced interfaces such as serial and parallel ports.

L. Acronym definitions:
   1. ACB: Automatic current balance.
   2. ATS: Automatic Transfer Switch.
   3. CCS: The PCS central computer system (CCS) consisting of computers and software. The personal computer-based hardware and software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software and functions.
   4. DPDT: Double-pole, double-throw.
   5. ECP: Electronic circuit protector.
   6. ES: Ethernet Switch.
   7. FAT: Factory acceptance test also known as Source Test.
   8. HART: Highway addressable remote transducer.
   9. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode, equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode, equipment is started or stopped and valves are opened or closed through a control algorithm within the PLC software. In the Off mode, the equipment is prohibited from responding from the PLC control.
   10. HMI: Human machine interface is a software application that presents information to an operator or user about the state of a process, and to accept and implement the operators control instructions. Typically information is displayed in a graphical format.
   11. ICSC: Instrumentation and control system contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.
   12. IJB: Instrument junction boxes: A panel designed with cord sets to easily remove, replace, or relocate instrument signals.
   13. I/O: Input/Output.
   14. IP: Internet protocol or ingress protection.
   15. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
   16. LAN: Local area network: A control or communications network that is limited to the physical boundaries of the facility.

17. LOI: Local Operator Interface is an operator interface device consisting of an alphanumeric or graphic display with operator input functionality. The LOI is typically a flat panel type of display mounted on the front of an enclosure with either a touch screen or tactile button interface.
18. LOR: Local-Off-Remote control function. In the Remote mode, equipment is started or stopped, and valves are opened or closed through the PLC based upon the selection of the HOA. In the Local mode, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.
19. NJB: Network junction box. An enclosure that contains multiple access points to various networks within the facility. Networks could be Ethernet, Ethernet/IP, Fieldbus, RIO, etc.
20. P&ID: Process and instrumentation diagram.
21. PC: Personal computer.
22. PCIS: Process control and instrumentation system: Includes the entire instrumentation system, the entire control system, and all of the Work specified in the Instrumentation and Control Specifications and depicted on the Instrumentation Drawings. This includes all the PCS and instruments and networking components as well as the various servers, workstations, thin clients, etc.
23. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
24. PCS: Process Control System: A general name for the computerized system that gathers and processes data from equipment and sensors and applies operational controls to the process equipment. It includes the PLCs and/or RIOs, LOIs, HMIs, both LCPs, VCPs and all data management systems accessible to staff.
25. PJB: Power junction box: An enclosure with terminal blocks that distribute power to multiple instruments.
26. PLC: Programmable logic controller.
27. PS: Power supply.
28. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.
29. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
30. SCADA: Supervisory control and data acquisition system: A general name for the computerized system that gathers and processes data from sensors and equipment located outside of the facility, such as wells, lift stations, metering stations, etc.
31. SELV: Safety extra-low voltage.
32. SFP: Small form-factor pluggable.
33. SPDT: Single-pole, double-throw.
34. SPST: Single-pole, single-throw.
35. UPS: Uninterruptible power supply.
36. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, LOI, HMI, etc.
37. WAN: Wide area network: A control or communications network that extends beyond the physical boundaries of the facility.

1.04 SUBMITTALS

A. General:
   1. Adhere to the wiring numbering scheme specified in Section 26_05_53 - Identification for Electrical Systems throughout the Project:
      a. Uniquely number each wire.
      b. Wire numbers must appear on Equipment Drawings.
   2. Some items of Work are represented schematically, and are designated for the most part by numbers, as derived from criteria in ISA-5.1:
      a. Employ the nomenclature and numbers designated in this Section and indicated on the Drawings exclusively throughout shop drawings, data sheets, and similar submittals.
      b. Replace any other symbols, designations, and nomenclature unique to a manufacturer's, suppliers, or subcontractor's standard methods with those identified in this Section and indicated on the Drawings.

B. Specific submittal requirements:
   1. Control Panel Drawings:
      a. General Requirements:
         1) Submit panel, enclosure, console, furniture, and cabinet layout drawings for all items provided.
         2) Use equipment and instrument tags as depicted on the P&IDs for all submittals.
         3) Nameplates and Wire Labeling:
            a) Nameplate legend including text, letter size, materials, and colors.
            b) As specified in Section 26_05_53 - Identification for Electrical Systems or as indicated on the Drawings.
         4) Structural Requirements:
            a) Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.
            b) Weight.
         5) Clearly show all modifications to existing circuits:
            a) Show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
      b. Required for materials and equipment listed in this and other Technical Sections.
      c. Front, side, rear, internal, external elevations and top and bottom views, showing all dimensions and all to scale.
         1) Locations of conduit entrances and access plates.
         2) Component layout and identification.
         3) Complete and detailed bills of materials:
            a) Including quantity, description, manufacturer, and part number for each assembly or component for each control panel.
            b) Include all items within an enclosure.
         4) Requirements for physical separation between control system components and 120 VAC, 480 VAC, and medium-voltage power cables.
         5) Complete grounding requirements for each system component including any requirements for PLCs, process LANs, and Control System equipment.

6) PLC rack and card layout:
    a) Provide a count of current I/O allocation
    b) Future I/O allocation.
    c) Quantity of spares provided.
7) NEMA rating.
8) Material and finish.

2. Schematics and Wiring Diagrams:
    a. General Requirements:
        1) Submit panel wiring diagrams for every panel that contains wiring.
        2) Use equipment and instrument tags as depicted on the P&IDs for all submittals.
        3) Nameplates and Wire Labeling:
            a) As specified in Section 26_05_53 - Identification for Electrical Systems or as indicated on the Drawings.
        4) Clearly show all modifications to existing circuits:
            a) Show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
    b. Include the following information:
        1) Name of panel.
        2) Wiring sizes and types.
        3) Terminal strip numbers.
        4) Terminal identification for device and field connections.
        5) Wire tags and labels.
        6) Functional name and manufacturer's designation for items to which wiring are connected.
        7) Set points for relays and control or alarm contact settings.
    c. Incorporate equipment manufacturer’s shop drawing information into the schematic diagrams in order to document the entire control system.
3. Loop Drawings:
    a. General Requirements:
        1) Submit loop drawings for every analog, discrete, fieldbus signal, vendor supplied equipment packages, and control panels.
            a) Includes all monitoring, alarming, interlocks, and control devices.
        2) Use equipment and instrument tags as depicted on the P&IDs for all submittals.
        3) Show and identify each component of each loop or system using requirements and symbols from ISA-5.4.
        4) Provide drawings for every instrumentation loop system:
            a) Furnish a separate drawing sheet for each system or loop diagram.
        5) Nameplates and Wire Labeling:
            a) As specified in Section 26_05_53 - Identification for Electrical Systems or as indicated on the Drawings.
        6) Clearly show all modifications to existing circuits:
            a) Show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
        7) Provide loop drawings in the format indicated in the contract drawings.
    b. Provide a complete index in the front of each bound volume:
        1) Index the loop drawings by systems or process areas.

c. In addition to the ISA-5.4 requirements, show the following details:
    1) Functional name of each loop.
    2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
    3) Show all terminal numbers, regardless of the entity providing the equipment.
    4) MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.
    5) Terminal assignments associated with every manhole, pull-box, junction box, conduit, and panel through which the loop circuits pass.
    6) Show vendor control panel, instrument panel, conduit, junction box, equipment and PCS terminations, termination identification, wire numbers and colors, power circuits, and ground identifications.
    7) Cables required for communication requirements.

4. PLC I/O List:
    a. A complete listing of the PCS system point I/O database:
        1) Include for each data point relevant parameters such as range, contact orientation, limits, incremental limits, I/O hardware address, and PLC assignment.
        2) Organize on a site-by-site basis and separate by point type.
        3) In addition to the active I/O points, list the implemented spare I/O points and the available I/O points remaining on each card, as well as other defined future points specified or shown.
        4) Upon completion of the Work, update all I/O lists to indicate the final as-built configuration of the systems:
            a) Organize as-built I/O list on a site-by-site basis, separated by equipment and point type.

5. Control Descriptions:
    a. For each control loop, provide programming logic in the form of a written functional description of the operation of the equipment, signals, and controls:
        1) Functional descriptions shall be modified to reflect the actual programming to be implemented in the PLCs.
        2) Include each function depicted or described in the Contract Documents.
        3) Include within the Control Description content:
            a) Specific requirements.
            b) Common requirements that pertain in general to all loops.
            c) Listing ranges, setpoints, timers, values, counter values, etc.
            d) Manual keyboard entries.
            e) Entry codes.
            f) System responses.
            g) Modes:
                (1) Startup.
                (2) Routine and normal operation.
                (3) Regulation and control.
                (4) Shutdown under specified modes of operation.
                (5) Emergency operating shutdown.

6. Instrument Data Sheets:
    a. The data sheets provided with the instrument specifications are preliminary and are not complete but are provided to assist with the

completion of final instrument data sheets. Additional data sheets may be required.

b. Furnish fully completed data sheets for each instrument and component according to ISA-20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

c. Format: Provide data sheets in Microsoft Word or Microsoft Excel.
   1) Features and options that are furnished.

d. Provide completed data sheet as specified in the Technical Sections and for each control system component.

7. Instrument Installation Drawings:
   a. Provide instrument installation, mounting, and anchoring details for all components and assemblies, including access requirements and conduit connection or entry details.
   b. Each installation shall be identified by the equipment or instrument by tag number.
   c. Provide certification by the instrument manufacturer that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable.
   d. Provide, at a minimum, the following contents for each detail:
      1) Necessary sections and elevation views required to define instrument location by referencing tank, building, or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor, etc.
      2) Ambient temperature and humidity where the instrument is to be installed.
      3) Corrosive qualities of the environment where the instrument is to be installed.
      4) Hazardous rating of the environment where the instrument is to be installed.
      5) Process line pipe or tank size, service, and material.
      6) Process tap elevation and location.
      7) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.
      8) Routing of tubing and identification of supports.
      9) Mounting brackets, stands, anchoring devices, and sunshades.
      10) Conduit entry size, number, location, and delineation between power and signal.
      11) NEMA ratings of enclosures and all components.
      12) Clearances required for instrument servicing.
      13) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

8. Product data:
   a. Provide a technical brochure or bulletin (“cutsheet”) for each instrument or equipment on the project labeled with equipment and instrument tags as depicted on the P&IDs.
      1) Submit with the corresponding data sheets:
      2) Organization: Index product data in the submittal by systems or loops.
   b. Engineering data:
      1) Test data and performance curves, when applicable.
   c. Manufacturer's technical reference manuals.

9. Commissioning Submittals:
    a. As specified in Section 01_75_17 - Commissioning.
    b. Manufacturer representative qualifications.
    c. Manufacturer certificates.
    d. Test plans.
    e. Test reports.
    f. Owner training submittals.
    g. Operation and maintenance manuals.
        1) Organize the operation and maintenance manuals for each process in the following manner:
            a) Section A - Process and Instrumentation Diagrams.
            b) Section B - Control Panel Drawings.
            c) Section D - Schematics and Wiring Diagrams.
            d) Section E - Loop Drawings.
            e) Section F - Network Diagrams.
            f) Section G - PLC I/O List.
            g) Section H - Control Descriptions.
            h) Section I - Instrument Data Sheets.
            i) Section J - Instrument Installation Drawings.
            j) Section K - Product Data.
            k) Section L - Sizing Calculations.
            l) Section M - Test Results.
            m) Section N - Operational Manual.
            n) Section O - Spare Parts List.
            o) Section P - PLC Programs.
10. Meetings:
    a. As specified in Section 01_31_19 – Project Meetings and in this Section.

1.05 QUALITY ASSURANCE

A. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

B. Provide equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

C. The ICSC must have their own operating UL listed panel fabrication facility.
    1. Panels must be fabricated at this facility and meet UL 508/508A requirements.

1.06 DELEGATED DESIGN

1.07 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt of instruments in the field:
    1. Outside of the package: Prominently display tag number identification.
    2. On each instrument: Provide a nameplate as specified in this Section.

1.08 PROJECT OR SITE CONDITIONS

A. Project conditions:
    1. Area classifications:
        a. Furnish enclosures that match the area classifications as specified in Section 26_05_00 - Common Work Results for Electrical.

B. Non-conditioned spaces:
   1. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines.

C. Outdoor installations:
   1. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
   2. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in the Sections for the equipment.

1.09 SEQUENCING

A. As specified in Section 01_31_19 - Project Meetings.

B. Project PCIS overview conference:
   1. Contractor leads the meeting.
   2. Timing:
      a. Prior to start of ICSC and Programmer Work.
   3. Attendees:
      a. Engineer, Owner, ICSC, and Programmer.
      b. Contractor.
      c. Electrical subcontractor.
      d. Manufacturers furnishing major pieces of equipment must attend, including but not limited to:
         1) Vendor control panels.
         2) Chemical feed systems.
         3) Motor control centers.
         4) Switchgear.
         5) Variable frequency drives.
         6) Lighting.
         7) Engine generators.
   4. Agenda:
      a. Meeting purpose:
         1) Review the entire project, equipment, control philosophy, schedules, and submittal requirements.
      b. Review entire project.
      c. Review equipment lists.
      d. Review control philosophy.
      e. Review schedules.
      f. Review submittal requirements.
      g. Safety and security.
      h. Action items.
      i. Next meeting.

C. System configuration meetings: Meet on at least the following occasions:
   1. Preliminary meeting:
      a. Contractor leads the meeting.

b. Timing:
    1) Before configuration work is begun.
c. Attendees:
    1) Engineer, Owner, ICSC, and Programmer.
d. Agenda:
    1) Meeting purpose:
        a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
    2) Review the ICSC provided examples of displays, display symbols, reports, etc. to show the capabilities of the system software.
    3) Safety and security.
    4) Action items.
    5) Next meeting.

2. Development review meeting:
    a. Contractor leads the meeting.
    b. Timing:
        1) After the initial database is entered and typical screens and reports have been entered.
    c. Attendees:
        1) Engineer, Owner, ICSC, and Programmer.
    d. Agenda:
        1) Meeting purpose:
            a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
        2) Review the system configuration.
        3) Review the HMI system database.
        4) Review the control schemes.
        5) Review the displays.
        6) Review the report formats.
        7) Safety and security.
        8) Action items.
        9) Next meeting.
3. Pre-submittal review meeting:
    a. Contractor leads the meeting.
    b. Timing:
        1) Before producing any submittals.
    c. Attendees:
        1) Engineer, Owner, ICSC, and Programmer.
    d. Agenda:
        1) Meeting purpose:
            a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
            b) Review an informal hardcopy of developed HMI screens for review by the Engineer.
        2) Review the system configuration.
        3) Review the HMI system database.
        4) Review the control schemes.
        5) Review the displays.
        6) Review the report formats.
        7) Review an informal hardcopy of developed HMI screens.
        8) Review the submittal schedule.
        9) Safety and security.

10) Action items.
11) Next meeting.

4. Final review meeting:
   a. Contractor leads the meeting.
   b. Timing:
      1) After initial completion of configuration work.
      2) Prior to the Source Test.
   c. Attendees:
      1) Engineer, Owner, ICSC, and Programmer.
   d. Agenda:
      1) Meeting Purpose:
         a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
      2) Review the system configuration.
      3) Review the HMI system database.
      4) Review the control schemes.
      5) Review the displays.
      6) Review the report formats.
      7) Safety and security.
      8) Action items.
      9) Next meeting.
   e. Make final format revisions after this review.

D. Control logic meetings: Meet on at least the following occasions:
   1. Preliminary meeting:
      a. Contractor leads the meeting.
      b. Timing:
         1) Before configuration work is begun on any PLCs programmed by the Contractor (including those provided through subcontractors and suppliers).
      c. Attendees:
         1) Owner, Engineer, ICSC, and Programmer.
         2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
      d. Agenda:
         1) Meeting purpose:
            a) Discuss overall control logic.
         2) Review list of each PLC and other programmable devices that will interface to the rest of the control system, including make, model, and a description of the interface.
         3) Review contact information for each individual responsible for programming each said PLC and other programmable device.
         4) Review schedule of submittals that will contain HMI/LOI interface information.
         5) Safety and security.
         6) Action items.
         7) Next meeting.
   2. Development review meeting:
      a. Contractor leads the meeting.

b. Timing:
    1) After approximately one-half of the HMI/LOI interface submittals have been submitted.
c. Attendees:
    1) Owner, Engineer, ICSC, and Programmer.
    2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
d. Agenda:
    1) Meeting purpose:
        a) Discuss progress on control logic.
    2) Discuss HMI/LOI interface submittals to date.
    3) Discuss HMI/LOI interface future submittals and their requirements.
    4) Discuss half of the screens "drafted" but not submitted.
    5) Review list of each PLC and other programmable devices that will interface to the rest of the control system, including make, model, and a description of the interface.
    6) Review contact information for each individual responsible for programming each said PLC and other programmable device.
    7) Review schedule of submittals that will contain HMI/LOI interface information.
    8) Safety and security.
    9) Action items.
        a) Document Vendor Control Panel programming requirements.
    10) Next meeting.

3. Pre-submittal review meeting:
    a. Contractor leads the meeting.
    b. Timing:
        1) Before producing any submittals.
    c. Attendees:
        1) Engineer, Owner, ICSC, and Programmer.
    d. Agenda:
        1) Meeting purpose:
            a) Coordinate submittals.
        2) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
        3) Review an informal hardcopy of developed HMI screens for review by the Engineer to determine that requirements are being sufficiently met.
        4) Review the submittal schedule.
        5) Safety and security.
        6) Action items.
        7) Next meeting.
4. Vendor control panel programming meetings:
    a. Contractor leads the meeting.
    b. Timing:
        1) Prior to start of vendor control panel programming Work.
    c. Attendees:
        1) Owner, Engineer, ICSC, and Programmer.

2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
3) Each equipment supplier who is providing equipment with a PLC and/or LOI.

d. Agenda:
1) Meeting purpose:
a) Coordinate control logic requirements for specific equipment.
2) Review minimum Vendor Control Panel programming requirements:
a) PLC to PLC global data mapping.
b) PLCs to HMI tags mapping.
c) Communication methods.
3) Review advanced Vendor Control Panel programming requirements, as applicable:
a) Tag naming conventions.
b) LOI screen colors and navigation.
c) Interlock and permissive definitions.
d) Alarms: Clearing, formats, colors, and status.
e) Standard code blocks for common control functionality.
4) Safety and security.
5) Action items.
6) Next meeting.

5. Final review meeting:
a. Contractor leads the meeting.
b. Timing:
1) After all HMI/LOI interface submittals have been submitted.
c. Attendees:
1) Owner, Engineer, and Programmer.
2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
d. Agenda:
1) Meeting purpose:
a) Discuss HMI/LOI interface submittals and requirements.
2) Review minimum programming requirements:
a) PLC to PLC global data mapping.
b) PLCs to HMI tags mapping.
c) Communication methods.
3) Review advanced requirements, as applicable:
a) Tag naming conventions.
b) LOI screen colors and navigation.
c) Interlock and permissive definitions.
d) Alarms: Clearing, formats, colors, and status.
e) Standard code blocks for common control functionality.
4) Safety and security.
5) Action items.
6) Next meeting.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

1.12 SYSTEM PROCESS START-UP

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 DESIGN AND PERFORMANCE REQUIREMENTS (NOT USED)

2.03 SYSTEM DESCRIPTION

A. This project involves the following:
   1. Addition of capacitance level switches in the electrical handholes.
   2. Addition of electric actuator gates in the settling basins at the treatment plant.
   3. Addition of surge protectors for signal, control and power cables coming from outdoors.

B. The electric handholes added as part of this project shall each be provided with capacitance level switches for generating alarm during high water level in the handholes as indicated on the drawings.
   1. Provide NEMA 4X Endress and Hauser Liquicap M Series FTI51/FTI52 model capacitance level switches requiring 120 VAC external power, one in each handhole.
   2. Calibrate the switches in each handhole application and provide necessary probe length to identify water level when it reaches one inch below the lowest conduit entry.
   3. Install switches near the top of the handhole to avoid submergence. Refer to contract drawings for tagging information and additional installation requirements.
   4. Route the high-level alarm from each switch back to the PLC1-RIO3. Use available spare discrete inputs available in the PLC for these high-level alarm inputs.
   5. Coordinate with the Owner to understand existing PLC/HMI programming standards and update the HMI graphics to show high level alarm inside these handholes.

C. The settling basin gates, as identified in the contract drawings, currently are provided with limit switches to provide open and close indication back to the associated PLC/RIO.
   1. The electric actuator provided as part of this project will result in the demo of the existing limit switches associated with the gates. The purpose of the actuator is to provide local controls from the actuator panel, with only open/close status back at the PLC/SCADA. No remote control required for these new gate actuators.
   2. Repurpose the existing PLC I/Os and tags for open/close from the existing limit switches for the open/close status from the new electric actuators for the gates.

3. Coordinate with the Owner to understand existing PLC/HMI programming standards and update the HMI graphics to show gate actuators in lieu of the limit switches.
4. Table below shows the summary of all the gate actuator addition, replacing the existing limit switches:

Item	Description
GATE NO. 114A	Settling Basin No. 1 Inlet Gate
GATE NO. 114B	Settling Basin No. 1 Inlet Gate
GATE NO. 115A	Settling Basin No. 1 Outlet Gate
GATE NO. 115B	Settling Basin No. 1 Outlet Gate
GATE NO. 116A	Settling Basin No. 2 Inlet Gate
GATE NO. 116B	Settling Basin No. 2 Inlet Gate
GATE NO. 117A	Settling Basin No. 2 Outlet Gate
GATE NO. 117B	Settling Basin No. 2 Outlet Gate
GATE NO. 118A	Settling Basin No. 5 Inlet Gate
GATE NO. 118B	Settling Basin No. 5 Inlet Gate
GATE NO. 119	Settling Basin No. 3 Waste Gate
GATE NO. 120	Settling Basin No. 4 Waste Gate
GATE NO. 122A	Settling Basin No. 5 Inlet Gate
GATE NO. 122B	Settling Basin No. 5 Outlet Gate
GATE NO. 123	Settling Basin No. 1 Waste Gate
GATE NO. 124	Settling Basin No. 2 Waste Gate

2.04 EXISTING PRODUCTS (NOT USED)

2.05 MATERIALS (NOT USED)

2.06 MANUFACTURED UNITS (NOT USED)

2.07 EQUIPMENT (NOT USED)

2.08 COMPONENTS

A. Furnish meters, instruments, and other components that are the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

B. Unless otherwise specified, furnish individual instruments that have a minimum accuracy of within 0.5 percent of full scale and a minimum repeatability of within 0.25 percent of full scale.

C. Signal transmission:
   1. Analog signals:
      a. Furnish analog measurements and control signals that vary in direct linear proportion to the measured variable, unless otherwise indicated.

b. Furnish electrical analog signals outside control panels that are 4-to-20 milliamperes 24 VDC, except as indicated.
c. Electrically or optically isolate all analog signals from other signals.
d. Furnish regulated analog signals that are not affected by changes in supply voltage or load resistance within the unit's rating.
e. Maintain the total 4-to-20 milliamperes loop impedance to 10 percent below the published value at the loop operating voltage.
f. Where necessary, reduce loop impedance by providing current-to-current (I/I) isolation amplifiers for signal re-transmission.

2. Pneumatic signals:
   a. All pneumatic signals: 3-to-15 pounds per square inch gauge.
3. Discrete input signals:
   a. As indicated in the controller hardware specification.
4. Discrete output signals:
   a. Dry contacts or TRIAC outputs (with express written approval by the Engineer) as needed to coordinate with the field device.
   b. Provide external terminal block mounted fuse with blown fuse indication for all discrete outputs.
   c. Provide interposing relays for all discrete outputs for voltage and/or current compatibilities.
   d. Provide interposing relays as required for functionality of the control circuit.
5. Signal performance and design criteria:
   a. Stability:
      1) After controls have taken corrective action, oscillation of the final control element shall not exceed 2 cycles per minute or a magnitude of motion of 0.5 percent of full travel.
   b. Response:
      1) Any change in setpoint or controlled variable shall produce a corrective change in position of the final control element and stabilized within 30 seconds.
   c. Agreement:
      1) Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
   d. Repeatability:
      1) For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position the final element.
   e. Sensitivity:
      1) Controls shall respond to a setpoint deviations and measured variable deviations within 1.0 percent of full scale.
   f. Performance:
      1) All instruments and control devices shall perform in accordance with the manufacturers' specifications.

D. Discrete circuit configuration:
   1. Configure discrete control circuits to fail safe, on loss of continuity or loss of power.

2. Alarm contacts: Fail to the alarm condition.
3. Control contacts fail to the inoperative condition unless otherwise indicated on the Drawings.

E. Grounding:
1. Analog signal cables shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
2. For communication and data line signal cable shields and drain wires should be grounded at both ends of the cable.
3. Insulate the shielding and exposed drain wire for each signal cable with heat-shrink tubing.
4. Terminate the signal cable shield on a dedicated grounding terminal block.
5. Provide isolating amplifiers within control panels for field equipment possessing a grounded input or output, except when the panel circuit is galvanically isolated.

F. Instrument air:
1. Where indicated on the Drawings, provide dry, filtered control air at 30 pounds per square inch gauge nominal pressure piped to all field instruments and instrument panels requiring air:
   a. Provide each field instrument with an integral, non-adjustable filter/regulator assembly to provide regulated air.
   b. Provide each instrument panel requiring air with an adjustable filter/regulator assembly with gauge and an air manifold to provide air to pneumatic instruments.
   c. Filter all air to 5-micron maximum particle size.
   d. Provide low pressure switch to alarm on insufficient air supply.

2.09 ACCESSORIES

A. Provide flow conditioning devices or other required accessories as needed to meet the accuracy requirements in the Contract Documents.

2.10 MIXES (NOT USED)

2.11 FABRICATION (NOT USED)

2.12 FINISHES (NOT USED)

2.13 SOURCE QUALITY CONTROL

PART 3 EXECUTION

3.01 EXAMINATION

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. The PCIS configurations are diagrammatic:
1. The locations of equipment are approximate unless dimensioned.

2. Where Project conditions require, make reasonable changes in locations and arrangements.

B. Field instruments installation:
   1. Install field instruments as specified in the Contract Documents, API RP 550 and RP 551, and the manufacturer's instructions.
   2. Mount field instruments so that they can be easily read, readily approached, and easily serviced, and so they do not restrict access to mechanical equipment:
      a. Mount field instruments on a pipe stand or local panel, if they are not directly mounted, unless otherwise indicated on the Drawings.
      b. Provide sun shields for field electronic instruments located outdoors.
   3. Make connections from rigid conduit systems to field instruments with PVC coated flexible conduit:
      a. Type of flexible conduit required for the area classification:
         1) Area classification as specified in Section 26_05_00 - Common Work Results for Electrical.
      b. Maximum length of 18 inches.
   4. Connect field instruments with cable as specified in the Electrical Specifications, except when the manufacturer requires the use of special cable, or otherwise specified in this Section:
      a. Special cable applications shall be in accordance with the NEC.
   5. Verify the correctness of each installation:
      a. Polarity of electric power and signal connections.
   6. Ensure all process connections are free of leaks.

C. Process sensing lines and air tubing:
   1. Install individual tubes parallel and/or perpendicular to and near the surfaces from which they are supported.
   2. Provide supports for rigid tubing at intervals of not more than 3 feet.
   3. Slope horizontal runs of instrument tubing at a minimum of 1/16-inch per foot to allow for draining of any condensate.
   4. Bends:
      a. Make bends for parallel lines symmetrical.
      b. Make bends without deforming or thinning the walls of the tubing.
   5. Square-cut and clean all ends of tubing before being inserted in the fittings.
   6. Provide bulkhead fittings at all panels requiring pipe and/or tubing entries.
   7. Use stainless steel tubing for all piping hard piped from the air header, unless otherwise indicated on the Drawings or not compatible with the fluids or atmosphere in the area:
      a. Use flexible connections only on moving equipment and under the constraint that the length shall be less than 1.5 times maximum travel of the equipment.

D. Existing instrumentation:
   1. Clean, recondition and re-calibrate each existing instrument to be reused, removed, or reinstalled using an authorized service facility of the instrument manufacturer.
   2. Provide certification of this Work before reinstallation of each instrument.

E. Cable and conductor termination:
   1. Terminate all cables and conductors on terminal blocks.

2. Terminal block enclosures:
    a. Suitable for the area classification as specified in Section 26_05_00 - Common Work Results for Electrical.

F. Surge protection:
1. Provide outdoor field instrument loops with voltage surge protection units installed on the instruments and the panel.
2. Individually fuse each 4 to 20 milliamperes direct current loop with a 1/2-ampere fuse between power supplies and receiver surge protectors.
3. Provide voltage surge protection for 4 wire transmitters and analyzers:
    a. Protect both power source and signal loop.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.01 COMMISSIONING – GENERAL

A. As specified in Section 01_75_17 – Commissioning and Technical Sections.

3.02 COMMISSIONING – SOURCE TESTING (NOT USED)

3.03 COMMISSIONING – INSTALLATION VERIFICATION (NOT USED)

3.04 COMMISSIONING – FUNCTIONAL TESTING

A. Assist with troubleshooting and correcting instrumentation and control issues.

3.05 COMMISSIONING – SYSTEM TESTING (NOT USED)

3.06 COMMISSIONING – OWNER TRAINING (NOT USED)

3.07 COMMISSIONING – DOCUMENTATION (NOT USED)

3.08 FIELD QUALITY CONTROL

3.09 ADJUSTING

A. Control valves:
1. Stroke control valves, cylinders, drives and connecting linkages from the control system as well as local control devices and adjust to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position.
2. Check control valve actions and positioner settings with the valves in place to ensure that no changes have occurred since the bench calibration.

B. Make revisions necessary to the control system software, as directed by the Engineer.
1. It is understood that the Contractor knows and agrees that changes will be required in the control system software during commissioning.

3.10 CLEANING

A. Oxygen service devices including piping, valves, and appurtenances shall be cleaned for oxygen service and certified by a qualified inspector prior to placing into service.

B. Vacuum clean control panels and enclosures before process start-up and again after final completion of the project.

C. Clean panel surfaces.

D. Return to new condition any scratches and/or defects.

E. Wipe instrument faces and enclosures clean.

F. Leave wiring in panels, manholes, boxes, and other locations in a neat, clean, and organized manner:
   1. Neatly coil and label all spare wiring lengths.
   2. Shorten, re-terminate, and re-label excessive spare wire and cable lengths, as determined by the Engineer.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

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SECTION 46_05_10

COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.02 SUMMARY

A. Section includes:
   1. Mechanical equipment requirements for:
      a. Basic design and performance criteria.
      b. Prescriptive requirements for common components.
      c. Installation requirements.

1.03 REFERENCES

A. American Bearing Manufactures Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Gear Manufacturer's Association (AGMA) Standards.

C. ASTM International (ASTM):
   1. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   2. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   3. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
   4. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   5. F594 - Standard Specification for Stainless Steel Nuts.

D. Hydraulic Institute (HI):
   1. 9.6.8 - Guideline for Dynamics of Pumping Machinery.

E. International Concrete Repair Institute (ICRI):
   1. Guideline No. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

F. International Organization for Standardization (ISO):
   1. 21940 – Mechanical Vibration – Rotor Balancing – Part 1: Introduction.

G. National Electrical Manufacturers Association (NEMA):
   1. MG-1 - Motors and Generators.

H. Society for Protective Coatings (SSPC):
   1. SP-1-Solvent Cleaning.

1.04 DEFINITIONS

A. Definitions used in this specification and equipment submittals for terms related to rotor-dynamic pumps shall be in accordance with HI 9.6.8, Appendix A, as clarified below.

B. These definitions shall be applied to equipment other than pumps, unless otherwise specified in technical sections.

C. Rotordynamic Analysis Level:
   1. The level of detail required for rotordynamic analysis is indicated in the technical sections schedules as None (no analysis required), Analysis Level 1, Analysis Level 2, or Analysis Level 3, which correlate to increasing levels of required detailed equipment design analysis. Analysis Levels 1, 2 and 3 are based on HI 9.6.8.
   2. Where these specifications differ from HI the more stringent shall apply.

D. Resonant Frequency:
   1. The frequency of a periodic excitation force that is close to the natural frequencies of an object. Also known as critical frequency, critical speed, or resonant speed.
   2. An undamped resonant frequency within the separation margin is always considered harmful under Level 1 analysis.
   3. A resonant frequency that occurs within a separation margin of 15 percent above or below the operating speed range and has a log decrement greater than +0.3 is considered harmful under Level 2 and Level 3 analysis.

E. Separation margin:
   1. The span of operating speeds within which interference between excitation orders and resonant frequencies indicate the possibility of harmful vibrations.
   2. The separation margin for a specific application extends 15 percent above and 15 percent below the span of operating speed required for the specified performance conditions.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Roof coordination.
   1. Show roof penetrations for mechanical equipment on roof drawing submittal and include mechanical equipment information:
      a. Type.
      b. Size.
      c. Location.
      d. Configuration of penetration and the surround.
      e. Weight.
      f. Anchoring and support details.

1.06 SUBMITTALS

A. Items in this Section are components of equipment or systems specified in other sections.
   1. Include data for this Section’s components with the equipment or system submittal.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. General:
   1. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries to provide a complete, operable unit.
   2. Manufacturer shall analyze all rubber-bearing vertical-column pumps, and equipment identified as non-reversing in the technical sections for reverse rotation and provide non reversing motor ratchets.
   3. Equipment that prevents reverse rotation shall be capable of both:
      a. Handling 150 percent of the maximum torque at maximum operating speed.
      b. 150 percent of torque that will be generated in reverse direction due to equipment shutoff head as calculated by the manufacturer.
   4. The motor shall be designed to run safely in the reverse direction at up to 140 percent times the reverse runaway speed under shutoff head conditions.

B. Rotordynamic analysis and vibration testing:
   1. Submit information for the Rotordynamic Analysis Level specified for each piece of equipment as shown in the Technical Sections prior to manufacture of the equipment.
   2. Rotordynamic analysis shall be performed on "like-new" and "as-worn" conditions, representing conditions when first installed and conditions when parts wear to the manufacturer's maximum allowable operating tolerances. Conditions assumed for the "as-worn" condition shall be 2 times the "like-new" tolerances unless specified otherwise.
   3. Rotordynamic analysis criteria:
      a. Torsional excitation forcing function magnitudes shall be no less than 1 percent of the maximum transmitted torque at given speed.
      b. Motor mass elastic information in accordance with NEMA MG-1 shall be obtained from the original equipment manufacturer and included in the analysis. Motors shall be precision balanced to ISO 21940 grade G2.5.
      c. Bearings:
         1) At maximum bearing loads an L-10 life of 100,000 hours in accordance with ABMA 9-11 to be proven.
   4. Submit factory and field testing requirements as specified in the Technical Sections and specified in Section 46_05_94 - Mechanical Equipment Testing after manufacture and installation respectively.
   5. Repair, replace, and modify equipment exhibiting vibration performance that does not meet criteria specified in this Section at no additional cost to Owner. Acceptable remedies include adjustments to equipment component geometry, materials, energy absorbing couplings, etc. Locking out speed interval(s) within equipment specified operating range is unacceptable.
   6. Vibration analysis expert:
      a. Provide vibration analysis expert when specified in the equipment Technical Sections.
         1) The vibration analysis expert must be a 3rd party, unaffiliated with the equipment vendor or Contractor.

b. The vibration analysis expert, and analysis shall be provided by one of the following or equal:
    1) Mechanical Solutions, Inc. (MSI, New Jersey).
    2) Engineering Dynamics Inc. (EDI, Texas).
c. The analysis shall be:
    1) Stamped by a registered professional mechanical engineer.
    2) Verified in-situ by the vibration analysis expert including certification that installation conforms to field conditions assumed in the reports.
    3) Verified in-situ by the vibration analysis expert including witness of at least one field vibration test, and certification that vibration measurements corroborate the rotordynamic analysis.
    4) Supplemented with additional field investigation and analysis should conditions during field vibration testing activity indicate non-compliance with these specifications; supplemental field investigation and analysis shall indicate remedies to comply with the specifications and shall be stamped by a registered professional mechanical engineer.

7. Rotordynamic Analysis Level 1:
    a. Before the equipment is released for manufacture it shall be determined that the equipment/motor structures do not have any harmful resonant frequencies in the lateral and torsional modes. Representative analysis results for identical equipment may be submitted.
    b. Calculate rotor lateral and torsional and equipment structural components' lateral frequencies with a spreadsheet calculation or finite element analysis software.
        1) Equipment structure lateral frequency shall include the motor.
        2) Speed changing drive systems (belt, gear) effects on rotational inertia and stiffness shall be incorporated.
    c. Determine the equipment system components (rotor and structure) resonant frequencies.
    d. An intersection of an equipment component resonant frequency with the 1x run speed excitation order that occurs within separation margin is unacceptable.
8. Rotordynamic Analysis Level 2:
    a. Before the equipment and motor are released for manufacture it shall be determined that the equipment/motor structures do not have any harmful critical speeds in the lateral and torsional modes.
    b. Calculate rotor lateral and torsional and structure lateral frequencies with finite element analysis software.
        1) Equipment structure lateral frequency shall include the motor.
        2) Speed changing drive systems (belt, gear) effects on rotational inertia and stiffness shall be incorporated.
        3) The rotational inertia of water within the impeller, in the wet well and inside the equipment structure, e.g., the column of a vertical pump, shall be included in the calculation at both the high level and low level conditions.
    c. Potentially harmful critical speeds shall be investigated further with a forced, damped analysis to determine component stresses do not exceed material properties.
    d. Forced damped analysis:
        1) Forced lateral analysis shall include forcing function magnitudes at least 10 percent of rotor disc weight at each disc position and

hydraulic imbalance at 5 operating conditions spaced equally over the equipment operating range. If synchronous motors are used ensure that the rotor analysis includes startup, shutdown, and motor control transients.

2) Forced torsional analysis shall include not less than 1 percent of the maximum permitted torque at any given speed. Damping shall be one percent of critical at all shaft elements.
3) The equipment rotor total stress (steady-state and alternating torque components plus lateral-bending stresses) shall not exceed:
    a) Constant torque: Total stress limited to 30 percent of the material fatigue limit and to a maximum of 18 percent of ultimate tensile strength.
    b) Variable torque (including variable speed equipment): Total stress limited to 50 percent of the material fatigue limit and to a maximum of 4 percent of the material ultimate tensile strength.
    c) Submit documentation of material fatigue limit.

e. Report submittals:
    1) Confirmation of compliance with this Section, or detailed exceptions taken.
    2) Software used for analysis.
    3) Results with interpretation.
    4) Preparer's professional engineering stamp and seal.
    5) Input data including component properties, materials and connectivity to other components.
    6) Schematic diagram of model mode shapes, nodes and elements.
    7) Bearing stiffness and damping properties, impeller/diffuser interaction coefficients, and seal dynamic properties.
    8) Campbell diagrams showing the system natural frequencies, excitation orders, and operating speed range for both lateral and torsional analysis.
        a) Campbell diagram shall include equipment operating range; excitation lines at 1x, 2x run speed, and vane pass (or equivalent); and critical speeds associated with equipment system components including the rotor, each major equipment structural component and the motor.
    9) Forced, damped analysis indicating acceptable material stress limits are maintained at interference points shown on the Campbell diagram.

9. Rotordynamic Analysis Level 3:
    a. Before the equipment and motor are released for manufacture it shall be determined that the equipment/motor structures do not have any harmful critical speeds in the lateral and torsional modes.
    b. Calculate rotor lateral and torsional and structure lateral frequencies with finite element analysis software.
        1) Equipment structure lateral frequency shall include the motor.
        2) Speed changing drive systems (belt, gear) effects on rotational inertia and stiffness shall be incorporated.
        3) The rotational inertia of water within the impeller, in the wet well and inside the equipment structure, e.g., the column of a vertical pump, shall be included in the calculation at both the high level and low level conditions.

c. Potentially harmful critical speeds shall be investigated further with a forced, damped analysis to determine component stresses do not exceed material properties.
d. Forced damped analysis:
    1) Forced lateral analysis shall include forcing function magnitudes at least 10 percent of rotor disc weight at each disc position and hydraulic imbalance at 5 operating conditions spaced equally over the equipment operating range. If synchronous motors are used ensure that the rotor analysis includes startup, shutdown, and motor control transients.
    2) Forced torsional analysis shall include 1 percent of the maximum permitted torque at any given speed. Damping shall be one percent of critical at all shaft elements.
    3) The equipment rotor total stress (steady-state and alternating torque components plus lateral-bending stresses) shall not exceed:
        a) Constant torque: Total stress limited to 30 percent of the material fatigue limit and to a maximum of 18 percent of ultimate tensile strength.
        b) Variable Torque (including variable speed equipment): Total stress limited to 50 percent of the material fatigue limit and to a maximum of 4 percent of the material ultimate tensile strength.
        c) Submit documentation of material fatigue limit.
e. Report submittals:
    1) Report 1: Executive Summary including:
        a) Confirmation of compliance with this specification section, or detailed exceptions taken.
        b) Software used for analysis.
        c) Results with interpretation.
        d) Preparer's professional engineering stamp and seal.
        e) Campbell diagrams showing the system natural frequencies, excitation orders, and operating speed range for both lateral and torsional analysis.
            (1) Campbell diagram shall include equipment operating range; excitation lines at 1x, 2x run speed, vane pass (or equivalent), line- and twice-line frequency, motor-pole frequency, torsional harmonics from reciprocating drivers (including up to 6 times operating speed), control pulse frequencies induced by VFDs (with certification from VFD manufacturer of frequencies up to 24 times motor running speed), any torque harmonic greater than 1 percent of steady torque at primary excitation, and synchronous motor requirements; and critical speeds associated with equipment system components including the rotor and each major equipment structural component.
        f) Report 1 shall not include detailed analysis elements listed for submittal under Report 2 below, submittal of full analysis details in Report 1 is unacceptable.
        g) Following submittal of Report 1, submit Report 2: Detailed Analysis including responses to comments made on Report 1: Rotor-dynamic Executive Summary.

2) Report 2: Rotor-dynamic Detailed Analysis including:
   a) Input data including component properties, materials and connectivity to other components.
   b) Schematic diagram of model mode shapes, nodes and elements.
   c) Bearing stiffness and damping properties, impeller/diffuser interaction coefficients, and seal dynamic properties.
   d) Forced, damped analysis indicating acceptable material stress limits are maintained at interference points shown on the Campbell diagram.
   e) Synchronous motor information including time-integration study results showing transient peak stresses at startup, shutdown and motor control transient events. Provide tomographic diagrams including root and keyway stress concentration locations and the corresponding speeds that result in reported peak stresses.

2.02 POWER TRANSMISSION SYSTEMS

A. V-belts, sheaves, shaft couplings, chains, sprockets, mechanical variable-speed drives, variable frequency drives, gear reducers, open and enclosed gearing, clutches, brakes, intermediate shafting, intermediate bearings, and U-joints:
   1. Rated for 24 hour-a-day continuous service, or for intermittent service with frequent stops-and-starts, whichever is most severe.
   2. Sized with a service factor of 1.5 or greater:
      a. Apply service factor to nameplate horsepower and torque of prime source of power and not to actual equipment loading.
      b. Apply service factors in accordance with AGMA or as specified in the Technical Sections.

2.03 BEARINGS

A. Oil or grease lubricated, ball or roller antifriction type, of standard manufacture.
   1. Design lubrication system based on the equipment location to operate in the temperatures as specified in Section 01_81_50 - Design Criteria.
      a. Design lubrication system to safely start after being shut off for 24 hours and operate safely:
         1) Suitable for the outdoor winter temperature as specified in Section 01_81_50 - Design Criteria.

B. Oil-lubricated bearings:
   1. Provide either pressure lubricating system or separate oil reservoir splash-type system as specified in the Technical Section.
   2. Design oil-lubrication system to safely absorb heat energy generated in bearings when equipment is operating in the following conditions:
      a. With the highest load and the temperature 15 degrees Fahrenheit above the outdoor summer temperature as specified in Section 01_81_50 - Design Criteria.

C. Grease lubricated bearings, except those specified to be factory sealed:
   1. Fit with easily accessible grease supply, flush, drain, and relief fittings.

2. Lubrication lines and fittings:
    a. Lines: Minimum 1/4-inch diameter stainless steel tubing.
    b. Multiple fitting assemblies: Mount fittings together in easily accessible location.
    c. Use standard hydraulic-type grease supply fittings:
        1) Manufacturers: One of the following or equal:
            a) Alemite.
            b) Zerk.

D. Ratings: Rated in accordance with ABMA 9 or ABMA 11 L10 life for bearings rating life of not less than 50,000 hours.

2.04 BELT DRIVES

A. Sheaves:
1. Separately mounted on bushings by means of at least 3 pull-up bolts or cap tightening screws.
2. When 2 sheave sizes are specified, provide separate belts sized for each set of sheaves.
3. Statically balanced for all; dynamically balanced for sheaves that operate at a peripheral speed of more than 5,500 feet per minute.
4. Key bushings to drive shaft.

B. Belts:
1. Anti-static type when explosion-proof equipment or environment is specified.
2. When spare belts are specified, furnish 1 spare belt for every different type and size of belt-driven unit:
    a. Where 2 or more belts are involved, furnish matched sets.
    b. Identify as to equipment, design, horsepower, speed, length, sheave size, and use.
    c. Package in boxes labeled with identification of contents.

C. Manufacturers: One of the following or equal:
1. Dodge, Dyna-V belts with matching Dyna-V sheaves and Taper-Lock bushings.
2. T. B. Woods, Ultra-V belts with matching Sure-Grip sheaves and Sure-Grip bushings.

2.05 FLANGED PIPING CONNECTIONS

A. Unless otherwise in the Technical Sections or indicated on the Drawings, provide flat face flanges.

2.06 ASSEMBLY FASTENERS

A. General service: Stainless steel, Type 316:
1. Bolts: In accordance with ASTM F593, Alloy Group 2.
2. Nuts: In accordance with ASTM F594, Alloy Group 2.
3. Washers: Alloy group matching bolts and nuts.

B. High-temperature service or high-pressure service: Stainless steel, Type 316:
1. Bolts: In accordance with ASTM A193, Grade B8M, Class 1, heavy hex.

2. Nuts: In accordance with ASTM A194, Grade 8, heavy hex.
3. Washers: Alloy group matching bolts and nuts.

C. Low-temperature service: Stainless steel, Type 316:
1. Bolts: In accordance with ASTM A320, Grade B8M, Class 1, heavy hex.
2. Nuts: In accordance with ASTM A194, Grade B8M, heavy hex.
3. Washers: Alloy group matching bolts and nuts.

2.07 GUARDS AT HIGH-TEMPERATURE SURFACES

A. Exposed surfaces having an external surface temperature of 120 degrees Fahrenheit or higher and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps or fixed ladders.

B. Cover with a thermal insulating material unless otherwise guarded against contact.
1. Insulation thickness such that the insulation exterior temperature is below 120 degrees Fahrenheit.
2. Insulation Type 3 and cover Type 5.

2.08 GUARDS AT MOVING COMPONENTS

A. Provide guards on rotating components that are within 7.5 vertical feet of an operating floor or platform.

B. Allow visual inspection of moving parts without removal.

C. Allow access to lubrication fittings.

D. Easily removable for maintenance.

E. Prevent entrance of rain or dripping water for outdoor locations.

F. Size belt and sheave guards to allow for installation of sheaves 15 percent larger and addition of 1 belt.

G. Materials:
1. Sheet metal: Carbon steel, 12-gauge minimum thickness, hot-dip galvanized after fabrication.
2. Fasteners: Type 316 stainless steel.

2.09 SHOP FINISHES

A. Manufacturer's standard primer and finish coatings.
1. Primer only if field coatings are to be applied.

2.10 GEAR MOTORS

A. Parallel shaft drives: Helical gearing.

B. Right-angle drives: Worm gearing.

C. Manufacturers: One of the following or equal:
   1. Baldor Electric Company.
   2. Bodine Electric Company.

2.11 GEAR REDUCTION UNITS

A. Design and performance criteria:
   1. Gear type:
      a. Helical or herringbone.
   2. AGMA Class II service:
      a. Use more severe service condition when such is recommended by unit's manufacturer.
   3. Cast-iron housing with gears running in oil.
   4. Anti-friction bearings.
   5. Thermal horsepower rating based on maximum horsepower rating of prime mover, not actual load.

2.12 MOUNTING AND LIFTING PROVISIONS FOR EQUIPMENT

A. Equipment bases and base plates:
   1. Provide equipment bases with machined support pads, dowels for alignment for mating of adjacent items, openings for electrical conduits, and openings to facilitate grouting.
   2. Provide jacking screws in bases and supports for equipment and for equipment weighing 500 pounds or more.
   3. Materials:
      a. Match equipment material or steel.
      b. Coating: Match equipment.

B. Steel support frames:
   1. Carbon steel:
      a. At exterior locations, and at interior wet or moist locations, provide continuous welds on both sides to close seams and edges between steel members.
      b. Grind closure welds smooth.

C. Lifting lugs or eyes:
   1. Equipment units weighing 50 pounds or more:
      a. Provide with lifting lugs or eyes to allow removal with lifting device.

2.13 NAMEPLATES

A. Fastened to equipment at factory in an accessible and visible location.

B. Metal engraved or stamped with text, holes drilled or punched for fasteners.

C. Material: Aluminum or stainless steel.

D. Fasteners: Number 4 or larger oval head stainless steel screws or drive pins.

E. Text:
   1. Manufacturer’s name, equipment model number, equipment serial number, and identification tag number.

2. Additional items indicated in the Technical Sections.
3. Indicate the following additional information as applicable:
    a. Maximum and normal rotating speed.
    b. Service class per applicable standards.
4. Include for pumps:
    a. Rated total dynamic head in feet of fluid.
    b. Rated flow in gallons per minute.
    c. Impeller, gear, screw, diaphragm, or piston size.
5. Include for motors:
    a. Drive speed.
    b. Motor horsepower with rated capacity.
6. Include for gear reduction units:
    a. AGMA class of service.
    b. Service factor.
    c. Input and output speeds.

2.14 PUMP SHAFT COUPLINGS

A. General:
1. Type and ratings: Non-lubricated designed for not less than 50,000 hours of operating life.
2. Sizes: Provide as recommended by manufacturer for specific application, considering horsepower, speed of rotation, balance, and type of service.
3. Suitable for an ambient temperature range between -40 degrees to +200 degrees Fahrenheit.

B. Close-couplings for electric-motor-driven equipment:
1. Manufacturers: One of the following or equal:
    a. Lovejoy.
    b. T.B. Woods.
2. Provide flexible couplings designed to accommodate angular misalignment, parallel misalignment, and end float.
3. Manufacture flexible component of coupling from synthetic rubber or urethane.
4. Provide service factor of 2.5 for electric motor drives and 3.5 for engine drives.
5. Do not allow metal-to-metal contact between driver and driven equipment.

C. Flexible couplings for direct connected electric-motor-driven equipment:
1. Manufacturers: One of the following or equal:
    a. Rexnord.
    b. T.B. Woods.
2. Provide flexible couplings designed to accommodate shock loading, vibration, and shaft misalignment or offset.
3. Provide flexible connecting element of rubber and reinforcement fibers.
4. Provide service factor of 2.0.
5. Connect stub shafts through collars or round flanges, firmly keyed to their shafts with neoprene cylinders held to individual flanges by through pins.

D. Spacer couplings:
1. Where cartridge-type mechanical seals or non-split seals are specified, provide a spacer-type coupling of sufficient length to remove the seal without disturbing the driver or driven equipment.

2.15 PUMP SEAL CHAMBER AND SEALS

A. Seal chamber (stuffing box):
   1. Large enough to retrofit with double mechanical seal.

B. Seal Types: Based on the following and as specified in the Technical Section:
   1. Type 1: Packing:
      a. Provide when specified in the Technical Section for wastewater, non-potable water, and sludge applications:
         1) Asbestos free.
         2) PTFE (Teflon™) free.
         3) Braided graphite.
         4) Manufacturers: One of the following or equal:
            a) Chesterton, 1400.
            b) John Crane.
      b. Provide when specified for drinking water service:
         1) Asbestos free.
         2) Material: Braided PTFE (Teflon™).
         3) Manufacturers: One of the following or equal:
            a) Chesterton, 1725.
            b) John Crane.
      c. Design:
         1) Packing gland to allow adjustment and repacking without dismantling pump except to open up stuffing box.
         2) Seal chamber (stuffing box) large enough to retrofit with double mechanical seal.
         3) Manufacturers: One of the following or equal:
            a) Chesterton, 1725.
            b) John Crane.
   2. Type 2: Mechanical seal, flushing, cartridge, single o-ring.
      a. Manufacturers: One of the following or equal:
         1) Chesterton, S10.
         2) John Crane, 5610 Series.
   3. Type 3: Mechanical seal, flushing, cartridge, double o-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, S20.
         2) John Crane, 5620 Series.
   4. Type 4: Mechanical seal, flushing, cartridge, double split-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, S20.
         2) John Crane, 5620 Series.
   5. Type 5: Mechanical seal, flushing, cartridge, single split-ring,:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, 442.
         2) John Crane, 5860.
   6. Type 6: Mechanical seal, flushless, cartridge, single split-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, 156.
         2) John Crane, 3740 Series.

C. Mechanical seals, Types 2 to 6:
   1. Balanced hydraulically.

2. Spring:
    a. Stationary, out of pumping fluid.
    b. Material as specified in the Technical Section. Hastelloy C; Type Elgiloy or 17-7 PH stainless steel for split seals.
3. O-ring: Viton™ 747.
4. Gland: Type 316L stainless steel.
5. Set screws: Type 316L stainless steel.
6. Faces: Reaction bonded, silicon carbide/carbon.
7. Minimum differential pressures in either direction: 300 pounds per square inch gauge.
    a. Manufacturers: One of the following or equal:
        1) Chesterton, 1400.
        2) John Crane, equivalent product.
8. Drinking water service:
    a. Asbestos free.
    b. Material: Braided PTFE (Teflon™).
    c. Manufacturers: One of the following or equal:
        1) Chesterton, 1725.
        2) John Crane, equivalent product.

D. Flushing system:
1. Provide flushing connections:
    a. 3/4-inch size.
    b. Provide API Standard 682 seal water plan arrangement as specified in the Technical Section:
        1) Plan 11 - Product stream seal water from discharge thru seal.
        2) Plan 13 - Product stream seal water thru seal to suction.
        3) Plan 23 - Closed loop seal water with cooler and pumping ring.
        4) Plan 32 - Production seal water discharged to product stream.
        5) Plan 54 - Production Seal Water Excluded from Product Stream.

2.16 SHIPPING

A. Prior to shipment of equipment:
1. Bearings (and similar items):
    a. Pack separately or provide other protection during transport.
    b. Greased and lubricated.
2. Gear boxes:
    a. Oil filled or sprayed with rust preventive protective coating.
3. Fasteners:
    a. Inspect for proper torques and tightness.

PART 3 EXECUTION

3.01 PRE-INSTALLATION

A. Field measurements:
1. Prior to shop drawings preparation, take measurements and verify dimensions indicated on the Drawings.
2. Ensure equipment and ancillary appurtenances fit within available space.

B. Sequencing and scheduling:
   1. Coordinate details of equipment with other related parts of the Work, including verification that structures, piping, wiring, and equipment components are compatible.
   2. Equipment anchoring: Obtain anchoring material and setting drawings from equipment manufacturers in adequate time for templates to be constructed and anchors to be cast-in-place.

3.02 LUBRICATION LINES AND FITTINGS

A. Support and protect lines from source to point of use.

B. Fittings:
   1. Bring fittings to outside of equipment in manner such that they are readily accessible from outside without necessity of removing covers, plates, housings, or guards.
   2. Mount fittings together wherever possible using factory-mounted multiple fitting assemblies securely mounted, parallel with equipment lines, and protected from damage.
   3. Fittings for underwater bearings: Bring fittings above water surface and mount on edge of structure above.

3.03 ALIGNMENT OF DRIVERS AND EQUIPMENT

A. Where drive motors or other drivers are connected to driven equipment by flexible coupling, disconnect coupling halves and align driver and equipment after driven equipment has been leveled on its foundation.

B. Comply with procedures of appropriate HI, AGMA Standards, alignment tolerances of equipment manufacturers and the following requirements to bring components into angular and parallel alignment:
   1. Maximum total coupling offset (not the per-plane offset): Not to exceed 0.5 mils per inch of coupling length for spacer couplings based on coupling length (not dial separation).
   2. Utilize jacking screws, wedges, or shims as recommended by the equipment manufacturer and as specified in the equipment sections.

C. Use reverse-indicator arrangement dial-type or laser-type alignment indicators: Mount indicators on the driver/coupling flange and equipment/coupling flange. Alignment instrumentation accuracy shall be sufficient to read angular and radial misalignment at 10 percent or less of the manufacturer's recommended acceptable misalignment.

D. Alignment and calculations shall include measurement and allowance for thermal growth, spacer coupling length, indicator separation, and axial spacing tolerances of the coupling.

E. When alignment satisfies most stringent tolerance of system components, grout between base and foundation.
   1. Allow minimum 48 hours for grout to harden.
   2. After grout hardens, remove jacking screws, tighten anchor bolts and other connections, and recheck alignment.
   3. Correct alignment as required.

3.04 EQUIPMENT SUPPORT AND ANCHORING TO STRUCTURES

A. Anchor equipment to structures as indicated on the Drawings and as specified.

B. Obtain final anchor bolt layouts for equipment prior to:
   1. Detailing reinforcement for equipment pads.
   2. Preparation of shop drawings for metal structures supporting equipment.

C. Anchor bolt templates:
   1. Provide templates as specified in the Technical Sections.
   2. Use final anchor bolt layout to construct templates for setting anchor bolts.
   3. Make templates:
      a. Rigid, and non-deformable during use.
      b. With longitudinal axes of anchors parallel.
      c. With longitudinal axes of anchors perpendicular to surface supporting the equipment.
   4. Templates may be reused for multiple locations of the same equipment only if:
      a. Templates are in "like-new" condition prior to each reuse.
      b. The anchor layout has not been deformed or damaged by previous installation, removal, or handling of templates.
   5. Sequence:
      a. Set and support templates prior construction of structures surrounding anchors.
      b. Position anchors in templates to provide designated embedment in supporting structure, with required projection for installation of grout, base plates, and hardware for tightening.
      c. Construct concrete or masonry around anchors using methods that preserve required anchor positions and alignment, and clearances to edges of supports or structures.

D. Anchor adjustment sleeves:
   1. Use of adjustment sleeves around anchors:
      a. Is at the option of the Contractor.
      b. Does not relieve Contractor of obligation to construct and use templates for setting of anchors.
      c. May required increased anchor embedment length to develop the strength of the anchor in the embedded length below the adjustment sleeve.
   2. Submittal requirements for anchor adjustment sleeves:
      a. Provide within sufficient time for Engineer approval and not less than 10 working days before setting those items.
      b. Proposed locations of sleeves.
      c. Details and dimensions of sleeves.
      d. Sleeve materials of construction, and coatings.
      e. Information on sleeve filler material and means of filler removal.
      f. Type, details, and dimensions of anchor bolts or anchor rods to be used with sleeves.
      g. Calculations showing development of anchor load capacity below the bottom of the sleeve.
      h. Plan for removal of sleeve fillers, if any.
      i. Plan for placement and consolidation of flowable grout inside sleeves and to a level equal to top of concrete slab or equipment pad surrounding the sleeve.

3.05 GROUTING UNDER EQUIPMENT BASES, BASE PLATES, SOLE PLATES, AND SKIDS

A. General:
   1. Comply with equipment manufacturer's installation instructions including:
      a. Tolerances for level.
      b. Tolerances for vertical and horizontal alignment.
      c. Requirements or recommendations for grouting spaces and grout installation.
      d. Recommendations for tightening of equipment anchors after grout has cured.
   2. Install equipment over grout as indicated on the Drawings or specified only after:
      a. Equipment is leveled and in proper alignment.
      b. Piping connections are complete and in alignment with no strain transmitted to equipment.
   3. Install flowable grout, as specified in Section 03_60_00 – Grouting, placed with forms and head boxes.
      a. Use flowable, non-shrink grout.
      b. Use flowable, non-shrink epoxy grout, only where indicated on the Drawings, where specified in Technical Sections, or when approved in advance by the Engineer.
      c. Grouting with dry-pack materials is not permitted.

B. Prepare equipment bases, base plates, soleplates, and skids for grouting:
   1. Concrete equipment bases:
      a. Roughen surface in accordance with ICRI, Guideline No. 310.2R, Surface Preparation Profiles CSP-3 and CSP-4.
      b. Clean roughened concrete surfaces:
   2. Base plates, soleplates, and skids:
      a. Clean surfaces in accordance with SSPC-SP-1-Solvent Cleaning, to remove dirt, dust, oil, grease, paint, and other material.

C. Level equipment for grouting:
   1. Use removable jack screws, or removable steel wedges and shims to support and level equipment bases, base plates, sole plates, and skids.
      a. Do not use leveling nuts placed on equipment anchors to support or level equipment bases, base plates, sole plates, and skids.
   2. Removable jack screws:
      a. Provide number, size, and locations of jack screws required to support and level equipment in accordance with manufacturer's recommendations.
      b. Drill and tap equipment base plates, sole plates, and skids for jack screws.
      c. Support jack screws on circular steel plates that have been epoxy bonded to the equipment foundation.
         1) Provide plates fabricated from Type 316 stainless steel where edges of support plates will have grout side cover of 3 inches or less in the finished work.

d. Make provision for removal of jack screws after grouting:
    1) Prevent grout from bonding to jack screws by wrapping jack screw threads that will be in contact with grout with multiple layers of tape or other material acceptable to Engineer.
e. Place and cure grout.
f. After grout is placed and cured:
    1) Remove jack screws and material used to prevent grout from bonding to jack screws.
    2) Provide jack screws to Owner for future use.
    3) Fill jack screw holes with grout.
    4) Cure grout as specified.

3. Removable steel wedges and shims:
    a. Use for equipment bases, base plates, sole plates, and skids where it is not practical to use jack screws.
    b. Provide number, size, and locations of wedges and shims required to support and level equipment in accordance with manufacturer's recommendations.
    c. Make provision for removal of wedges and shims after grouting:
        1) Prevent grout from bonding to wedges and shims by wrapping wedges and shims that contact grout with multiple layers of tape or other material acceptable to Engineer.
        2) Locate and orient wedges and shims to allow for removal after grouting, and to facilitate placement of grout in the remaining voids.
    d. Place and cure grout.
    e. After grout is placed and cured:
        1) Remove wedges and shims, and material used to prevent grout from bonding to them.
        2) Fill jack screw holes with grout.
        3) Cure grout as specified.

D. Construct grout forms:
1. Provide forms:
    a. Rigid with adequate strength to withstand placement of grout.
    b. With surfaces that will produce a smooth, uniform finish for grout edges exposed in the finished work.
    c. That allow grout to flow horizontally beyond the perimeter of the equipment base plate a distance not less than the thickness of the grout, and not less than 1 inch.
2. Install forms:
    a. Seal form cracks and joints with elastomeric sealant to make form watertight.
    b. Line form surfaces in contact with grout with polyethylene film, or coat with 2 coats of heavy-duty paste wax.
3. Construct grout "head box" over entire length of one side of form.
    a. Make head box height sufficient to force grout to flow under full dimensions of equipment base and to the surrounding form faces.

E. Pre-grouting procedures:
    1. Concrete surfaces receiving flowable, non-shrink grout:
        a. Saturate concrete surface in contact with grout and concrete surfaces extending not less than least 6 inches beyond limits of grout with clean water for a minimum of 24 hours prior to grouting.
        b. Just prior to grout placement, remove standing water using clean rags or oil-free compressed air. Provide "saturated surface dry" (SSD) concrete for grout placement.
    2. Concrete surfaces receiving flowable, non-shrink epoxy grout:
        a. Do not saturate concrete prior to grout placement.

F. Grout placement and curing:
    1. Place and cure grout as specified in Section 03_60_00 – Grouting, and in this Section.
    2. Grouting:
        a. Keep level of grout in head box above bottom of equipment bases, base plates, sole plates, and skids always to drive flow under base.
        b. Maintain continuous grout flow from head box to opposite sides of forms without trapping air or forming voids.
        c. Vibrate, rod, or chain grout to facilitate grout flow, to consolidate grout, and to remove entrapped air.
    3. After grout sets, remove forms and trim grout edges at 45-degree angle from bottom edge of equipment bases, base plates, sole plates, and skids.
    4. Cure grout as specified in Section 03_60_00 - Grouting.

G. After grout is cured:
    1. Remove jack screws or wedges and shims, and material used to prevent grout from bonding to leveling devices.
    2. Fill pockets from removed leveling devices with grout.
    3. Cure filled voids as specified in Section 03_60_00 - Grouting.
    4. Tighten equipment anchors in accordance with equipment manufacturer requirements.

3.06 FIELD FINISHES

A. When touchup or repair is required, apply primer and coating systems as recommended by the equipment manufacturer.

END OF SECTION

SECTION 46_05_94

MECHANICAL EQUIPMENT TESTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Testing of mechanical equipment and systems.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

C. National Institute of Standards and Technology (NIST).

1.03 SUBMITTALS

A. Provide Source Test Plans as specified in Section 01_75_17 - Commissioning.

B. Provide Installation and Functional Testing Plans as specified in Section 01_75_17 - Commissioning.

C. Provide vendor operation and maintenance manual as specified in Section 01_78_24 - Operation and Maintenance Manuals.
   1. Include motor rotor bar pass frequencies for motors larger than 500 horsepower.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Commissioning of equipment as specified in:
   1. This Section.
   2. Section 01_75_17 - Commissioning.
   3. Equipment sections:
      a. If testing requirements are not specified, provide Level 1 Tests.

B. Test and prepare piping prior to equipment testing.

C. Operation of related existing equipment:
   1. Owner will operate related existing equipment or facilities necessary to accomplish the testing.

2. Schedule and coordinate testing as required by Section 01_75_17 - Commissioning.

D. Provide necessary test instrumentation that has been calibrated within 1 year from date of test to recognized test standards traceable to the NIST or approved source.
   1. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for tests.
   2. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

E. Test measurement and result accuracy:
   1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments.
      a. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.
   2. Do not adjust results of tests for instrumentation accuracy.
      a. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

3.02 VARIABLE SPEED EQUIPMENT TESTS

A. Establish performance over the entire speed range and at the average operating condition.

B. Establish performance curves for the following speeds:
   1. The speed corresponding to the rated maximum capacity.
   2. The speed corresponding to the minimum capacity.
   3. The speed corresponding to the average operating conditions.

3.03 PUMP TESTS, ALL LEVELS OF TESTING

A. Test in accordance with the following:
   1. Applicable HI Standards.
   2. This Section.
   3. Equipment sections.

B. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:
   1. From 0 to plus 5 percent of head at the rated design point flow.
   2. From 0 to plus 5 percent of flow at the rated design point head.
   3. No tolerance for head and flow when ranges are specified.
   4. No negative tolerance for the efficiency at the rated design point, and other specified conditions.
   5. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other Sections of the Specifications.

3.04 DRIVERS TESTS

A. Test motors as specified in the applicable equipment section.

B. Test other drivers as specified in the equipment section.

3.05 NOISE REQUIREMENTS AND CONTROL

A. Perform noise tests in conjunction with vibration test analysis.

B. Make measurements in relation to reference pressure of 0.0002 microbar.

C. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

D. Set sound level meter to slow response.

E. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.06 PRESSURE TESTING

A. Hydrostatically pressure test pressure containing parts at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher.

3.07 INSPECTION AND BALANCING

A. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits.

B. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

C. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

D. Critical speed of rotating equipment:
   1. Satisfy the following:
      a. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.
      b. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.
      c. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

E. Vibration tests:
    1. Definitions:
        a. Root mean square: for pumps operating at speeds greater than 600 rpm, the vibration measurement shall be measured as the overall velocity in inches per second root mean square (RMS).
        b. Peak-to-peak displacement: The root means squared average of the peak-to-peak displacement multiplied by the square root of 2.
        c. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.
        d. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.
        e. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.
            1) Manufacturers: One of the following or equal:
                a) Rockwell Automation, Entek Group, "Spike Energy" analysis.
                b) CSI, "PeakVue."
        f. Rotor bar pass frequency (RBF), for detecting loose rotor bars.
        g. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.
        h. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.
        i. Preferred operating range: Manufacturer’s defined preferred operating range (POR) for the equipment.
        j. Allowable operating range: Manufacturer’s defined allowable operating range (AOR) for the equipment.
    2. Vibration instrumentation requirements:
        a. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12-bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high-frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.
            1) Manufacturers: One of the following or equal:
                a) Computational Systems Inc., (CSI) Division of Emerson Process Management, Model 2120A, Data Collector/analyzer with applicable analysis software.
                b) Pruftechnik, VIBXPERT II.
        b. Analyzer settings:
            1) Units: English, inches/second, mils, and gravitational forces.
            2) Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.
            3) Sample averages: 4 minimum.
            4) Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.

5) Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.
6) Fast fourier transform windowing: Hanning Window.
7) High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.

c. Accelerometers:
1) For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.
a) Manufacturers: One of the following or equal:
(1) Wilcoxon Research, Model 797L.
(2) PCB, Model 393C.
2) For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.
a) Manufacturers: One of the following or equal:
(1) Wilcoxon Research, Model 793.
(2) Entek-IRD Model 943.

3. Accelerometer mounting:
a. Use magnetic mounting or stud mounting.
b. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.
c. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.

4. Vibration acceptance criteria:
a. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.
b. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Conditions and Application Data	Overall Peak-to-Peak Displacement	
	Field, mils	Factory, mils
Operation within the POR	3.0	4.0
Operation within the AOR	4.0	5.0
Additive value when measurement location is greater than 5 feet above foundation.	2.0	2.0
Additive value for solids-handling pumps	2.0	N/A
Additive value for slurry pumps	2.0	N/A

c. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

HI Pump Type	Horsepower	Field Test	Factory Test
		Overall RMS	Overall RMS
Horizontal Solids Handling Centrifugal Pumps	Below 33 hp	0.25	0.28
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type) Vertical Solids Handling Centrifugal Pumps	Between 33 and 100 hp	0.28	0.31
	100 hp and above	0.31	0.34
	Below 33 hp	0.30	0.33
Vertical Turbine, Mixed Flow, and Propeller Pumps (solids-handling type pumps)	Between 33 and 100 hp	0.32	0.35
	100 hp and above	0.34	0.35
Non-Solids Handling Centrifugal Pumps HI Types BB1, BB2, BB3, BB4, BB5, OH1, OH2, OH3, OH4, OH5, and OH7	Below 268 hp	0.15	0.19
	268 hp and above	0.19	0.22
Vertical Turbine, Mixed Flow, and Propeller Pumps HI Types VS1, VS2, VS3, VS4, VS5, VS6, VS7, and VS8	Below 268 hp	0.13	
	268 hp and above	0.17	
Slurry Pumps		0.25	0.30
Motors		See Applicable Motor Specification	See Applicable Motor Specification
Gear Reducers, Radial		Not to exceed AGMA 6000-B96 limits	Not to exceed AGMA 6000-B96 limits
Other Reducers, Axial		0.1	N/A

d. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.

e. Additional criteria:
   1) No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.
   2) The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.

3) For motors, the following shall be cause for rejection:
a) Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that is more than 40 percent of the peak at rotational frequency.
b) Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.
c) Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.
d) Phasing problems evidenced by 1/3 line frequency side band spectral peaks around the 2 times electrical line frequency peak.
4) The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

5. Vibration testing results presentation:
a. Provide equipment drawing with location and orientation of measurement points indicated.
b. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.
c. When Vibration Spectra Data required:
1) Plot peak vibration velocity versus frequency in cycles per minute.
2) Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.
3) Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.
4) Plot motor spectra on a log amplitude scale versus frequency.
d. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.
e. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.08 TESTING LEVELS

A. Level 1 Tests:
1. Level 1 Performance Test:
a. General:
1) For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.
2) Operate at rated design load conditions.

3) Confirm that equipment is properly assembled.
4) Confirm the equipment moves or rotates in the proper direction.
5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

b. Pumps:
1) Comply with general performance test requirements as specified in this Section.
2) Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
a) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in the applicable equipment section.
b) Use actual driver for field tests.
3) Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.

2. Level 1 Vibration Test:
a. Test requirement:
1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.
2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
b. Equipment operating condition: Test at specified maximum speed.

3. Level 1 Noise Test:
a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Tests:
1. Level 2 Performance Test:
a. General:
1) For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.
2) Operate at rated design load conditions.
3) Confirm that equipment is properly assembled.
4) Confirm the equipment moves or rotates in the proper direction.
5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.

b. Pumps:
1) Comply with general performance test requirements as specified in this Section.

2) Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
    a) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in the applicable equipment section.
    b) Use actual driver for field tests.
3) Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.
4) Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.

2. Level 2 Vibration Test:
    a. Test requirement:
        1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
        2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.
    b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.
    c. Natural frequency test of field installed equipment:
        1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears, and supports.
        2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.
        3) Perform with equipment and attached piping full of intended service or process fluid.
3. Level 2 Noise Test:
    a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Tests:
1. Level 3 Performance Tests:
    a. General:
        1) For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.
        2) Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.

3) Confirm that equipment is properly assembled.
4) Confirm the equipment moves or rotates in the proper direction.
5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
7) Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure, and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
8) Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

b. Pumps:
1) Comply with general performance test requirements as specified in this Section.
2) Test 4 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test at full speed.
a) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in the applicable equipment section.
b) Use actual driver for field tests.
3) Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.
4) Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.
5) Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:
a) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.
b) Perform efficiency testing with test fluids at maximum rated speed.
c) Perform priming time testing with test fluids at maximum rated speed.

2. Level 3 Vibration Test:
a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.

b. Perform High Frequency Enveloping Analysis for gears and bearings.
    1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.
    2) Report results in units of acceleration versus frequency in cycles per minute.
c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).
d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.

3. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plain view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Tests:
1. Level 4 Performance Test:
    a. General:
        1) For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.
        2) Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
        3) Confirm that equipment is properly assembled.
        4) Confirm the equipment moves or rotates in the proper direction.
        5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
        6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
        7) Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings, using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
        8) Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
    b. Pumps:
        1) Comply with general performance test requirements as specified in this Section.
        2) Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.

3) Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.
4) Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.
5) Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
6) Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:
    a) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.
    b) Perform efficiency testing with test fluids at maximum rated speed.
    c) Perform priming time testing with test fluids at maximum rated speed.

2. Level 4 Vibration Test: Same as Level 3 vibration test.
3. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

END OF SECTION