DESIGN AND CONSTRUCTION OF JOHN T. HICKERSON WRF REHABILITATION PROJECT

REQUEST FOR PROPOSAL

RFP No.: 04-20

December 10, 2019

El Paso Water – Public Service Board

1154 Hawkins Boulevard

El Paso, TX 79925

TABLE OF CONTENTS

SECTION 1: GENERAL INFORMATION

1.1 Background

The John T. Hickerson Water Reclamation Facility, formerly known as the Northwest Wastewater Treatment Plant, treats residential and industrial wastewater generated in northwest El Paso, TX. The plant was originally built in 1989 with a treatment capacity of 5 million gallons per day (MGD) and later expanded in the 1990s to a new total treatment capacity of 17.5 MGD. It is noted that throughout this document the original 5 MGD treatment train is referred to as the "Original Plant", "Old Plant", or "original treatment train" and the 12.5 MGD expansion as the "new plant" or "new treatment train".

The plant is currently treating wastewater flows of up to 12.5 MGD utilizing the new treatment train only. The original treatment train has been nonoperational since its expansion. El Paso Water (EPWater) wants to rehabilitate the original train to bring it back into service. EPWater intends to complete this work using the design-build delivery method. The improvements include, but are not limited to, the following:

- Furnish and construct temporary bypass structure and piping at the splitter box
- Furnish and replace splitter box and gates
- Furnish and install replace the existing HVAC at the blower and WAS buildings
- Furnish and install a new emergency generator.
- Install Owner's pre-purchased aeration basin blowers and channel aeration blowers
- Furnish and replace electrical gear associated with the Old Plant including panels wires and conduits
- Furnish and replace RAS/WAS/sump pumps, fittings, and control equipment
- Concrete replacement and repairs to aeration and clarifier basins to address leaks
- Furnish and replace diffused aeration grids and flow control valves
- Furnish and replace all clarifier mechanisms
- Furnish and replace valves, flow meters, piping as necessary (including yard piping)
- Furnish and replace SCADA components

On September 16, 2019 EPWater issued a Request for Qualifications (RFQ) for the *Design and Construction of John T. Hickerson Water Reclamation Facility (WRF) Rehabilitation Project*. EPWater is hereby soliciting Proposals from the short-listed teams to advance to the second evaluation step, the Request for Proposal (RFP), to select the Design-Build Contractor for this project.

1.2 Purpose

The purpose of this solicitation is to continue the evaluation process to select the design-build contractor that offers the best value to EPWater for design and construction services.

1.3 Project Goals

The selected design-build contractor is expected to achieve the following, but not limited, goals:

- Conduct any necessary treatment/hydraulic modeling in a timely manner to verify treatment train
- Furnish and install all necessary equipment and make all necessary repairs to successfully bring the original plant back into service while maintaining the new plant under continued, non-interrupted, operation.
- Comply with all applicable laws and regulations including EPWater, International Building Code (latest edition), TCEQ, OSHA, and City of El Paso standards
- Provide the necessary resources, qualified personnel, materials, equipment, and incidentals in a timely manner to meet the project schedule
- Complete the Project on time and within budget
- Total project cost is not to exceed $10 million. It shall include all construction, labor, materials, testing, design, pre-construction services, and pre-purchase of blowers (installation to be completed by design-build contractor), complete in place.

1.4 Supplemental Information

The following supplemental information shall be part of this RFP and are included in the form of Appendices at the end of this document:

Appendix A: Condition Assessment Technical Memorandum
Appendix B: Performance-Based Technical Specifications for Rehabilitation
Appendix C: Scope of Work for Pre-Construction Phase Services
Appendix D: Scope of Work for Construction Phase Services
Appendix E: List of Allowable Manufacturers
Appendix F: Design-Build Contract for Pre-Construction Phase Services
Appendix G: Design-Build Contract for Construction Phase Services
Appendix H: Performance-Based Technical Specifications for Pre-Purchased Blowers

SECTION 2: NOTICES TO PROPOSING TEAMS

2.1 Delivery Method

This Project will be procured by the Progressive Design-Build delivery method. It follows the typical two-step procurement process involving an RFQ and RFP. This RFP will only be available to qualified Design-Build Contractor short-listed from the RFQ step. The following steps are being followed to complete this project.

Step 1: RFQ. Qualified teams are shortlisted.

Step 2: RFP. A design-build contractor is selected. Teams' responses to the RFP include technical evaluation, lump sum fee for pre-construction services, and a nonbinding guaranteed maximum price (GMP). The nonbinding GMP and fee for preconstruction phase services shall be submitted separately in a sealed envelope.

Step 3: Pre-Construction Phase Service. The selected team ("design-build contractor"; "design-build team"; "Proposer") from Step 2 and EPWater will contract for the Pre-Construction Phase Services only. This will be an independent contract. Refer to Section 3 for the scope of work. All documents completed by the design-build contractor shall be property of EPWater.

Step 4: Construction Phase Services. Contingent upon successful negotiation of GMP, the design-build contractor and EPWater will go into a new contract for the construction phase services.

Step 5: Off-Ramp. EPWater reserves the right to select a different contractor if a GMP cannot be negotiated during Step 4. The designer may or may not be asked to complete the design.

2.2 Delivery Address

All documents including the final RFP, communications, and all other information shall be directed to EPWater's purchasing agent:

Attention: Rosemary Guevara
Sr. Purchasing Agent
El Paso Water -Public Service Board
1154 Hawkins Boulevard
El Paso, Texas 79925
rguevara@epwater.org
(915) 594-5628

2.3 Schedule of Events

The following Schedule of Events table represents EPWater's best estimate of the schedule that will be followed. All times are Mountain Time. EPWater reserves the right to modify the schedule as required.

Event	Date
EPWater issues RFP to short-listed design-build contractors	December 10, 2019
Non-mandatory pre-RFP Meeting (Hickerson Plant, see 2.7.2)	December 12, 2019 @ 10:00 AM
Deadline for submission of Questions	January 10, 2020
EPWater publishes clarifications	January 15, 2020
RFP Due	January 31, 2020 @ 3:00 PM
EPWater announces selected design-build contractor	February 14, 2020
Contract Award	March 11, 2020

2.4 Cone of Silence

The "Cone of Silence" is imposed upon each RFQ, RFP or Bid after advertising. The Cone of Silence prohibits communications with EPWater employees to attempt to influence the purchasing decision. As such, the Cone of Silence prohibits any communication regarding RFP's, RFQ's or Bids between, among others:

- Potential vendors, service providers, bidders, or consultants and EPWater employees.
- Potential vendors, service providers, bidders, or consultants, any member of the Board, the President/CEO, or their respective staff and members of the respective Selection Committee.

The provisions do not apply to, among other communications:

- Oral communications with Purchasing Agent or Administrative Analyst, provided the communications is limited strictly to matters of process or procedure already contained the solicitation document;
- The provisions of the Cone of Silence do not apply to oral communications at pre-proposal or pre-bid conferences, oral presentations before selection committees, contract negotiations during duly notice public meeting, public presentations made to the President/CEO and Board members during a duly noticed public meeting; or

- Communications in writing at any time unless specifically prohibited by the applicable, RFP, RFQ or bid document.

In addition to any other penalties provided by law, violation of the Cone of Silence by any proposer or bidder shall render that proposer's or bidder's RFP, RFQ or bid award voidable. Any person having personal knowledge of a violation of these provisions shall report such violations to the EPWater General Counsel and the Purchasing Agent.

The "Cone of Silence" applies to any and all potential subcontractors as well.
As permitted by the above-mentioned policy, written submission of ATC's and requests for clarification as instructed in the respective sections this RFP. Additionally, EPWater may issue written requests for clarification of the submitted Proposal(s) during the evaluation period.

2.5 Submitting Questions

All inquiries regarding this Project and procurement must be submitted in writing via e-mail to the Senior Purchasing Agent Ms. Rosemary Guevara at rguevara@epwater.org by the time and dates stated in Section 2.3.

Responses to questions and other information including modifications to the scope, dates, and procedures may be issued by EPWater in the form of Addenda up to the Proposal Due date.

2.6 Insurance Requirements

Proposer should review carefully the minimum insurance requirements set forth in the Agreement. It should be noted that there will be two contracts (pre-construction and construction phases).

2.7 Other Notices

1. Proposal Preparation Cost.
   This solicitation does not commit EPWater to pay any costs incurred in preparing and submitting the proposal or to contract for the services specified. This RFP is not to be construed as a contract or a commitment of any kind, nor does it commit El Paso Water to pay for any costs incurred in the preparation of a formal presentation, or for any costs incurred prior to the execution of a formal contract.

2 Pre-RFP Meeting.
A non-mandatory Pre-RFP meeting will be hosted at the John T. Hickerson Wastewater Reclamation Facility, 701 Executive Center Boulevard, El Paso, TX 79936. Refer to Section 2.3 for date and time.

Statements and responses made during meetings shall be non-binding until issued as Addenda to this RFP. EPWater reserves the right to rephrase, correct, or modify previous oral statements issued by its staff or consultants as necessary.

3 General Provisions Regarding Proposals.
The "Proposal" shall mean the Proposer's complete packet as instructed by this RFP including a Technical Proposal, Pre-Construction Fee Proposal, Appendices, and Addenda. Each Proposal shall be organized, tabbed, clearly titled and identified and shall be submitted without reservations, qualifications, conditions or assumptions. Failure to provide all the information requested and completed Forms as specified may result in rejection or a lower rating. No substantive change shall be made to the Forms supplied by this RFP.

4 Inclusion of Proposal in Agreement Documents.
Portions of the successful Proposal will become part of the Agreement documents.

5 Commitments in the Proposal.
The verbiage used in each Proposal will be interpreted and evaluated based on the level of commitment provided by Proposer. Tentative commitments will be given no consideration. For example, phrases such as "we may" or "we are considering" will be given no consideration in the evaluation process since they do not indicate a firm commitment.

6 Ownership of Proposal and Applicability of Public Information.
All written and electronic submissions in response to this RFP will become property of EPWater and part of the Project records subject to public information disclosures.

7 Project Funding.
EPWater's total funding for this project is $10,000,000 US dollars. Total project cost is not to exceed $10 million. It shall include all construction, labor, materials, testing, design, pre-construction services, and pre-purchase of blowers (installation to be completed by design-build contractor), complete in place.

8 DBE and MBE.
Proposer shall familiarize himself/herself with requirements such as DBE/MBE, minimum wage rates, Equal Employment Opportunity, and others as specified in EPWater's Front-Ends.

9 Qualifications to Do Business.
The business entities and personnel encompassing the Proposer's Team shall be qualified to do business in the State of Texas for EPWater as of the anticipated Award date.

10 Standards.
All work shall comply with El Paso Water Utilities Public Service Board Standards Manual for Water, Wastewater, and Reclaimed Water Systems, latest edition. The standards can be accessed at EPW's web page.

11 Definitions.
- "**Proposer**", "design-build contractor", "Respondent", "design-build team", and "Teams" shall refer to the combination of a lead Contractor, lead Designer, and subconsultants seeking RFP selection and to complete the design and construction of the project.
- "**El Paso Water**", "EPWater", "Owner", and "El Paso Water – Public Service Board" shall refer to the funding agency and project owner.
- "**Days**" shall mean calendar days, inclusive of weekdays, weekends, and holidays.
- "**Original Plant**", "Old Plant", or "Original Treatment Train" refer to the subject of this RFP and to which the rehabilitation improvements are to be made.
- "**New plant**" or "new treatment train" refer to the plant's expansion. The scope of work in this RFP does not include this treatment train.
- "**Pre-Construction Phase Services**" shall mean those services required to be performed by the design-build contractor required to fulfill the Pre-Construction Phase obligations as stated in the contract agreement.

- "**Guaranteed Maximum Price**" (GMP) means the amount proposed by the design-build contractor and accepted by the Owner as the maximum cost to the Owner for the design and construction of the Work in accordance with the contract documents. The GMP includes design-build contractor's construction phase (including but not limited to materials, labor, testing, commissioning), all design, general condition costs, cost of the Work, design-build contractor's contingency amount, and Owner's special cash allowance.
- "**RFP**" (Request for Proposal) or "Procurement" shall mean this packet in its entirety including all Appendices and Addenda issued up to the RFP due date.
- "**Work**" shall mean the provisions of all services, labor, materials, supplies, equipment, testing, commissioning, which are inferable to complete Project. Work includes, but it is not limited to, the Pre-Construction Phase Services, Design Services, the GMP proposal, the Construction Phase Services, and any additional services and other services required.

SECTION 3: SCOPE OF WORK

The scope of work for the Pre-Construction Services and Construction Phase Services can be found in Appendices C and D, respectively. Other supplemental information containing information impacting the SOW is provided as Appendices:

Appendix A: Condition Assessment Technical Memorandum
Appendix B: Performance-Based Technical Specifications for Rehabilitation
Appendix C: Scope of Work for Pre-Construction Phase Services
Appendix D: Scope of Work for Construction Phase Services
Appendix E: List of Allowable Manufacturers
Appendix F: Design-Build Contract for Pre-Construction Phase Services
Appendix G: Design-Build Contract for Construction Phase Services
Appendix H: Performance-Based Technical Specifications for Pre-Purchased Blowers

SECTION 4: RFP REQUIREMENTS

4.1 Due Date and Address

The due date and time for Proposal submittals are provided in Section 2.3**.** Late proposals will not be accepted and will be considered non-responsive.

Please submit your RFP in sealed envelopes to the following address:

El Paso Water – Public Service Board
1154 Hawkins Boulevard
El Paso, Texas. 79925.
Attention: Rosemary Guevara, Sr. Purchasing Agent

Please submit your sealed envelopes to Ms. Rosemary Guevara. Do not submit to the ground floor lobby front (security) desk.

4.2 Format

The RFP is to be submitted in two (2) separate sealed packages: 1) Technical Approach and 2) GMP and Fee Proposal.

Sealed Envelope # 1: **Technical Approach**

- Page Limit. Twenty-five (25) single-sided pages (front only, no double sided). Covers, cover letters, dividers, and the proposed project schedule (one sheet 11x17) will not count towards this limit. Submit ten (10) hardcopies and one (1) PDF on a flash drive.
- Paper Size and Font: 8-1/2" by 11" sheets, single spaced. Add page number at the lower left corner. Times New Roman, 11-point

- Dividers. Add dividers for each new Section and label accordingly.

Sealed Envelope # 2: Non-binding GMP and Fee Proposal for Pre-Construction Phase Services

- Page Limit. Four (4) single-sided pages (front only, no double sided). Covers, cover letters, dividers will not count towards this limit. Submit one (1) hardcopy.

- Paper Size and Font: 8-1/2" by 11" sheets, single spaced. Add page number at the lower left corner. Times New Roman, 11-point

Address Technical and GMP/Fee Proposal in the order presented below.

Response Submittal Content

Design-build contractors shall follow the structure listed next. Points will be deducted for not organizing it as shown. A new tab must be added for every new Section. Sub-section must be clearly identified. Please submit the Technical Approach (Sections 1 through 7) and GMP and Fee Proposal (Section 8) in separate envelopes.

Section	Title
1.0	**Table of Contents**
2.0	**Summary of Project Approach Design, Pre-Construction, and Construction**
2.1	Understanding and Improvements
2.2	Design Team Approach
2.2	Construction Team Approach
3.0	**Guaranteed Maximum Price (GMP) Approach**
4.0	**Risks**
4.1	Known Unknowns
4.2	Proposed Solutions
5.0	**Schedule and Reports**
5.1	Monthly Status Reports and Two-Week Look-Ahead
5.2	Project Schedule
5.3	Project Schedule Approach
6.0	**Safety**
6.1	Safety Procedures Example
7.0	**Quality Assurance/Quality Control**
7.1	Quality Processes
7.2	Quality During Construction Administration
7.3	Timely Dispute Resolutions
8.0	**Price/Fee Proposals**
8.1	Fee Proposal for Pre-Construction Services
8.2	Non-Binding Guarantee Maximum Price (GMP)

4.3 Technical Proposal

The Technical Proposal shall follow the structure provided in Section 4.2. Design-Build Team will utilize this Section to address key technical aspects of the project described in Section 5.3.

Proposer should provide new information and knowledge acquired and not simply reiterate the contents of this RFP. Other past projects may be presented as they relate to and may aid in the successful completion of this project.

Generally, the Technical Proposal should be written to communicate **how** the Team will execute this Project with the available information at hand. Refer to Section 5.

To the extent possible, Proposer should refrain from repeating generalized information previously presented in the Statement of Qualifications.

4.4 Fee Proposal for Pre-Construction Phase Services

Design-build teams will prepare and submit a lump-sum fee to complete the work under the Pre-Construction Phase Services. Refer to the scope of work referenced in Section 3.

It is noted that the Pre-Construction Phase Services will have an independent contract for such services. Refer to Section 2.1. Proposal shall follow format in Section 4.2.

EPWater will evaluate the submitted fee and analyze for uniformity. EPWater reserves the right to request additional information for clarifications during the evaluation process.

4.5 Non-Binding Guarantee Maximum Price (GMP) Proposal

Design-build contractors will prepare and submit a non-binding GMP. It will be accepted by EPWater for informational purposes only. This initial amount will serve as a reference later, if the team is selected, during the Pre-Construction Phase Services. Refer to format in Section 4.2.

4.6 Other

Requests for Clarifications of Submitted Proposals

EPWater may issue written requests for clarification of the submitted Proposal(s) during the evaluation period, as allowed by the Cone of Silence provisions. The evaluation period is scheduled to commence after proposals are received and thus concluded shortly. Refer to schedule provided in Section 2.3.

Modifications and Withdrawals

At its sole discretion, Proposer may modify, withdraw, or replace its proposal up to the Proposal Due date. Such requests must be made in writing and notarized.

SECTION 5: PROPOSAL EVALUATION AND AWARD

5.1 Selection Committee

Proposing Teams shall adhere to EPWater's cone described in Section 2.4. The following lists the Section Committee. EPWater reserves the right to modify the Section Committee without notice.

Selection Committee

- Alan Shubert, P.E.
- Marcela Navarrete, C.P.A.
- Gilbert Trejo, P.E.
- Kristina Mena, Ph.D.
- Ivonne Santiago, Ph.D., P.E.
- Bryan Morris, P.E.
- Carlos Dominguez, P.E.
- Warren Marquette, P.E.
- Paul Rivas
- Ivan Hernandez, P.E.

5.2 Evaluation Factors

The proposal evaluation process is designed to award the contract, not necessarily to the Respondent of least cost, but rather to the Respondent with the best combination of attributes (i.e., qualifications and experience, cost) based upon the evaluation factors specifically established for this RFP and Section 2269.359 of the Government Code.

Respondents must provide all information outlined in the Evaluation Factors to be considered responsive. Proposals will be evaluated based on the responsiveness of the Respondent's information to the Evaluation Factors which will demonstrate the Respondent's understanding of the Project Objectives and capacity to perform the required services of this Request for Proposals.

Proposals will be evaluated based on the following Evaluation Factors:

EVALUATION FACTORS	MAXIMUM POINTS
Technical Evaluation Factors	
RFP Organization and Presentation	2
Summary of Project Approach Design, Pre-Construction, and Construction	25
Guarantee Maximum Price (GMP) Approach	20
Risks	10
Schedule and Project Status Reports	15
Safety	3
Quality Assurance/Quality Control	15
Total Technical Points	**90**
Fee Evaluation Factor	
Fee Proposal for Pre-Construction Services (Lump Sum)	5
Non-Binding Guarantee Maximum Price (GMP)	5
Total Fee Points	**10**
TOTAL POINTS	**100 points**

The establishment, application and interpretation of the above Evaluation Factors shall be solely within the discretion of El Paso Water. EPWater reserves the right to determine the suitability of proposals on the basis of all these factors.

5.3 Evaluation Factors Description

The Evaluation Committee shall evaluate and rate each submittal. Respondents not providing a response to each of the criteria listed in this RFP shall be considered nonresponsive and ineligible for consideration.

The maximum points that shall be awarded for each of the Evaluation Factors are detailed and described next.

Technical Evaluation

Factor	Maximum Points	NOTE: Responses shall be organized using the numerical system provided under "RFP Structure" in Section 4.2
RFP Organization and Presentation	2	Proposing teams will be evaluated on the organization, format, completeness, ease of evaluation, and structure (Section 4.2) of the RFP.
Summary of Project Approach Design, Pre-Construction, and Construction	25	1. Understanding and Improvements: Provide a summary of the respondent's team/team's understanding of the scope of the services and goals of the project as it relates to all phases of the project. Identify any changes to the scope of services which may improve to enhance the cost or schedule efficiencies for the project. 2. Design Team Approach: Provide the respondent team's approach to the successful completion of the design activities and discuss the potential benefits from these activities to the overall project. Identify any specialized skills or special considerations necessary that respondent's team will provide. 3. Construction Team Approach: Provide respondent team's approach to the successful completion of the constriction of this project. Identify any specialized skills or special considerations necessary that respondent's team/team will provide.
Guaranteed Maximum Price (GMP) Approach	20	1. GMP Approach: The GMP Approach evaluation criteria is for design-build teams to provide the backup information and methodologies that support how the GMP was reached. Teams will be evaluated on how detailed of an approach is provided. The actual GMP dollar amount is to be provided under the Price/Fee Evaluation Criteria. Do not include any prices/fees as part of this evaluation criteria.
Risks	10	1. Unknown Knowns: Provide a list of anticipated problems the team is aware during the design and construction of the project. 2. Proposed Solutions: Provide a list of proposed solutions for the anticipated problems (known unknowns) listed in number 1.
Schedule and Project Status Reports		1. Monthly Status Reports and Two-Week Look-Ahead: Provide an example monthly project status report. It must include an example of a schedule status summary.

Factor	Maximum Points	NOTE: Responses shall be organized using the numerical system provided under "RFP Structure" in Section 4.2
	15	Provide an example of a two-week look-ahead. The example should include upcoming materials, deliveries and labor disciplines on site, completion percentage and indemnification of items that could possibly delay schedule. 2. Project Schedule: This category will be used to evaluate design-build teams in respect to their proposed completion time. Teams are to submit a complete project schedule using the critical path method and that includes the following phases of the project: pre-construction services (design 0% to 60%), design (60% to 100%), construction, and commissioning. Teams shall propose a total project duration and indicate the time for each phase, substantial and final completion dates must be noted. Time must be in calendar days. Paper size of 11" by 17" shall be utilized to present the schedule. The schedule does not count towards the total page limit described in Section 4.2. Refer to formula below. 3. Project Schedule Approach: Provide a summary of how was the schedule provided in number 2 above reached. Explain what was considered and expand on your critical path. Also, explain how you would a recovery schedule be implemented if needed.
Safety	3	1. Safety Procedures Example: Respondent shall submit an example of safety procedures plan from two (2) previous DB projects (or alternate delivery). Some of the key points to include are emergency procedures, safety permits, safety programs, job site inspections, fall protection, lockout/tagout procedures, and site inspection form.
Quality Assurance/Quality Control	15	1. Quality Processes: Provide a summary of the processes for 1) Quality Management, 2) Quality Control, and 3) Quality During Design. For Quality Management Process, describe the proposed processes for both design and construction teams to include, but not limited to, required 3rd party inspection and testing, as well as coordination with Construction Management inspectors. For the Quality Control Process, describe which key team member handles quality control reviews and when are they typically conducted. Also, how will your team quality plan be maintained when passing over from the design team to the construction team. Identify team members that by providing name, position, and qualifications. For Quality During Design and Pre-Construction Services, describe the team's processes for design review and coordination of items to ensure a quality construction set – may include owner's review sessions, peer review, cost estimating, value engineering, specifications/plans coordination, redline pickup process, and constructability review. How will your design team encourage and ensure efficient coordination of this process between subcontractors, EPWater, EPWater's construction manager, and construction team?

Factor	Maximum Points	NOTE: Responses shall be organized using the numerical system provided under "RFP Structure" in Section 4.2
		Which team member will handle QC reviews and explain when they are typically conducted? Identify team members that will be responsible for these tasks and the team member that will have the ultimate QC authority for design, construction, and project management. Provide the name, position, and qualifications for each identified team member. 2. Quality During Construction Administration: Describe your team/team's process for construction administrative review of items such as project submittals, builder requests for design changes or substitutions, and/or Request for Information (RFI) reviews. How will these reviews be coordinated between project components, as-builts, and various subcontractors? How will Respondent's team/team ensure prompt and complete logging of RFI/Field Directives/submittals? How will Respondent's team/team ensure timely responses to RFIs, submittals and/or change requests? 3. Timely Dispute Resolution: Describe your team's approach to resolve disagreements between your Team and the EPWater pertaining to an item such as cost, quality, or schedule.

MAXIMUM TOTAL TECHNICAL EVALUATION POINTS……90 Points

The project schedule will be scored as follows:

$$Proposed\ Project\ Schedule\ Score = \frac{Shortest\ Project\ Duration\ (from\ all\ teams)}{Proposed\ Project\ Duration} * 5\ points$$

GMP/Fee Evaluation

Factor	Max Points	NOTE: Responses shall be organized using the numerical system demonstrated under "RFP Structure" in Section 4.2
Fee Proposal for Pre-Construction Services (Lump Sum)	5	1. Lump Sum Fee: Provide a lump-sum fee to complete the work included under the pre-construction phase services. Refer to scope of work in Section 3. See formula below for scoring.
Non-Binding Guarantee Maximum Price (GMP)	5	1. Non-binding GMP: Based on the information available to design-build teams including the technical memorandum, and performance specifications, proposing teams shall provide a GMP to complete the design (from 60% to 100%), all construction, testing, installation of the blowers, commissioning, complete in place. Refer to formula below.

MAXIMUM TOTAL GMP/FEE EVALUATION POINTS……10 Points

The proposed Pre-Construction Services Fee (lump sum) shall be obtained as follows:

$$Pre-Construction\ Service\ Fee\ Score = \frac{Lowest\ Fee\ (from\ all\ teams)}{Proposed\ Fee} * 5\ points$$

The non-binding GMP will be scored as follows:

$$Non - binding\ GMP\ Score = \frac{Lowest\ GMP\ (from\ all\ teams)}{Proposed\ GMP} * 5\ points$$

5.4 Evaluation and Award General Information

1. The Selection Committee will evaluate and rank responses based solely on the Evaluation Factors set forth in this RFP and, if applicable, the results of any interviews. See number 2 below. Factors not specified in the RFP will not be considered. El Paso Water reserves the right to waive any minor irregularities or technicalities in the offers received. Responses will be evaluated on an individual basis against the requirements stated in the RFP.

2. The Selection Committee may conduct oral interviews. Design-build teams shall be informed via Addendum and it shall include the criteria in which teams will be scored.

3. At the completion of the evaluation period, EPWater shall notify the highest ranked Design-Build Team that EPWater will commence negotiations and schedule negotiation meetings as appropriate.

4. If at any step of this procurement process EPWater is unable to negotiate a satisfactory contract with the selected Design-Build Team, EPWater shall, formally and in writing, end all negotiations with that team. EPWater reserves the right to proceed negotiations with the next Design-Build Team in the order of selection ranking until a contract is reached or negotiations with all ranked Design-Build Teams end.

5. Contract shall be awarded to the Design-Build Team that successfully negotiates a contract with EPWater and that submits the proposal offering the best value on the basis of the published selection criteria and on its ranking evaluations.

6. Any final design-build contract with the selected Design-Build Team shall be posted for the award of the contract by the Public Service Board (PSB) and shall not be effective until the PSB approves such contract and authorizes its execution.

7. Final Award, Execution and Delivery of Agreement. Final Award will be made by the EPWater Public Service Board in accordance with the established purchasing procedures.

8. Debriefings. Pursuant to the Cone of Silence provisions, teams that were not selected can request a debriefing to go over their score upon the posting of the contract nominated for award on the Board's Agenda. Teams who wished to be debriefed must request the debriefing in writing within seven (7) consecutive calendar days after the posting of the contract nominated for award on the Board Agenda. All debriefing request(s) after seven (7) consecutive calendar days will not be considered. Debriefing requests shall be sent electronically to:

   Sr. Purchasing Agent Ms. Rosemary Guevara at rguevara@epwater.org and (915) 594-5628.

SECTION 6: APPENDICES

APPENDIX A

John T. Hickerson WRP Rehabilitation Project

Condition Assessment Technical Memorandum

Prepared by:

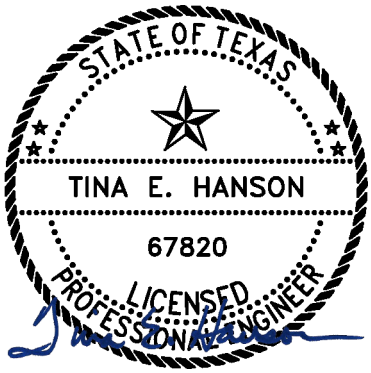
221 N. Kansas St., Ste. 730
El Paso, Texas 79901

August 15, 2019

Garver Project No.: 19W06075

Engineer's Certification

I hereby certify that this Condition Assessment Technical Memorandum for the John T. Hickerson WRP Rehabilitation Project was prepared by Garver under my direct supervision for El Paso Water Utilities.



Tina Hanson, PE
State of Texas PE License 67820
TBPE Firm Registration 5713

8/15/2019

Table of Contents

List of Figures

List of Tables

Appendix

1.0 Purpose

The purpose of this technical memorandum is to document the condition assessment conducted during the site visit at the John T. Hickerson Water Reclamation Plant (Hickerson WRP) on June 12th, 2019, which included personnel from Garver, El Paso Water Utilities, and ECM International, Inc. The Hickerson WRP includes two main treatment trains, an "old plant" and a "new plant", which together have a permitted capacity of 17.5 million gallons per day (MGD). The old plant was originally rated for 5 MGD but has been out of service for approximately 20 years. The primary objective of this project is to rehabilitate the old plant and extend its useful service life to regain pertinent treatment capacity at the Hickerson WRP.

The site visit generally served as a visual condition assessment to document process components requiring rehabilitation prior to the reinstatement of the old plant. The anticipated improvements generally consist of:

- Replacement of aeration basin blowers and channel aeration blowers
- Replacement of electrical gear associated with the old train
- Concrete repairs to aeration basins and clarifier basins to address leaks (by ECM)
- Replacement of diffused aeration grids and flow control valves
- Replacement of clarifier mechanisms
- Replacement of return activated sludge (RAS) pumps, valves, flow meters, and piping as necessary
- Other ancillary improvements that are identified during the condition assessment

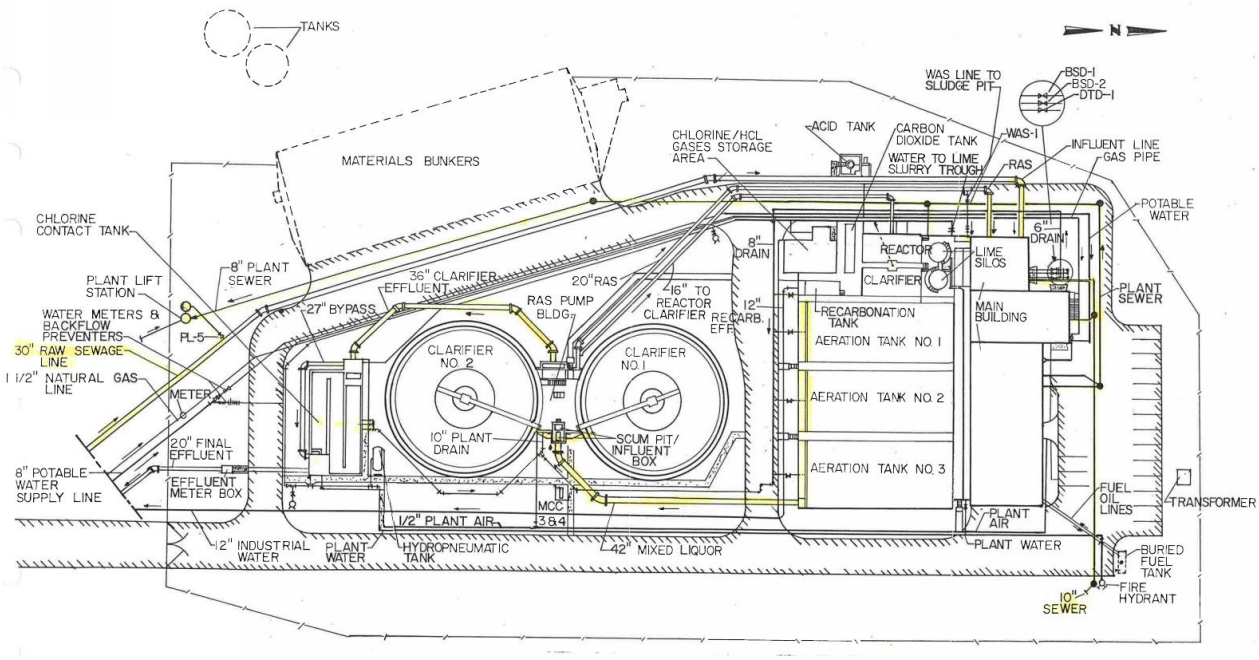


Figure 1-1: Old Plant Site Layout

2.0 Facility Description

The old plant was originally constructed in 1985 and employs a conventional activated sludge wastewater treatment process, sized to treat an annual average daily flow (AADF) of 5 MGD and 15 MGD peak two-hour flow (P2HF). The primary process components this report intends to address are the liquids treatment processes, including, but not limited to:

- Aeration Splitter Structure
- Aeration Basins
- Blower Complex
- Final Clarifiers
- RAS/WAS Pump Station

2.1 Overall Process Description

The treatment plant operates as a conventional activated sludge plant without primary clarifiers. The overall process train at the Hickerson WRP, depicted as **Figure 2-1**, includes screening, grit removal, aeration, secondary clarification, and disinfection (note that the flow split between the "old plant" and "new plant" currently occurs after screening and grit removal). Chlorine is used for effluent disinfection. Waste sludge is thickened via dissolved air flotation (DAF), stabilized by lime addition, dewatered, and then trucked to a landfill for final disposal.

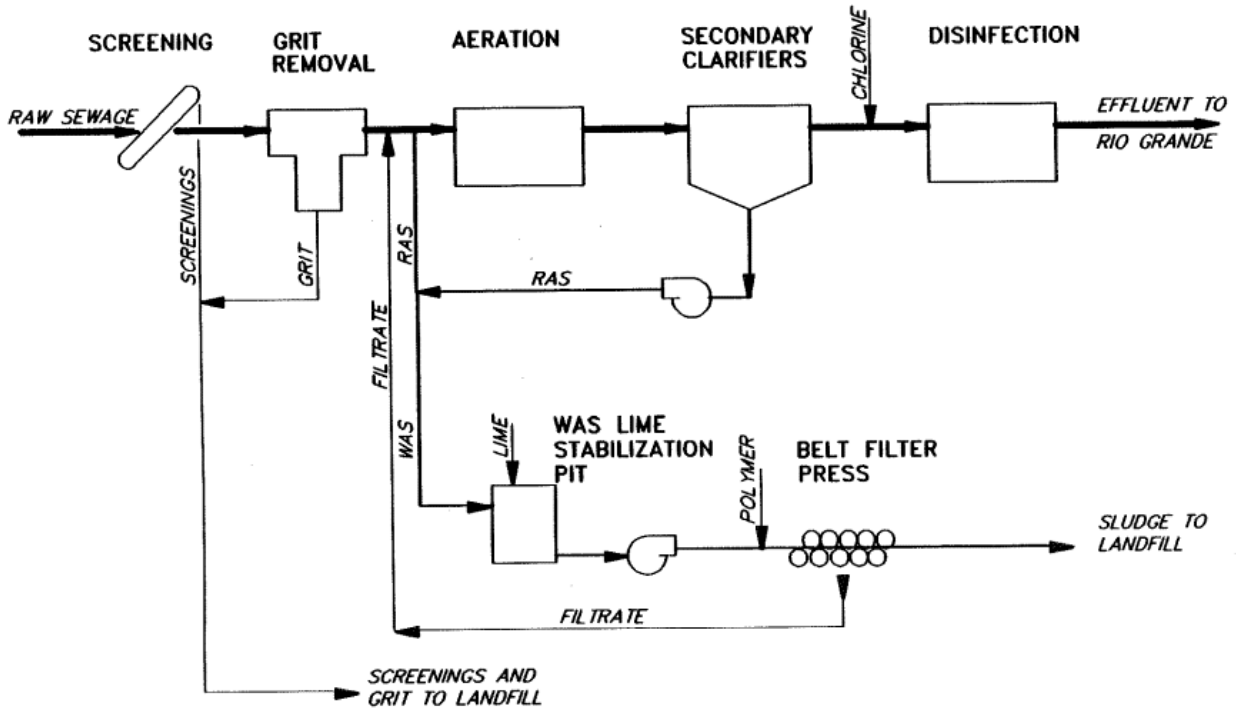


Figure 2-1: Old Plant Process Flow Diagram

2.2 Original Design Criteria

The old plant was originally designed to treat municipal wastewater to a slightly different standard than the new plant. The old plant was not designed for nitrification; therefore, operated on a much shorter sludge age than modern-day plants generally maintain. Although the original discharge permit only included effluent limits for 5-day biochemical oxygen demand (BOD_5) and total suspended solids (TSS), the original design plans claim the old plant was designed for the reduction of ammonia-nitrogen (NH_3-N), nitrate-nitrogen (NO_3-N), and phosphate-phosphorus (PO_4-P). The following table summarizes the original design criteria, included on sheet four of the *1983 Northwest Treatment Plant* drawing set.

Table 2-1: Old Plant Original Design Criteria

Parameter	Daily Average (mg/L)
BOD_5	20*
TSS	20*
NH_3-N	5
NO_3-N	20
PO_4-P	8
Included in original discharge permit** Source: ***1983 Northwest Treatment Plant Record Drawings, Sheet 4; NPDES Permit No. TX0087149	

2.3 Current Permit

The new plant was designed to include nitrification and lower daily average values for BOD_5 and TSS of 10 and 15 mg/L, respectively. The following table summarizes the existing permitted discharge limits.

Table 2-2: Current Discharge Permit

Parameter	Daily Average (mg/L)
BOD_5	10
TSS	15
NH_3-N	4
Source: ***TPDES Permit No. WQ0010408009, December 17, 2010***	

2.4 Current Process Control Strategy

2.4.1 Aeration Control

The old plant was originally designed with automatic control of the aeration blowers, utilizing dissolved oxygen (DO) probes to maintain a DO setpoint. The DO probes within the aeration basins fouled frequently,

preventing proper blower control and prompting the removal of DO probes from the blower control loop and modification to manual control of the aeration system.

3.0 Main Facility Components

3.1 Aeration Splitter

The aeration splitter structure was built as part of the expansion to split flow between the new plant and the old plant. Flow splitting is accomplished via slide gates in the grit effluent channel, with four gates allocated for routing flow to the new plant and two for the old plant. The RAS line from the old plant is independent from the new plant RAS line; however, RAS from both plants can be combined and discharged to the common grit effluent channel prior to flow splitting, or can be discharged directly downstream of the aeration splitter structure to isolate the old plant RAS to be returned to the old plant only. The new plant also has the capability to isolate its respective RAS line and maintain a closed solids loop. The figure below generally represents the aeration splitter structure, showing three slide gates used for flow allocation.

Figure 3-1: Aeration Splitter

The aeration splitter structure was originally constructed in 1995 with the addition of the new plant to direct flows from the headworks to the new plant. The aeration splitter structure is also used to isolate any aeration basin from service for maintenance and repairs. The following table summarizes the details of the existing aeration splitter structure.

Table 3-1: Design Criteria for Aeration Splitter

Parameter	Criteria
Construction	1995
Service	Gates routing to old plant abandoned since 1996
Flow Split Strategy	4 slide gates route to new plant, 2 to old plant

3.2 Aeration Basins

The old plant includes three (3) aeration basins to treat the influent wastewater biologically. Components of the existing old plant aeration basins currently include ceramic diffusers, the influent and effluent channel have coarse bubble diffusers, and each basin has three influent butterfly gates controlling the flow from the influent channel. **Figure 3-2** below shows one of the aeration basins fully drained.

Figure 3-2: Aeration Basin

The following table summarizes the physical characteristics of the existing aeration basins included in the old plant.

Table 3-2: Design Criteria for Aeration Basins

Parameter	Criteria
Construction	1985
Service	Abandoned since 1996
Geometry	Rectangular
Dimensions of Each	100-ft x 45-ft x 15-ft
Side Water Depth	15-ft
Aeration Volume, per basin	67,500-ft^3
Total Aeration Volume	202,500-ft^3
Loading Rate (lb BOD/1,000 ft^3/day)	41
Detention Time, hours at average flow (5 MGD)	5.8
Aeration Basin Diffuser Material	Ceramic
Air Piping Material	Stainless Steel

3.3 Blower Complex

The blower complex includes three (3) main blowers for the aeration basins and two (2) blowers for channel aeration. **Figure 3-3** below shows a motor of one of the blowers.

Figure 3-3: Aeration Blower Pump Motor

Detailed blower design criteria is included in the table below.

Table 3-3: Design Criteria for Blower Complex

Parameter	Criteria
Construction	1985
Service	Abandoned since 1996
Geometry	3 Single stage centrifugal aeration blowers
Aeration Blower Motor Data	300 hp – Siemens-Allis
Aeration Blower Design Criteria	Roots/Dresser Blower - IGVC Centrifugal Compressor, Serial: #HV-132, Size: 16 IGC-V, Max input speed: 3600 RPM, Gear Ratio: 14.03 (information for Blower #3)
Blower Capacity, each (SCFM)	6,000
Total Blower Capacity (SCFM)	18,000
Plant Elevation (ft)	4,000
Barometric Pressure (psia)	12.68
Inlet Temperature (*F)	100
Inlet Relative Humidity (%)	40
Discharge pressure (psig)	7.5
Pressure rise across blower (psig)	7.7
Channel Blower Motor Data	Hoffman 25 hp (nameplate corroded)

3.4 Secondary Clarifiers

The plant currently has two secondary clarifiers for final clarification and sludge collection, one of these can be seen in **Figure 3-4** below. The clarifiers use plow type rake mechanisms with full radius scum skimmers. The two clarifiers share a common scum wet well with a dedicated submersible scum pump. Flow split between the two clarifiers is accomplished with four upward opening gates (two dedicated to each clarifier).

Figure 3-4: Secondary Clarifiers

The following table includes detailed design criteria for the existing secondary clarifiers at the old plant.

Table 3-4: Design Criteria for Secondary Clarifiers

Parameter		Criteria
Construction		1985
Service		Abandoned since 1996
Geometry		Circular
Number of Secondary Clarifiers		2
Diameter		100-ft
Side Water Depth		14.2-ft
Total Surface Area		15,000-ft^2
Overflow Rate (excluding center diffusion well) (gpd/ft2)	Average	412
	Peak	824

3.5 RAS/WAS Pump Station

The plant currently has three RAS pumps with variable frequency drives (VFDs), which can also be utilized to drain the aeration basins. WAS is wasted by manually turning a valve on the RAS line. **Figure 3-5** below shows the RAS pump station.

Figure 3-5: RAS/WAS Pump Station

The following table includes detailed information regarding the RAS/WAS pump station

Table 3-5: Design Criteria for RAS/WAS Pump Station

Parameter		Criteria
Construction		1985
Service		Abandoned since 1996
Pump Type		3 RAS Horizontal end suction non-clog centrifugal pumps
Min RAS	Capacity (gpm)	1,300
	Head (ft)	5.8
	Speed (rpm)	485
Min RAS	Capacity (gpm)	2,690
	Head (ft)	14.8
	Speed (rpm)	875

3.6 Electrical

The Hickerson WRP electrical system was last updated in 1996. See **Figure 3-6** for the existing ene-line diagram. Each area of the plant has 480 volts (V) switchgear where 13.8 kilovolt (KV) plant electrical power distribution voltage is reduced to 480V equipment utilization voltage via transformer. The 480V switchgears presently supplying electrical power to Train No.1 area is Switchboard SWBD-M. Switchboard SWBD-M control distribution of power to motor control centers (MCCs) where the power is further distributed to each equipment in the area.

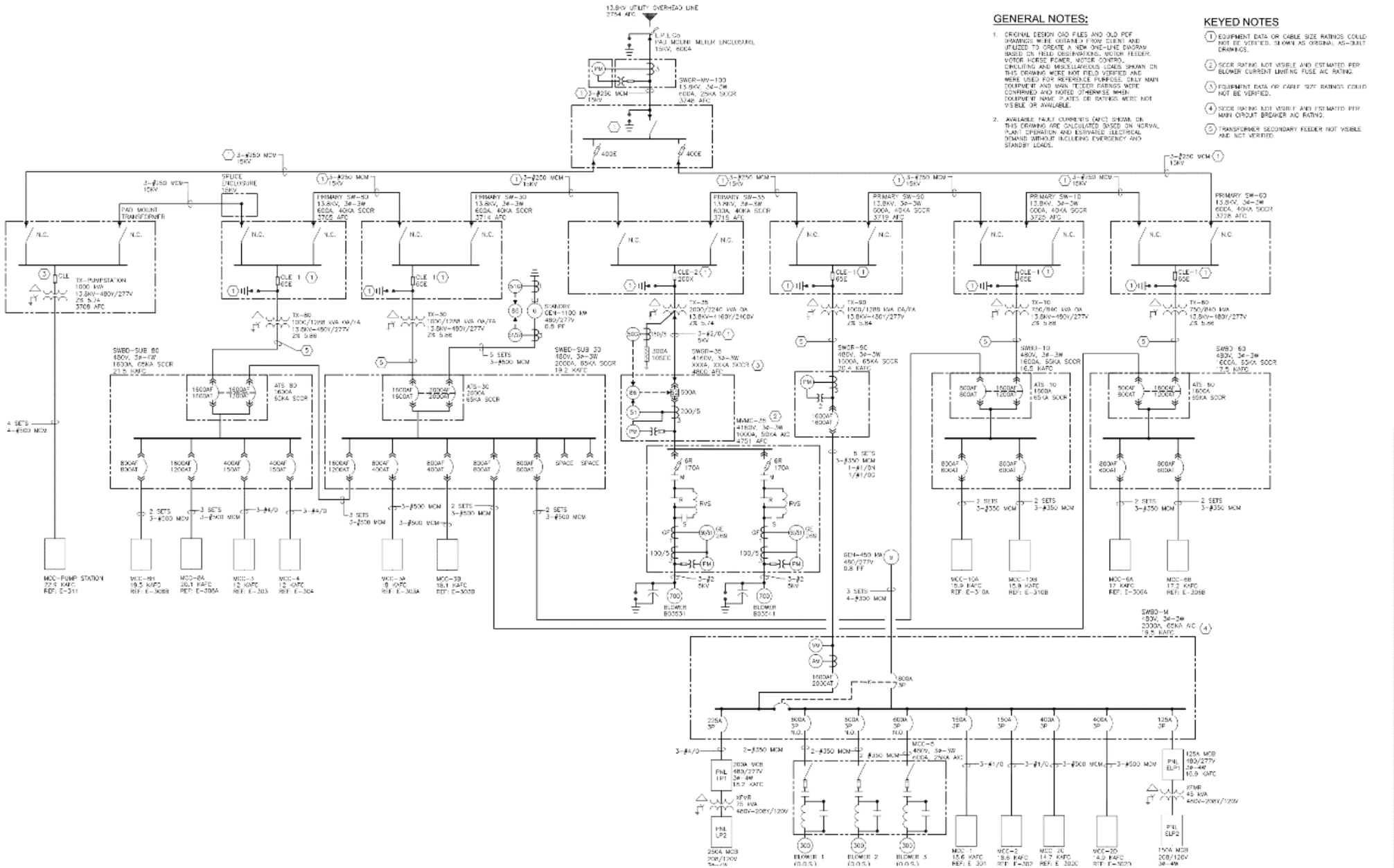


Figure 3-6: Existing One-Line Diagram

3.7 Instrumentation/Controls

During the plant upgrade in 1996, the upgraded part of the plant was designed with Level 1 Control Architecture. Level 1 control comprises of the data acquisition devices and the controllers, including the real-time data processing but does not include the Supervisory level. Due to the size of the plant, the control system was implemented with multiple programmable logic controllers (PLCs). All the processes within the upgraded part of the plant can be monitored and controlled via a master PLC at the Main building. At the existing Train No.1, each process has a local relay control panel to control each individual process.

4.0 Condition Assessment and Recommendations

The site visit and assessment of the Hickerson WRP Treatment Train No. 1 was conducted on June 12, 2019 and was attended by:

- Carlos Dominguez (EPW)
- Hugo Ruiz (EPW)
- Fred Murillo (EPW)
- Edne Romero (EPW)
- Arturo Vega (EPW)
- Daniel Angel (EPW)
- Manuel Perez (EPW)
- David Ornalez (EPW)
- Aide Zamarron (EPW)
- Tina Hanson (Garver – Process/Mechanical)
- Brian Chong, PE (Garver – Electrical)
- Rusty Tate, PE (Garver – Process /Mechanical)
- Atzuko Reveles (ECM – Structural/Site Civil)

Garver is scoped to provide process/mechanical and electrical improvement recommendations, while ECM will be providing structural and site civil recommendations.

4.1 Aeration Splitter

4.1.1 Condition Assessment

Due to concrete deterioration the slide gates currently do not seal. The RAS lines are visually in good condition from the outside, however, plant staff reported they had a fresh coat of paint and that under this paint they are in bad shape. **Figure 4-1** details the concrete deterioration.

Figure 4-1: Splitter Box Concrete Deterioration

4.1.2 Recommendations

It is recommended that a scope is included in the design-build (D-B) procurement to develop an approach to fix the splitter box and control the flow split. The RAS line from the RAS/WAS pump station should be replaced.

4.2 Aeration Basins

4.2.1 Condition

The diffusers are in decent condition and are likely salvageable; however, it is recommended they are replaced membrane disc diffusers. The air piping appears to be stainless steel but is not in operable condition and should be replaced. The influent butterfly gates can be seen in **Figure 4-2** and are in poor condition (as well as the concrete surrounding them). Staff reported that if the air is turned off on the coarse bubble diffusers, sand drops into the channel.

Figure 4-2: Aeration Basin Butterfly Gates

4.2.2 Recommendations

It is recommended that the ceramic diffuser grids be replaced with membrane disc diffusers, per staff request. All air piping will need to be replaced, and the butterfly gates should be replaced with weir gates. Scope should be included in D-B procurement to develop an approach to remove scum from the aeration basin (AB) effluent channel. Some potential options that D-B may propose for this application include: skimmer, new box at the end of channel, or spray nozzles.

4.3 Blower Complex

4.3.1 Condition

Regarding building structure, the lunchroom, shop, offices, and toilets are all in adequate condition and functional and therefore do not need to be included in the D-B scope. EPW staff reported that when the blowers were operational, there were issues with surging, which was thought to be due to the blower intake. Intake has a common header that pulls air through a box filter on the roof, which can be seen in **Figure 4-3**, and staff thought this was undersized. The existing channel blowers are only used to provide air to the influent and effluent channels. There is potential to provide channel aeration capacity from the AB blowers in lieu of separate channel blowers. The existing heating, ventilation, and air conditioning (HVAC)

equipment is non-operational, and some equipment is missing. The existing air intake filter measured differential pressure across the filters and the pressure gauges have been removed. The plant previously had roof swamp coolers and two ventilation fans. The overhead crane system currently has no hoist.

Figure 4-3: Intake Box Filter in Blower Building

4.3.2 Recommendations

Due to the age and condition it is recommended to replace all five blowers. It was noted that staff prefers high efficiency turbo blowers but doesn't want units that are as loud as the expansion blowers. Blower inlet piping should be replaced and re-worked to avoid surge conditions. Blower discharge piping should be replaced. A new heating, ventilation, and air conditioning (HVAC) system should be installed.

4.4 Secondary Clarifiers

4.4.1 Condition

The equipment age and condition are poor. The arms, scum collector and drive mechanisms are nonoperational. The secondary clarifier's arm and scum pump can be seen in **Figures 4-4** and **4-5**.

Figure 4-4: Non-operational Secondary Clarifier Arm

Figure 4-5: Scum Pump to be Replaced

4.4.2 Recommendations

Mechanisms should be replaced with new spiral rake mechanisms with a full radius rotating scum collection trough. The scum pump should be replaced. Plant staff requested weir covers and a chlorine feed for algae control similar to what is in place at the new plant.

4.5 RAS/WAS Pump Station

4.5.1 Condition

The pumps are in poor condition and are currently not operable, piping is extremely corroded, HVAC does not operate, and air intake was removed with the new plant expansion. **Figure 4-6** below is an example of the deterioration in the pump station.

Figure 4-6: Concrete Deterioration around RAS Pump Piping

4.5.2 Recommendations

It is recommended that the entire structure be gutted and replaced with all new equipment, including pumps, piping, electrical, HVAC, etc. A new air intake should also be installed.

4.6 Appurtenant Components

4.6.1 Condition

Plant water systems are in use and operational. The plant water system includes three water loops: 1W – potable water, 2W – process water (old train), and 3W – reuse water. The plant lift station is in adequate condition and is currently in use and therefore does not need to be included in the D-B contract. The hydropneumatic system is no longer needed and therefore does not need to be included in the D-B contract.

4.6.2 Recommendations

The water system will be needed for new seal water system for the RAS/WAS pumps.

4.7 Electrical

4.7.1 Condition

The current electrical equipment at train no.1 was installed before 1987. Most of the electrical equipment was abandoned and de-energized in 1996. The electrical equipment that supplies power are:

- SWBD-M: Switchboard SWBD-M is located in the Blower building.It subfeeds Motor Control Centers MCC-1, MCC-2, MCC-5, MCC-2C, MCC-2D, and PanelBoard CB-PNL-ELP1 and CB-PNL_LP1. Switchboard SWBD-M was installed before 1987 and is in poor condition.
- MCC-1: MCC-1 is located in the Blower building and supplied power to the Bar Screen No.1, Degrit Conveyor, WAS Pump No.3, Belt Filter Press Conveyor, and Aeration LP Blower No.1. MCC-1 was installed before 1987 and is in poor condition.
- MCC-2: MCC-2 is located in the Blower building and supplied power to the Bar Screen No.2, Degrit Drive, WAS Pump No.2, Belt Filter Press Pump No.1, and Aeration LP Blower No.2. MCC-2 was installed before 1987 and is in poor condition.
- MCC-5: MCC-5 is located in the Blower building and supplied power to Blower Nos. 1,2, &3. MCC-5 was installed before 1987 and is in poor condition.
- Panelboard LP1: Panelboard LP1 is located in the Blower building. Panelboard LP1 was installed before 1987 and is in poor condition.
- Panelboard ELP1: Panelboard ELP1 is located in the Blower building. Panelboard ELP1 was installed before 1987 and is in poor condition.
- Panelboard LP2: Panelboard LP2 is located in the Blower building. Panelboard LP2 was installed before 1987 and is in poor condition.
- Panelboard ELP2: Panelboard ELP2 is located in the Blower building. Panelboard ELP2 was installed before 1987 and is in poor condition.
- MCC-2C: MCC-2C is located south side between Clarifier No.1 and Clarifier No.2. MCC-2C is currently fed from Switchgear SW-80. MCC-2C supplied power to RAS Pump No.3, Chlorination Jet Pump No.2, Clarifier No.2 Drive Motor, Clarifier No.2 Scum Tube, Lift Station Pump No.2, RAS Pump Room Exhaust Fan, Plant Water Pump No.2, and Panelboard ELP4. MCC-2C was installed before 1987 and is in poor condition.
- MCC-2D: MCC-2D is located south side between Clarifier No.1 and Clarifier No.2. MCC-2C is currently fed from Switchgear SW-80. MCC-2D supplied power to RAS Pump Nos.1 & 2, Chlorination Jet Pump No.1, Clarifier No.1 Drive Motor, Clarifier No.1 Scum Tube, Lift Station Pump No.1, and Plant Water Pump No.1. MCC-2C was installed before 1987 and is in poor condition.

See following pages for images of existing electrical equipment.

Figure 4-7: Existing Switchgear SW-SUB-90-SW-SUB-35 and 10

Figure 4-8: Existing Switchboard SWBD-M

Figure 4-10: Existing CB-MCC-1

Figure 4-9: Existing CB-MCC-2

Figure 4-11: Existing Panelboard ELP1

Figure 4-12: Existing Panelboard ELP2

Figure 4-13: Existing Panelboard LP1

Figure 4-14: Existing Transformer LP2

Figure 4-15: Existing Transformer ELP2

Figure 4-16: Existing Motor Control Center CB-MCC-5

Figure 4-17: Existing Panelboard LP2

Figure 4-18: Existing Motor Control Center

Figure 4-19: Existing Motor Control Center

4.7.2 Recommendations

1. Replace existing 13.8KV 600Amp fused switch “SW-90” with new 13.8KV 600Amp fused switch.
2. Replace existing 1000/1288 KVA OA/FA pad mounted transformer with new 1500/2000 KVA OA/FA pad mounted transformer.
3. Replace existing 1600Amp main circuit breaker and power meter with new 2000Amp main circuit breaker and power meter.
4. Replace all existing conduit and conductors from existing fused switch “SW-90” to switchboard “SWBD-M” with new rated loads.
5. Replace existing 2000Amp service entrance switchboard “SWBD-M” with new 2000Amp service entrance switchboard.
6. Replace existing 200Amp Panel “LP1” with new 200Amp panel.
7. Replace existing 250Amp Panel “LP2” with new 250Amp panel.
8. Replace existing 75 KVA transformer with new 75 KVA transformer.
9. Remove existing Motor Control Center MCC-1, MCC-2, and MCC-5 and replace with 1600Amp Motor Control Center. Replace all conduit and conductors from associated MCCs to all existing associated loads.
10. Replace existing 600Amp Motor Control Center “MCC-2C” with new 600Amp Motor Control Center. Replace all conduit and conductors from existing MCC to all existing loads.
11. Replace existing 600Amp Motor Control Center “MCC-2D” with new 600Amp Motor Control Center. Replace all conduit and conductors from existing MCC to all existing loads.
12. Replace existing 125Amp Panel “ELP1” with new 125Amp panel.
13. Replace existing 150Amp Panel “ELP2” with new 150Amp panel.
14. Replace existing 45 KVA transformer with new 45 KVA transformer.
15. Replace existing 600Amp Motor Control Center “MCC-3” with new 600Amp Motor Control Center.

16. Replace existing 600Amp Motor Control Center “MCC-4” with new 600Amp Motor Control Center.
17. Provide and install local control panels and a master control panel for all new blowers. Field install new conduit and conductors from each blower to local control panels and local control panels to master control panel.
18. Provide and install conduit and ethernet cable from blower master control panel to existing control room. All blowers’ functions shall also be controls and monitors from main control room. Provide all required hardware for a complete working system.
19. Provide and install new control panel and VFDs for new RAS pumps. Provide and field install all new conduit and conductors.
20. Provide and install conduit and fiber optic cable from new RAS control panel to existing control room. All RAS motor’s functions shall also be controls and monitors from main control room. Provide all required hardware for a complete working system.
21. Reprogram existing HMI to include graphics for all new train no.1 equipment.
22. Provide and install a complete working Turn-Key SCADA system for all proposed equipment.

4.8 Instrumentation

4.8.1 Condition

Currently, each existing blower is controlled by a local blower control panel. All existing local blower control panels are not working and are in poor condition.

4.8.2 Recommendations

Provide a local control panel with a compact PLC to control and monitor of each individual process at Train No.1. The new local control panel will be located within close proximity to each process equipment. Provide a free-standing control panel with one main PLC to monitor and control all the process in Train No.1. This local panel for Train No. 1 should have a new local HMI for control in the event that the Master PLC goes down. Connect the new main PLC to existing Master PLC via ethernet cable. Updates to the existing HMI screen will require modification of the current plant overview page.

5.0 Summary

Summarized in Table 5-1 are the findings and recommendations of the site assessment conducted of the Hickerson WRP on June 12, 2019.

Table 5-1: Summary of Condition Assessment

Facility	Component	Condition	Recommendation
Aeration Splitter	Slide gates	Poor	Replace
	RAS lines	Poor	Replace
Aeration Basins	Ceramic diffusers	Fair	Replace with membrane diffusers
	Air Piping	Fair	Replace
	Butterfly gates	Poor	Replace with sluice gates
Blower Complex	Blowers	Poor	Replace
	Inlet piping	Poor	Re-work to avoid surging
	Discharge piping	Poor	Replace
	HVAC system	Poor	Install new
	Back-Up Generator	Poor	Install new
Secondary Clarifiers	Plow rake mechanism	Poor	Replace with spiral rake mechanism
	Scum Pump	Poor	Replace
RAS/WAS Pump Station		Poor	Replace pumps, piping, electrical, HVAC and install new air intake
Electrical		Poor	See section **4.7.2** for recommendation of electrical changes
Instrumentation			
		Poor	Replace instrumentation throughout all process areas.

General Physical Condition Rating Guidelines:
Good: stable during the early portion of the planning period, with no immediate attention required.
Fair: requires some initial repair to remain stable
Poor: requires replacement or reconstruction in the immediate future.

Appendix A – Structural Condition Assessment (ECM)

Appendix A: Structural Assessment and Recommendations

ECM visited the Hickerson WRP treatment train No. 1 (original treatment train) on June 18, July 19, and July 23, 2019 to conduct a visual assessment of the structural components in this project.

This Appendix of the Technical Memorandum assesses the structural integrity of original treatment Train Facilities between the splitter box next to the degrit structure and the secondary clarifiers. **Figure A-1** details the original treatment train. Specifically, the facilities assessed in this Section include the following:

- Splitter Box
- Blower Building - equipment pads and overhead crane system
- Aeration basins 1, 2, and 3
    - Influent channel
- Clarifiers 1 and 2
- RAS/WAS pump building

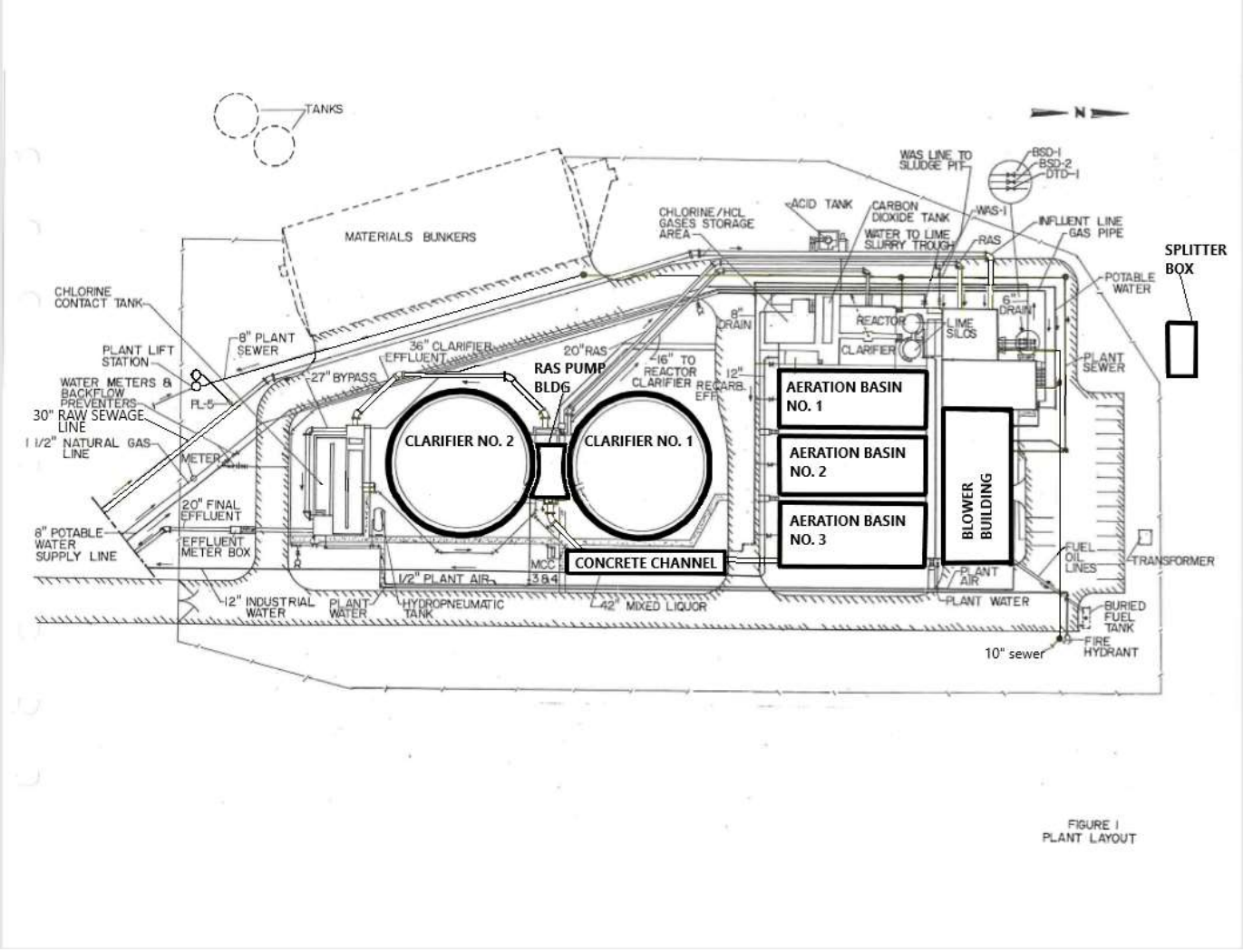


Figure A-1: Original Treatment Train

1.0 Splitter Box

A. Condition Assessment

The existing splitter box is located north of the plant next to the degrit structure. The exterior of the splitter box appears to be in good condition; however, the interior is in poor condition. The slide gates do not operate or seal properly due to the deterioration of the concrete of the inner walls comprising the splitter box. Refer to **Figure A-2.**

Figure A-2: Splitter Boxes Concrete Deterioration

B. Recommendations

The following is recommended for the splitter box.

- Bypass. The design-build contractor will have to determine whether another temporary structure along with its location will be ~~is~~ required to bypass the flow during the replacement of the new plant. Shutdown of the splitter box is to be discussed with El Paso Water personnel.
- Splitter Box and Gates. It is recommended that the entire splitter box and all gates be replaced. We recommend that the new splitter box be constructed with Type V cement without pozzolans. The design-build contractor is to provide a design, constructability and sequencing of this task for review. The existing yard piping connected to the splitter box will need to be replaced. This is the piping that convey wastewater to the aeration basins.

2.0 Aeration Basins

A. Condition Assessment

The original treatment train has three concrete aeration basins. Basin number 1 is located at the ~~north~~ west end of the basins. The exterior concrete walls and dividing walls of the aeration basins are in good condition. There are vertical cracks in various locations, including some larger cracks in the dividing walls that are causing water to seep from basin to basin. There are two channels that span the length of the north end of the basins, adjacent to the building. Both of these channels have several vertical cracks extending from the grate elevation to the floor elevation of the channel. The influent butterfly gates can be seen in **Figure A-3** below and are in poor condition as well as the concrete surrounding them.


Figure A-3: Aeration Basins

B. Recommendations

The following is recommended for the aeration basins and influent channels:

- Additional Assessment. The design-build contractor must complete an assessment of the concrete walls and floors of the aeration basins and influent channel. The assessment must include all sluice gates and concrete at the connection between the yard piping (coming from splitter box) and influent channel. The results and recommendations are to be provided and compared to the following recommendations.
- Concrete Cracks. Full-depth repairs of all cracks in the basins and channels are recommended, in lieu of superficial repairs. The cracks in the exterior walls, basin dividing walls and channel walls, and floor should be repaired using a low viscosity epoxy injection repair method. The entire surface of the concrete walls should be coated with a Perma-shield (or equivalent) to ensure no water seepage into the walls. A leak test should be conducted prior to final completion of the project to ensure that the leak issue will be properly addressed.
- Safety Guardrails. The south side of Basins 1, 2 and 3 and the east side of Basin 3 are missing approximately 200 linear feet of safety guardrails. The design-build contractor shall ensure that guardrails are provided and installed as per current OSHA Guidelines and Standards.

3.0 Blower Complex

A. Condition Assessment

The building structure is in good condition and is not part of the scope of work. The blower, electric panel, and generator concrete pads are in good condition. **Figure A-4** shows the condition of the blower and electric panel concrete pads. When the blower units are removed, the concrete pads must be assessed by the design-build team to ensure that they meet the new blowers' footprint and vibration requirements. The overhead crane system currently has no hoist assembly and the rail beams contain a gap which would impede proper functioning. Refer to **Figure A-5.**

Figure A-4: Blowers and Electrical Panels

Figure A-5: Crane within Blower Complex

B. Recommendations

- Equipment Concrete Pads. The existing concrete pads may be reused and retrofitted for the new blowers, electric panels, controls, and generator. The new blowers and generator should be anchored with anti-vibration mounts. In the event that the concrete pad is in poor condition after the existing equipment is removed, we recommend that the concrete pads be replaced and sized as per the equipment suppliers' requirements.

- Crane System. The old crane system was rated for lifts of up to 2-Ton. Once the weight and location of the new equipment is confirmed, it is recommended that the existing railing system be utilized by replacing old parts with new parts if needed.

The HVAC system is not part of this structural assessment and was not evaluated; however, it is noted that the design-build contractor will need to provide an assessment and replaced existing HVAC system if required.

4.0 Secondary Clarifiers

A. Condition Assessment

The exterior walls of both clarifiers are in good condition. There are a few minor vertical cracks, however, they are not structurally noteworthy and no water seepage was observed. The floors from Clarifier No. 1 contain alligator cracks that extended throughout floor. **Figure A-7** shows these cracks in the floor of Clarifier No. 1 and the seepage from the channel to the clarifier. The same type and extent of the cracks was also observed in Clarifier No. 2.

The effluent troughs of both clarifiers are also in good condition. There are a few locations long the troughs that contain cracks, thus allowing wastewater to seep into Clarifier No. 1.
Figure A-6 shows the trough condition of Clarifier No. 1.

Figure A-6: Clarifier No. 1

Figure A-7: Clarifier No. 2

B. Recommendations

- Additional Assessment. The design-build team must complete an in-depth evaluation of the existing concrete components and provide recommendations.
- Replacement of Floors. Based on visual inspection, it appears that the concrete floors from both clarifiers need to be replaced to mitigate future seepage and continuing deterioration. Epoxy coated rebar should be used as reinforcement for the new concrete when replacing the concrete floors. The cracks in the trough's walls and influent channel walls should be repaired using a low viscosity epoxy injection repair method.

5.0 RAS/WAS Pump Room

A. Condition Assessment

The walls in the returned activated sludge (RAS) and waste activated sludge (WAS) pump room were in fair condition. **Figure A-8** shows the condition of the RAS pump room walls. There are water stains on the walls, which appear to come from the clarifiers, however when the clarifier's troughs were filled with water, no seepage was observed. Staff reported that they have not observed any leaks along the walls or from the roof of the RAS pump room. Moisture may also be seeping into the joint between the clarifiers and the building's roof during rain events.

The floor of the RAS/WAS pump room had standing water at the time of the evaluation coming from the pump and pipes leakage. This leak is also believed to be the result of an underground pipe coming from Clarifier 2. The floor has severe concrete deterioration and must be considered for replacement. **Figure A-9** shows the floor of the RAS/WAS pump room.

Figure A-8: RAS Pump Room Walls


Figure 4-9: RAS Pump Room Floor

B. Recommendations

- Additional Assessment. The design-build contractor must evaluate the WAS/RAS building and determine the cause of the leak resulting in water in the floor.
- Crack Repairs. Any cracks in the walls of the RAS/WAS pump room should be repaired with a full-depth repair method. The cracks in the walls should be repaired using a low viscosity epoxy injection repair method. The entire surface of the concrete walls should be coated with a Perma-shield (or equivalent) to ensure no seepage. The seepage at the joint between the Clarifier No. 1 and the building should be repaired.

- Floor Replacement. Contingent upon the additional assessment and determination of the leak, it is recommended that the concrete floor be replaced using epoxy coated rebar as reinforcement for the new concrete. The concrete pads should be replaced and sized as per the new equipment suppliers' requirements. The new equipment should be anchored with anti-vibration mounts.

- New Roof Hatch. The size of the existing hatch opening should be considered to determine whether it is large enough to introduce the new equipment into the building. If required, the hatch should be enlarged accordingly.

- Painting. The WAS/RAS pump building must be fully painted on the interior side.

The HVAC system is not part of this structural assessment and was not evaluated; however, it is noted that the design-build contractor will need to provide an assessment and replace existing HVAC system if required.

APPENDIX B

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Sleeves and sleeve seals for cables.

B. Related Sections include the following:
   1. Division 26 Section

1.2 DEFINITIONS

A. EPDM: Ethylene-propylene-diene monomer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

A. Field quality-control test reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association (NETA) or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

1.5 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Service Wire Compnay

2. General Cable Corporation.
3. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70. No aluminum on project.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN, XHHW and RHH-RHW-USE. Cables sized 250 Kcmil and larger shall be type RHH-RHW.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper, stranded.

B. Branch Circuits: Copper, stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type RHW-2 single conductors in raceway.

B. Exposed Feeders: Type RHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type RHH-RHW-USE-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type RHH-RHW-USE-2 single conductors in raceway.

E. Feeders in Cable Tray: Type RHH-RHW-USE-2, single conductors in raceway for larger than 4/0 AWG; Otherwise Type TC tray cable.

F. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW, single conductors in raceway.

I. Variable Frequency Drive Branch Circuits: Shielded cable, size adjusted for published ampacity of cable. 2KV rated insulation, per UL 1277 NFPA 79 ICEA S-95-658/NEMA WC-70 as

manufactured by Service Wire Company type VFD cable, with grounding connector by the same manufacturer.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. Class 1 Control Circuits: Type THHN-THWN, in raceway.

L. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables only in office areas and where indicated by Owner in Process areas.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Cable splicing, in general, will not be allowed. Where applicable, all wiring connections to be made using terminal block type connections. Wire nut use will be permitted only where allowed by the Owner and Engineer.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.
   1. Megger Test and Continuity Test of individual conductors to ground after installation.
   2. Visual observation of conductor at accessible locations.

B. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test the following for compliance with requirements.

a. All panel feeders.
b. All motor feeders.
c. All control wires for continuity.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
   1. Dry-Type distribution transformers.

1.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components and location and size of each field connection.
   1. Wiring Diagrams: Power, signal and control wiring.

C. Qualification Data: For testing agency

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For transformers to include in emergency, operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

B. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

D. Comply with IEEE C57.12.91, “Test Code for Dry-Type Distribution and Power Transformers.”

1.5 DELIVERY, STORAGE AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer’s written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is

not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

1.6 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03. Construct housekeeping pad for floor mounted transformers.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Eaton Electrical Inc.; Cutler-Hammer Products.
2. Siemens Energy & Automation, Inc.
3. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and –tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.
1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.
1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

E. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above normal full capacity.

F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 80 deg C rise above 40 deg C ambient temperature.

G. Energy Efficiency for Transformers Rated 15 kVA and larger:
1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

H. Electrostatic Shielding: Each winding shall have an independent, single full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:
    a. Capacitance between Primary and Secondary windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
    c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

I. Wall Brackets: Manufacturer's standard brackets.

J. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure and ambient temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 16 Section "Grounding and Bonding for Electrical systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements.

C. Ground the neutral on the secondary of all transformers.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

B. Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

C. Remove and replace units that do not pass tests or inspections and retest as specified above.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed “Satisfactory Test” label to tested component.

3.5 ADJUSTING

A. Monitor transformer secondary voltage at each unit for at least 2 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 23 00 - LOW-VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes metal-enclosed, low-voltage power circuit-breaker switchgear rated 1000 V and less for use in ac systems.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Service

B. GFCI: Ground-fault circuit interrupter.

1.4 SUBMITTALS

A. Product Data: For each type of switchgear, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings and finishes.

B. Shop Drawings: for each type of switchgear and related equipment.
   1. Dimensioned plans, elevations, sections and details, including required clearances and service space around equipment. Include the following:
      a. Tabulation of installed devices with features and ratings.
      b. Enclosure types and details.
      c. Outline and general arrangement drawing showing dimensions, shipping sections, and weights of each assembled section.
      d. Bus configuration with size and number of conductors in each bus run, including phase, neutral and ground conductors of main and branch buses.
      e. Current rating of buses.
      f. Short-time and short-circuit current rating of switchgear assembly.
      g. Nameplate legends.
      h. Mimic-bus diagram.
      i. UL listing for series rating of installed devices.
      j. Features, characteristics, ratings and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring diagrams: Power, signal and control wiring.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances and required area above and around switchgear where pipe and ducts are prohibited. Show switchgear layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Field quality-control test reports.

E. Updated mimic-bus diagram reflecting field changes after final switchgear load connections have been made, for record.

F. Operation and Maintenance Data: For switchgear and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 section "Operation and Maintenance Data," include the following:
   1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
   2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain switchgear through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles and dimensional requirements of switchgear and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchgear in sections of lengths that can be moved past obstructions in delivery path.

B. Store switchgear indoors in clean dry space with uniform temperature to prevent condensation. Protect switchgear from exposure to dirt, fumes, water, corrosive substances and physical damage.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace building components and structures to provide pathway for moving switchgear into place.

B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not exceeding 40 degrees C.
   2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of switchgear and components with other construction that penetrates ceilings or is supported by them, including conduits, piping, equipment and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels.

B. Coordinate size and location of concrete bases.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: subject to compliance with requirements, provide products by one of the following:
   1. ABB Inc.

2. Cutler-Hammer, Inc.; Eaton Corporation.
3. Square D; Schneider Electric.

2.2 RATINGS

A. Nominal system voltage: 480/277 V, 4 wire, 60 Hz.

B. Main-Bus continuous: 2000 A or as noted on Drawings.

C. Short-Time and Short-Circuit Current: 65k AIC Minimum; Match rating of highest-rated circuit breaker in switchgear assembly. Short circuit rating: see Coordination Studies Section for requirements.

2.3 FABRICATION

A. Factory assembled and tested and complying with IEEE C37.20.1.

B. Indoor Enclosure Material: Steel

C. Finish: IEEE C37.20.1, manufacturer's standard gray finish over a rust-inhibiting primer on phosphatizing-treated metal surfaces.

D. Section barriers between main and tie circuit-breaker compartments shall be extended to rear of section.

E. Bus isolation barriers shall be arranged to isolate line bus from load bus at each main and tie circuit breaker.

F. Circuit-breaker compartments shall be equipped to house drawout-type circuit breakers and shall be fitted with hinged outer doors.

G. Auxiliary Compartments: Match and align with basic switchgear assembly. Include the following:
1. Bus transition sections.
2. Hinged front panels for access to metering, accessory, and blank compartments.

H. Bus bars connect between vertical sections and between compartments. Cable connections are not permitted.
1. Main Phase Bus: Uniform capacity the entire length of assembly.
2. Neutral bus: 50 percent of phase-bus ampacity, except as indicated. Equip bus with pressure-connector terminations for outgoing circuit neutral conductors. Include braces for neutral-bus extensions for busway feeders.
3. Phase- and Neutral-Bus Material: tin-plated copper or aluminum.
4. Use copper for connecting circuit-breaker line to copper bus.
5. Feeder Circuit-Breaker Load Terminals: tin-plated copper or aluminum.
6. Ground Bus: hard-drawn copper of 98 percent minimum conductivity, with pressure connector for feeder and branch circuit ground conductors, minimum size 1/4 by 2 inches.
7. Supports and Bracing for Buses: Adequate strength for indicated short-circuit currents.
8. Neutral bus equipped with pressure-connector terminations for outgoing circuit neutral conductors. Neutral-bus extensions for busway feeders are braced.
9. Neutral Disconnect Link: bolted, uninsulated, 1/4 by 2-inch copper bus, arranged to connect neutral bus to ground bus.
10. Provide for future extensions from either end of main phase, neutral, and ground bus by means of predrilled bolt-holes and connecting links.

2.4 COMPONENTS

A. Instrument Transformers: Comply with IEEE C57.13.
   1. Potential Transformers: Secondary-voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X and Y.
   2. Current Transformers: Ratios as indicated; burden and accuracy class suitable for connected relays, meters and instruments.

B. Multifunction Digital-Metering Monitor: UL-listed or recognized, microprocessor-based unit suitable for three- or four-wire systems and with the following features:
   1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
   2. Switch-selectable digital display of the following:
      a. Phase Currents, Each Phase: Plus or minus 1 percent.
      b. Phase-to-Phase Voltages, three Phase: Plus or minus 1 percent.
      c. Phase-to-Neutral voltages, three Phase. Plus or minus 1 percent.
      d. Three-Phase Real Power: Plus or minus 2 percent
      e. Three-Phase Reactive Power: Plus or minus 2 percent.
      f. Power Factor: Plus or minus 2 percent.
      g. Frequency: Plus or minus 0.5 percent.
      h. Integrated Demand, with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
   3. Mounting: Display and control unit flush or semi flush mounted in instrument compartment door.
   4. Unit to have ethernet port for connection to external monitoring systems.

C. Surge Arresters: distribution class, metal-oxide-varistor type. Comply with IEEE C62.11 and NEMA LA 1.
   1. Install in cable termination compartments and connect in each phase of circuit.
   2. Coordinate rating with circuit voltage.

D. Provision for future Devices: Equip compartments with rails, mounting brackets, supports, necessary appurtenances and bus connections.

2.5 CIRCUIT BREAKERS

A. Description: comply with IEEE C37.13.

B. Ratings: As indicated for continuous, interrupting, and short-time current ratings for each circuit breaker; voltage and frequency ratings same as switchgear.

C. Operating Mechanism: Mechanically and electrically trip-free, stored-energy operating mechanism with the following features:
   1. Normal Closing Speed: Independent of both control and operator.
   2. Slow Closing Speed: Optional with operator for inspection and adjustment.
   3. Stored-Energy Mechanism: Electrically charged, with optional manual charging.
   4. Operation counter.

D. Trip Devices: Solid-state, overcurrent trip-device system consisting of one or two current transformers or sensors per phase, a release mechanism and the following features:
   1. Functions: Long-time-delay, short-time-delay, and instantaneous-trip functions, independent of each other in both action and adjustment.
   2. Temperature Compensation: Ensures accuracy and calibration stability from minus 5 to plus 40 degrees C.
   3. Field-adjustable, time-current characteristics.

4. Current Adjustability: Dial settings and rating plugs on trip units or sensors on circuit breakers or a combination of these methods.
5. Ground-fault protection with at least three short-time-delay settings and three trip-time-delay bands; adjustable current pickup. Arrange to provide protection for the following:
    a. Four-wire circuit or system.
    b. Four-wire, double-ended substation.
6. Trip Indication: Labeled, battery-powered lights or mechanical targets on trip device to indicate type of fault.

E. Drawout Features: Circuit-breaker mounting assembly equipped with a racking mechanism to position circuit breaker and hold it rigidly in connected, test, and disconnected positions. Include the following features:
1. Interlocks: Prevent movement of circuit breaker to or from connected position when it is closed, and prevent closure of circuit breaker unless it is in connected, test or disconnected position.
2. Circuit-Breaker Positioning: An open circuit breaker may be racked to or from connected, test, and disconnected positions only with the associated compartment door closed unless live parts are covered by a full dead-front shield. An open circuit breaker may be manually withdrawn to a position for removal from the structure with the door open. Status for connection devices for different positions includes the following:
    a. Test Position: Primary disconnects devices disengaged and secondary disconnect devices and ground contact engaged.
    b. Disconnected Position: Primary and secondary devices and ground contact disengaged.

F. Arc Chutes: Readily removable from associated circuit breaker when it is in disconnected position, and arranged to permit inspection of contacts without removing circuit breaker from switchgear.

G. Padlocking Provisions: for installing at least three padlocks on each circuit breaker to secure its enclosure and prevent movement of drawout mechanism.

H. Operating Handle: One for each circuit breaker capable of manual operation.

I. Electric Close Button: One for each electrically operated circuit breaker.

J. Mechanical Interlocking of Circuit Breakers: Uses a mechanical tripping lever or equivalent design and electrical interlocks.

K. Undervoltage Trip Devices: Adjustable time-delay and pickup voltage.

L. Indicating Lights: To indicate circuit breaker is open or closed, for main and bus tie circuit breakers interlocked either with each other or with external devices.

2.6 ACCESSORIES

A. Accessory Set: Furnish tools and miscellaneous items required for circuit-breaker and switchgear test, inspection, maintenance and operation.
1. Racking handle to manually move circuit breaker between connected and disconnected positions.
2. Portable test set for testing all functions of circuit-breaker, solid-state trip devices without removal from switchgear.
3. Relay and meter test plugs suitable for testing switchgear meters and switchgear class relays.

B. Storage for Manual: Include a rack or holder, near the operating instructions, for a copy of maintenance manual.

2.7 IDENTIFICATION

A. Mimic Bus: Continuous mimic bus, arranged in single-line diagram format, using symbols and lettered designations consistent with approved mimic-bus diagram.
   1. Mimic-bus segments coordinated with devices in switchgear sections to which applied, to produce a concise visual presentation of principal switchgear components and connections.
   2. Medium: Painted graphics, as selected by Engineer.
   3. Color: Contrasting with factory-finish background; as selected by Engineer from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces where switchgear will be installed for compliance with installation tolerances, required clearances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with applicable portions of NECA 400.

B. Anchor switchgear assembly to 4-inch, channel-iron floor sill embedded in concrete base and attach by bolting.
   1. Sills: Select to suit switchgear; level and grout flush into concrete base.
   2. Concrete Bases: 3 1/2 inches high, reinforced, with chamfered edges. Extend base no more than 3 inches in all directions beyond the maximum dimensions of switchgear unless otherwise indicated or unless required for seismic anchor support.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, brackets and temporary blocking of moving parts from switchgear units and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."

B. Diagram and Instructions:
   1. Frame and mount under clear acrylic plastic on the front of switchgear.
      a. Operating Instructions: Printed basic instructions for switchgear, including control and key-interlock sequences and emergency procedures.
   2. Storage for Maintenance: Include a rack or holder, near the operating instructions for a copy of maintenance manual.

3.4 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each switchgear bus, component, connecting supply, feeder and control circuit.
   2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
   1. Inspect switchgear installation, including wiring, components, connections, and equipment. Test and adjust components and equipment.
   2. Verify that electrical control wiring installation complies with manufacturer's submittal by means of point-to-point continuity testing. Verify that wiring installation complies with requirements in Division 26 Sections.
   3. Complete installation and startup checks according to manufacturer's written instructions.
   4. Assist in field testing of equipment including pretesting and adjusting of equipment and components.
   5. Report results in writing.

C. Perform the following field tests and inspections and prepare test reports:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for each of the following NETA categories:
      a. Switchgear.
      b. Circuit breakers.
      c. Protective relays.
      d. Instrument transformers.
      e. Metering and instrumentation
      f. Ground-fault systems.
   2. Remove and replace malfunctioning units and retest as specified above.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform as infrared scan of each switchgear. Remove front and rear panels so joints and connections are accessible to portable scanner.
   1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchgear 11 months after date of Substantial Completion.
   2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   3. Record of Infrared Scanning: Prepare a certified report that identifies switchgear checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable, protective-relay trip characteristics.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of switchgear. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to switchgear, according to manufacturer's written instructions, throughout periods when switchgear environment is not controlled for temperature and humidity within manufacturer's stipulated service conditions.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchgear. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Service and distribution switchboards rated 600 V and less.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
   2. Detail enclosure types for types other than NEMA 250, Type 1.
   3. Detail bus configuration, current, and voltage ratings.
   4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
   5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
   6. Detail utility company's metering provisions with indication of approval by utility company.
   7. Include evidence of NRTL listing for series rating of installed devices.
   8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
   10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Qualification Data: For qualified Installer.

D. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Field Quality-Control Reports:
1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.

C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:
   1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
   2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
      b. Altitude: Not exceeding 4000 feet (1219 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:
   1. Ambient temperatures within limits specified.
   2. Altitude not exceeding 4000 feet (1219 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
   2. Indicate method of providing temporary electric service.
   3. Do not proceed with interruption of electric service without Owner’s written permission.
   4. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Square D.
   2. Eaton
   3. Siemens

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.
4. All breakers shall be molded case, bolted, thermomagnetic type. No plug-in type allowed. Adjustable electronic trip devices

C. Nominal System Voltage: 480Y/277 V and as indicated on the drawings.

D. Main-Bus Continuous: As indicated on the drawings. No silver plating allowed.

E. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces at the project location."

F. Indoor Enclosures: Steel, NEMA 250, Type 1 for dry indoor only. Type 4X for moist, corrosive and outdoor environment.

G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

H. Barriers: Between adjacent switchboard sections.

I. Arc Flash resistant: All switchboard shall equipped with arc flash resistant features with reinforced hinges, covers and latches.

J. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

K. Customer Metering Compartment: See El Paso Electric Company standards.

L. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

M. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

N. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated copper or aluminum.
2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with compression connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
3. Ground Bus: 1/4-by-1-inch or the minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
5. Neutral Buses: 60 percent of the ampacity of phase buses unless otherwise indicated, equipped with compression connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

O. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install floor mounted switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete or Miscellaneous Cast-in-Place Concrete."
   1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Acceptance Testing Preparation:
   1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
      b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
      c. Instruments and Equipment:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Switchboard will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring and communication units.

END OF SECTION

SECTION 26 24 19 - MOTOR-CONTROL CENTERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes motor-control centers for use on ac circuits rated 600 V and less.

B. Related Sections include the following:
   1. Division 26 Section “Surge Protection for Low-Voltage Electrical Power Circuits” for low-voltage power, control, and communication surge suppressors.

1.2 SUBMITTALS

A. Product Data: For each type of controller and each type of motor-control center. Include dimensions and manufacturer’s technical data on features, performance, electrical characteristics, ratings and finishes.

B. Shop Drawings: for each motor-control center.
   1. Include dimensioned plans, elevations, sections and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features and ratings. Include the following:
      a. Each installed unit’s type and details.
      b. Nameplate legends.
      c. Short-circuit current ratings of buses and installed units.
      d. Vertical and horizontal bus capacities.
      e. UL listing for series rating of overcurrent protective devices in combination controller.
      f. Features, characteristics, ratings, and factory settings of each motor-control center unit.
   2. Wiring Diagrams: Power, signal and control wiring for class and type of motor-control center. Provide schematic wiring diagram for each type of controller.

C. Coordination Drawings: floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around motor-control centers where pipe and ducts are prohibited. Show motor-control center layout and relationships between electrical components and adjacent structural and mechanical elements. Show compliance with NFPA 70, Article 240.24 height limitation of overcurrent device operating handles. Show support locations, type of support and weight on each support. Indicate field measurements.

D. Qualification Data: for manufacturer and testing agency.

E. Field quality-control test reports.

F. Operation and Maintenance Data: for motor-control centers, all installed devices and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section “Operation and Maintenance Data,” include the following:
   1. Routine maintenance requirements for motor-control centers and all installed components.
   2. Manufacturer’s written instructions for testing and adjusting overcurrent protective devices.

G. Load-Current and Overload-Relay heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 250 miles of Project site, a service center capable of providing training, parts and emergency maintenance and repairs.

B. Source Limitations: Obtain motor-control centers and controllers of a single type through one source from a single manufacturer.

C. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction and marked for intended use.

D. Comply with NFPA 70.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver motor-control centers in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.

B. Handle motor-control centers according to the following:
   1. NEMA ICS 2.3, “Instructions for the Handling, Installation, Operation and Maintenance of Motor Control Centers Rated Not More Than 600 Volts.”
   2. NECA 402, “Recommended Practice for Installing and Maintaining Motor Control Centers.”

1.5 COORDINATION

A. Coordinate layout and installation of motor-control centers with other construction including conduit, piping, equipment and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

C. Coordinate features of motor-control centers, installed units, and accessory devices with pilot devices and control circuits to which they connect.

D. Coordinate features, accessories, and functions of each motor-control center, each controller, and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Spare fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
   2. Indicating Lights: Two of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Siemens
   2. Schneider Electric – SquareD

3. Eaton – Cutler Hammer

2.2 MOTOR-CONTROL CENTERS

A. Wiring: NEMA ICS 3, Class I, Type B.

B. Enclosures: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location. Standard, 20" depth.
   1. Compartments: Modular; individual doors with concealed hinges and quick-captive screw fasteners. Interlocks on combination controller units requiring disconnecting means in off position before door can be opened or closed, except by operating a permissive release device.
   2. Interchangeability: Compartments constructed to allow for removal of units without opening adjacent doors, disconnecting adjacent compartments, or disturbing operation of other units in motor-control center; same size compartments to permit interchangeability and ready rearrangement of units, such as replacing three single units with a unit requiring three spaces, without cutting or welding.
   3. Final installation height of disconnect devices, accounting for pad height under the motor control center, shall be in compliance with NFPA 70, Article 240.24.
   4. Wiring spaces: Wiring channel in each vertical section for vertical and horizontal wiring to each unit compartment; supports to hold wiring in place.

C. Short-Circuit Current Rating for Each Section: Equal to or greater than indicated available fault current in symmetrical amperes at motor-control center location.

2.3 BUSES

A. Material: Tin plated hard-drawn copper, 98 percent conductivity.

B. Ampacity Ratings: Based on 40 deg C ambient and 30 deg C rise.

C. Neutral Buses: 60% size or as available relative to the main ampacity.

D. Equipment Ground Bus: Non-insulated, horizontal configuration; adequate for equipment ground conductors; bonded to enclosure.

E. Horizontal Bus Arrangement: Main phase, neutral and ground buses extended with same capacity the entire length of motor-control center, with provision for future extension at both ends by bolt holes and captive bus splice sections or equivalent.

F. Short-Circuit Withstand Rating: Same as short-circuit current rating (SCCR) of section. See Coordination Study for minimum rating.

2.4 FUNCTIONAL FEATURES

A. Description: Modular arrangement of controllers, control devices, overcurrent protective devices, transformers, panelboards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center.

B. Controller Units: Combination controller units of types and with features, ratings and circuit assignments indicated:
   1. Install units up to and including Size 3 on draw out buckets with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions.

2. Provide units with short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center sections.
3. Equip units in Type B motor-control centers with pull-apart terminal strips or drawout terminal boards for external control connections.
4. Controller Disconnecting Means: Factory-assembled combination disconnect and controller.
    a. Circuit-Breaker Disconnecting Means: NEMA AB1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

C. Overcurrent Protective Devices: Individual feeder-tap units through 225-A rating shall have drawout buckets with connectors that automatically line up and connect with vertical-section buses while being racked into their normal, energized positions. Installed height, including that of the concrete base, of operating handles of overcurrent protective devices shall not exceed the height limitation of NFPA 70, Article 240.24.

D. Thermo-magnetic, with adjustable electronic trip unit.

E. Surge Protective Devices: Via circuit breaker to act as SC protection and means of disconnection.

F. Spaces and Blank Units: Compartments fully bused and equipped with guide rails or equivalent, ready for insertion of drawout units.

G. Spare Units: Type, sizes, and ratings indicated; installed in compartments indicated “spare.”

2.5 ACROSS-THE-LINE CONTROLLERS

A. Magnetic Controller: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.
1. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

B. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.
1. MCP Disconnecting Means:
    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
    b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    c. Auxiliary NO/NC contact that operates to indicate “ON” or “OFF”.

C. Overloads: Solid state type, electronic design with a 5:1 adjustment range, current based measurement protection, thermal memory, integrated I/O points, and enhanced phase loss protection.

2.6 REDUCED-VOLTAGE CONTROLLERS

A. Solid-State, Reduced-Voltage controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.
1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.
2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
3. LED indicators showing motor and control status, including the following conditions;

a. Control power available.
b. Controller on.
c. Overload trip.
d. Loss of phase.
e. Short silicon-controlled rectifier.

4. Motor running (shorting) NEMA rated contactor operating automatically when full voltage is applied to motor.

5. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

2.7 VARIABLE FREQUENCY DRIVES (VFD)

A. Description: Where drives are indicated on the one lines and plan view as a stand-alone unit with cooling fans, furnish NEMA ICS 2, pulse-width-modulated, 6 pulse variable frequency drives with passive filters; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase, induction motor by adjusting output voltage and frequency.
1. Provide unit suitable for operation of standard and premium-efficiency motor as defined by NEMA MG 1.
2. Control Circuit: 120 V; obtained from integral control power transformer with a control power transformer of sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

C. VFD shall meet or exceed the latest version of IEEE Standard 519 with regard to harmonics generated by the non-linear loads. Factory certification of IEEE 519 compliance shall be submitted to the engineer prior to shipment.

D. Line Reactor: Each variable frequency drive must be equipped with an input reactor and all related component to meet IEEE Standard 519. They must be harmonic compensated and be UL-506 and UL-508 approved. The continuous current rating of the reactor must be equal to or greater than the rms input current rating of the drive. Reactors must be copper wound with a UL class H (180 C) insulation system. They must be suitable for an ambient temperature of 45 C and a have a maximum temperature rise of 115 C. Their watts loss must be less than 1% of the rated load. Box lug type terminals must be provided on all reactors rated from 2 amps thru 400 amps. Higher current reactors may be supplied with copper tab type terminals.

E. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.

F. Unit Operating Requirements:
1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
3. Minimum Efficiency: 96 percent at 60 Hz, full load.
4. Minimum Displacement Primary-Side Power Factor; 96 percent.
5. Overload Capability: 1.1 times the base load current for 60 seconds, 2.0 times the base load current for 3 seconds.
6. Starting Torque: 100 percent of rated torque or as indicated.
7. Speed Regulation: Plus or minus 1 percent.
8. Ambient Temperature: 0 to 40 degrees C.

G. Isolated control interface allows controller to follow control signal over an 11:1 speed range.
   1. Electrical Signal: 4 to 20 mA at 24 V.

H. Internal Adjustability Capabilities:
   1. Minimum speed: 5 to 25 percent of maximum rpm.
   2. Maximum Speed: 80 to 100 percent of maximum rpm.
   3. Acceleration: 2 to a minimum of 22 seconds.
   4. Deceleration: 2 to minimum of 22 seconds.
   5. Current Limit: 50 to a minimum of 110 percent of maximum rating.

I. Self-Protection and Reliability Features:
   1. Input transient protection by means of surge suppressors.
   2. Under-and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
   3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 20 performance.
   4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
   5. Instantaneous line-to-line and line-to-ground overcurrent trips.
   6. Loss-of-phase protection.
   7. Reverse-phase protection.
   8. Short-circuit protection.
   9. Motor over temperature fault.

J. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration shall not damage controller, motor or load.

K. Power-Interruption Protection: Prevents motor from re-energizing after a power interruption until motor has stopped.

L. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
   1. Power on.
   2. Run.
   3. Overvoltage.
   4. Line fault.
   5. Overcurrent.
   6. External fault.

M. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.

N. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate controller output current, voltage, and frequency.

O. Integral disconnecting Means: NEMA AB1, instantaneous-trip circuit breaker with lockable handle.

P. Remote Indicating Circuit Terminals: Mode selection, controller status and controller fault.

2.8 FEEDER OVERCURRENT PROTECTION

A. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   1. Electronic Trip Unit circuit Breakers: RMS Sensing; field-replaceable rating plug; with the following field-adjustable settings:

a. Instantaneous trip.
b. Long-and short-time pickup levels.
c. Long-and short-time time adjustments.
d. Ground-fault pickup level, time delay and I^2t response.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings and number of poles.
1. Lugs: Mechanical Compression style, suitable for number, size, trip ratings and material of conductors.
2. Application Listing: Appropriate for application: Type SWD for switching fluorescent lighting loads; type HACR for heating, air-conditioning, and refrigerating equipment.
3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.9 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.

C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.

D. Control Relays: Auxiliary and adjustable time-delay relays.

E. Elapsed Time Meters: Heavy duty, LED type, with digital readout in hours.

F. Multifunction Digital-Metering Monitor: UL-listed or –recognized, microprocessor-based unit suitable for three-or-four-wire systems and with the following features:
1. Inputs from sensors or 5-A current-transformer secondaries, and potential terminals rated to 600 V.
2. Switch-selectable digital display of the following:
a. Phase Currents, Each Phase: Plus or minus 1 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
d. Three-Phase Real Power: Plus or minus 2 percent.
e. Three-Phase Reactive Power: Plus or minus 2 percent.
f. Power Factor: Plus or minus 2 percent
g. Frequency: Plus or minus 0.5 percent.
h. Integrated Demand with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2 percent.
3. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.
4. Unit to have ethernet port for connection to external monitoring system.

G. Current-Sensing, Phase-Failure Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

2.10 FACTORY FINISHES

A. Finish: manufacturer’s standard paint applied to factory-assembled and –tested, motor-control centers before shipping. MCC shall be ANSI 70 light gray or approved by OWNER.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive motor-control centers for compliance with requirements, installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. Anchor each motor-control center assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with motor-control center mounting surface.

B. Install motor-control centers on concrete bases.

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

3.5 IDENTIFICATION

A. Identify motor-control center, motor-control center components, and control wiring according to Division 26 Section "Identification for Electrical Systems."

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between motor-control devices according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each motor-control center element, bus, component, connecting supply, feeder and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components and equipment.
2. To assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
3. Report results in writing.

C. Perform the following field test and inspections and prepare test reports:
1. Perform each electrical test and visual and mechanical inspection tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain components of motor-control centers including solid-state controllers and variable frequency controllers.

END OF SECTION

SECTION 26 29 33 SOLID STATE REDUCED VOLTAGE STARTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Solid State Reduced Voltage Controller

B. Related Sections
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 QUALIFICATIONS

A. Manufacturer
   1. The manufacturer shall have a minimum of 10 years experience in the manufacturer of solid-state reduced voltage controllers.

B. Support
   1. The manufacturer shall maintain factory trained and authorized service facilities within 100 miles of the project and shall have a demonstrated record of service for at least the previous ten years.
   2. Support personnel are to be direct employees of the manufacturer.
   3. The manufacturer shall provide all required start-up and training services.

C. Certification
   1. To ensure all quality and corrective action procedures are documented and implemented all manufacturing locations shall be certified to the ISO-9001 Series of Quality Standards.
   2. Third party manufacturers and brand labeling shall not be allowed.

1.3 REFERENCES

A. The controller shall be designed to meet the applicable requirements of:

B. EN

   1. UL
   2. NEMA

C. These standards shall include:
   1. Creep distances and clearances 600V (UL/CSA) and 690V (IEC)
   2. Power terminal markings per EN 50005 and EN 60947
   3. Dielectric withstand per UL508 and IEC947
   4. Noise and radio frequency (RF) immunity per NEMA ICSA1-109
   5. Surge withstand per IEEE587 and IEC 801-5

1.4 ENVIRONMENTAL REQUIREMENTS

A. Confirm to specified service conditions during and after installation of products

B. Maintain area free of dirt and dust during and after installation of products

1.5 PRE-MANUFACTURE SUBMITTALS

A. Refer to Division 01 Section 01 33 00, SUBMITTALS for submittal procedures.

B. Shop Drawings
   1. Elevation drawings showing dimensional information
   2. Structure Descriptions showing
      a. Enclosure ratings
      b. Fault ratings
      c. Other information as required for approval
   3. Conduit locations
   4. Unit Descriptions including amperage ratings, frame sizes, trip settings, pilot devices, etc.
   5. Nameplate Information
   6. Schematic wiring diagrams

C. Product Data
   1. Publications on solid state reduced voltage controller.
   2. Data Sheets and Publications on all major components
      a. Contactors
      b. Circuit Breaker and Fuse information including time current characteristics
      c. Control Power Transformers
      d. Pilot devices
      e. Relays

D. Specification Response
   1. Detailed response to this specification showing where in the literature each requirement is satisfied.
   2. All clarifications and exceptions must be clearly identified.

E. Testing and Test Reports
   1. Testing shall be per manufacturer's standard.
   2. A copy of the test reports shall be provided as part of the Closeout documentation.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Division 01 Section 01 77 00, CLOSEOUT PROCEDURES for procedure on submittal of closeout documentation.

B. Contractor shall provide certification that the solid-state reduced voltage controller has been installed in accordance with the manufacturer's instructions.

C. The Contractor shall provide certification that the Contractor has properly adjusted any timing devices required in the starting circuitry.

D. Final Drawings. The manufacturer shall provide final drawings reflecting the "As-Shipped" status of the installed equipment. The contractor shall be responsible for making any changes to the "As-Shipped" drawings from the manufacturer to reflect any field modifications.

E. Maintenance Data
   1. Solid state reduced voltage controller installation instructions and User Manual
   2. Installation / Operation instructions for major components such as circuit breakers, contactors, etc.
   3. Parameter Listing
   4. Field Service report from start-up service
   5. Solid state reduced voltage controller spare parts listing and pricing

6. Include name and phone number for a local distributor for the spare parts.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall coordinate the shipping of equipment with the manufacturer.

B. Contractor shall store the equipment in a clean and dry space.

C. The contractor shall protect the units from dirt, water, construction debris and traffic.

D. During storage the contractor shall connect internal space heaters (if specified) with temporary power.

1.8 FIELD MEASUREMENTS

A. The Contractor shall verify all field measurements prior to the fabrication of the solid state reduced voltage controller.

1.9 SPARE MATERIALS

A. Provide one (1) set of (3) of each size power fuse utilized.

B. Provide spares equal to 10 percent of the installed quantity for primary and secondary control power fuses.

C. Provide one (1) spare control relay for each unique relay utilized on the project.

1.10 WARRANTY

A. The manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.

B. The manufacturer shall confirm this warranty as part of the submittal.

C. This warranty applies only to stand alone solid-state reduced voltage controllers.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Danfoss

2. ABB

3. Eaton

2.2 RATINGS

A. The solid-state reduced voltage controller shall accept an input voltage of 480 VAC, three phase plus or minus 10 percent

B. Environmental Ratings
1. Storage ambient temperature range: -20 to 50 degrees C.

2. Operating ambient temperature range: 0 to 50 degrees C.
3. The relative humidity range: 5% to 95% non-condensing.
4. Operating elevation: up to 1200 Meters.

C. Definitions
1. The Solid-State Reduced Voltage Controller Unit shall refer to the actual controller unit that will be mounted within the specified enclosure.
2. The Solid-State Reduced Voltage Controller System shall refer to the controller unit and all items specified under Controller System Options.

2.3 SOLID STATE REDUCED VOLTAGE CONTROLLER UNIT DESIGN

A. The open-type controller device shall be modular, consisting of a power structure and a logic component.

B. Power Structure
1. The power structure shall include an SCR bypass.
2. The power structure shall include a built-in overload.
3. For ratings 1 Amps to 1250 Amps, the power structure shall consist of three power poles with integral heatsinks.
4. Power poles are to be modular in design that each is easily replaceable.
5. Back-to-back SCR pairs shall be the only power switching semiconductor means acceptable. Diode-SCR (Silicon Controlled Rectifier) combinations shall not be acceptable.
6. SCRs shall have the following minimum repetitive peak inverse voltage ratings.
   a. 1400V for units rated 200 to 480V
   b. 1600V for units rated 200 to 600V
   c. 1800V for units rated 230 to 690V

C. Logic Component
1. The logic component shall be a self-contained control module, compatible with the full range of power structures. The control module shall mount directly to the power structure.
2. The control module shall provide digital microprocessor control and supervision of all controller operation, including pulse firing of the SCRs.
3. The control module shall consist of the following.
   a. Self-tuning power supply accepting control power input from 100 to 240 VAC or 24V AC/DC, 50/60 Hz.
   b. Logic control circuitry incorporating a latch circuit for three-wire control.
   c. SCR firing circuitry that incorporates an RC snubber network to prevent false firing.
   d. Input / output circuitry
   e. Digital programming keypad
   f. Backlit LCD display
   g. DPI communication port.
4. The control module shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assemblies.
5. The control terminals shall be easily accessible and located on the front top of the device. The terminals shall be UL rated for 300 Volts, 10 Amps maximum and accept a maximum of two wires rated number 18 to number 14 AWG.

2.4 CONTROLLER UNIT FEATURES

A. Starting Modes
1. The controller shall provide the following starting modes as standard.
   a. Soft Start with Selectable Kickstart
      1) Programmable initial torque value of 0 to 90 percent of locked rotor torque

2) Programmable acceleration ramp time from 0 to 30 seconds
3) A selectable kickstart, or boost, shall be provided at the beginning of the voltage ramp. The kickstart shall provide a current pulse of 400 percent of the full load current. The kickstart time shall be adjustable from 0 to 2 seconds.

b. Current Limit Start
1) Provides means of limiting the maximum starting current
2) Programmable for 50 to 400 percent of full load current

c. Full Voltage Start
1) Provides across the line starting.
2) Ramp time shall be less than 0.25 seconds.

d. Dual Ramp Start
1) Provides two separate soft start profiles with separately adjustable ramp times and initial torque settings.
2) Programmable acceleration times from 0 to 30 seconds.
3) Programmable initial torque values from 0 to 90 percent of locked rotor torque.

Soft Stop
4) The Soft Stop option shall provide a voltage ramp-down for an extended motor stopping time.
5) Soft Stop shall be initiated by a dedicated Soft Stop input. A coast-to-rest stop shall still be possible with a separate stop input.
6) Programmable voltage ramp down time from 0 to 60 seconds.
7) The load shall stop when the motor voltage drops to a point where the load torque is greater than the motor torque.

e. Preset Slow Speed
1) Provides a slow speed for applications requiring a slow speed
2) The Preset Slow Speed option shall provide two jog speeds in the forward direction: high (15 percent of base speed) and low (7 percent of base speed).
3) The Preset Slow Speed option shall provide two jog speeds in the reverse direction: high (20 percent of base speed) and low (10 percent of base speed). Reverse operation of the motor shall be available in the jog mode without the use of a reversing contactor.
4) The starting current for the slow speed operation shall be user adjustable from 0 to 400 percent of the motor's full load current rating.
5) The running current for the slow speed operation shall be user adjustable from 0 to 400 percent of the motor's full load current rating.

2. The controller shall provide options for the following mutually exclusive starting and stopping modes. Refer to the system specifications for the option (if any) required.

a. Pump Control
1) The Pump Control option shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomena commonly referred to as "water hammer." Methods utilizing Soft Start with Soft Stop shall not be acceptable.
2) Closed loop control shall be achieved without using external sensors or feedback devices.
3) Pump Stop shall be initiated by a dedicated Pump Stop input. A coast-to-rest stop shall still be possible with a separate stop input.
4) Programmable starting time from 0 to 30 seconds.
5) Programmable stopping time from 0 to 120 seconds.

B. LCD Display
1. An alphanumeric, backlit LCD display shall be provided for controller set-up, diagnostics, status and monitoring. The display shall be four-line, 16 characters minimum.
2. Digital parameter adjustment shall be provided through a keypad. Analog potentiometer adjustments are not acceptable.

C. Overload Protection
   1. Shall meet applicable standards as a motor thermal protective device.
   2. Shall utilize three-phase current sensing. The use of two current transformers shall be unacceptable.
   3. Selectable trip classes of 10, 15, 20 and 30 shall be provided as standard.
   4. Electronic thermal memory shall provide enhanced motor protection.

D. Digital I/O
   1. A minimum of four auxiliary contacts shall be provided for customer use.
   2. The contacts shall be rated for 240 Volts AC maximum.
   3. Contact configuration shall be programmable and contain the following configurations:
      a. Normal Operation (N.O. or N.C.)
      b. Up-to-Speed Indication (N.O. or N.C.)
      c. External Bypass
      d. Fault Indication (N.O. or N.C.)
      e. Alarm Indication (N.O. or N.C.)
      f. Network Controlled Output (N.O. or N.C.)

E. DPI Serial Communication Port
   1. A DPI serial communication port shall be provided as standard.
   2. A communication protocol interface module for connection to Ethernet shall be provided.

F. Monitoring
   1. The controller shall provide the following monitoring functions indicated through the LCD display:
      a. Three-phase current
      b. Three-phase voltage
      c. Power in kW
      d. Power usage in kWh or mWh
      e. Power factor
      f. Motor thermal capacity usage
      g. Elapsed time

G. Protection and Diagnostics
   1. The following protection shall be provided as standard with the controller:
      a. Pre-start line fault advising of shorted SCR or missing load connection with phase indication
      b. Running line fault advising power loss, shorted SCR or missing load connection.
      c. Pre-start power loss with phase indication
      d. Over-temperature
      e. Open Gate with phase indication
   2. The following programmable protection shall be provided as standard with the controller:
      a. Underload
      b. Undervoltage
      c. Overload
      d. Overvoltage
      e. Voltage Unbalance
      f. Excessive Starts Per Hour
      g. Phase Reversal
      h. Stall
      i. Jam
   3. When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.
   4. Fault diagnostics shall be indicated in descriptive text on the LCD display. The exclusive use of fault codes is unacceptable.

5. An auxiliary contact that is programmable for fault indication shall be provided for customer use.

2.5 SOLID STATE REDUCED VOLTAGE CONTROLLER SYSTEM FEATURES

A. Enclosure
1. NEMA 12 enclosure for indoor use to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids. They shall be designed to meet drip, dust and rust resistance tests. No ventilation openings shall be allowed.
2. Paint: ANSI 49 Gray
3. Unless indicated differently, provide top entry and bottom exit for power cables
4. Provide a 6.25" x 2" door mounted white lamacoid nameplate with black letters (message to be defined during submittal).
5. UL Label

B. Transient Protection Modules
1. Transient protection with separately mounted protective modules.
2. Protective modules shall consist of metal oxide varistors (MOVs) in combination with capacitors to protect the power components from electrical transients and / or electrical noise. The capacitors shall be provided to shunt noise energy away from the controller's electronics.
3. The MOVs and capacitors shall be encapsulated in a clear material for easy inspection.
4. The protective modules shall be mounted so that they will not cause damage to the power components upon absorbing an electrical transient.
5. The MOVs shall be rated for a minimum of 220 joules.

C. Input Isolation Contactor
1. An input contactor between the AC line and the controller shall be provided.
2. The contactor shall have three N.O. and three N.C. auxiliary contacts.

D. Bypass Contactor
1. A bypass contactor with overload shall be provided.
2. The contactor shall have four N.O. auxiliary contacts.

E. Control Power Transformer
1. Provide a control power transformer mounted and wired inside of the system enclosure.
2. The transformer shall be rated for an additional 100 VA for customer use.
3. The transformer shall be provided with fused primary and secondary protection.

F. Selector Switches
1. Provide selector switches, mounted on the enclosure door, for the following operations:
   a. Local/Off/Remote mode
   b. Vibration Alarm Enable/Disable
   c. Soft Start/Off/Bypass mode
   d. Motor Start Permissive Enable/Disable
2. The devices shall be Allen-Bradley Bulletin 800E pilot devices (22.5mm, NEMA Type 4/4X/13) mounted on the enclosure door.

G. Pushbuttons
1. Provide pushbuttons, mounted on the enclosure door, for the following operations:
   a. Local Start
   b. Local Stop
   c. Vibration Alarm Reset
   d. Soft Starter Fault Reset
2. The devices shall be Allen-Bradley Bulletin 800E (22.5mm, NEMA Type 4/4X/13) pilot devices mounted on the enclosure door.

H. Pilot Lights
1. Provide pilot lights, mounted on the enclosure door, for indication of:
a. Test Run Mode
b. Motor Space Heater On
c. Vibration Alarm Disabled
d. Discharge Valve Closed
e. MPR Lockout
f. Motor Stopped
g. Running on Soft Starter
h. Running on Bypass
i. Vibration Alarm
j. Soft Starter Fault
2. Pilot lights shall be transformer type.
3. The devices shall be Allen-Bradley Bulletin 800E (22.5mm, NEMA Type 4/4X/13) pilot devices mounted on the enclosure door.

I. Pump Control Option
1. For pumping applications provide the Pump Control option.

J. Human Interface Module
1. Provide a door mounted Human Interface Module with integral display and programming keys.
2. The display shall show operating conditions, adjustments and fault indications.
3. The display shall be backlit LCD and shall consist of four lines of 16 characters alphanumeric.

K. Multifunction Protection Relay: Motor protection shall be provided by a microprocessor-based relay equipped with the following protection monitoring, control, automation and reporting functions. Self-checking functions shall be included. Specific requirements are as follows:
1. The relay shall include the following protection functions:
Motor Thermal Overload Model (49)
1) Provides integrated thermal protection for locked rotor starts, running overload, imbalance current/negative sequence current heating, and repeated or frequent starting
2) Processes the stator and rotor models simultaneously
3) Supports high-inertia starts (requires voltage option and full-load slip setting)
4) Has settable or learned motor-stopped cooling time constant
5) Allows settable or learned starting thermal capacity
6) Provides ambient temperature biasing via external RTD input
a). Phase, neutral, residual, and negative-sequence overcurrent elements (50P/50N/50G/50Q)
b). Phase, residual, and negative-sequence time-overcurrent elements (51P/51G/51Q)
c). Motor differential current (87)
d). Current imbalance (46)
e). Over- and under frequency (81)
f). Phase reversal (47)
g). Load-loss (undercurrent) (37)
h). Load-jam
i). Anti-backspin timer protection
j). Starts-per-hour (notching or jogging device) (66)
k). Minimum-time-between-starts (66)
l). Start motor timer
m). Star-Delta starting
n). Two-speed motor protection
o). Forward/Reverse start protection

p). Speed switch input (stall)
q). Breaker/Contactor failure

2. When voltage inputs are specified, the relay shall provide the following protection elements:
   a. Over- and undervoltage (59, 27)
   b. Underpower (37)
   c. Reactive power (VAR)
   d. Power factor (55)
   e. Voltage-based over- and underfrequency (81)
   f. Loss of potential (60)
3. The relay shall offer the following temperature input features:
   a. Availability of as many as 12 RTD inputs in an external module (SEL-2600) or 10 RTD inputs with an internal card, which, when included, shall have the following features:
      1) Optical fiber transmission of RTD temperatures (using SEL-2600) to relay: range of up to 1000 m
      2) Separately field-selected RTD types: Pt100, Ni100, Ni120, or Cu10
      3) Noise immunity (50 Hz and higher) on RTD inputs up to 1.4 Vac peak
      4) One contact input (with SEL-2600)
   b. RTD inputs to the motor relay shall support the following:
      1) Thermal overload model biasing
      2) Temperature alarms and trips (49)
      3) RTD open- or short-circuit indication
   c. Capability of one PTC (positive temperature coefficient) thermistor input (49)
4. The relay shall offer the following programmable automation features:
   a. 32 local control logic points, 32 remote control logic points, 32 latching logic points, 32 counters, 32 math variables, 32 logic variables, and 32 timers
   b. SELOGIC® programming language with Boolean and math equations capability for logic and control capability
5. Communications/integration support shall include the following:
   a. ASCII, Modbus® RTU, DeviceNet, Telnet, FTP, Modbus® TCP/IP, and IEC 61850 protocols
   b. Digital Relay-to-Relay Communications. The relay shall have eight transmit and eight receive logic elements for dedicated relay-to-relay communications. These elements shall be available for use in control logic.
   c. One front-panel EIA-232 port and one rear-panel EIA-232 or EIA-485 port, one fiber-optic serial port, and single or dual-redundant, copper or fiber-optic Ethernet port
   d. Capability for an additional rear-panel EIA-232 or EIA-485 port
   e. Windows®-based PC software for settings and retrieving reports
6. The relay shall offer the following front-panel visualization features:
   a. The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, and configuration parameters on a front-panel LCD display.
   b. The display shall have a capability to show rotating custom messages and data. Thirty-two display messages shall be provided.
   c. The front panel shall also have a minimum of six user-programmable LEDs and four user-programmable pushbutton controls with eight programmable LEDs.
7. Monitoring and reporting hardware functions shall offer the following:
   a. Motor start reports (up to as many as five of the latest starts)—Start data including currents, voltages (option), calculated percent slip, and percent rotor thermal capacity used are sampled at a settable rate for 720 sets of the motor start data
   b. Motor start trends—Starting time, maximum start current, minimum start voltage (option), and maximum start percent rotor thermal capacity use averages for each of the past 18 months, together with number of starts in each month

c. Load-Profile Monitoring—Provide periodic snapshot (selectable rate from every 5 to 60 minutes) of as many as 17 selectable analog quantities.
d. Motor operating statistics—Starts, running time, peak/average data, and trip/alarm counters
e. Event summaries—Fault type and trip data including time of tripping
f. Event reports—15-cycle length (as many as 19 reports) or 64-cycle length (as many as 4 reports) with 16-samples/cycle resolution
g. Sequential Events Recorder (SER)—As many as 1024 time-tagged, most recent input, output, and element transitions
h. Data stored in nonvolatile, flash memory

8. Hardware features shall offer the following:
   a. Operating temperature range of –40° to +85°C
   b. Power supply input operating voltage range of 24–48 Vdc, 110–250 Vdc, or 110–240 Vac
   c. Demodulated IRIG-B time synchronization input capability or PTC input capability
   d. Optional 10 internal RTD inputs or 12 external RTD inputs
   e. 5 A or 1 A, ac current inputs IA, IB, IC, and IN with optional 2.5 mA sensitive IN input
   f. 300 V maximum, three ac voltage inputs and three phase motor differential current inputs
   g. Flexible, configurable I/O including digital I/O and analog I/O
   h. Electromechanical or fast, high-current interrupting (optional) digital outputs
   i. Optoisolated digital inputs
   j. Jumper-selectable current (up to ± 20 mA range) or voltage (up to ± 10 volts range) analog inputs
   k. Jumper-selectable current (up to ± 20 mA range) or voltage (up to ± 10 volts range) analog outputs
   l. Relay front panel shall meet the requirements of NEMA12/IP65
   m. Conformally coated circuit boards
   n. Class 1, Division 2 hazardous locations applications

PART 3 - EXECUTION

3.1 MANUFACTURER'S FIELD SERVICES

A. The service division of the manufacturer shall perform all start-up services. The use of third party supplier start-up personnel is not allowed.

B. Start-up personnel shall be direct employees of the manufacturer and shall be degreed engineers.

C. Provide a minimum of (2) hours of on-site start-up service for each controller (4 hours minimum).

D. At a minimum, the start-up service shall include:
   1. Pre-Power Check
      a. Megger Motor Resistances: Phase to Phase and Phase to Ground
      b. Verify system grounding per manufacturer's specifications
      c. Verify power and signal grounds
      d. Check connections
      e. Check environment
   2. Power-up and Commissioning
      a. Measure Incoming Power Phase-to-Phase and Phase-to-Ground
      b. Measure DC Bus Voltage
      c. Measure AC Current Unloaded and Loaded
      d. Measure Output Voltage Phase-to-Phase and Phase-to-Ground

3. Record all measurements
4. Tune for system operation
5. Provide Parameter Listing

3.2 TRAINING

A. Manufacturer to provide a quantity of (1) two hour session of on-site instruction.

B. The service engineer shall perform training.

C. The instruction shall include the operational and maintenance requirements of the controller.

D. The basis of the training shall be the installed controller, the engineered drawings and the user manual. At a minimum, the training shall:
1. Review of the engineered drawings identifying the components shown on the drawings.
2. Review starting / stopping options for the controller.
3. Review operation of the Human Interface for programming and monitoring of the controller.
4. Review the maintenance requirements of the controller.
5. Review safety concerns with operating the controller.

END OF SECTION

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes packaged engine-generator sets for standby power supply with the following features:
   1. Diesel engine.
   2. Unit-mounted cooling system.
   3. Unit-mounted and remote-mounting control and monitoring.
   4. Performance requirements for sensitive loads.
   5. Outdoor enclosure.

B. Related Sections include the following:
   1. Division 26 Section “Transfer Switches” for transfer switches including sensors and relays to initiate automatic-starting and –stopping signals for engine-generator sets.

1.2 DEFINITIONS

A. Operational Bandwidth: the total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.3 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
   1. Thermal damage curve for generator.
   2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, plan and elevation views with overall location and interconnection point dimensions, method of field assembly, components, and location and size of each field connection.
   1. Include product data for generator and all accessories: batteries and charger, engine generator set, muffler, exhaust piping external to unit, weatherproof and sound attenuating enclosure, remote annunciator(s), remote emergency stop, load center and lighting integral to enclosure, cooling system heaters. In addition, fuel consumption rate curves at various loads, ventilation and combustion air requirements, thermal damage curves for generator, time current characteristic curves for generator protective device and electrical ratings and diagrams including schematic and interconnection diagrams.
   2. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   3. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   4. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
   5. Wiring diagrams: Power, signal, and control wiring.

C. Qualification Data: For manufacturer.

D. Source quality-control test reports.
   1. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.

2. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements. Factory test reports including noise level, exhaust emissions, and field quality test.
3. Report of sound generation.
4. Report of exhaust emissions showing compliance with applicable regulations.
5. Certified Torsional vibration compatibility: comply with NFPA 110.

E. Factory and Field quality-control test reports. Provide electronic and up to six (6) copies of each factory and field test report on the actual packaged electric generating plant provided, indicating results for all tests described herein.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
2. Project record drawings clearly indicating operating features and including as-built shop drawings, outline drawings, schematic and wiring diagrams.
3. Instructions for erection and alignment, including tolerances and preparation for use.
4. Starting, normal running, emergency, and shutdown procedures.
5. Normal maintenance, inspections, and lubrication procedures.
6. Spare parts list.

G. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer: Company specializing, in packaged engine generator systems with minimum ten years documented experience. Packaged generator assembly shall meet UL 2200 requirements.

C. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

D. Source Limitations: Obtain packaged generator sets, transfer switches and auxiliary components through one source from a single manufacturer.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with UL 2200.

J. Engine Exhaust Emissions: Comply with applicable state and local government requirements; use EPA-governed tier ratings.

1.5 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt inserts into bases.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators, transfer switches and associated auxiliary components that fall in materials or workmanship within specified warranty period.
   1. Warranty Period: 1 year from date of Substantial Completion.

1.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting load transfer and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating, but no fewer than two of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: Two set each of lubricating oil, fuel, and combustion-air filters.
   4. Belts: One set of all required belts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include the following:
   1. Onan/Cummins Power Generation

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and –tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.
   2. Provide unit with suitable spring-type vibration isolators and mount on structural steel base.

C. Capacities and Characteristics:
   1. Motor starting kVA shall be 400 kVA based on a sustained RMS voltage drop of no more than 10% of no load voltage with the specified kVA load at near zero power factor applied to the engine-generator set.
   2. Output Connections: Three-phase, four wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.
4. Diesel Engine Driven Generating Set, complete with accessories, shall be maximum **750** KW or as required by design.
5. Generator shall be 0.8 power factor, 480/277 volts, 3 phase, 4 wire, 60 Hertz, Class B 105 degree Celsius alternator temperature rise capable of starting loads in the following sequence:
   Step 1: Lighting and control loads of 50KVA and 37.5 KVA
   Step 2: One 400 HP motor, 1.15 service factor, code letter G, full voltage starting.
6. Generator shall be capable of starting loads in a above sequence with not more than 20% instantaneous terminal voltage drop, and not more than 10% sustained terminal volt drop. Sustained voltage drop shall be defined as the voltage drop at a period of time specified by the engineer after review of the generator data sheets.

D. Generator-Set Performance:
1. The generator set manufacturer shall verify the engine as capable of driving the generator with all accessories in place and operating at the nameplate rating after de-rating for the range of temperature expected in service and the altitude of the installation.
2. The engine-generator set shall be capable of picking up 100% of nameplate kW, less applicable de-rating factors, in one step with the engine-generator set at operating temperature.
3. Steady-State Voltage Operational Bandwidth: 3 percent of rated output voltage from no load to full load.
4. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
5. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
6. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
7. Transient Frequency Performance: Less than 5 percent variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
8. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
9. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 250 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.
10. Start time: Comply with NFPA 110, Type 10, system requirements.

2.3 ENGINE

A. Type: Liquid cooled, full diesel compression ignition engine, either naturally aspirated or turbocharged, 4-cycled engine required, or as approved by the ENGINEER.

B. Fuel: Fuel oil, Grade DF-2 with low Sulphur.

C. Rated Engine Speed: The engine speed will be suitable for direct connection to the generator without exceeding engine manufacturer's published curves. Speed must not exceed 1800 RPM.

D. Maximum Piston Speed for Four-Cycle Engines: The engine BMEP will not exceed 351 PSI, when producing rated load. Piston speed shall be 2250 feet per minute (fpm) or less.

E. Lubrication System: The following items are mounted on engine or skid:
   1. Filter and Strainer: Dual filter with isolation valve rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

F. Engine Fuel System:
   1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
   2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

G. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C). Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

H. Governor: Adjustable isochronous, with speed sensing. Isochronous electronic type to maintain engine speed within 0.5 percent, steady state, and 1 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes.

I. Safety Devices: Engine shutdown on high water temperature, low oil pressure, over-speed, and engine over-crank. Limits as selected by manufacturer.

J. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump to keep unit operating at rated capacity at ambient of 104 deg F.
   1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
   2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
   3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
   4. Coolant Hose: flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
      a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
      b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

K. Exhaust System: Provide critical grade silencer, with muffler companion flanges and flexible exhaust fitting, suitable for horizontal orientation, sized in accordance to manufacturer's instructions. The muffler shall be mounted so its weight is not supported by the engine.

   1. Muffler/Silencer: High degree, critical-rated stainless steel muffler with maximum silencing capacity mounted on unit. Include a suitable length of flexible stainless steel exhaust tubing for mounting between engine and muffler. Sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

   2. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine. Provide drain line to drip pan.

3. Provide a suitable rain cap at the stack outlet. Provide all necessary flanges and special fittings for proper installation.

L. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and “blocked filter” indicator.

M. Engine Accessories: Include intake air filter, fuel filter, fuel priming pump, automatic electric fuel shutoff, fuel/water separator, gear-driven water pump, positive displacement mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements, dipstick oil level indicator, and oil drain valve with hose extension. Include engine mounted battery charging alternator with solid state voltage regulator.

N. Starting System: 24-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Provide a DC battery starting system with number of batteries and battery capacity as sized by the manufacturer adequate for (4) 30 second cranking periods (total of 2 minutes) along with all additional loads being run on the DC system. Battery submittal shall include type, amp-hour rating and cold cranking amps.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range. Include accessories required to support and fasten batteries in place.
7. Battery-Charging alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
8. Battery Charger: current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperatures from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
    f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

A. Comply with NFPA 30.

B. Fuel Tank: Comply with UL 142, factory-fabricated, double-walled, sub-base fuel tank assembly, with the following features:

1. Containment: Integral rupture basin.
    a. Leak Detector: Locate in rupture basin for remote indications of fuel tank leak.
2. Minimum Tank Capacity: As recommended by engine manufacturer for an uninterrupted period of 24 hours' operation at 100 percent of rated power output of engine-generator system without being refilled.
3. Pump Capacity: Exceeds maximum flow of fuel drawn by engine-mounted fuel supply pump at 110 percent of rated capacity, including fuel returned from engine.
4. Low-Level Alarm Sensor: Liquid-level device operates alarm contacts at 25 percent of normal fuel level.
5. Provide 2 spare contacts for remote indication of fuel system detection alarms.
6. High-Level Alarm Sensor: Liquid-level device operates alarm and redundant fuel shutoff contacts at midpoint between overflow level and 100 percent of normal fuel level.
7. Provide vent piping as required by the fuel tank manufacturer, and local and state codes.
8. Provide flexible supply and return line fittings and all connections for connecting fuel system to the engine in compliance with applicable codes and regulations. All fuel piping shall be pressure tested for minimum 2 hours.
9. Piping Connections: Factory-installed fuel supply and return lines from tank to engine; local fuel fill, vent line, overflow line; and tank drain line with shutoff valve.
    a. Subbase tanks shall be provided with the following top-mounted tank openings as a minimum:
        1). Primary Tank
            a) Fuel supply and fuel return openings (1" NPT minimum each).
            b) Normal (primary) tank vent opening on primary tank (2" NPT minimum).
            c) Emergency pressure-relief (secondary) vent opening sized per NFPA 30.
            d) Opening for Low-level and high level fuel alarm switches (2" NPT minimum)
            e) Mechanical fuel gauge opening (1 1/2" NPT minimum)
            f) Stick port opening (1 1/2" NPT minimum)
            g) Tank fill bung (2" NPT minimum)
        2). Secondary Tank
            a) Monitoring port on interstice of secondary tank (2" NPR minimum)
            b) Emergency pressure-relief (secondary) vent opening sized per NFPA 30.
10. The top of the subbase tank shall include provisions for containment of minor leakage of engine fluids. A liquid-tight containment lip shall be formed with 1" or larger welded steel angle. The containment area should encompass as a minimum the subbase tank top below the engine and within the weather-proof enclosure.
11. Fill Assembly: The tank fill connection shall be a cam-lock style tight-fill used in conjunction with an overfill prevention valve set to stop the flow of fuel when the tank reaches 95% of tank capacity. The fill shall be located such that the delivery operator has direct access to the tank gauge. The fill shall also include a spill containment bucket that is accessible from outside the generator enclosure. Spill containment bucket to be 5 gallons minimum.
12. Tank Gauging: A mechanical, direct reading, type of fuel level gauge indicator shall be provided in addition to any electronic monitoring system. The fuel level indicator shall be one of the following: Series 6500 Senior Gauge, Manufactured by Rochester Gauges Inc., a "Scully" Gauge, a Hersey Direct Reading Mechanical or Magnetic gauge, or equivalent.
13. Leak and Overfill Alarms:
    a. A liquid sensor shall be mounted inside the secondary tank and wired to the major engine alarm. Sensor shall be INCON TSP-ULS or equal.
    b. A remote overfill alarm horn with an independent alarm silence switch shall be provided. The alarm shall be wired to sound at 90% of tank capacity.
14. Signage: Tanks shall be labeled with fuel type and capacity. Labels shall be 2" white letters on black background and attached to the tank with adhesive.
15. Accessories:
    a. Emergency vent shall be OPW 202 or equal sized by tank manufacturer per NFPA 30.

b. Dielectric couplings and/or flanged kits shall be provided at all copper to steel connections and as required to isolate the piping from the tank.

16. Vandal-resistant fill cap.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
1. AC voltmeter.
2. AC ammeter.
3. AC frequency meter.
4. DC voltmeter (alternator battery charging).
5. Engine-coolant temperature gage.
6. Engine lubricating-oil pressure gage.
7. Running-time meter.
8. Ammeter-voltmeter, phase-selector switch(es).
9. Generator-voltage adjusting rheostat.

D. Supporting Items: Include sensors, transducers, terminals, relays and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.

F. Common Remote Audible Alarm: Signal the occurrence of any events listed below without differentiating between event types. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
1. Engine high-temperature shutdown.
2. Lube-oil, low-pressure shutdown.
3. Overspeed shutdown.
4. Remote emergency-stop shutdown.
5. Engine high-temperature prealarm.
6. Lube-oil, low-pressure prealarm.
7. Fuel tank, low-fuel level.
8. Low coolant level.

G. Remote Emergency-Stop Switch: Wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Insulated-case, electronic-trip type; 100 percent rated; complying with UL 489.
   1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
   2. Trip Settings: Selected to coordinate with generator thermal damage curve.
   3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
   4. Mounting: Adjacent to or integrated with control and monitoring panel.

B. Ground-Fault Indication: Comply with NFPA 70, “Emergency System” signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 ALTERNATOR

A. Insulation: ANSI/NEMA MG 1, Class B-Standby.

B. Alternator Speed: 1,800 rpm.

C. The unit shall be single bearing, self-aligning 4-pole, brushless, synchronous type, revolving field windings.

D. Provide SPD protection, as recommended by manufacturer to ensure protection against external surges.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Drive: Generator shaft be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

B. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

C. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

D. Enclosure: Drip proof.

E. Instrument Transformers: Mounted within generator enclosure.

F. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
   1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

G. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

H. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

I. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Prefabricated or pre-engineered walk-in enclosure with the following features:

1. Construction: Sound attenuated, galvanized-steel, metal-clad, integral structural-steel-framed building erected on concrete foundation with sub-base fuel tank.
2. Structural Design and Anchorage: Comply with ASCE 7 for wind loads.
3. Space Heater: Thermostatically controlled and sized to prevent condensation.
4. Intake Louvers: Motorized, equipped with bird screen and filter.
5. Discharge Dampers: Gravity.
6. Intake and Discharge Plenums: Sound attenuating with screens.
7. Fuel Tank Monitor Panel: Within enclosure.
8. Fuel Tank Vent: Through roof type.
9. Insulated to R15 level.
10. Enclosure Power: 37KVA dry type transformer, 480/208/120 three phase NEMA 3R with min. 12 circuits loadcenter.
11. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine-generator-set components.
12. Muffler Location: Within enclosure.
13. Access Doors: Hinged, gasketed, lockable with inside operators.

B. Engine Cooling Airflow Through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Automatic Dampers: At engine cooling air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

C. Interior Lights with Switch: Factory-wired, vapor-proof LED type fixtures within housing: arranged to illuminate controls and accessible interior.

D. Convenience Outlets: Factory wired, GFCI. Arrange for external electrical connection.

E. Sound Attenuation: Enclosure to include sound attenuating features including interior insulation and perforated liner.
   1. Gravity discharge damper.
   2. Sound attenuating intake plenum
   3. Sound attenuating discharge plenum.
      Enclosure to be sound attenuated to maximum of 73 dB(A) at 21 feet.

2.10 ACCESS

A. For access to enclosure, a metal step assembly complete with landing and handrail shall be provided for enclosures whereby bottom of access door is located 24" above finished grade or higher.

2.11 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
   1. Material: Natural rubber.
   2. Number of Layers: Three

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
   1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick,

elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.12 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer. Color shall be desert sand or approved by OWNER.

2.13 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
9. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch. Insert static deflection on 4-inch –high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Provide concrete pad for step assembly as required. Provide four foot minimum landing at grade.

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

B. Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section “Identification for Electrical Systems.”

3.5 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection (except those indicated to be optional) for “AC Generators and for Emergency Systems” specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
   3. Battery Tests: Equalize charging of battery cells according to manufacturer’s written instructions. Record individual cell voltages.
      a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
      b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
      c. Verify acceptance of charge for each element of the battery after discharge.
      d. Verify that measurements are within manufacturer’s specifications.
   4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
   5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
   6. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge at four locations at property boundary and compare measured level with required values. Prepare and submit noise level testing report to Engineer.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Contractor shall commission tank overfill alarm and prevention valve setting with Owner and Engineer.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirement are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

L. Load Bank: Provide a portable load bank and test unit at full load for a minimum of 8 hours.

M. Provide a full tank of fuel at the time of substantial completion.

N. Provide manufacturer developed tank chart with measuring device function to gallons conversion. Mount laminated copy inside generator enclosure for use by the fuel delivery operator.

O. The Contractor shall notify the State of the work to be performed within the times required prior to installation procedures.

P. The Contractor shall obtain all permits and pay all fees required by the State and local jurisdictions.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION

SECTION 26 36 00 – AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches.

B. Related Sections include the following:
   1. Division 26 Section “Engine Generators” for generators.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section “Operation and Maintenance Data,” include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches through generator supplier.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 110.

G. Comply with UL 1008 unless requirements of these specifications are stricter.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Automatic Transfer Switches:
      a. Cummins

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to 70 deg. C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
   1. Switch Action: Double throw; mechanically held in both directions.
   2. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Where four-pole switches are indicated, provide neutral pole switched simultaneously with phase poles.

H. Factory Wiring: Train and bundle factory wiring and label, consistent with shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in division 16 Section “Identification for Electrical Systems.”
   1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
   2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
   3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

I. Enclosures: General-purpose NEMA 250, type 12 for indoor and type 4X stainless steel for outdoor, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.

C. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external manual operator shall be safely operated from outside of the transfer switch enclosure while the enclosure door is closed.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Automatic Transfer-Switch Features:
1. Open-Transition
2. Transfer switches indicated as service-entrance rated shall be provided with a neutral-to-ground main bonding jumper to meet UL service entrance requirements. Ground fault protection shall be provided for all switches rated 1000 amperes or more applied on 480Y/277 Vac systems in accordance with NEC Article 230-95.
3. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
4. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
5. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
6. Time Delay for Retransfer to Normal source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
7. Test Switch: Simulate normal-source failure.
8. Switch-Position Pilot Lights: Indicate source to which load is connected.
9. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency –source sensing circuits.
    a. Normal Power Supervision: Green light with nameplate engraved “Normal Source Available.”
    b. Emergency Power Supervision: Red light with nameplate engraved “Emergency Source Available.”
10. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
11. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicated override status.
12. Engine Starting contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

13. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
14. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.
    1. Concrete Bases: 3 1/2 inches high, reinforced, with chamfered edges. Extend base no more than 3 1/2 inches in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support.

B. Identify components according to Division 26 Section “Identification for Electrical Systems.”

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Ground equipment according to Division 26 Section “Grounding and Bonding for Electrical Systems.”

B. Connect wiring according to Division 26 Section “Low-Voltage Electrical Power Conductors and Cables.”

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:
    1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
    2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    a. Check for electrical continuity of circuits and for short circuits.
    b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
    c. Verify that manual transfer warnings are properly placed.
    d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.
    a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    b. Simulate loss of phase-to-ground voltage for each phase of normal source.
    c. Verify time-delay settings.
    d. Verify pickup and dropout voltages by data readout or inspection of control settings.
    e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
    f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.
    g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.
5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
    a. Verify grounding connections and locations and ratings of sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contract resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

F. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.
1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below.

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

B. Related Requirements:
1. Section 26 24 13 "Switchboards" for factory-installed SPDs.
2. Section 26 14 19 “Motor Control Centers” for factory-installed SPDs.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Minimum ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL SPD REQUIREMENTS

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Comply with UL 1449.

D. MCOV of the SPD shall be the nominal system voltage.

2.2 SERVICE ENTRANCE SUPPRESSOR

A. Acceptable Manufacturers:

   1. Eaton

   2. SSI

B. SPDs: Comply with UL 1449, Type 1.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1. The SPD shall be listed as Type 1 SPD, suitable for use in Type 1 or Type 2 applications.
   1. SPDs with the following features and accessories and monitoring capabilities:

      a. Integral disconnect switch.
      b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
      c. LED indicator light display for protection status for each phase.
      d. Audible alarm with on/off silence function with diagnostic test functions.
      e. Minimum one (1) set of NO/NC Form C dry contacts.
      f. Surge counter: Dual Surge counters continuous and resettable.
      g. Time/Date stamp of all events.

D. Comply with UL 1283.

E. Electrical Noise Filters- each unit shall include a high-performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B. SPD shall include a EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

F. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 600 kA and 300 kA per Mode. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

G. Protection modes and UL 1449 VPR for grounded wye circuits with [**480Y/277 V**] [**208Y/120 V**], three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: [**1000 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
2. Line to Ground: [**1200 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
3. Neutral to Ground: [**1200 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
4. Line to Line: [**1800 V for 480Y/277 V**] [**1000 V for 208Y/120 V]**

H. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.
2. Line to Ground: **1000 V**.
3. Line to Line: 1000 V.

I. SCCR: Equal or exceed 300 kA.

J. Inominal Rating: 20 kA.

2.3 TYPE 2 SUPPRESSOR

A. Acceptable Manufacturers:

1. Eaton

2. SSI

B. SPDs: Comply with UL 1449, Type 2.

C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
1. SPDs with the following features and accessories:

a. Integral disconnect switch.
b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
c. LED indicator light display for protection status for each phase.
d. Audible alarm with on/off silence function with diagnostic test functions.
e. Minimum one (1) set of NO/NC Form C dry contacts.
f. Surge counter: Dual Surge counters continuous and resettable.
g. Time/Date stamp of all events.

D. Comply with UL 1283.

E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 300 kA and 150 kA per Mode. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

F. Protection modes and UL 1449 VPR for grounded wye circuits with [**480Y/277 V**] [**208Y/120 V**], three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: [**1200 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
2. Line to Ground: [**1200 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
3. Neutral to Ground: [**1500 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
4. Line to Line: [**1800 V for 480Y/277 V**] [**1000 V for 208Y/120 V]**

G. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:
1. Line to Neutral: 700 V.

2. Line to Ground: [**700 V**] [**1000 V**].
3. Line to Line: 1000 V.

H. SCCR: Equal or exceed 200 kA.

I. Inominal Rating: 20 kA

2.4 TYPE 3 SUPPRESSORS

A. Acceptable Manufacturers:

1. Eaton

2. SSI

B. SPDs: Comply with UL 1449, Type 3.
   a. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
   b. LED indicator light display for protection status for each phase.
   c. Audible alarm with on/off silence function with diagnostic test functions.
   d. Minimum one (1) set of NO/NC Form C dry contacts.
   e. Surge counter.

C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

D. Comply with UL 1283.

E. Protection modes and UL 1449 VPR for grounded wye circuits with [**480Y/277 V**] [**208Y/120 V**], three-phase, four-wire circuits shall not exceed the following:
   1. Line to Neutral: [**1000 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
   2. Line to Ground: [**1200 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
   3. Neutral to Ground: [**1200 V for 480Y/277 V**] [**700 V for 208Y/120 V**].
   4. Line to Line: [**2000 V for 480Y/277 V**] [**1000 V for 208Y/120 V**]

F. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
   1. Line to Neutral: 700 V.
   2. Line to Ground: 700 V.
   3. Neutral to Ground: 700 V.
   4. Line to Line: 1000 V.

G. SCCR: Equal or exceed 100 kA.

H. Inominal Rating: 20 kA.

2.5 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

B. Outdoor Enclosures: NEMA 4X 316 Stainless Steel.

2.6 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Install dedicated grounding conductor from SPD to ground rod as short and straight as possible.

E. Use crimped connectors and splices only. Wire nuts are unacceptable.

F. The SPD manufacturer’s technician shall perform a system checkout and start-up in the field to assure proper installation, operation and to initiate the warranty of the system. The technician will be required to do the following:
   1. Verity voltage clamping levels utilizing a diagnostic test kit, comparing factory readings to installed readings.
   2. Verify N-G connection. Before energizing, installer shall verify service and separately derived system Neutral to Ground bonding jumpers per NEC.
   3. SPD Type 1 shall be installed on the line side of the main service disconnect in the service entrance rated installation.
   4. SPD Type 2 and 3 shall be installed as shown on drawings.
   5. Record information to a product signature card for each product installed.

G. Wiring:
   1. Power Wiring: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
   2. Controls: Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
   1. Compare equipment nameplate data for compliance with Drawings and Specifications.
   2. Inspect anchorage, alignment, grounding, and clearances.
   3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 26 90 20 – PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. The work to be included under this section of the Specifications shall consist of furnishing all materials, labor, equipment, tools, supplies, and incidentals for installation of all programmable logic controllers. The work shall include every item of construction necessary for a complete and acceptable installation as shown on the Drawings and as specified herein.

B. Related Sections:
1. Section 26 90 00 - General Instrumentation and Control
2. Section 26 90 10 - Process and Analytical Instruments
3. Section 26 90 30 - Computer System and Network
4. Section 26 90 40 - Process Control Descriptions

C. Manufacturer's Support: The PLC system manufacturer shall maintain, as a part of a national network, engineering service facilities within 100 miles of the project, to provide start-up service, emergency service calls, repair work, service contracts, maintenance, and training. Emergency service shall be available within twenty-four hours of notification.

1.2 REFERENCES

A. Definitions: Symbols, Definitions, and Abbreviations: All symbols, definitions, and engineering unit abbreviations utilized shall conform to IEEE 100-84, S50.1, and S51.1, where applicable.
1. SCADA – Supervisory Control and Data Acquisition
2. PLC – Programmable Logic Controller
3. RIO – Remote Input/Output chassis
4. HMI – Human Machine Interface
5. OIT – Operator Interface Terminal
6. I/O – Input/Output
7. MTU – Master Telemetry Unit
8. RTU – Remote Telemetry Unit
9. Operating Program – Operating system, SCADA or other core software
10. Integrated Operating Platform – System of installed, connected, and configured hardware, operating programs, and networking equipment
11. PLC and HMI Programming – Software configuration of operating programs to implement plant control strategies

1.3 SCOPE

A. The following lists the PLCs that are part of the control system at the facility.
1. Master Blower Control Panel
2. RAS/WAS area

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following PLCs installed at the facility shall be Allen-Bradley CompactLogix and ControlLogix:
1. CompactLogix 5380 Series
2. ControlLogix 5580 Series

B. Other PLCs provided under this contract, including those furnished as part of vendor supplied equipment packages, shall be Allen-Bradley ControlLogix or Allen-Bradley CompactLogix as required for the application.

2.2 EQUIPMENT

A. Each ControlLogix PLC shall consist of the following basic components:
   1. Power supply module properly sized for the I/O load. The power supply input shall be 120VAC single phase.
   2. Chassis with capacity for modules, including spares, as detailed in the plans.
   3. L7x series processor module with a minimum of 4MB memory. Processors shall be the same model for all provided PLCs.
   4. Ethernet communication module.
   5. The following I/O modules as required for the application.
      a. 5069-IF8 – 8 Channel Analog Input Card
      b. 5069-OF8 – 8 Channel Analog Output Card
      c. 5069-IA16 – 16 Channel Digital Input Card
      d. 5069-OA16 – 16 Channel Digital Output Card

B. Each ControlLogix RIO shall consist of the following basic components:
   1. Power supply module properly sized for the I/O load. The power supply input shall be 120VAC single phase.
   2. Chassis with capacity for modules, including spares, as detailed in the plans.
   3. Ethernet communication module.
   4. The following I/O modules as required for the application.
      a. 5069-IF8 – 8 Channel Analog Input Card
      b. 5069-OF8 – 8 Channel Analog Output Card
      c. 5069-IA16 – 16 Channel Digital Input Card
      d. 5069-OA16 – 16 Channel Digital Output Card

C. Each CompactLogix PLC shall consist of the following basic components:
   1. Power supply module properly sized for the I/O load. The power supply input shall be 120VAC single phase.
   2. 1769-L36ERM processor with a minimum of 3MB memory.
   3. Integral Ethernet/IP communication ports.
   4. The following I/O modules as required for the application.
      a. Model 1769-IF8 – 8 Channel Analog Input Module
      b. Model 1769-OF4 – 4 Channel Analog Output Module
      c. Model 1769-IA32 – 32 Channel Digital Input Module
      d. Model 1769-OA32 – 32 Channel Digital Output Module

D. Provide I/O points as indicated in the drawings.

E. Each PLC shall be installed with a minimum of 20% spare I/O points of each type utilized in its I/O structure.

F. Each PLC shall have a removable nonvolatile memory card installed with capacity greater than or equal to processor internal memory. The controller shall be configured to load a copy of the program from nonvolatile memory whenever there is no project in the controller and power is applied.

G. The PLCs shall be capable of and shall be configured to provide stand-alone operation in the event of a communications link failure.

H. The necessary interface cables, communications cables, power cables, bus extension cables, modular card slot fillers, and other ancillary parts shall be furnished and installed as integral parts of the control system.

I. Nameplates shall be provided for each module, device, and other equipment with appropriate data such as the equipment number, rating, serial number, and manufacturer.

J. All I/O cards shall be furnished with removable terminal blocks to simplify card wiring and replacement.

K. The Contractor shall furnish the Owner the following spare replacement parts:
   1. One (1) Processor Module of each type
   2. Two (2) I/O modules of each type

L. PLC Control Panel Materials
   1. Enclosures for indoor dry locations: Furnish and install NEMA 12 enclosures unless noted otherwise. These enclosures shall have a window for viewing the status of the PLC.
   2. Enclosures for indoor wet locations: Furnish and install NEMA 4X stainless steel enclosures with window for viewing status of the PLC.
   3. Enclosures for outdoor locations: Furnish and install NEMA 4X stainless steel enclosures. All outdoor enclosures with OITs or other indication devices shall have a stainless steel sun shade.

M. PLC Control Panel Components – Each PLC control panel shall contain the following components:
   1. Current Loop Surge Protection Devices: The 4-20mA signal loop channels on the PLC analog inputs and outputs shall be protected against static discharge, lightning, and faulty wiring with three stage surge protection terminal block devices. Devices shall be PLUGTRAB series as manufactured by Phoenix Contact or equal.
   2. Discrete Output Relays: Terminal block style interposing relays shall be used for all 120VAC PLC outputs. Devices shall be PLC-RSC-120UC/21 as manufactured by Phoenix Contact or equal.
   3. Current Loop Power Supplies: When required, the instrument transmitter shall be furnished with a separate power supply to provide the loop power for 2-wire instruments. The power supplies shall be DIN rail mounted, 120VAC input, 24VDC output, with output load rated as required for the instrument. Power supplies shall be provided by Phoenix Contact, Allen-Bradley, or Sola.
   4. Terminal Strips and Accessories: Provide DIN rail mounted terminal strips including fused terminals with blown fuse indication, ground terminals and terminal groups for each incoming or outgoing device circuit including group tag identifying the device and identified terminals for each incoming or outgoing wire. Provide terminal end, partition and separation plates as required. Provide pre-engraved vinyl marking strips with terminal and group identification as shown on the submittal drawings. Provide group tags and terminals or as indicated on the drawings or equals. Do not splice control wires. Provide DIN rail mounted relay bases with LED coil indicators and arc suppression for plug-base relays. Identify each terminal with the wire designator from the wire number i.e. "+", "-", "SH", "NO", "NC", "COM", "L1", "N", etc. Provide 20% spare terminals and I.D. tags of each designation. Provide 20% spare connectors, fittings, wire ties, labels and markers of each type provided.
   5. Relays: Provide relays as required to implement indicated control functions. General purpose, alternating and time delay relays may be used within their ratings for logic, timing and sequencing but shall not be used to drive loads in excess of 80% of their contact "make" or "break" ratings. Provide interposing power relays to drive loads such as starters larger than NEMA size 1 and all other utilization equipment with loads greater

than specified for general purpose and time delay relays. Provide relays rated to drive the load as required. Relays shall be provided with an LED status indicator.

a. General Purpose Relays: Provide tube-base relays rated 120VAC, DPDT or 3PDT, 10 Amp contacts rated to break inductive loads of 3 Amperes. Provide Allen-Bradley 700 Type HA, Potter Brumfield or as indicated on drawings or equal. Provide additional relays as required to obtain sufficient numbers of contacts.

b. Time Delay Relays: Provide relays for which the time delay is based on the presence or absence of control voltage at the relay. Unless indicated otherwise, provide DIP switch programmable multifunction relays including time delay on energization, time delay on de-energization or one-shot timing as indicated. Provide continuous control power to the relay if required, whether indicated or not. The shop drawings shall reflect the actual proposed connection and timing diagram for the specific relays to be provided. Provide relays rated 120VAC, DPDT or 3PDT, 10 Amp contacts rated to break inductive loads of 3 Amperes. Provide tube-base relays as manufactured by SSAC or equal.

c. Power Relays: Provide heavy-duty solenoid type relays with contacts rated not less than 10 amperes continuous at 300 volts AC. Provide a minimum of four reversible poles or four universal or double-throw poles. Relays shall be type 700N as manufactured by Allen-Bradley or equal.

6. Grounding: Each panel shall be provided with a copper equipment grounding bar, ground lugs, and bonding cable and fittings as required.

7. Nameplates: Each enclosure shall be identified by a nameplate including its designation and service name as specified. Panel mounted instruments and control devices shall be identified by a nameplate including the tag number and service name. Control devices shall be provided with Manufacturer's standard legends indicating function (example: STOP, START, HAND-OFF-AUTO, etc.) Provide engraved, acrylic plastic laminate nameplates, 1/16” thick, 1" x 6" minimum for junction boxes and panels, sized to fit for control devices and stations, engraved in black letters on white face and punched for and fastened with self-tapping 10/32 stainless steel screws and silicone adhesive.

8. Uninterruptible Power Supply (UPS): Each PLC panel shall contain a UPS to provide seamless and continuous operation of equipment during power outages. The UPS shall provide backup power with true sine wave output, fault indicator, overload indicator and a replace batteries indicator. Contractor shall furnish and install a bypass toggle switch that bypasses the UPS in case of failure. UPS shall be manufactured by APC.

9. Ethernet Switch: See Specification 26 90 30 –Computer System and Network.

2.3 GENERAL

A. The PLC components specified herein shall be configured as part of the Integrated Operating Platform Basic Process Control System (BPCS) as defined in 26 90 00 – General Instrumentation and Control.

B. The Contractor shall utilize personnel who are skilled and experienced in the panel fabrication, installation, setup, and configuration of the PLCs being furnished under this contract.

C. The Contractor shall furnish and install all of the I/O listed in the Drawings utilizing the I/O modules listed in this Specification.

D. All wiring shall be neatly installed and wire ways shall be used wherever possible. All wiring shall be identified at all terminating locations by Tag ID as identified in Drawings.

E. Any PLC furnished as part of a vendor supplied equipment package shall be accessible for future program monitoring and revisions. If password protection of any kind is implemented, the vendor or Contractor shall supply all passwords or other security information to the Owner and the Engineer.

F. The Contractor shall furnish the Owner final as-built copies of documented PLC programs for vendor supplied equipment packages, on electronic media, suitable for future troubleshooting or modifications by others.

G. The Contractor shall furnish and install the conduit, power wiring, signal wiring, communications wiring, fiber optic cables, and network components that make up the distributed control system as shown on the Drawings.

H. The Contractor shall furnish the necessary enclosures, racks, power supplies, surge protection devices, communications modules, PLC processors, I/O modules, PLC power supplies, loop power supplies, and Ethernet devices for all of the programmable logic controller units. The Contractor shall furnish and install the necessary fiber optic cables, Ethernet cables, instrument signal cables, and control circuits required for monitoring and controlling the equipment within the project site facilities.

I. All accessories and assemblies shall be installed in accordance with the manufacturer's installation instructions.

J. The Contractor shall furnish the Owner two complete copies of the operations and maintenance manuals for all PLC components detailed in this Specification.

END OF SECTION

SECTION 44 42 13 - FINE BUBBLE FIXED-GRID AERATION EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: the Work necessary to furnish all labor, materials, equipment and incidentals required and manufacture, completely install, adjust, protect, put in operation and test the Fine Bubble Fixed-Grid Aeration Equipment as specified herein.

1.2 GENERAL

A. Like items of equipment provided hereinafter shall be the end products of one Manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and Manufacturer's services.

B. Unit Responsibility: The Work requires the Fine Bubble Fixed–Grid Membrane Aeration System complete with all accessories and appurtenances (including, but not necessarily limited to, drop legs, manifolds, lateral pipes, piping supports, couplings, diffusers, diffuser holders, retainers, gaskets, orifices, drain lines, moisture purge system, nuts, bolts, anchors, taps, valves) be the end product of one responsible Manufacturer. The Manufacturer shall assume all responsibility for mating the Fine Bubble Fixed-Grid Aeration System to the Aeration Distribution Systems piping and Aeration Basin trains to obtain the performance specified. The Manufacturer shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Design-Build Contractor's responsibilities.

1.3 SUBMITTALS

A. General: Administrative, shop drawings, samples, quality control, and contract closeout submittals shall conform to the requirements as specified by the Owner.

B. Submit the following additional specific information:
   1. Shop Drawings:
      a. Make, model, and weight of each equipment assembly.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction with accompanying chemical compatibility data.
      c. Performance data showing compliance with specification requirements. Include:
         1). Complete head loss calculations for the aeration equipment starting from the Manufacturer's limit of responsibility (top of the drop leg through membrane diffuser orifice and water in Aeration Basin train).
      d. Drawings and calculations shall show how the system will expand/contract under the range of conditions specified and demonstrate that drop legs, manifold headers, lateral pipes, pipe fittings, expansion joints, piping supports, etc., for the entire system supplied comply with requirements specified.
      e. Detailed mechanical and structural drawings showing the equipment fabrications, all plans, elevations, and cross section details of construction, dimensions and anchor bolt locations and interface with other items. Include:
         1). Dimensions, size, and locations of connections to other work, and weights of equipment associated therewith.
      f. Details, including materials of construction, of the Membrane Diffuser Element and Membrane Diffuser Element Holder, retainer ring, gasket, orifice, flanged joints, and moisture purge system.

g. Details showing how the diffuser element holder is attached to the distribution header.
h. Details of piping supports, expansion joints, and pipe taps.
i. Details showing how the drop leg, manifold and distribution lateral supports will be connected to the Aeration Basin trains.
j. Certify that the diffuser Manufacturer has coordinated with manufacturer of blower and air filtration system for compatibility with diffuser system (i.e. blowers meet removal requirements of the filters).
k. Diffuser Testing Plan as specified herein.
l. PVC Solvent.

2. Quality Control Submittals:
   a. Certified copies of the results of all Factory Functional and Field Performance Test reports after tests have been completed.
   b. Certified copies of the dynamic wet pressure (DWP) test report prior to delivery of diffusers.
   c. Certified copies of the oxygen transfer efficiency (OTE) test report.
   d. Certified copies of the EPDM material characteristics demonstrating compliance with these specifications.
   e. Special shipping, storage and protection, and handling instructions.
   f. Manufacturer's printed installation instructions. Include:
      1). Description of the Design-Build Contractor's proposed method for ensuring a level installation of all equipment and methods of tightening of bolts, diffuser hold-down rings, etc.
   g. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
3. Contract Closeout Submittals:
   a. Service records for maintenance performed during construction.
   b. Warranty.

1.4 QUALITY CONTROL

A. Balancing: Rotating elements of equipment, except small, commercially packaged equipment, shall be statically and dynamically balanced at the factory prior to final assembly. The Design-Build Contractor shall furnish certified copies of all test results.

1.5 FACTORY TESTING

A. Prior to initiation of production, the Design-Build Contractor shall submit for the Owner's review a testing plan to ensure consistently good quality and uniformity of the diffuser assemblies. After testing, test results for all diffusers tested shall be submitted for approval and tested diffusers shall be identified.

B. Oxygen Transfer Testing:
1. Submit certified oxygen transfer performance curves to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.
2. Perform shop test with air rate and mass rate of oxygen transfer equivalent to the proposed diffuser design.
3. A 5% variance on the allotted air at each condition shall be allowed.
4. Use a testing and data analysis procedure equivalent to the ASCE Standard for the Measurement of Oxygen Transfer in Clean Water.
5. The ratio of the total diffuser surface area (AD) to the tank surface area (AT) used for testing will be the actual ratio of the installation.
6. Perform a minimum of 3 tests at each design air flow rate. Test results shall not vary more than 10% from the mean.
7. The cobalt catalyst used shall not raise the cobalt ion concentration in the test tank above 0.5 mg/l.

8. Base the amount of technical grade sodium sulfite added for each test on the stoichiometric quantity of chemical required plus a suitable additional amount to completely deoxygenate the test water for at least one minute before the dissolved oxygen level increase from zero.
9. Test may be conducted using the same test water up to a TDS level of 2000 mg/L.
10. Determine dissolved oxygen values using properly calibrated probes with recorders.
    a. Collect at least one sample per test and analyze for dissolved oxygen using the Azide modification of the Winkler Method as specified by Standard Methods.
    b. Use a minimum of four D.O. probes during the test.
11. Before the first test and after the last test of each water change, take samples and test for total suspended solids, total dissolved solids, total hardness, alkalinity, iron, manganese, residual chlorine, pH, cobalt and temperature.
12. If testing results do not meet full scale design requirements as specified, one (1) retest will be allowed prior to manufacturer disqualification.

1.6 OPERATION AND MAINTENANCE DATA

A. O&M Manuals: Manuals shall be provided by the Design-Build Contractor for review and approval by Owner.

B. Maintenance Summary Forms: Forms shall be submitted for review and approval by Owner in a format approved by the Owner.

1.7 WARRANTY

A. Provide warranty for a period of 18 months after the final acceptance of the equipment by the Owner. Manufacturer shall furnish replacement parts to the Owner for any items found to be defective within the 18-month warranty period. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the Manufacturer will promptly repair or replace the defective equipment without additional cost to the Owner.

B. Spare parts identified within this specification shall not be used to address warranty repairs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The fine bubble fixed-grid aeration system equipment shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

B. Materials, equipment, components and accessories specified in this Section shall be products of manufacturers with similar equipment successfully installed and operating in the United States for 10 years or longer.

C. Manufacturer of components and accessories specified herein shall be as follows:
    1. SSI Aeration
    2. Environmental Dynamics, Inc. (EDI)

2.2 GENERAL REQUIREMENTS

A. All equipment shall be supplied complete. Parts shall be proportioned to have liberal strength, stability and stiffness and shall be especially adapted for the intended service. Ample room and facilities shall be provided for inspection, repairs, and adjustments.

B. All equipment furnished herein is intended to be submerged. No part shall be of any material other than membrane, plastic, PVC, Type 304L or greater stainless steel, Hastelloy C, Monel, or gasket material.

C. It shall be the responsibility of the Manufacturer to ensure the actual equipment furnished meets all requirements specified herein.

D. Rated Diffuser Air Flow Rate: 1.75 scfm per diffuser (Maximum acceptable).

E. The equipment shall be suitable for operation with compressed air at temperatures entering the drop pipe of 220°F. Stainless steel dropleg shall be designed to reduce mean temperature of air entering PVC pipe to a maximum of 135°F.

F. All PVC moldings and extrusions for the Aeration Basin trains shall be produced from Schedule 40 PVC compound complying with ASTM D3915. PVC parts shall be suitable for long term exposure to compressed air at temperatures up to 135°F. Solvent weld all PVC joints in the factory. All solvent welding shall be with solvent cements specifically formulated for use with PVC in compliance with ASTM D2564. No field solvent welding will be permitted.

G. Manufacturer shall coordinate with centrifugal blower manufacturer to ensure compatibility of components furnished, include air intake filters. Provide documentation to Owner demonstrating such coordination.

H. All anchor bolts shall be epoxy type, insensitive to moisture, 304L stainless steel, and a minimum diameter of 3/8".

2.3 AERATION BASINS SERVICE CONDITIONS

A. The supplied diffuser system shall be capable of providing the oxygen rates and efficiencies given the following site conditions:
1. Maximum Ambient Air Temperature: 115°F.
2. Minimum Ambient Air Temperature: -15°F.
3. Site Elevation: 3800 MSL.

B. The entire system, including the drop leg, manifold, laterals, drain lines and moisture purge system shall allow for expansion and contraction under the following conditions:
1. Winter conditions, empty Aeration Basin trains (-15°F).
2. Summer conditions, empty Aeration Basin trains (115°F).
3. Operation with air supply at 220°F and Aeration Basin trains full.
4. Operation with air supply at 220°F and water level in Aeration Basin trains 1-ft above diffusers.

C. Side Water Depth: 15-ft.

2.4 AERATION BASIN SYSTEM DESCRIPTION

A. All of the equipment specified herein is intended to be a complete aeration system capable of transferring atmospheric oxygen into the activated sludge mixed liquor and creating adequate mixing to keep the mixed liquor solids in suspension. The following components are part of this system and shall be installed in each Aeration Basin train as specified herein:
1. Piping: Drop legs to each grid, manifolds, lateral pipes, piping supports and couplings to stainless steel headers.
2. Diffusers: Fine bubble membrane diffusers, diffuser holders, retainers, gaskets, and orifices.
3. Diffuser Accessories:

a. Drain lines and moisture purge system.
b. Diffuser pressure monitoring panel.
c. Fixed joints.
d. 304 stainless steel bolts, nuts and gaskets for flange joints.
e. 304 stainless steel anchor bolts.
f. Accessory piping, taps, and valves as specified.

4. Other equipment as required for provision of a completely operational aeration system.

B. The membrane diffusers and piping grid shall be laid out on the bottom of the Aeration Basin trains. Increase the number of diffusers provided over the amount specified in order to comply with the performance requirements specified.

C. Diffuser Layout:

Aeration Basin (Minimum Requirements)	Count
Trains	3
Grids / Train	2
Droplegs / Train	2

2.5 AERATION BASIN PERFORMANCE REQUIREMENTS

A. Furnish for each grid as defined: a drop leg, manifold header, lateral piping, membrane diffusers, and flow control orifices to operate at an air flow rating of 1.75 scfm per diffuser (maximum acceptable).

1. The maximum dynamic pressure loss through the installed aeration system (including flow control orifices, membrane diffusers, and water level in the Aeration Basin trains) starting from the top of the drop leg, at the water surface elevation, at below air flows per grid, at maximum operating water depth, with required diffusers in place, shall be no greater than 6.81 psi at standard conditions.
2. The system shall be designed such that the airflow rate per diffuser does not exceed 1.75-scfm.
3. The system shall provide air flow rates as required to adequately suspend solids (0.12 scfm/ft^2).
4. Each diffuser grid shall be provided with blank diffusers equal to 10% of the active diffusers.
5. Diffuser system shall provide a minimum SOTE of 24%

B. Supply and install the diffuser system to meet the following conditions:

1. Air flow rates from a minimum of 0.6 SCFM to a maximum of 1.75 SCFM per diffuser.
2. In addition to the above requirements, the installed diffuser system shall be capable of providing the minimum oxygen requirements at the specified air flow rates and service conditions considering. The system shall uniformly distribute air flows within each grid under all airflows specified herein:

System Summary with All Basins in Service .	
Volumetric Air Flow Rate (SCFM Total)	12,000
Diffuser Submergence (ft)	14.00

2.6 FINE BUBBLE MEMBRANE DIFFUSERS AND ASSEMBLIES

A. Furnish diffuser assemblies including diffuser, gasket, holder, retaining ring and air flow control orifice.

B. Membrane Diffusers and Gaskets:

1. Furnish 9-inch membrane disc diffusers.
2. Furnish screw on retainer rings with a positive “O” ring seat.

3. Threading diffuser directly into a hole tapped into the header shall be allowed as long as the header is a minimum schedule of 80.

Description	Value/Units	ASTM
Base Polymer:		EPDM
Coating:		PTFE
UV Resistance:	Carbon Black	
Specific Gravity:	1.25 or Less	
Ozone Resistance: (72 Hrs; 40°C, pphm)	No Cracks @ 2 x Magnification	D1171 Test Method A
Durometer, Shore A:	58 Point ± 5	2240
Tensile Strength: (Unperforated)	1,200 psi/Min.	D412
Elongation at Break:	350% Min.	D412
Elongation (% Retained): (70 Hrs. @ 100°C)	75% Max.	D573
Accelerated Aging	40% Max.	D395
Compression Set: (Under Constant Deflection – 22 Hrs. @ 70°C)		Test Method B
Modulus @ 300%	500 psi/Min.	D412

4. Furnish diffuser membranes with uniform distribution of air bubble release across the active surface of the diffuser element when submerged in water. Manufacture membrane discs with integral sealing gasket.
5. Furnish diffuser membranes to meet or exceed the following criteria:
   a. Membrane shall collapse and seal when aeration system air is turned off.
   b. Membrane shall be able to collapse onto support base when air is not being diffused.
   c. EPDM membrane disc diffusers shall be furnished with multi-layered fluoro-elastomer encapsulating barrier layer or coating. Single layer coatings comprising blending adhesive/PTFE or PTFE powder blended into the EPDM rubber shall not be acceptable.
6. Membrane Longevity: Longevity of the proposed membrane diffusers shall have been demonstrated in at least three full-scale municipal installations operating continuously for a minimum of three years. Test reports, prepared by an independent testing agency, shall confirm membrane longevity through compliance with the following maximum allowed percent (+/-) change in each membrane property. Tests shall be conducted by an independent third-party, and data for a minimum of three diffusers from each installation shall be provided.

Property	Maximum Percent Change
Durometer	5%
Weight	5%
Permanent Set	.05%

Test reports shall be submitted for approval by Owner.

C. Observe diffuser for uniform air distribution across the active surface of the diffuser at 1.0 SCFM and 2" of submergence. Active surface area is defined as the horizontal projected area of the diffuser.

D. Furnish PVC or polypropylene (PP) diffuser element holders with an air plenum chamber below the diffuser support plate. Provide a mechanism to attach the diffuser to the holder.
   1. Element holders shall provide complete peripheral edge support for the diffuser element.
   2. Solvent weld or press-fit element holders to the distribution headers in the factory to resist dead load of 200 lbs. applied vertically to the outer edge of the diffuser unit.
   3. Furnish retaining device to securely hold and seal the diffuser to the holder.
      a. Design diffuser assembly and retaining device to prevent air escape at the diffuser element-sealing gasket interface. Make gasket integral with diffuser.
      b. Provide a method to vary the applied sealing force between the sealing gasket and diffuser. Sealing method or retaining device shall generate a minimum of 50 pounds per inch of circumference of the sealing gasket to provide a long-term positive seal and prevent air escape, except through the active area of the diffuser.
   4. Provide screw on retainer rings with a positive “O” ring seat and a minimum of 2 1/2 complete threads for engagement. Threads shall have a minimum cross-section of 1/8”. Alternatives utilizing a threaded nipple design for attaching diffuser to header must use stainless steel nipples and stainless steel inserts molded into the PVC headers.

2.7 PIPING

A. Furnish drop legs and headers, which shall be manufactured from sheets and plates of 304 stainless steel with a 2D finish.

B. Alternatively, Schedule 80 Polyvinyl Chloride (PVC) air headers are acceptable given air temperatures are within design constraints of PVC pipe.

C. All manifolds, distribution piping, couplings, tees, joints, diffuser holders and other PVC piping and parts shall be manufactured of Polyvinyl Chloride (PVC).

D. All PVC piping shall be suitable for use in wastewater. Air manifolds and laterals shall be Schedule 40 PVC or equivalent.

E. Manifolds shall be supplied fixed or flanged joints, pipe supports, etc., as required by the Manufacturer and approved by the Owner, for alignment of the system. All underwater joints shall be positive locking type and anti-rotational.

F. The Distribution laterals shall include the piping, factory installed diffuser element holders, joints, and air purge - drainage system.

G. The distribution laterals shall connect to the manifold by fixed joint connections. Required accessories shall be provided for each connection. Design connections and supports to resist thrust generated by expansion and contraction of the system.

H. Provide for any expansion or contraction of the diffuser piping resulting from temperature change. Each system shall allow for expansion and contraction over the specified SERVICE CONDITIONS. There shall be no thermally induced stresses due to expansion and contraction over SERVICE CONDITIONS specified. Joints shall be air-tight and not allow movement of the pipe at the joint. Expansion and contraction shall take place through the supports.

I. All piping gaskets shall be butyl rubber, neoprene, or a composition suitable for air to 220°C. Gasket material shall be suitable for long term immersion in wastewater.

2.8 SUPPORTS

A. All pipe support anchors shall have a factor of safety of 10 or greater against calculated buoyant forces when installed.

B. The diffusers shall be leveled for uniform distribution of air for oxygen transfer and mixing as specified herein. All diffuser piping and diffusers shall be capable of being leveled to this tolerance and remaining level under all conditions of operation whether the tanks are full, partially full, or empty.

C. Air distribution lateral supports shall be of Type 304 stainless steel and allow for a ± 2" vertical adjustment for alignment of the air distribution laterals in the field. Adjusting and aligning mechanism shall be adjustable within its limits to allow precise leveling of the air distribution headers and diffuser assemblies to within ± 1/8" of a common horizontal plane without removing the header from the support. Supports shall provide a minimum 1/2" vertical adjustment in either direction when in place and all diffusers are level.

D. Drop legs shall be supported with Type 304 stainless steel. Design-Build Contractor shall install supports to tank floor in compliance with Manufacturer's recommendations

E. Lateral piping shall include an expansion-contraction system consisting of guide supports which allow longitudinal movement for expansion and contraction. Supports shall:
   1. Provide proper bracing and means for accurate field alignment and adjustment of diffuser piping vertically and longitudinally. Each pipe section shall have at least two supports and support spacing shall not exceed 7.5'. Each support shall be epoxy anchored to the tank.
   2. Guide supports shall consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanisms shall provide a full circumferential 1.5" wide contoured bearing surface with chamfered leading edges to minimize binding of the air distribution header. Sliding mechanism shall provide minimum resistance to movement of the air distribution header under full buoyant uplift load. Mechanism shall provide 1/8" clearance around the lateral and be self-limiting if the mechanism is over tightened. Worm gear and radiator type clamps shall not be utilized for attaching header pipe to supports.
   3. Fixed Support straps shall have 1 1/2" wide top and bottom contoured bearing surface with punched burrs to positively grip the air distributor when tightened.
      a. Design strap to be self-limiting to prevent stressing the distributor if the clamp is over tightened.
   4. Allow for complete removal of supports from the basin to facilitate in-basin maintenance.

F. Manifold supports shall be Type 304 stainless steel. Design-Build Contractor shall install manifold supports to tank floor in compliance with Manufacturer's recommendations.
   1. Provide supports with a mechanism to provide for ± 2" vertical and 1/2" lateral adjustment for alignment of the manifold in the field.

2.9 AIR PURGE SYSTEM

A. Provide one drain line, sump, and air lift purge system for each grid as specified and install as recommended by the Manufacturer and approved by the Owner.
   1. Furnish one PVC in-line sump and purge system to drain the entire submerged aeration piping system for each aeration grid.
   2. The sump shall be integral with the manifold line and its bottom elevation shall be lower than the invert of the manifold air distribution headers.
   3. Connect sump to 3/4" diameter schedule 40 PVC airlift line extending from the sump invert elevation. Anchor the 3/4" schedule 40 PVC line on the wall and extend to a point above the tank water level and terminate with a horizontally mounted PVC ball valve at the top rail of the handrail. Provide handles for operation of ball drain valves from walkway. Air lift line shall utilize a 1" purge hose between the sump and the vertical pipe run at the aeration tank wall.
   4. Support air lift eductor with Type 304 stainless steel wall brackets, every five feet (maximum).

2.10 SPARE PARTS AND SPECIAL TOOLS

A. Spare Parts:

1. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration shall be properly protected by encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

B. Provide the following spare parts and special tools:

Qty	Item
50	Membrane diffuser elements and gaskets
10	Membrane diffuser holder retainer rings
10	Membrane diffuser holders
5	Manifold supports
10	Air distribution supports
3	Air distribution sections
10	Air distributor repair couplings
5	Fixed joint assemblies
1	Complete set of special tools necessary to perform maintenance
1	Complete drain line, sump, air purge systems as specified

C. Spare parts shall not be used during warranty period.

D. All spare parts shall be packed in suitable storage containers and legibly marked as to the contents.

2.11 FABRICATION

A. Shop Assembly: The system shall be factory assembled and tested.

PART 3 - EXECUTION

3.1 GENERAL

A. Coordination shall include space and structural requirements, clearances, utility connections, signals, outputs and features required by the manufacturer including safety interlocks.

3.2 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. Each drive unit, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.

B. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.3 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. All diffusers shall be packed in suitable strong cartons or boxes. Diffusers of the same permeability rating shall be stamped on each carton in legible numerals.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay between time of shipment and installation, including any prolonged period at the site.

C. No shipment shall be made until the Design-Build Contractor has an approved shop drawing submittal.

3.4 INSTALLATION

A. All equipment shall be installed in accordance with the Manufacturer's instructions.

B. Clean air mains, blowers, filters and drop legs prior to installing diffuser elements.

C. Protect diffuser elements from freezing at all times.

D. Protect diffuser elements from un-pressurized submergence in wastewater.

3.5 FIELD QUALITY CONTROL

A. Functional Test: After the installation of all aeration system equipment, the equipment shall be subject to field acceptance tests as specified herein.

B. Mounting Tests: Support and tie-down provisions of the piping shall be tested to ensure that they have a factor of safety of 10 against calculated buoyant forces.
   1. Upon installation of the supports and prior to installation of piping, all of the supports of each type shall be tested. Testing shall include no less than 10% of the supports of each type, chosen at random to be witness tested by the Owner. Each support chosen for test shall be attached to a lever which shall be placed on a fulcrum. A static load shall be applied to the opposite end producing a vertical extracting force on the support tie-down equal to 10 times the calculated maximum buoyant force to which the support tie-downs will be subjected in normal operation as detailed above. The application of the test load shall be such that the entire pipe support, including pipe hold down strap, is tested. Upon a test failure, the entire system will require testing under the above specified conditions. Repair and replace all equipment not meeting the test requirements.

C. Inspection of Piping: The piping shall be inspected for proper joints, supports and tie-downs, end plugs and drain relief valves.

D. Level Test: Each tank shall be filled with clear water to the top of the diffusers. The level of the diffusers shall then be checked to see that they are at an elevation differential that the Manufacturer has recommended. Should it be necessary to correct the elevation of any diffuser assembly as a result of this check, such action shall be taken prior to proceeding further.

E. Uniformity and Leakage Test: Each tank shall be filled with water to a depth of 1' above the diffusers. The air supply will be turned on to minimum and maximum air flow rates as specified herein and air supplied evenly to all headers. The surface of the water will then be visually inspected to see that air flow is uniformly distributed across the tanks and that no air leaks are present within the piping system. All piping joints will be soap bubble tested to ensure no air leaks are present. If, in the opinion of the Owner, there are areas of consistently low or high air quantity

release, or leaks within the piping system, make all necessary adjustments to correct these deficiencies.

1. During the uniformity and leakage test the aeration system pressure shall be monitored and recorded.

F. Operations Test: Perform an operations test by filling the basin with clean water to the design depth and operating the aeration system at design conditions for 5 consecutive days. After the operations test is complete, drain the tank and inspect the aeration system for any damage. Repair any damage to the satisfaction of the Owner and the Manufacturer's Representative.

G. Cost of Testing: All of the above field tests, including the filling, dewatering, and cleaning of the aeration tanks, shall be conducted at the expense of the Design-Build Contractor. The costs of all re-testing, if required, shall also be borne by the Design-Build Contractor.

3.6 MANUFACTURER'S SERVICES

A. A Manufacturer's representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services here under, travel time excluded:

1. (2) person-days for installation assistance, inspection, and certification of the installation. Provide Certificate.
2. (2) person-days during operational field testing.
3. (1) person-days for pre-startup classroom or jobsite training of Owner's personnel.

B. Training of Owner's personnel shall be at such times and at such locations as required and approved by the Owner.

3.7 MANUFACTURER'S CERTIFICATES

A. Provide Manufacturer's certificate(s) in a format acceptable by the Owner.

END OF SECTION

SECTION 44 42 13.13 – COARSE BUBBLE CHANNEL AERATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the Work necessary to furnish all labor, materials, equipment and incidentals required. Install air headers and diffusers for the influent and effluent aeration basin channels, complete and ready for operation and field test, as specified herein.

1.2 GENERAL

A. Like items of equipment provided hereinafter shall be the end products of one Manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and Manufacturer's services.

B. Unit Responsibility: The Work requires the Coarse Bubble Removable Channel Aeration System complete with all accessories and appurtenances (including, but not necessarily limited to, drop legs, distribution headers, stainless steel supports, anchor bolts, flange connection gaskets, nuts, and bolts, hoist for header removal, lateral assemblies, air riser, control valves, couplings, and diffusers) be the end product of one responsible Manufacturer. The Manufacturer shall assume all responsibility for mating the Coarse Bubble Removable Channel Aeration System and the aeration distribution system piping and concrete influent channel basin to obtain the performance specified. The Manufacturer shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Design-Build Contractor's responsibilities.

1.3 SUBMITTALS

A. General: Administrative, shop drawings, samples, quality control, and contract closeout submittals shall conform to the requirements as specified by the Owner.

B. Submit the following additional specific information:
   1. Shop Drawings:
      a. Make, model, and weight of each equipment assembly.
      b. Manufacturer's catalog information, descriptive literature, specifications, and identification of materials of construction.
      c. Performance data showing compliance with specification requirements. Include:
         1). Complete head loss calculations for the aeration equipment starting from the Manufacturer's limit of responsibility (top of the drop leg through coarse bubble diffuser system and water in influent channel).
      d. Drawings and calculations shall show how the system will expand/contract under the range of conditions specified and demonstrate that drop legs, distribution headers, lateral pipes, pipe fittings, expansion joints, piping supports, diffusers, diffuser connectors, air header leveling tee, flanges, etc., for the entire system supplied comply with requirements specified.
      e. Detailed mechanical and structural drawings showing the equipment fabrications, all plans, elevations, and cross section details of construction, dimensions and support locations and interface with other items. Include:
         1). Dimensions, size, and locations of connections to other work, and weights of equipment associated therewith.
      f. Certify that the diffuser Manufacturer has coordinated with Manufacturer of the blower and air filtration system for compatibility with diffuser system.

2. Quality Control Submittals:
    a. Certified copies of the results of all Factory Functional and Field Performance Test reports.
        1). Certified Performance Curve.
    b. Special shipping, storage and protection, and handling instructions.
    c. Manufacturer's printed installation instructions. Include:
        1). Description of the Design-Build Contractor's proposed method for ensuring a level installation of all equipment.
    d. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
3. Contract Closeout Submittals:
    a. Service records for maintenance performed during construction.
    b. Warranty.

1.4 OPERATION AND MAINTENANCE DATA

A. O&M Manuals: Manuals shall be provided by the Design-Build Contractor for review and approval by Owner.

B. Maintenance Summary Forms: Forms shall be submitted for review and approval by Owner in a format approved by the Owner.

1.5 WARRANTY

A. Provide warranty for a period of 18 months after the final acceptance of the equipment by the Owner. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the Manufacturer will promptly repair or replace the defective equipment without additional cost to the Owner.

B. Spare parts identified within this specification shall not be used to address warranty repairs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The coarse bubble channel aeration system equipment shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

B. Materials, equipment, components and accessories specified in this section shall be products of manufacturers with similar equipment successfully installed and operating in the United States for 10 years or longer.

C. Manufacturer of components and accessories specified herein shall be as follows:
1. Sanitaire Water Pollution Control Corporation
2. SSI Aeration
3. Environmental Dynamics, Inc. (EDI)

2.2 GENERAL REQUIREMENTS

A. All equipment shall be supplied complete. Parts shall be proportioned to have strength, stability and stiffness and shall be especially adapted for the intended service. Ample room and facilities shall be provided for inspection, repairs, and adjustments.

B. All welded parts and assemblies including drop legs, headers, diffusers, connectors, fabricated supports, flanged joints and expansion joints shall be fabricated from sheets and plates of Type 316L stainless steel with a 2D finish. Other non-welded parts and pieces such as bolts, nuts, washers and follower flanges shall be made from Type 316 stainless steel.

C. All gaskets shall be 45 to 55, Durometer (Shore A) neoprene.

D. The drop legs and air distribution headers shall be of adequate size and thickness to support the diffusers, allow removal of the entire assembly.

E. All welding on this equipment shall be completed in the factory. Field welding shall not be permitted. All welding shall be by the shielded arc, inert gas, MIG, or TIG method. Filler wire shall be added to all welds to provide for a cross section of weld metal equal to, or greater than, the parent metal. Butt welds shall have full penetration to the interior surface and gas shielding shall be provided to the interior and exterior of the joint.

F. All welds shall have a surface finish equal to the smoothness of a 2D sheet finish. Interior weld beads shall be smooth, evenly distributed, with an interior projection not exceeding 1/16" beyond the I.D. of the pipe or fittings.

G. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration left by welding shall be removed by pickling.

H. After fabrication, all stainless steel assemblies and parts shall be passivated by immersion in a pickling solution of 6% nitric acid and 3% hydrofluoric acid at 140 °F for a minimum of 15 minutes. Parts shall be free of iron particles or other foreign material. A complete neutralizing operation shall be required by immersion in a tri-sodium phosphate rinse.

I. The equipment shall be suitable for operation with compressed air at temperatures up to 220 °F.

J. All components shall be finish coated in the shop as specified and shall not require field painting.

K. All anchor bolts shall be epoxy type, insensitive to moisture, 316 stainless steel, and a minimum diameter of 3/8".

2.3 SERVICE CONDITIONS

A. The Coarse Bubble Channel Aeration System will be located in the influent and effluent channels of the activated sludge aeration basins..

B. The entire system, including the drop legs, manifold, laterals and diffusers, shall allow for expansion and contraction under the following conditions:

2.4 PERFORMANCE REQUIREMENTS

A. All of the equipment specified herein is intended to be a complete system to agitate flow of mixed liquor in the aeration basin influent channel to maintain a uniform mixture and keep solids in suspension. The channel aeration headers shall be positioned along the aeration basin influent and effluent channels. The header shall be located so that the centerline of the diffusers is 1-foot above the channel invert.

B. The channel aeration system shall be installed so that a diffuser grid is located in the influent and effluent channels between each individual aeration basin. This grid shall be isolated from the other grids to provide a higher flow rate during normal operation. Diffuser grids installed

beneath aeration basin influent weirs shall be installed so that the air flow rate can be adjusted as required to allow an equal flow split between weirs while keeping the activated mixed liquor in suspension.

C. The equipment shall provide a mixing air rate of 3-5 SCFM per foot-length in the influent channel.

D. Design diffusers, balancing nozzle and orifice insert to operate at the following maximum head loss. The maximum head loss is defined as the losses measured from the flange connection at the drop leg, through diffuser and water at the specified air rate.
   1. Maximum head loss 2.0 psi.
   2. Air rate per diffuser 15 SCFM (at 14.7 psia, 24°C/75.2 °F and 36% relative humidity).

2.5 SYSTEM DESCRIPTION

A. All of the equipment specified herein is intended to be complete aeration equipment capable of transferring air into the activated sludge mixed liquor and creating adequate mixing to keep the mixed liquor solids in suspension. The following components are part of this system and shall be installed in the influent channel as specified herein:
   1. Type 316 stainless steel drop legs with quick disconnect follower flange and lifting lugs.
   2. Type 316 stainless steel air distribution headers.
   3. Type 316 stainless steel supports.
   4. Air diffuser with proper connecting devices.
   5. Lateral assemblies.
   6. Air riser.
   7. Manual air flow control valves for each drop leg.
   8. Bolts, nuts and gaskets for flange joints.
   9. Anchor bolts.
   10. Accessory piping, taps, and valves as specified.
   11. Portable hoist for header removal.
   12. Other equipment as required for provision of a completely operational Removable Channel Aeration System.

B. The Channel Aeration System shall be constructed as to allow the diffusers to be removed from the channel without taking the channel out of service.

C. The channel aeration system shall be laid out on the bottom of the aeration basin influent channel as specified herein.

2.6 DROP LEGS

A. Provide a stainless steel drop leg.
   1. Provide an adaptor flange with thru bolts for connection to the air distribution piping.
   2. Provide a seat on the adaptor flange with an “O” ring to seal connection at the top of the drop leg.
   3. Provide loose follower flange, face ring, and bolts at top of drop leg for connection to the adaptor flange. Design bolts with retainer to hold connector bolts in place when drop leg is disconnected.
   4. Provide lift lugs at the top elbow and at suitable intervals on the drop leg for attachment of the hoist lifting cable.
   5. Provide a flange connection at the bottom of the drop for connection to the air header complete with beveled face for “O” ring seal, two (2) ¾” connector bolts and two tapped holes.

B. Stainless steel drop legs shall be supported with Type 316 stainless steel and shall be anchored with Type 316 stainless steel bolts and hardware. The Design-Build Contractor shall install distribution header supports to channel floor in compliance with equipment Manufacturer's recommendations.
1.

2.7 DUPLEX DIFFUSER CONNECTORS

A. Factory weld Duplex Diffuser Connectors to the invert centerline of the Air Header Assembly.

B. Design diffuser connectors for two diffusers.

C. Furnish stainless steel plugs for all unused diffuser connectors.

D. Provide connectors of length appropriate to the header diameter and positioned so that air exiting the diffusers clears the header.

E. Design header and diffuser connectors as follows:
1. Reinforce the connector header weld joint by providing gussets continuously welded between the vertical side wall of the header and the connector ends to limit long term flexure failure. Minimum gusset thickness is 0.125".
2. Weld connector to the header with a full penetration butt weld to minimize potential for crevice corrosion between header and connector. Use of fillet welds at the connection between the diffuser connector and header is not permitted.
3. Resist a vertical dead load applied to the threaded end of the connector that results in a bending moment of 1,000 inch-lbs without exceeding 24,000 PSI design stress in any part of the header wall or connect.
4. Header wall thickness for un-reinforced connectors must comply with previously specified requirements.

2.8 SUPPORTS AND ANCHOR BOLTS

A. Provide two (2) supports per header fabricated of 5/8" threaded rod and two (2) epoxy type anchors, insensitive to moisture, 316 stainless steel, and a minimum diameter of 3/8".

B. Provide two (2) locator fins on front and back side of the support and a support cradle fabricated of eleven (11) gauge materials.

C. Design supports for 3" of total vertical adjustment.

2.9 AIR DIFFUSERS

A. Provide diffusers fabricated of 316L stainless steel material.

B. Design diffuser for operating range of 8 – 40 scfm.

C. Design diffusers with cast schedule 80 – 3/4" NPT threaded nozzle and acetyl orifice insert, if required, an inverted air reservoir, air exit ports and a full-length deflector.
1. Design diffusers to provide full wide band aeration with a minimum air release perimeter of 48" per diffuser. Release air uniformly along a minimum two (2) foot band beyond each side of the header.
2. Locate exit ports discharging air into liquid on horizontal planes at two levels.

D. Diffuser Deflector
1. Provide deflector for each diffuser for its full length and width.

2. Design deflector to direct the liquid being aerated along the diffuser reservoir walls so that the air exits through the ports and is sheared into small bubbles and distributed into the liquid.

2.10 SPARE PARTS AND SPECIAL TOOLS

Provide the following spare parts and special tools:

Qty	Item
12	Diffusers
8	Sets of all gaskets, seals, packing, etc.

A. All spare parts shall be packed in suitable storage containers and legibly marked as to the contents.

PART 3 - EXECUTION

3.1 SHIPPING, STORAGE, HANDLING, AND PROTECTION

A. All diffusers shall be packed in suitable strong cartons or boxes. Separator sheets of corrugated cardboard or other suitable material shall be placed between the diffusers in packing. The range of the rating shall be stamped on each carton in legible numbers.

B. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay between time of shipment and installation, including any prolonged period at the site.

C. No shipment shall be made until the Design-Build Contractor has an approved shop drawing submittal.

3.2 INSTALLATION

A. All equipment shall be installed in accordance with the Manufacturer’s instructions.

B. Follow Manufacturer's recommendations for sequencing of equipment installation.

C. Level aeration system such that all diffusers connected to a header are within Manufacturer’s recommended common horizontal plane.

D. Ensure air mains, blowers, filters and drop legs are free of debris prior to installing diffuser elements.

3.3 FIELD TEST

A. Functional Test: After the installation of Channel Aeration System, the equipment shall be subject to field acceptance tests as specified herein.

B. Mounting Tests: Support and tie-down provisions of the piping shall be tested to ensure that they have a factor of safety of 10 against calculated buoyant forces.
1. Upon installation of the supports and prior to installation of piping, all of the supports of each type shall be tested. Testing shall include no less than 10% of the supports of each type, chosen at random to be witness tested by the Owner. Each support chosen for test shall be attached to a lever which shall be placed on a fulcrum. A static load shall be applied to the opposite end producing a vertical extracting force on the support tie-down equal to 10 times the calculated maximum buoyant force to which the support tie-downs

will be subjected in normal operation as detailed above. The application of the test load shall be such that the entire pipe support, including pipe hold down strap, is tested. Upon a test failure, the entire system will require testing under the above specified conditions. Repair and replace all equipment not meeting the test requirements.

C. Inspection of Piping: The piping shall be inspected for proper joints, supports and tie-downs, and end plugs.

D. Level Test: The influent channel shall be filled with clear water to the top of the diffusers. The level of the diffusers shall then be checked to see that they are at an elevation differential of which the Manufacturer has recommended. Should it be necessary to correct the elevation of any diffuser assembly as a result of this check, such action shall be taken prior to proceeding further.

E. Uniformity and Leakage Test: The influent channel shall be filled with water to a depth of 1' above the diffusers. The air supply will be turned on to minimum and maximum air flow rates as specified and air supplied evenly to all headers. The surface of the water will then be visually inspected to see that air flow is uniformly distributed across the tanks and that no air leaks are present within the piping system. All piping joints will be soap bubble tested to ensure no air leaks are present. If in the opinion of the Owner, there are areas of consistent low or high air quantity release, or leaks within the piping system, make all necessary adjustments to correct these deficiencies.
   1. During the uniformity and leakage test the system pressure shall be monitored and recorded.

F. Operations Test: Perform an operations test by filling the channel with clean water to the design depth and operating the system at design conditions for 5 consecutive days. After the operations test is complete, drain the tank and inspect the aeration system for any damage. Repair any damage to the satisfaction of the Owner and the Manufacturer's Representative.

G. Cost of Testing: All of the above field tests, including the filling, dewatering, and cleaning of the Aeration channel, shall be conducted at the expense of the Design-Build Contractor. The costs of all re-testing, if required, shall be the responsibility of the Design-Build Contractor.

3.4 MANUFACTURER'S SERVICES

A. A Manufacturer's Representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services here under, travel time excluded:
   1. (1) person-day for installation assistance, inspection, and certification of the installation. Provide Certificate.
   2. (1) person-day during operational field testing.
   3. (1/2) person-days for pre-startup classroom or jobsite training of Owner's personnel.

B. Training of Owner's personnel shall be at such times and at such locations as required and approved by the Owner.

3.5 MANUFACTURER'S CERTIFICATIONS

A. Provide Manufacturer's certificate(s) in a format acceptable by the Owner.

END OF SECTION

SECTION 44 42 23 – SPIRAL TYPE CLARIFIER MECHANISMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the Work necessary to furnish and install, complete, spiral type clarifier mechanisms, all related equipment, materials, and appurtenances.

1.2 GENERAL

A. Like items of equipment provided hereinafter shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts and manufacturer's services.

B. Unit Responsibility: The Work requires that the clarifier mechanisms, walkways, scum tubes/collectors, weirs and baffles, local control panels, instruments, and components, complete with all accessories and appurtenances be the end product of one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, the Design-Build Contractor shall obtain each system from the responsible supplier of the equipment, which supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features, and functions without altering or modifying the Design-Build Contractor's responsibilities. The Design-Build Contractor is responsible for providing the equipment systems as specified herein.

1.3 REFERENCES

A. The following is a list of standards which may be referenced in this Section:
   1. American Gear Manufacturers Association (AGMA): 908-B89, Geometry Factor for Determining the Pitting Resistance and Bending Strength of Spur, Helical, and Herringbone Gear Teeth.
   2. American Institute of Steel Construction (AISC): Specifications for the Design, Fabrication, and Execution of Structural Steel for Buildings.
   3. American National Standards Institute/American Bearing Manufacturers Association (ANSI/ABMA): 9 & 11, Load Ratings and Fatigue Life for Ball Bearings and Roller Bearings.
   4. American National Standards Institute/American Gear Manufacturers Association (ANSI/AGMA):
      a. 2000-A88, Gear Classification and Inspection Handbook Tolerances and Measuring Methods for Unassembled Spur and Helical Gears.
      b. 2001-C95, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
      c. 2002-B88, Tooth Thickness Specification and Measurement.
      d. 2003-B97, Rating the Pitting Resistance and Bending Strength of Generated Straight Bevel, Zerol Bevel, and Spiral Bevel Gear Teeth.
      e. 2004-B89, Gear Materials and Heat Treatment Manual.
      f. 2009-A98, Bevel Gear Classification, Tolerances and Measuring Methods.
      g. 6001-D97, Design and Selection of Components for Enclosed Gear Drives.
      h. 6010-F97, Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives.
      i. 6022-C93, Design Manual for Cylindrical Wormgearing.
      j. 6034-B92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
      k. 9005-D94, Industrial Gear Lubrication.
   5. American Society of Mechanical Engineers (ASME): B29.1M, Precision Power Transmission Roller Chains, Attachments, and Sprockets.
   6. American Welding Society (AWS):

a. B2.1, Standard for Welding Procedure and Performance Qualification.
b. D1.1, Structural Welding Code – Steel.
c. QC 1, Standard for AWS Certification of Welding Inspectors.

7. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48, Standard Specification for Gray Iron Castings.
   c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   d. A148/A148M, Standard Specification for Steel Castings, High Strength, for Structural Purposes.
   e. 6A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   f. A193/A193M, Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   g. A276, Standard Specification for Stainless Steel Bars and Shapes.
   h. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   i. A285/A285M, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.
   j. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
   k. A384, Standard Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies.
   l. A385, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   m. A536, Standard Specification for Ductile Iron Castings.
   n. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   o. D3034, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
8. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   a. NEMA MG-1.

1.4 DEFINITIONS

A. Alarm Torque: 90 percent of design running torque.

B. Cutout Torque: 120 percent of design running torque.

C. Design Running Torque:
   1. Torque used to select size, strength, and type of materials and components for mechanism and drive system.
   2. At which or below will provide continuous 24 hour per day mechanism operation for period of not less than 20 years at design torque condition and rotational speed without damage, permanent deformation or overload.
   3. Equal to 50 percent on overload device scale.

D. Slenderness Ratio: Ratio of unbraced length to least radius of gyration.

E. Submerged Metal: Metal below gear head drive and a plane 18 inches above weir elevation indicated.

F. Ultimate Torque: 200 percent of design running torque and below which no portion of mechanism will be damaged if operated for only a short period of time (a few seconds) and equal to 100 percent on overload device scale.

G. Certified Welding Inspector (CWI): As defined in AWS QC 1.

1.5 SUBMITTALS

A. Submittals shall be provided by the design-build contractor for review by the Owner.

B. General: Administrative, shop drawings, samples, quality control and contract close-out submittals shall conform to the requirements as specified by the Owner.

C. Submit the following additional specific information:
   1. Shop Drawings:
      a. Equipment Assembly: Make, model, weight, and horsepower of each.
      b. Manufacturer's Catalog: Product information, descriptive literature, dimensional layouts, specifications, standard and specialized equipment assembly cuts, and identification of materials of construction.
      c. Detailed Drawings:
         1). Structural, Mechanical, and Electrical: Show equipment fabrications and interface with other items including dimensions, size, and locations of connections to other work, and weights of associated equipment.
         2). Structural and Mechanical: Details of walkway bridge, rotating rake arm trusswork.
      d. Design Details:
         1). Running, Alarm, Cutout, and Ultimate Torque ratings of drive unit assembly.
         2). Ultimate Torque load capabilities of drive unit assembly, torque cage, rotating rake arm trusswork.
      e. Hydraulic calculations and performance verification data.
      f. Certification of Structural Calculations: Letter of certification for structural design of mechanism, shall be signed and sealed by registered professional engineer (Designer). Copies of detailed structural design calculations shall not be submitted for review. If submitted, calculations will be returned without review.
      g. Structural Loads: Static, dynamic, and torque reaction loads to be transferred into structure at center column and access bridge support locations.
      h. Details of torque sensing and load indication device.
      i. Identification of outside utility requirements for each component such as air, water, and power.
      j. Power and control wiring diagrams, including terminals and numbers.
      k. Functional description of internal and external instrumentation and controls to be supplied including list of parameters monitored, controlled, or alarmed.
      l. Painting/Coating System(s): Include manufacturer's descriptive technical catalogue literature and specifications.
      m. Diameter of ball race.
      n. Motor nameplate data per NEMA MG-1, motor manufacturer and any appurtenances.
      o. Functional and Performance test description and results.
   2. Quality Control Submittals:
      a. Designer qualifications:
         1). Designer: Professional engineer registered in the State of Texas.
         2). Must show 10 years experience with clarifier mechanism design.
      b. Manufacturer's Certificate of Compliance.
      c. Special shipping, storage and protection, and handling instructions.
      d. Test procedures.
      e. Test results, reports, and certifications.
      f. Operation and Maintenance Data.
      g. Manufacturer's Certificate of Proper Installation.

3. Contract Closeout Submittals: Service records for maintenance performed during construction.

1.6 OPERATION AND MAINTENANCE DATA

A. O&M Manuals: Manuals shall be provided by the Design-Build Contractor for review and approval by Owner.

B. Maintenance Summary Forms: Forms shall be submitted for review and approval by Owner in a format approved by the Owner.

1.7 WARRANTY

A. Provide warranty for a period of 12 months after the final acceptance of the equipment by the Owner. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the Manufacturer shall promptly repair or replace the defective equipment without additional cost to the Owner.

B. Spare parts identified within this specification shall not be used to address warranty repairs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Where a manufacturer's standard equipment name and/or model number is listed, the equipment system shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

B. Materials, equipment, components and accessories specified in this section shall be products of manufacturers with similar size equipment successfully installed and operating in the United States for 10 years or longer.

C. Manufacturer's of components and accessories specified herein shall be as follows:
1. Walker Process Equipment
2. WesTech Engineering, Inc
3. OVIVO

2.2 GENERAL REQUIREMENTS

A. Furnish units meeting performance and design requirements as specified and as shown on the Drawings.

B. Performance Requirements:
1. Separate solids from the clear liquid.
2. Collect and convey thickened sludge to center sludge hopper.
3. Capable of normal operation with sludge stored in the unit.
4. Collect floating scum from the surface and discharge it to an outlet scum trough.

C. Design Requirements:
1. Design Running Torque: Drive unit shall be sized such that worm gear, spur gear, and pinion all meet Design Running Torque in accordance with AGMA 2001 and 6034. Design Running Torque shall be selected by Manufacturer for service conditions specified.
2. Rotational Speed: Constant speed between 0.05 rpm and 0.1 rpm.

3. Capable of withstanding, without failure or permanent deformation of any part, torque load of at least twice Design Running Torque and loads generated while sweeping in thickener floor bottom grout.
4. Gears, Bearings, Chains, and Sprockets: Above water surface of clarifier.
5. Drive Mechanism: Design to allow removal of internal gears, balls, and strip liners without walkway bridge removal.
6. Base design upon all-welded construction except at locations requiring periodic field adjustment and as specifically approved.
7. At Ultimate Torque load, stresses in members shall not exceed 90 percent of material yield strength.
8. Slenderness Ratio: Maximum of 120 for any compression member and maximum of 240 for any tension member.

2.3 SUPPLEMENTS

A. See supplemental data sheets to this Section for additional equipment system product, component, and accessory information and requirements.

2.4 CENTER DRIVE UNIT ASSEMBLY

A. Ultimate Torque Rating: Not less than 200 percent of Design Running Torque.

B. Motor, Primary and Final Speed Reducers: Separately and independently mounted at center gear head drive platform. Mounting configurations that piggyback or otherwise vertically stack these components are not acceptable.

C. Primary Speed Reducer:
1. Horizontally mounted cylindrical-worm or helical-worm gear motor type with gears supported by anti-friction bearings. Connected to secondary speed reducer via a chain or direct coupled drive system with drive sprocket directly mounted on its output shaft.
2. AGMA 6034-B92 and AGMA Service Classification II.
3. Service Factor: Minimum 1.4 based upon Design Running Torque.
4. Overhung Load Rating: Exceed chain pull by minimum 1.75, based on Ultimate Torque.
5. Oil Fill, Drain and Level Indicator Devices, and Lubricant: ANSI/AGMA 9005-D94.

D. Chain Drive:
1. Roller Chain: Standard, ANSI B29.1.
2. Connect drive sprocket on primary speed reducer to driven sprocket on secondary speed reducer input shaft.
3. Steel Sprockets: Minimum of 12 teeth.
4. Chain:
    a. Service Factor: Minimum 4.0.
    b. Power Transmission Rating: 1.75 based on pull and power required respectively at the Ultimate Torque Rating.

E. Low Speed Final Reduction Unit:
1. Enclosed turntable, balls in main bearing annular radial thrust raceway type, balls in compression and renewable strip liners, continuous multipoint contact contoured raceway type with hardened surfaces and balls (Precision bearings).
2. Ring Gear: Internal or external toothed, spur pinion gear driven, attached to secondary speed reducer output shaft.
3. Low Speed Gearset:
    a. Design and Rated: ANSI/AGMA 2001-D04.
    b. Service Factor: Minimum 1.5 based upon Design running Torque. Power Rating:
    c. Lower of pitting resistance and bending strength ratings for pinion and gears.

d. Based upon continuous 24 hours per day service at Design Running Torque for 180,000 hours minimum.

4. Spur Pinion Gear:
   a. Steel: Heat treated; integral with or keyed to its shaft.
   b. Wall Thickness (Above Keyway): Minimum depth of one tooth.
5. Ring Gear:
   a. Solid one-piece or split construction of ductile (nodular) iron (ASTM A536), cast steel (ASTM A148), or heat-treated alloy steel.
6. Split Gear Construction:
   a. Machined, minimum two alignment dowels, joined with Type 316 stainless steel bolts.
   b. Allowable Stresses (Calculated): Reduced to 85 percent joint efficiency for split gear construction.
   c. Bolt to center torque cage that support and rotate collection mechanism.
   d. Teeth: Full depth, ANSI/AGMA 2001-D04.
7. Main Bearing:
   a. Ball Raceway Diameter: Minimum 40 inches, low unit ball load and stability without guide shoes or steady bearings.
   b. Raceways and Balls: ABMA L-10 life of minimum 180,000 hours when operating continuously at Design Running Torque.
8. Load Carrying Balls:
   a. Steel: Chrome alloy, hardened to 60-65 Rockwell ”C.”
   b. Diameter: Minimum 1-1/2 inches. If all balls are load-carrying, 1-inch diameter balls will be acceptable.
   c. Crushing Strength: Minimum 120,000 pounds.
   d. Spacer Balls: 1/16-inch lesser diameter than, and of same material as, load carrying balls.
   e. Balls: Field replaceable without access walkway removal.
   f. Raceways: Four 1/4-inch thick by 1/2-inch wide, vacuum degassed high carbon steel renewable liner strips force fit into base and ring gear, and specially hardened to 38-46 Rockwell “C.”
9. Ring Gear, Pinion Gear, and Main Bearing Ball Races:
   a. Oil bathed, steel dust shield, and felt seal protected.
   b. Oil fill, drain and level indicator devices, and lubricant conforming to ANSI/AGMA 9005-D94.
   c. Casing with manual condensate drain.
   d. Oil filling and level pipe, drain plug, and sight gauge. Attach pipe to turntable bottom within base center for easy access.

F. Mechanism Overload Device:
1. Mechanical or Hydraulic: Actuate integral contacts to indicate impending overload and shutoff drive motor at predetermined load.
2. Impending Overload Contact (Alarm Torque): Actuate at 90 percent of Design Running Torque.
3. Motor Shutdown Contact (Cutout Torque): Actuate at 120 percent of Design Running Torque.
4. Provide shear pin limit switch to protect drive unit in case of control system failure. Pin shall break at 160 percent of Design Running Torque or as recommended by Manufacturer.
5. Contacts: Single-pole, double-throw rated 5 amps, 120V ac.
6. Enclosure: NEMA Type 4X cast aluminum.
7. Indicating Pointer: Indicate relative load on graduated scale up to Ultimate Torque.

2.5 STATIONARY CENTER INFLUENT COLUMN

2.6 A STATIONARY CYLINDRICAL STEEL INFLUENT COLUMN OF ¼” MINIMUM WALL THICKNESS SHALL BE PROVIDED. ONE END SHALL HAVE A SUPPORT FLANGE FOR

BOLTING TO THE TANK FLOOR OVER THE INFLUENT LINE, WITH A SIMILAR FLANGE AT THE TOP FOR SUPPORTING THE DRIVE UNIT AND WALKWAY. THE STRUCTURE AND ANCHOR BOLTS SHALL PROVIDE ADEQUATE SUPPORT FOR THE ENTIRE MECHANISM DEAD LOAD PLUS LIVE LOAD AND TORQUE WITH AN ADEQUATE FACTOR OF SAFETY TO ELIMINATE EXCESSIVE DEFLECTION OR VIBRATION. SUITABLE OPENINGS SHALL BE PROVIDED IN THE UPPER PORTION OF THE COLUMN TO ALLOW UNRESTRICTED PASSAGE OF THE FLOW INTO THE ENERGY DISSIPATING INLET.FEEDWELL AND ENERGY DISSIPATING INLET (EDI)

A. Dual Gate EDI (Option A):
   1. A dual gate rotating circular energy dissipating inlet with bottom shall be supported by the cage and be designed to diffuse the liquid into the feedwell in a bi-directional direction without excessive disturbance or formation of vertical velocity currents. The EDI shall be designed to positively prevent sludge from depositing within the EDI and shall include bottom drain holes.
   2. The diameter, depth, and detention time of the EDI shall be included in the submittal with the design calculations and shall show proper process application as evidenced by the required successful operating installations.
   3. The rotating EDI shall be designed with a full bottom extending to within 1" of the center column. It shall include an upper rim angle for stiffness. Multiple, discharge ports shall be provided to induce impinged flow. The vertical wall of the gates shall not restrict the flow. The gates shall have a fixed bottom to prevent vertical currents as the flow exits the EDI. Impinged flow EDI designs which are not field adjustable or rely on drop pipe designs are not equal and therefore not acceptable.
   4. The EDI shall be made of not less than 3/16" thick steel plate with necessary stiffening angles.

I. EDI (Option B):
   1. The clarifier shall be equipped with an EDI located inside the rotating flocculation feedwell. The EDI shall be designed to dissipate the energy of the incoming flow by way of multiple baffled inlet ports equally spaced around the EDI.
   2. The center dispersion well shall include a bottom plate to fit within one inch of the center column. The well shall be constructed of 3/16 inch plate. EDI outlet ports equally spaced around the periphery shall be provided for energy dissipation. The outlet ports shall impart a tangential flow into the outer flocculating feedwell and shall have bottom plates to prevent short circuiting.
   3. The bottom plate of the EDI shall be provided with properly sized drain holes.

J. Feedwell
   1. The flocculating feedwell shall be located outside of the EDI to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.
   2. The supports for the feedwell shall be located either above the liquid extending from the cage or bridge, or on the rake arms. Submerged supports from the rake arms shall be designed so as to minimize horizontal flow disruption.
   3. No feedwell support or feedwell spliced connection shall be contained within the annular space formed between the feedwell and EDI. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge.
   4. The diameter, depth, detention time, and exit velocities shall match the process application calculations.
   5. The feedwell shall be made of not less than 3/16 inch thick steel plate and a minimum 1/4 inch thick shapes.

2.7 ACCESS WALKWAY

A. Access Walkway Support System:
   1. All-welded rolled wide flange beam type bridge or truss construction supported rigidly at one end on clarifier wall with thermal expansion compensating anchorage.
      a. Final Clarifiers are supported by outer most launder wall. Field verify and coordinate.
   2. Diagonally cross brace and space beams as necessary to carry loads and produce required clear walkway width.

B. Bridge Design:
   1. Maximum Vertical Deflection: 1/360 of span under uniform 50-pound per square foot of walkway surface live load, plus dead load. Camber for 1/3 live load plus dead load.
   2. Maximum Horizontal Deflection: 1/360 of span under uniform horizontal loading of 50 pounds per linear foot.
   3. Walkway Surface Elements: Do not utilize to reduce calculated bridge deflections.
   4. Designed to support mechanism.

C. Walkway Surface: 1-1/2-inch minimum thickness aluminum grating and extend in width to at least guardrail/handrail supports.

D. Walkway Width: 36 inches minimum clear between guardrails/handrails.

E. Guardrails/Handrails:
   1. Extend all along both sides of bridge and all around center platform.
   2. Shall be constructed of Anodized Aluminum.
   3. Truss type bridge members shall not be used as guardrail/handrail. Attach top and intermediate rails specified to bridge elements using standard premanufactured wall bracket units.

F. Kickplates:
   1. Shall be constructed of Anodized Aluminum.
   2. Four-inch minimum high by 3/16-inch minimum thickness anodized aluminum, attached with Type 316 stainless steel fasteners.
   3. Located around center platform perimeter and full length of both sides of access walkway.

2.8 RAKE ARMS AND SLUDGE WITHDRAWAL

A. Quantity: Two full radius rake arms per mechanism (minimum).

B. Full radius, all-welded steel diagonally braced box truss design that supports and rotates spiral type sludge scraper blades. Supported from center shaft.

C. Sufficient strength and rigidity such that at Ultimate Torque load and while sweeping in floor grout no member will be stressed to level beyond maximums allowed by current AISC Specifications.

D. Steel: ASTM A36, angular and tubular elements. Designed to meet or exceed current AISC Specifications when continuous torque of the drive unit is applied.

E. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

F. Squeegees: Materials: 20-gauge Type 316 stainless steel.
   1. Bolts, Nuts, and Washers: Type 316 stainless steel.

2. Vertical Alignment: Between 1/2-inch minimum and 1-1/2-inch maximum clearance above grouted clarifier bottom. Designed for a 2-inch minimum adjustment in the vertical plane.
3. Attached to steel sludge scraper blades.

G. Rotating Sludge Collection Drum:
1. A rotating sludge collection drum shall be provided to collect settled solids raked to the center by the rotating spiral blades. The collected sludge shall be discharged from the tank by way of the RAS sludge pipe as shown on the contract drawings.
2. The sludge collection drum shall rotate with the center cage and shall be provided with sludge collection ports located directly in front of each rotating spiral rake blade. The ports shall be sized to collect thickened sludge from the bottom most dense sludge layer to maximize underflow solids concentration.
3. The rotating sludge drum shall be constructed of ¼ inch steel plate. A neoprene seal shall be provided to seal against the center column. A stainless steel seal shall be provided to seal against the tank floor.

2.9 WEIR PLATES

A. Weirs shall be constructed of fiberglass reinforced plastic (FRP).

2.10 DENSITY CURRENT BAFFLE

A. Provide density current baffles sized and located by Manufacturer. Manufacturer shall design and select equipment as necessary to meet performance requirements specified herein.

2.11 SCUM COLLECTION

A. The clarifier mechanism shall be provided with two skimming arms with ducking skimmer blades to move and remove any floating scum from the entire tank's water surface, twice per revolution, to a full-radius stainless steel scum collection trough.

B. The scum removal device shall consist of a full-radius scum collection trough, extending from the stilling well to a terminal scum box with flanged connection for scum discharge line tie-in.

2.12 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General:
1. Provide all necessary electrical components and wiring for a complete, functional system.
2. Motor starters for constant-speed, 460-volt motors shall be provided in a separate motor control center specified. Provide all necessary control functions to properly interface with this motor starter.

B. Wiring: The Drawings and Specifications indicate the anticipated wiring for the equipment provided under this section. If additional wiring is required, or if required wiring does not match what is indicated, the Design-Build Contractor shall make the necessary modifications to the electrical wiring and documentation as part of the lump sum price. Wiring shall meet the requirements of NFPA 70. Insulation shall be rated 600 volts, minimum. Low-voltage (24V) signals shall be run in twisted, shielded pair cable.

C. Electrical Raceways: Electrical wiring shall be installed in conduit. Raceways shall be installed in accordance with NFPA 70.

2.13 INSTRUMENTATION AND CONTROLS

A. General: The Drawings and these Specifications depict the minimum functional requirements of the control system to be provided. Provide all items not specifically called out which are required to implement the functions described herein. The supplier shall provide all instrumentation and controls necessary to provide a safe and operable system. The specific control system proposed shall be subject to the approval of the Owner.

B. Instrumentation: Provide and install an electromechanical torque sensing-device that is actuated by thrust from the worm gear. The device shall provide indication of torque sensed and shall provide two independently adjustable SPDT torque alarm contacts (HIGH and HIGH-HIGH). The device shall be mounted in a NEMA 4X enclosure with an integral conduit box and terminals. Contacts shall be rated for a minimum of 5A at 120V ac.

C. Control Panel: The control panel shall at a minimum be provided with the following functions.
   1. Hand switches and other controls:
      a. Clarifier ON/OFF
      b. Solenoid Valve ON/OFF/AUTO (Scum Beach spray)
      c. Reset
   2. Alarms:
      a. Clarifier FAILURE
      b. 90% HIGH TORQUE
      c. Solenoid Valve FAILURE
   3. Status:
      a. Clarifier ON/OFF
      b. Solenoid Valve ON/OFF (Scum Beach spray)
      c. 90% HIGH TORQUE
      d. 120% HIGH TORQUE
   4. External Interfaces: Provide the following interfaces between the control panel and items outside the system package.
      a. Dry Contacts:
         1). ON motor
         2). OVERLOAD motor
         3). 90% TORQUE
         4). 120% TORQUE
   5. Scum Beach Spray Control: In AUTO, the scum beach spray solenoid valve shall operate on a timer and shall initiate based on an operator selected frequency.

2.14 DISSIMILAR METALS

A. Isolate dissimilar metals or connectors to prevent direct contact and electrical conductivity.
   1. Use 1/8-inch thick continuous neoprene gasket to insulate aluminum gratings, checker plate and handrail post bases from access walkway support bridge and other components.
   2. Use insulating washers and Teflon sleeves at bolted connections.

2.15 ACCESSORIES

A. Lifting Lugs: Provide on equipment assemblies and components weighing over 100 pounds.

B. Anchor Bolts: Provide coated Type 316, stainless steel bolts, sized by equipment manufacturer and at least 1/2 inch in diameter.

C. Equipment Identification Plates: Provide 16-gauge, Type 316 stainless steel, identification plate securely mounted on each separate equipment component and panel in a readily visible location. Plate shall bear 1/4-inch high engraved block type black enamel filled equipment identification number and letters.

2.16 TOOLS AND SPARE PARTS

A. Tools: The work includes furnishing two complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts:
   1. All equipment shall be furnished with the specified manufacturers spare parts, as indicated in the individual equipment sections.
   2. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.
   3. At a minimum furnish, tag, and box for shipment and storage the following spare parts and special tools:

Item	Quantity
Gaskets, O-rings, keys, dowels, and Pins	One complete set per unit
Gear reducer bearings and seals	One complete set per unit
Shear pins of each different size	Six per unit
Drive chain and/or belts	One set each type and per unit size
Special tools required to maintain or dismantle drive unit except for low speed main bearing, but including that required for removal/insertion of main bearing race balls	One complete set
Lubricants	As required for 1 year of continuous operation.

2.17 FABRICATION

A. General: Fabricate bridge beam or stringer sections in continuous unbroken pieces.

B. Shop Assembly:
   1. Shop fabricate and assemble mechanism components in the largest sections practicable and permitted by transportation carrier regulations.
   2. Properly match-mark units for ease of field erection.
   3. Completely assemble center drive unit in manufacturer’s shop and test to assure proper operation, and calibration of torque controls.
   4. Completely shop assemble and test control panels.
   5. Divide large assemblies into flanged sections. Bolt together with Type 316 stainless steel fasteners and provide continuous field seal welds at all connections.

C. Shop/Factory Finishing:

1. Exposed metal surfaces of motors, gear reducers, and assemblies shall be factory prepared and primed and field finish coated with a system approved by the Owner.
2. Surfaces inaccessible subsequent to erection shall be prepared, primed, and finished in accordance with Owner's requirements.
3. Seal welding shall be provided for submerged welded joints. Skip welds are not acceptable.

PART 3 - EXECUTION

3.1 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. Each drive unit, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.

B. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Mechanisms, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.3 INSTALLATION

A. Installation shall be by the Design-Build Contractor with coordination from Manufacturer.

B. Anchor Bolts: Provide templates and specify bolts for furnishing by Design-Build Contractor.

C. Manufacturer shall coordinate with Design-Build Contractor during all phases of installation to ensure that manufacturer's representative is present during critical installation operations.

3.4 FIELD QUALITY CONTROL

A. Prior to placement of clarifiers into service, check weir plate settings by filling clarifiers with water to design elevation shown on the Drawings. Readjust as recommended by Owner.

B. Weirs: Level to within plus or minus 1/16 inch of design elevation.

C. Functional Tests: Conduct on each mechanism. Test for continuous 3-hour period without malfunction, as witnessed by and approved by Owner.

D. Performance Test:
1. Conduct on each completed assembly in accordance with accepted test procedures.

2. Perform under actual or approved simulated operating conditions.
3. Perform to confirm mechanical and structural compliance with specified torque requirements.
4. Load each mechanism to 120 percent of Design Running Torque to demonstrate mechanism's structural capability to withstand resulting loads.
    a. Apply loads to mechanism's rake arms through cables or other means anchored to basin floor or wall. Utilize hydraulic cylinder, springs, or other means that allows machine to rotate for peripheral distance of at least 3 feet under load.
    b. Accomplish testing with machine in operation.
    c. Conduct static torque test on mechanism. Anchor both collector arms, start collector drive, and load drive to 120 percent of Design Running Torque to demonstrate mechanism's structural capability to withstand resulting loads.
5. Demonstrate mechanism overload devices; verify actual torques at which Alarm and Cutout (shutdown) contacts are actuated.
    a. Correlate with scale indications.
    b. Prepare test report containing results.
6. Replace shear pins after torque testing is completed. Spare parts shall not be used.

3.5 MANUFACTURERS' SERVICES

A. A manufacturer's representative for the equipment specified herein shall be present at the job site for the minimum person-days listed for the services hereinunder for each unit provided, travel time excluded:
    1. Installation, Startup, and Testing Services:
        a. 1 person day for installation assistance, inspection, and Certificate of Proper Installation.
        b. 1 person-day for functional and performance testing.
        c. Provide Qualifications of Manufacturer's Representative.
    2. Training Services:
        a. 1 person-day of prestart classroom or jobsite training of Owner's personnel.
        b. Training of Owner's personnel shall be at such times and at such locations as required and approved by the Owner.

3.6 MANUFACTURER'S CERTIFICATES

A. Provide Manufacturer's certificate(s) of proper installation to Owner upon completion of field testing in Owner-approved format.

3.7 SUPPLEMENTS

A. Supplement listed below, following "END OF SECTION," is part of this Specification.
    1. Clarifier Mechanisms Data Sheet – Final Clarifier No. 1 & No. 2.

END OF SECTION

Section 44 42 23.1: SPIRAL TYPE CLARIFIER MECHANISMS

PROJECT:	EPW Hickerson WRF Rehabilitation Improvements
OWNER:	El Paso Water
EQUIPMENT NAME(S):	FINAL CLARIFIER NO. 1 AND FINAL CLARIFIER NO. 2

EQUIPMENT DESCRIPTION

Clarifier Diameter:	100’-0”
SWD:	14’-2”

MOTOR DATA

Type:	Squirrel-cage induction meeting requirements of NEMA MG1.

SECTION 44 42 56.43 – HORIZONTAL END SUCTION NON-CLOG CENTRIFUGAL PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the Work necessary to furnish and install the horizontal end suction non-clog centrifugal pumps and components, complete including all related equipment, materials, and appurtenances.

1.2 GENERAL

A. Like items of equipment provided hereinafter shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

B. Unit Responsibility: The Work requires that the pump, complete with all accessories and appurtenances (including, but not necessarily limited to, electric motors, pumps, and components), be the end product of one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, the Contractor shall obtain each system from the responsible supplier of the equipment, which supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Contractor's responsibilities under the Contract Documents. The Contractor is responsible to the Owner for providing the equipment systems as specified herein.

1.3 SUBMITTALS

A. Submittals shall be provided by the design-build contractor for review by the Owner.

B. General: Administrative, shop drawings, samples, quality control, and contract close-out submittals shall conform to the requirements as specified by the Owner.

C. Manufacturer's recommendations: Accompanying the Shop Drawings, submit two copies of the manufacturer's current recommended method of installation.

D. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of, and at no additional cost, to the Owner.

1.4 OPERATION AND MAINTENANCE DATA

A. O&M Manuals: Manuals shall be provided by the design-build contractor for review and approval by Owner.

B. Maintenance Summary Forms: Forms shall be submitted for review and approval by Owner in a format approved by the Owner.

1.5 WARRANTY

A. Provide warranty for a period of 12 months after the final acceptance of the equipment by the Owner. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the Manufacturer shall promptly repair or replace the defective equipment without additional cost to the Owner.

B. Spare parts identified within this specification shall not be used to address warranty repairs.

1.6 PERFORMANCE AFFIDAVIT

A. The Design-Build Contractor shall submit manufacturer's standard performance affidavit for equipment to be furnished in accordance with this section. In the performance affidavit, the manufacturer must certify to the Design-Build Contractor and the Owner that the equipment will meet in every way the performance requirements for the application specified. Shop drawings will not be reviewed prior to the receipt by the Owner of an acceptable performance affidavit. The performance affidavit must be signed by an officer of the company manufacturing the equipment and witnessed by a notary public. The performance affidavit must include a statement that the equipment will not clog or bind on solids typically found in the application set forth.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The manufacturer shall furnish horizontal end suction non clog centrifugal pumps and all appurtenances as specified. The pumps shall be specifically designed to pump solids at heavy consistencies. The pump must have demonstrated the ability to pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field applications

B. Materials, equipment, components and accessories specified in this Section shall be products of manufacturers with similar size equipment successfully installed and operating in the United States for 10 years or longer.

C. Materials, equipment, components, and accessories specified in this section shall be products of:

1. Pentair Fairbanks Nijhuis

2.2 PUMP SCHEDULE

A. Return Activated Sludge (RAS) Pumps: Three (3) horizontal end suction, non-clog centrifugal pumps, operated via variable frequency drives (VFDs)

B. Design Flow – 2,690 gpm at best efficiency point of system curve.

C. Solids Handling: Shall be capable of passing 4.5” solid.

2.3 PUMP CONSTRUCTION

A. General: Major components shall be of gray cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blowholes or other casting irregularities.

B. Type: Horizontal mount, non-clog single stage, flexible coupling, base mounted.

C. Casing: The pump casing shall be ASTM 48, Class 30, cast-iron capable of hydrostatic test @150% of maximum discharge pressure and have a register fit to ensure alignments. Tapping openings provided for priming, venting, draining and suction and discharge gauge connections. Back pullout and rotation in 45-degree increments to accommodate piping orientation.

D. Shaft: 400 Series Stainless steel with replaceable shaft sleeve.

E. Shaft Sleeves: Stainless Steel hardened to 300 – 350 BHN with Buna O Ring Sealing between the impeller and the hub. Threaded to tighten when rotating in normal service direction.

F. Impeller: Enclosed, Cast Iron A48-CL30 Construction, two ports, back vanes. Radial flow, , dynamically balanced at time of pump assembly. The impeller shall be keyed to the shaft and securely fastened with stainless steel fasteners. Impeller shall be "non-clog" type and capable of passing a 4.50-inch solid.

G. All impellers are to be statically balanced to ensure smooth operation, also hydraulically balanced except in some small sizes where end thrust is but a minor factor.

H. Wearing Rings - Renewable type Impeller and Casing wear rings; Impeller Wear ring shall be Stainless Steel with a hardness of 300 – 350 BHN. Casing wear ring shall be stainless steel with a hardness of 450 – 484 BHN. Running clearances between the impeller and casing shall be designed to minimize leakage between suction and discharge. The impeller shall not contact the suction or casing wear ring under any operating load condition.

I. Backhead: A separately cast close-grained cast iron backhead with large access openings and integral sealing box conforming to ASTM A48 Class 30 shall be provided. The sealing box shall be designed for use with conventional packing or mechanical seal without requiring re-machining. The sealing box shall be furnished with a ¼" injection and vent tap for a clear water or grease connection to a water seal ring to prevent air from entering the pump through the sealing box. A ¾" minimum sealing box drain tap shall be provided. Sealing box leakage will be collected by the packing box drain trough and piped directly to drain, eliminating drippage to the floor. A minimum of 5 rings of graphite-impregnated synthetic packing and split PTFE Coating water seal ring shall be furnished. Glands shall be two-piece split interlocking, made of cast iron, held in place by studs and nuts. Flush water shall be supplied at a rate of 1 GPM at shutoff pressure or 10 psig above operating pressure, whichever is greater.

J. Painting and Surface Preparation: All external pump components shall include 2 coats of Modified Alkyd Enamel Paint with Surface preparation per SSPC-SP10 Near White Blast Cleaning.

K. Safety guards: All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 US gage or heavier galvanized or aluminum-clad sheet steel or 1/2 inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized.

L. Anchor bolts: Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts shall be furnished for each bolt. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

M. Equipment bases: A cast iron or welded steel baseplate shall be provided for each pump, compressor, and other item of equipment which is to be installed on a concrete base. Each baseplate shall support the unit and its drive assembly; shall be of a neat design with pads for anchoring the units; shall have a raised lip all around; and shall have a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and grouted in place.

N. Special tools and accessories: Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

O. Shop painting: Design-Build Contractor shall develop specification that lists fabrication requirements, including indicated shop assembly, and shop prime/finish coatings.

P. Lubrication: Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during start-up or shutdown and shall not waste lubricants.Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by the Owner.

Q. Balance: All rotating parts shall be accurately machined and shall be in as rotational balance as is possible. Excessive vibration shall be cause for rejection of equipment. Resonance shall be avoided at operating speeds. Vibration displacement (peak to peak) as measured at any point on the machine shall not exceed requirements of the Hydraulic Institute at any operating speed. At any operating speed, the ratio of rotative speed to the critical speed of a unit or components shall be less than 0.8 or more than 1.3. Design-Build Contractor shall provide the services of an independent testing company to check the balance of the installed pump at operating conditions and submit a report to the Owner at no additional cost to the Owner. Tests shall include displacement, velocity, and critical speed of vibrations with certified test results. Testing services shall be Cullum-Brown Company, ABC (American Bearing Co.), Douglas Pump Co, or approved equal.

2.4 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system.

B. Motor Requirements: Drive motor shall be designed with a 1.15 service factor. Shall be foot mounted, TEFC enclosure, Premium Efficiency, 3 phase, 60 cycle, 460 volt. The motor shall be sized for non-overloading conditions along the entire pump curve.

C. Motors: Provide squirrel-cage induction motors meeting requirements of NEMA MG1.

D. Controls shall interface with pump motor and relays shall be housed in control panels provided by others.

2.5 ACCESSORIES

A. Anchor bolts shall be Type 316 stainless steel. Number and size as recommended by manufacturer.

B. Provide lifting lugs on equipment on equipment over 100 pounds.

C. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.6 TOOLS AND SPARE PARTS

A. Tools: The work includes furnishing two complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts: All equipment shall be furnished with the specified manufacturers spare parts, as indicated in the individual equipment sections. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.

Provide, at a minimum, the following spare parts for each pump:

ITEM	QUANTITY
Seal	1
Lubricant	As required for 1 year operation.

In addition to the above, provide the following spare parts:

ITEM	QUANTITY
Impeller	1
Special Tools	2 sets

PART 3 - EXECUTION

3.1 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. Each pump package, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall' be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.

B. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected

from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.3 INSTALLATION

A. Install in strict accordance with manufacturer's directions and recommendations.

B. Lubricants: The installation includes oil and grease for initial operation by Contractor.

3.4 FIELD QUALITY CONTROL

A. Functional Tests: Prior to acceptance of each pump installation, each unit shall be run and inspected to demonstrate its proper installation, absence of vibration, and quite operation. Additionally, each unit shall be run to demonstrate its ability to operate without overloading, jamming or excessive shaft runout. A unit failing to field test shall be readjusted and retested. If the unit fails to retest, the unit will be rejected, and the Contractor shall replace it. The Contractor shall provide replacement units that will perform as specified.

3.5 MANUFACTURERS' SERVICES

A. A manufacturer’s representative for the equipment specified herein shall be present at the job site for the minimum person-days listed for the services hereinunder, travel time excluded:

Installation, Startup, and Testing Services:

a. 1 person day for installation assistance, inspection, and Certificate of Proper Installation.
b. 1 person-day for functional and performance testing.
c. Provide Qualifications of Manufacturer's Representative.

Training Services:

d. 1 person-day of prestart classroom or jobsite training of Owner’s personnel.
e. Training of Owner’s personnel shall be at such times and at such locations as required and approved by the Owner.

B. Manufacturer’s Certificates

Provide Manufacturer’s certificate(s) of proper installation to Owner upon completion of field testing in Owner-approved format.

END OF SECTION

SECTION 44 42 56.70 VERTICAL DRY PIT CHOPPER PUMP

PART 1 - GENERAL

1.1 SUMMARY

A. The work in this section shall include furnishing and placing into operation vertical mounted sewage pump(s) complete with submersible motor, stand and cable as specified herein. The complete pump station shall be submersible up to 65 feet above the inlet pipe level.

1.2 GENERAL

A. Like items of equipment provided hereinafter shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

B. Unit Responsibility: The Work requires that the pump, complete with all accessories and appurtenances (including, but not necessarily limited to, electric motors, pumps, and components), be the end product of one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, the Design-Build Contractor shall obtain each system from the responsible supplier of the equipment, which supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Design-Build Contractor's responsibilities under the Contract Documents. The Design-Build Contractor is responsible to the Owner for providing the equipment systems as specified herein.

1.3 SUBMITTALS

A. Submittals shall be provided by the design-build Design-Build Contractor for review by the Owner.

B. General: Administrative, shop drawings, samples, quality control, and contract close-out submittals shall conform to the requirements as specified by the Owner.

C. Submit the following additional specific information:
   1. Shop Drawings:
      a. Drawings showing complete dimensional data.
      b. Detailed drawings showing pump out vanes, upper cutter, impeller and cutter bar, cutter nut, arrangement of mechanical seal and pump housing and lubrication system.
      c. Pump Curve showing specified performance point.
      d. Part list indicating materials of construction.
      e. Details and mechanical of construction for the pedestal base plate and discharge piping.
      f. Outline drawing of control relays.
      g. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and any motor modifications.
   2. Quality Control Submittals:
      a. Factory Functional Test Reports.
      b. Manufacturers Performance Affidavit.
      c. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
      d. Special shipping, storage and protection, handling instructions.
      e. Manufacturer's printed installation instructions.
      f. Manufacturer's Certificate of Proper Installation.

g. Suggested spare parts lists to maintain the equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance.
h. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
i. Field test logs.

D. Contract Closeout Submittals: Service records for maintenance performed during construction.

1.4 OPERATION AND MAINTENANCE DATA

A. O&M Manuals: Manuals shall be provided by the design-build Design-Build Contractor for review and approval by Owner.

B. Maintenance Summary Forms: Forms shall be submitted for review and approval by Owner in a format approved by the Owner.

1.5 WARRANTY

A. The pumps shall be provided with 60 months (5 years) warranty against defects in materials and or workmanship. The warranty shall cover the entire pump, not individual components. Upon warranty occurrence, the manufacturer's authorized service center shall remove the pump, repair, reinstall and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken.

B. Spare parts identified within this specification shall not be used to address warranty repairs.

1.6 PERFORMANCE AFFIDAVIT

A. The Design-Build Contractor shall submit manufacturer's standard performance affidavit for equipment to be furnished in accordance with this section. In the performance affidavit, the manufacturer must certify to the Design-Build Contractor and the Owner, that the Contract Documents have been examined, and that the equipment will meet in every way the performance requirements set forth in the Contract Documents for the application specified. Shop drawings will not be reviewed prior to the receipt by the Owner of an acceptable performance affidavit. The performance affidavit must be signed by an officer of the company manufacturing the equipment, and witnessed by a notary public. The performance affidavit must include a statement that the equipment will not clog or bind on solids typically found in the application set forth.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The station shall be equipped with vertical dry mounted close-coupled submersible wastewater pump(s) with integral motor cooling system.

B. Materials, equipment, components and accessories specified in this Section shall be products of manufacturers with similar size equipment successfully installed and operating in the United States for 10 years or longer.

C. Manufacturers of components and accessories specified herein shall be as follows:

1. Flygt
2. Vaughan

2.2 SERVICE CONDITIONS

A. Pump shall not be damaged by operating dry for short periods of time.

2.3 PUMP SCHEDULE

A. Secondary Scum Pump: Two (2) vertical dry pit submersible pumps.

2.4 PERFORMANCE REQUIREMENTS

A. Rated Capacity (US gpm): 250, at best efficiency point of system curve.

2.5 PUMP CONSTRUCTION

A. Casing Material: Cast Iron, ASTM A48 Class 35B

B. Cooling Jacket: Stainless Steel AISI 316

C. Impeller and Insert Ring: A 532 ALLOY III A (25% chrome)

D. Stator Housing: ASTM A-48, Class 35B

E. Pump Shafting: Shall be ASTM A479 S43100-T

F. Seal: Corrosion resistant Tungsten Carbide WCCR

G. Mounting Type: Vertical, submersible, dry pit

H. The impeller shall be a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes, and shall be wear resistant against sand and grit.

I. The motor of the pump shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be submersible according standard IEC 60034 and protection class IP 68. It shall continue to operate satisfactorily even when the station is subjected to a flooding and the motor is permanently submerged by a water column of 65 feet. Motors which only can be submerged for a limited time (IP 67) shall not be considered as equal.

J. The motor shall be capable of operating the pump at continuous duty (S1) in an ambient temperature up to 104°F. Operational restrictions or the demand of auxiliary cooling systems like fans or blowers are not acceptable. It shall be designed to run on an adjustable speed drive (ASD).

K. Stator shall be insulated with class H trickle impregnated insulation rated at 356°F.

L. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board.

M. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 284°F (140°C) and one leakage sensor floating type located in a leakage chamber below the main bearing. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.

N. The motor shall be capable of no less than 15 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out. The suction and discharge flange of the pump shall both be drilled according ANSI B16.1-89; tab.5.

O. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.

P. Due to the likely presence of sand and or grit the impeller and the insert ring shall be made of ASTM A-532 Alloy III A with 25% chrome and the leading edges shall be hardened to 60 HRC.

Q. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The pump shall be capable of operating continuously (S1) in an ambient temperature up to 122°F (50 °C) and transport liquids with a temperature up to 104°F (40°C). Operational restrictions at temperatures below 122°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

R. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable. The shaft shall be sealed by two mechanical seals, each having an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function.

S. Motor and Hydraulic shall be designed and supplied by the pump manufacturer.

T. The shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single row ball bearing to handle radial loads. The lower bearing shall be a double row angular contact ball bearing to handle the thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump performance field.

U. Each pump shall be provided with a positively driven, dual tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

V. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside.

The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.

W. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

X. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Y. The motor shall be equipped with 30 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

Z. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate.

a) Minimum 3-point hydraulic performance test according HI 11.6:2012 Grade 2B

b) No-Leak seal integrity test

c) Electrical integrity test

2.6 SUPPORT STAND FOR PUMP(S)

A. Each pump has to be supplied with a stand made of painted steel and a 90° suction elbow made of cast iron. The suction flange shall be drilled according ANSI B16.1-89; tab.5.

B. For each pump the supplier has to erect a steel reinforced concrete pedestal according to the pump manufacturers installation guidelines.

C. The inlet elbow shall have an inspection hatch of at least 5"

D. It shall be possible to rotate the pump housing in steps of 15° to adjust the discharge position infinitely relative to the inlet pipe.

2.7 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system.

B. Motors: Provide squirrel-cage induction motors meeting requirements of NEMA MG1.

C. Controls shall interface with pump motor and relays shall be housed in control panels.

2.8 ACCESSORIES

A. Anchor bolts shall be Type 316 stainless steel. Number and size as recommended by manufacturer.

B. Provide lifting lugs on equipment on equipment over 100 pounds.

C. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.9 TOOLS AND SPARE PARTS

A. Tools: The work includes furnishing two complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts:
1. All equipment shall be furnished with the specified manufacturers spare parts, as indicated in the individual equipment sections.
2. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.
Provide, at a minimum, the following spare parts for each pump:

ITEM	QUANTITY
Mechanical Seal	1
Lubricant	As required for 1-year operation.

In addition to the above, provide the following spare parts:

ITEM	QUANTITY
Impeller	1
Special Tools	2 sets

PART 3 - EXECUTION

3.1 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. Each drive unit, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall' be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.

B. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.3 INSTALLATION

A. Install in strict accordance with manufacturer's directions and recommendations.

B. Lubricants: The installation includes oil and grease for initial operation by Design-Build Contractor.

3.4 FIELD QUALITY CONTROL

A. Functional Tests: Prior to acceptance of each pump installation, each unit shall be run and inspected to demonstrate its proper installation, absence of vibration, and quite operation. Additionally, each unit shall be run to demonstrate its ability to operate without overloading, jamming or excessive shaft runout. A unit failing to field test shall be readjusted and retested. If the unit fails to retest, the unit will be rejected, and the Design-Build Contractor shall replace it. The Design-Build Contractor shall provide replacement units that will perform as specified.

3.5 MANUFACTURERS' SERVICES

A. A manufacturer’s representative for the equipment specified herein shall be present at the job site for the minimum person-days listed for the services hereinunder, travel time excluded:

1. Installation, Startup, and Testing Services:
    a. 1-person day for installation assistance, inspection, and Certificate of Proper Installation.
    b. 1 person-day for functional and performance testing.
    c. Provide Qualifications of Manufacturer's Representative.
2. Training Services:
    a. 1 person-day of prestart classroom or jobsite training of Owner’s personnel.
    b. Training of Owner’s personnel shall be at such times and at such locations as required and approved by the Owner.

B. Manufacturer’s Certificates

1. Provide Manufacturer’s certificate(s) of proper installation to Owner upon completion of field testing in Owner-approved format.

END OF SECTION

SECTION 44 42 56.73 HORIZONTAL DRY PIT CHOPPER PUMP

PART 1 - GENERAL

1.1 SUMMARY

A. The Work section shall include furnishing and placing into operation horizontal mounted sewage pump(s) complete with submersible motor, carriage, rails and cable as specified herein and as indicated on the drawings. The complete pump station shall be submersible up to 65 feet above the inlet pipe level.

1.2 GENERAL

A. Like items of equipment provided hereinafter shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer’s services.

B. Unit Responsibility: The Work requires that the pump, complete with all accessories and appurtenances (including, but not necessarily limited to, electric motors, pumps, and components), be the end product of one responsible system manufacturer or responsible system supplier. Unless otherwise indicated, the Design-Build Contractor shall obtain each system from the responsible supplier of the equipment, which supplier shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features and functions without altering or modifying the Design-Build Contractor's responsibilities under the Contract Documents. The Design-Build Contractor is responsible to the Owner for providing the equipment systems as specified herein.

1.3 SUBMITTALS

A. Submittals shall be provided by the design-build Design-Build Contractor for review by the Owner.

B. General: Administrative, shop drawings, samples, quality control, and contract close-out submittals shall conform to the requirements as specified by the Owner.

C. Submit the following additional specific information:
   1. Shop Drawings:
      a. Drawings showing complete dimensional data.
      b. Detailed drawings showing pump out vanes, upper cutter, impeller and cutter bar, cutter nut, arrangement of mechanical seal and pump housing and lubrication system.
      c. Pump Curve showing specified performance point.
      d. Part list indicating materials of construction.
      e. Details and mechanical of construction for the pedestal base plate and discharge piping.
      f. Outline drawing of control relays.
      g. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and any motor modifications.
   2. Quality Control Submittals:
      a. Factory Functional Test Reports.
      b. Manufacturers Performance Affidavit.
      c. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
      d. Special shipping, storage and protection, handling instructions.
      e. Manufacturer's printed installation instructions.

f. Manufacturer's Certificate of Proper Installation.
g. Suggested spare parts lists to maintain the equipment in service for a period of 1 year and 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance.
h. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
i. Field test logs.

D. Contract Closeout Submittals: Service records for maintenance performed during construction.

1.4 OPERATION AND MAINTENANCE DATA

A. O&M Manuals: Manuals shall be provided by the design-build Design-Build Contractor for review and approval by Owner.

B. Maintenance Summary Forms: Forms shall be submitted for review and approval by Owner in a format approved by the Owner.

1.5 WARRANTY

A. The pumps shall be provided with 60 months (5 years) warranty against defects in materials and or workmanship. The warranty shall cover the entire pump, not individual components. Upon warranty occurrence, the manufacturer's authorized service center shall remove the pump, repair, reinstall and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken

B. Spare parts identified within this specification shall not be used to address warranty repairs.

1.6 PERFORMANCE AFFIDAVIT

A. The Design-Build Contractor shall submit manufacturer's standard performance affidavit for equipment to be furnished in accordance with this section. In the performance affidavit, the manufacturer must certify to the Design-Build Contractor and the Owner, that the Contract Documents have been examined, and that the equipment will meet in every way the performance requirements set forth in the Contract Documents for the application specified. Shop drawings will not be reviewed prior to the receipt by the Owner of an acceptable performance affidavit. The performance affidavit must be signed by an officer of the company manufacturing the equipment, and witnessed by a notary public. The performance affidavit must include a statement that the equipment will not clog or bind on solids typically found in the application set forth.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The station shall be equipped with horizontal dry mounted close-coupled submersible wastewater pump(s) with integral motor cooling system.

B. Materials, equipment, components and accessories specified in this Section shall be products of manufacturers with similar size equipment successfully installed and operating in the United States for 10 years or longer.

C. Manufacturers of components and accessories specified herein shall be as follows:

1. Flygt
2. Vaughan

2.2 SERVICE CONDITIONS

A. Pump shall not be damaged by operating dry for short periods of time.

2.3 PUMP SCHEDULE

A. Waste Activated Sludge (WAS) Pumps: Two (2) horizontal dry pit chopper pumps, operated via variable frequency drives (VFDs).

2.4 PERFORMANCE REQUIREMENTS

A. Waste Activated Sludge (WAS) Pumps:

1. Rated Capacity (US gpm): 320, at best efficiency point of system curve.

2.5 PUMP CONSTRUCTION

A. Casing Material: Cast Iron, ASTM A48 Class 35B

B. Cooling Jacket: Stainless Steel AISI 316

C. Impeller and Insert Ring: A 532 ALLOY III A (25% chrome)

D. Stator Housing: ASTM A-48, Class 35B

E. Pump Shafting: Shall be ASTM A479 S43100-T

F. Seal: Corrosion resistant Tungsten Carbide WCCR

G. Mounting Type: Horizontal, submersible, dry pit

H. The impeller shall be a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes, and shall be wear resistant against sand and grit.

I. The motor of the pump shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be submersible according standard IEC 60034 and protection class IP 68. It shall continue to operate satisfactorily even when the station is subjected to a flooding and the motor is permanently submerged by a water column of 65 feet. Motors which only can be submerged for a limited time (IP 67) shall not be considered as equal.

J. The motor shall be capable of operating the pump at continuous duty (S1) in an ambient temperature up to 104°F. Operational restrictions or the demand of auxiliary cooling systems like fans or blowers are not acceptable. It shall be designed to run on an adjustable speed drive (ASD).

K. Stator shall be insulated with class H trickle impregnated insulation rated at 356°F.

L. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board.

M. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 284°F (140°C) and one leakage sensor floating type located in a leakage chamber below the

main bearing. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.

N. The motor shall be capable of no less than 15 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out. The suction and discharge flange of the pump shall both be drilled according ANSI B16.1-89; tab.5.

O. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.

P. Due to the likely presence of sand and or grit the impeller and the insert ring shall be made of ASTM A-532 Alloy III A with 25% chrome and the leading edges shall be hardened to 60 HRC.

Q. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The pump shall be capable of operating continuously (S1) in an ambient temperature up to 122°F (50 °C) and transport liquids with a temperature up to 104°F (40°C). Operational restrictions at temperatures below 122°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

R. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable. The shaft shall be sealed by two mechanical seals, each having an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function.

S. Motor and Hydraulic shall be designed and supplied by the pump manufacturer.

T. The shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single row ball bearing to handle radial loads. The lower bearing shall be a double row angular contact ball bearing to handle the thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump performance field.

U. Each pump shall be provided with a positively driven, dual tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

V. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.

W. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

X. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Y. The motor shall be equipped with 30 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

Z. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate.

a) Minimum 3-point hydraulic performance test according HI 11.6:2012 Grade 2B

b) No-Leak seal integrity test

c) Electrical integrity test

2.6 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General: Provide all necessary electrical components and wiring for a complete, functional system.

B. Motors: Provide squirrel-cage induction motors meeting requirements of NEMA MG1.

C. Controls shall interface with pump motor and relays shall be housed in control panels.

2.7 ACCESSORIES

A. Anchor bolts shall be Type 316 stainless steel. Number and size as recommended by manufacturer.

B. Provide lifting lugs on equipment on equipment over 100 pounds.

C. Nameplates: Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in accessible locations with stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.8 TOOLS AND SPARE PARTS

A. Tools: The work includes furnishing two complete set of special tools recommended by the manufacturer for maintenance and repair of each separate type of equipment; tools shall be

stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts:

1. All equipment shall be furnished with the specified manufacturers spare parts, as indicated in the individual equipment sections.
2. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.
   Provide, at a minimum, the following spare parts for each pump:

ITEM	QUANTITY
Mechanical Seal	1
Lubricant	As required for 1-year operation.

In addition to the above, provide the following spare parts:

ITEM	QUANTITY
Impeller	1
Special Tools	2 sets

PART 3 - EXECUTION

3.1 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. Each drive unit, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall' be separately crated, clearly marked as to the contents, and shipped on the same shipment as the drives.

B. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weathertight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.3 INSTALLATION

A. Install in strict accordance with manufacturer's directions and recommendations.

B. Lubricants: The installation includes oil and grease for initial operation by Design-Build Contractor.

3.4 FIELD QUALITY CONTROL

A. Functional Tests: Prior to acceptance of each pump installation, each unit shall be run and inspected to demonstrate its proper installation, absence of vibration, and quite operation. Additionally, each unit shall be run to demonstrate its ability to operate without overloading, jamming or excessive shaft runout. A unit failing to field test shall be readjusted and retested. If the unit fails to retest, the unit will be rejected, and the Design-Build Contractor shall replace it. The Design-Build Contractor shall provide replacement units that will perform as specified.

3.5 MANUFACTURERS' SERVICES

A. A manufacturer’s representative for the equipment specified herein shall be present at the job site for the minimum person-days listed for the services hereinunder, travel time excluded:

1. Installation, Startup, and Testing Services:
   a. 1-person day for installation assistance, inspection, and Certificate of Proper Installation.
   b. 1 person-day for functional and performance testing.
   c. Provide Qualifications of Manufacturer's Representative.
2. Training Services:
   a. 1 person-day of prestart classroom or jobsite training of Owner’s personnel.
   b. Training of Owner’s personnel shall be at such times and at such locations as required and approved by the Owner.

B. Manufacturer’s Certificates

1. Provide Manufacturer’s certificate(s) of proper installation to Owner upon completion of field testing in Owner-approved format.

END OF SECTION

APPENDIX C

SCOPE OF WORK FOR PRE-CONSTRUCTION PHASE SERVICES

Following the selection of the design-build contractor and successful negotiation of lump sum fee, the *Pre-Construction Phase Services* shall commence after the notice to proceed issued by El Paso Water (EPWater). The services to be provided under this phase shall include:

1) Inspection/Testing Services,
2) Evaluation Report,
3) Design and Modeling Services, and
4) Guaranteed Maximum Price (GMP).

Design-build contractor is not entitled to reimbursement for any costs incurred for Pre-Construction Phase Services performed before issuance of the Notice to Proceed. All deliverables produced by the design-build contractor shall become property of the EPWater.

The design-build contractor shall perform the following Pre-Construction Phase Services.

1.0 **INPECTION/TESTING SERVICES AND EVALUATION REPORT**

1.1 MEETINGS. Design-build contractor is to attend a total of five (5) meetings as follows:

1) Kick-off meeting and pre-testing coordination,
2) Report review meeting at 50% complete, and
3) Final report review meeting at 100% complete,
4) Design update (at mid-term of design) and GMP meeting (at 50% complete), and
5) Design review meeting and final GMP.

Design-build contractor shall prepare meeting agendas and provide meeting minutes for each meeting. The meetings are to be held at EPWater's headquarters, 1154 Hawkins Boulevard.

1.2 FIELD TESTING. The design-build contractor is to complete the inspection and testing to confirm the actual state of the treatment train components listed below. The purpose of this task is to determine whether components need to be replaced, refurbished, or replaced such that they can provide 20-years of useful life. Design-build contractors shall refer to the Scope of Work for the Construction Phase Services. The findings from this testing is to be included in the evaluation report.

1) Odor Control Evaluation. Design-build contractor shall evaluate and inspect the existing odor control system at the "New Plant" to ensure an equivalent system would be adequate for the "Old Plant".
2) Splitter Box:
    a. gates,
    b. piping,
    c. concrete
3) Aeration Basins (three):
    a. concrete (including influent channels),
    b. safety handrails and kickplates,
    c. piping,

    d. valves,
    e. gates,
4) Clarifiers (two):
    a. concrete,
    b. grouting,
    c. weirs
    d. center walkway, handrails, kickplates, and bridge
    e. scum removal,
    f. piping,
5) WAS/RAS Pump Rooms:
    a. electrical,
    b. controls,
    c. lighting,
    d. piping,
    e. valves,
    f. Interior and exterior painting,
    g. HVAC
6) Blower Room (entire building):
    a. Interior and exterior lighting,
    b. Panelboards
    c. Transformers
    d. roof,
    e. Interior and exterior painting,
    f. hoist,
    g. HVAC,
    h. equipment pads,
    i. piping
    j. valves
    k. Sound attenuation to provide 80 dB or less 6-feet from the blowers
    l. Sound attenuation to comply with current OSHA standards
7) Piping
    a. Buried plant water system for "Old Plant"
    b. Buried potable water system for "Old Plant"
    c. Buried plant drain system for "Old Plant"
    d. Buried plant sewer system for "Old Plant'
    e. Buried process piping for "Old Plant"
    f. Buried valves for "Old Plant'
    g. Large diameter piping utilized to move wastewater between treatment processes

Upon completion of the inspection/testing, the design-build contractor shall complete an evaluation report listed under 1.3 summarizing its findings and recommendations for additional testing including destructive testing.

1.3 EVALUATION REPORT. The design-build contractor is to complete the evaluation report summarizing, at a minimum, the following:

- Findings of field inspection and testing
- Evaluation of Owner's technical memorandum/design criteria
- Value Engineering
- Detailed scope of work
- Cost Estimate

- Project Schedule

2.0 **DESIGN AND MODELING SERVICES**
The design-build contractor is to deliver the following:

2.1 DESIGN
1) 60% drawings. Design-build contractor shall ensure that the design drawings are aligned with 1) the Owner's preferred manufacturers and 2) Owner's performance-based specification. The drawings must be provided electronically (AutoCAD and PDF) and seven (7) hard copies (11" by 17").
2) 100% technical specifications. Design-build contractor shall ensure that these technical specifications are aligned with 1) the Owner's preferred manufacturers and 2) Owner's performance-based specification. Seven (7) hard copies and electronic (PDF) files must be provided.

3) Material inventory. Design-build team must develop and provide a list with all the equipment and materials that is to be installed in the project. At a minimum, it must include size, quantity, location to be installed, manufacturer, and description.

4) Specifications. At a minimum, the design-build contractor shall include the following specifications:

Section	Description
02 41 00	Demolition
03 11 00	Formwork
03 21 00	Reinforcing Steel
03 30 00	Cast-In-Place Concrete
03 39 00	Concrete Curing
03 62 00	Non-shrink Grouting
10 26 16	Protective Corridor Handrail
26 05 02	Basic Electrical Requirements
26 05 04	Basic Electrical Methods
26 29 23	Low-Voltage Adjustable Frequency Drive
31 23 16	Excavation
31 23 23	Trench Backfill
33 05 01	Cement-Lined Ductile Iron Pipe and Fittings
33 05 31	Polyvinyl Chloride Pipe
41 22 00	Crane Systems

The design shall, at a minimum, include the following:

- All reviewed calculations completed to date
- Hydraulic calculations (including air calculations for aeration system), completed and reviewed
- Geotechnical Report
- Elevations verified throughout treatment train
- Complete list of construction contract drawings
- Complete guide specifications set including drafts of Engineer's development sections

Civil Drawings:
- Cover sheet and legends complete
- Grading Plans and demolition plans Plan and profile sheets
- Sections and details

- Typical details

Structural Drawings:
- Foundation plans
- Repair plans
- Other plans and sections and details

Mechanical Drawings:
- General arrangement drawings
- Sections and details
- Schedules
- All major equipment, pipe sizes, work clearances, equipment spacing, and access shown
- System flow diagrams complete

Electrical Drawings:
- Electrical Site plans
- Electrical One-Line diagrams
- Blower building power and lighting plans
- RAS/WAS area power and lighting plans
- Control schematics
- Panel, duct-bank, pull box, light fixtures and cable/conduit panel schedules
- Electrical equipment elevations
- Grounding plans
- Electrical details
- Load Analysis
- PLC control panel layouts
- I/Os card layouts

Instrumentation:
- Process/Instrumentation Diagrams complete and tag numbers shown
- Process control narrative and strategies essentially complete and tag numbers included
- Panel layout drawings and details
- Communication Network block diagrams

2.2 MODELING. Design-Build Contractor shall provide necessary modeling to confirm design.

3.0 **GUARANTEE MAXIMUM PRICE (GMP)**
The design-build contractor shall submit a guarantee maximum price (GMP).
The GMP proposal must include, at a minimum, the following:

1) Written description and documentation. It must explain how it was derived that specifically identifies the clarifications and assumptions made by the design-build contractor in the GMP and the monetary amounts attributable to them. It must have all supporting documents to identify and describe in detail all items, assumptions, costs, contingencies, schedules and other matters necessary and relevant for proper execution and completion of the Work and for establishment of the GMP.

2) Breakdown. It shall include, without limitation, a breakdown of design-build contractor's estimated General Conditions Costs and estimated Costs of the Work organized by trade, contingency amounts, construction phase fee;

3) Proposed Contract Time. It includes the dates for notice to proceed, Substantial Completion and Final Completion, and Commissioning.

El Paso Water may accept or reject the GMP proposal or attempt to negotiate its terms with design-build contractor. Upon acceptance by El Paso Water of the GMP proposal in writing, both parties shall execute the GMP Proposal and the terms of the GMP Proposal, including the GMP and the supporting documents, shall become part of the Contract between El Paso Water and the design-build contractor. If El Paso Water rejects the GMP proposal, loses funding, deems the project economically unfeasible under its sole discretion, or the parties are unable or unwilling to agree on a GMP, the Pre-Construction Phase Services will be concluded and all deliverables become property of EPWater.

The contract documents outline specific information related to the GMP.

4.0 **DELIVERABLES**

The next table summarizes the deliverables and due time, all times are in calendar days.

The evaluation report (50% complete) at the Mid-Term Deliverable shall include the following:

- Final Findings of field inspection and testing
- Initial Evaluation of Owner's technical memorandum/design criteria
- Value Engineering
- Initial scope of work
- Review of Cost Estimate
- Revised project schedule (initial project schedule to be submitted with the RFP)

The evaluation report at the Final-Term Deliverable shall include the following:

- Final Findings of field inspection and testing (completed at the Mid-Term Deliverable)
- Final Evaluation of Owner's technical memorandum/design criteria
- Value Engineering (completed at the Mid-Term Deliverable)
- Final detailed scope of work
- Final Cost Estimate
- Final project schedule

Mid-Term Deliverables		**Final-Term Deliverables**	
Deliverable	**Due**	**Deliverable**	**Due**
Inventory list (material/equipment)	50 days after NTP	Inventory list (material/equipment)	100 days after NTP
Field evaluation/inspection	20 days after NTP	Evaluation report (100% complete)	40 days after NTP
Evaluation report (50% complete)	25 days after NTP	100% specifications	100 days after NTP
GMP (50% complete)	60 days after NTP	60% design drawings	110 days after NTP
		GMP (100%)	120 days after NTP

APPENDIX D

SCOPE OF WORK FOR CONSTRUCTION PHASE SERVICES

Following the completion of the Pre-Construction Phase Services and successful negotiations of the guaranteed maximum price (GMP), El Paso Water (EPWater) and the design-build contractor shall commence the *Construction Phase Services* under a new contract. The ultimate goal of this project is to bring the Old Plant back into service. Thus, the design-build contractor shall provide all necessary services (labor, design, testing, modeling, installation, commissioning) to complete the design and construction as follows:

1.0 DESIGN AND MODELING SERVICES

1.1 MEETINGS. The design-build contractor shall prepare and conduct, at a minimum, the following meetings/workshops:

1) Design kick-off meeting;
2) Review meeting of 60% design (completed during Pre-Construction Phase Services);
3) Design progress review workshop;
4) 90% design review workshop and
5) 100% design review workshops

Design-build contractor shall prepare presentations, meeting agendas, and meeting minutes for all of the meetings/workshops. The meetings/workshops are to be held at EPWater's headquarters, 1154 Hawkins Boulevard.

1.2 DESIGN. The design at 60% complete is to be delivered during the Pre-Construction Phase Services. Thus, the services to be provided under the Construction Phase Services shall be to finish the design at 100% complete and provide construction documents. The construction documents shall include drawing sheets and specifications (signed and sealed).

All design shall be in accordance with El Paso Water Public Service Board Design Manual for Water, Wastewater, and Reclaimed Water Systems Design Standards, latest edition. At a minimum, the following disciplines are expected to be included in the design package:

- Civil
- Mechanical
- Structural
- Electrical
- Instrument and Controls

It shall be noted that EPWater has selected specific material and equipment for this project. Refer to the Allowable Manufacturers List and Owner's Performance-Based Specifications. Design-build contractors shall ensure its design and construction are concurrence with these selections.

1.3 DESIGN DELIVERABLES

- 90% Complete Design Documents.
    - Submit drawings and specifications files electronically (PDF)

- Submit seven (7) hard copies. Drawings shall be printed on 11"x17" paper. Specifications shall be printed on 8 ½" x 11" paper.

- 100% Complete Design Documents – final set signed and sealed.
  - Submit drawings and specifications files electronically (AutoCAD and PDF)
  - Submit seven (7) hard copies. Drawings shall be printed on 11"x17" paper. Specifications shall be printed on 8 ½" x 11" paper.
  - Submit one (1) set of contractor's redlines with each pay application during construction
  - Submit one (1) set of record drawings (mylars) at the end of the project.

1.4 MODELING

The design-build contractor shall provide all necessary modeling to confirm its design.

2.0 CONSTRUCTION SERVICES

The design-build contractor shall furnish all labor, services, tools, equipment, material, parts, testing, geotechnical laboratory, surveying, installation, incidentals, complete in place, necessary to perform and complete in a good and workmanlike manner all improvements necessary to bring the Old Plant back into service.

2.1 PLANT REHABILITATION IMPROVEMENTS. The following table contains the improvements to be completed by the design-build contractor. The construction and equipment shall be in accordance with the List Allowable Manufacturers and Owner's Performance-Based Technical Specifications.

FACILITY	IMPROVEMENT	NOTES
Splitter Structure	Furnish and replace concrete, slide gates, RAS lines, and flow control valve/meter structure to ensure proper flow splitting between treatment trains. It may include a temporary bypass box during improvements	
Aeration Basins and Channel	Furnish and replace existing ceramic diffusers with membrane diffusers	
	Furnish and install odor control system to include aeration basin covers and aeration influent channel covers and foul air treatment	
	Furnish and replace entire air piping	
	Furnish and replace existing butterfly gates with slide gates. All slide gates to be fabricated stainless steel.	
	Furnish and replace aluminum handrails and kick plates all around basins	
	Furnish and rework inlet piping to avoid surging	
	Furnish and replace discharge piping	
	Replace existing butterfly gates with slide gates. All slide gates to be fabricated stainless steel.	
Blower Building	Install 3 blowers (pre-purchased by EPWater) including equipment pads, complete in place	
	Rework inlet piping to avoid surging	
	Furnish and install sound attenuation to reduce blower's noise such that it is no more than 80	

FACILITY	IMPROVEMENT	NOTES
	dBA at 6 feet from the blowers and no more than 90 dBA in break room and offices.	
	Furnish and replace discharge air piping	
	Furnish and replace HVAC system	
	Furnish and replace backup generator diesel including wiring and conduits. It is to be set outside the building, include equipment pad, complete in place.	
	Furnish and replace hoist crane system.	
	Furnish and replace concrete equipment pads	
	Furnish and replace roof with 1.5 inches thick of Thermo-Flex with Vinyl. Color to be selected by EPWater.	
Secondary Clarifiers	Furnish and replace existing plow rake mechanism with spiral rake mechanism	
	Furnish and replace scum pumps	
	Furnish and replace weirs, center walkway, handrails, kickplates, and bridge	
RAS/WAS Pump Station	Furnish and replace pumps	
	Furnish and replace piping	
	Furnish and replace HVAC system	
	Install new air intake	
Electrical	Furnish and replace existing power meter with new power meter	
	Furnish and install all existing conduit and conductors from existing fused switch “SW-90” to switchboard “SWBD-M” with new rated loads	
	Furnish and replace existing 2000Amp service entrance switchboard “SWBD-M” with new 2000Amp service entrance switchboard	
	Replace existing 200Amp Panel “LP1” with new 200Amp panel	
	Furnish and replace existing 200Amp Panel “LP1” with new 200Amp panel	
	Furnish and replace existing 250Amp Panel “LP2” with new 250Amp panel	
	Furnish and replace existing 75 KVA transformer with new 75 KVA transformer	
	Furnish and remove existing Motor Control Center MCC-1, MCC-2, and MCC-5 and replace with 1600Amp Motor Control Center	
	Furnish and replace all conduit and conductors from associated MCCs to all existing associated loads	
	Furnish and replace existing 600Amp Motor Control Center “MCC-2C” with new 600Amp Motor Control Center. Replace all conduit and	

FACILITY	IMPROVEMENT	NOTES
	conductors from existing MCC to all existing loads	
	Furnish and replace existing 600Amp Motor Control Center "MCC-2D" with new 600Amp Motor Control Center. Replace all conduit and conductors from existing MCC to all existing loads	
	Furnish and replace existing 125Amp Panel "ELP1" with new 125Amp panel	
	Furnish and replace existing 150Amp Panel "ELP2" with new 150Amp panel	
	Replace existing 45 KVA transformer with new 45 KVA transformer	
	Replace existing 600Amp Motor Control Center "MCC-3" with new 600Amp Motor Control Center	
	Replace existing 600Amp Motor Control Center "MCC-4" with new 600Amp Motor Control Center	
	Provide and install local control panels and a master control panel for all new blowers. Field install new conduit and conductors from each blower to local control panels and local control panels to master control panel	
	Provide and install conduit and ethernet cable from blower master control panel to existing control room. All blowers' functions shall also be controls and monitors from main control room. Provide all required hardware for a complete working system	
	Provide and install new control panel and VFDs for new RAS pumps. Provide and field install all new conduit and conductors	
Instrumentation and Control	Provide and install conduit and fiber optic cable from new RAS control panel to existing control room. All RAS motor's functions shall also be controls and monitors from main control room. Provide all required hardware for a complete working system	
	Provide and install new local control panel with compact PLC to control and monitor each individual process within the "old plant"	
	Reprogram existing HMI to include graphics for all new train no.1 equipment	
	Provide and install a complete working Turn-Key SCADA system for all proposed equipment	
	Install fault tolerant fiber optic loop to connect all local control panel at each	Refer to the SCADA

FACILITY	IMPROVEMENT	NOTES
	process within "old plant" to the "new plant" master SCADA server	integration note after this table
	Provide local and remote-control capability at each control panel with option for local HMI screen on panel	
	Furnish and replace / Upgrade all local gauges with new gauges and transmitters to bring signal to local control panel. These signals should be routed from local PLC to master SCADA	
Civil	Furnish and replace buried water system for Old Plant	Contingent upon testing completed during Pre-Construction Phase
	Furnish and replace buried potable water system for Old Plant	Contingent upon testing completed during Pre-Construction Phase
	Furnish and replace buried drain system for Old Plant	Contingent upon testing completed during Pre-Construction Phase
	Furnish and replace buried sewer system for Old Plant	Contingent upon testing completed during Pre-Construction Phase
	Furnish and replace buried process piping system for Old Plant	Contingent upon testing completed during Pre-Construction Phase
	Furnish and replace buried valves for Old Plant	Contingent upon testing completed during Pre-Construction Phase
	Furnish and replace buried large diameter pipes that move wastewater between treatment processes for Old Plant. • Splitter box and aeration basins. • Aeration basins and clarifiers. • Clarifiers and filters • RAS lines • WAS lines	Contingent upon testing completed during Pre-Construction Phase

FACILITY	IMPROVEMENT	NOTES
Structural	Replace floors from both clarifiers and provide grouting	Contingent upon testing completed during Pre-Construction Phase
	Patch all concrete walls at aeration basins	
	Furnish and replace concrete aeration basin's influent channel	Contingent upon testing completed during Pre-Construction Phase

SCADA Integration. The design-build contractor shall provide a complete SCADA system that will provide remote monitoring and control of the "Old Plant" via the fiber network from the existing SCADA HMI screens. In addition to the remote monitoring and control, the design-build contractor shall also implement local OIT (operator interface terminal) at each PLC. The design-build contractor shall provide all PLC programming, creation of new HMI screens and modifications to the existing HMI screens for all "old plant" monitoring data, control functionality, and alarming.

2.2 CONTRACTOR'S REDLINES AND RECORD DRAWINGS. The design-build team shall keep a set of drawings and document any changes in the construction not reflected in the design documents. An updated copy shall be provided to EPWater or its Construction Manager consultant prior to every monthly pay application.

2.3 CLOUD-BASED SOFTWARE. The design-build contractor shall provide at no additional cost to EPWater a cloud-based software for the project and provide access to EPWater and its Construction Manager consultant. Design-build contractor shall upload the construction drawings to be updated on a weekly basis and construction activities daily.

2.4 QUALITY CONTROL/QUALITY ASSURANCE.

- The design-build contractor shall hire at no additional cost to EPWater an independent laboratory to provide testing services for all concrete and compaction work accordance to applicable ACI and ASTM standards, respectively, and to a frequency recommended by the industry.
- All new piping (air, water, wastewater, drain, diesel, and stormwater), pumps, diffusers, generator, variable frequency drives (VFD), monitoring equipment, hoist crane, roofing, electrical, mechanical, and communication shall be tested to ensure proper installation according to industry standards and manufacturers recommendations, whichever is more stringent. Successful testing shall be the basis for payment.

Appendix E: List of Allowable Manufacturers

The following table shows the allowable manufactures for the equipment shown. Design-build contractor shall ensure its design and construction are consistent with the information provided herein.

Major Equipment	Allowable Manufacturers
Power Meter	Siemens
Surge Protection Device	Eaton; SSI
Air Mass Flowmeter	Sierra
DO Meters	Hack
LED Lights	LSI Lighting; H.E. Williams
MOV	Bettis 5CE 300; IEM
Generator (26 32 13)	Cummins with open transition ATS
VFD (soft starters)	Eaton; ABB
Low Voltage Switchgear (26 23 00)	AAB; Eaton; Square-D; Schneider Electric
Motor Control Centers (26 24 19)	Eaton; Square-D; Schneider Electric
Programmable Logic Controllers (26 90 20)	Allen-Bradley
Fine-Bubble Fixed-Grid Aeration Equipment (44 42 13)	• SSI Aeration • Environmental Dynamics, Inc. (EDI)
Coarse Bubble Channel Aeration System (44 42 13.13)	• Sanitaire Water Pollution Control Corporation • SSI Aeration • Environmental Dynamics, Inc. (EDI)
Spiral Type Clarifier Mechanisms (44 42 23)	• Walker Process Equipment • WesTech Engineering, Inc. • OVIVO
Horizontal End Suction Non-Clog Centrifugal Pumps (44 42 56.43) – RAS	Fairbanks Morse
Vertical Dry Pit Chopper Pump (44 42 56.70) – Scum	Flygt
Horizontal Dry Pit Chopper Pump - WAS	Flygt
VFD	Danfoss, Eaton, ABB

APPENDIX F

AGREEMENT
FOR
PROFESSIONAL ENGINEERING SERVICES

THE STATE OF TEXAS }
COUNTY OF EL PASO }

PROJECT:

This AGREEMENT is made and entered into by and between , a , hereinafter referred to as the ENGINEER, and EL PASO WATER UTILITIES - PUBLIC SERVICE BOARD, a component unit of the City of El Paso, Texas, a home rule municipal corporation, hereinafter referred to as the OWNER.

WITNESSETH:

WHEREAS, the OWNER has a requirement for professional engineering services to provide study, design, bid, and possible construction phase engineering services for the above-referenced project, hereinafter called the "Project;"

and,

WHEREAS, the OWNER intends to contract with others for construction of the Project,

and,

WHEREAS, ENGINEER and OWNER wish to enter into an agreement, hereinafter referred to as "Agreement", for furnishing professional engineering services;

and,

WHEREAS, ENGINEER represents it possesses the qualifications to perform the necessary professional engineering services in connection with the Project;

NOW THEREFORE, IN CONSIDERATION OF THE MUTUAL PROMISES AND COVENANTS OF THE PARTIES HERETO, IT IS AGREED AS FOLLOWS:

SECTION 1 GENERAL

1.1. The OWNER agrees to retain the ENGINEER and the ENGINEER agrees to perform professional engineering services for the Project as an independent contractor and professional consultant as set forth below:

ENGINEER shall provide for the OWNER professional engineering services in all phases of the Project to which this Agreement applies. The services furnished by the ENGINEER were preliminarily defined in its proposal dated in response to Owner's Request for Submittals of . Services shall be more definitively described and contracted for by

Task Orders, which shall become attachments to this Agreement and that set forth the ENGINEER's Services, Time of Performance, Payment, Deliverables, Key Personnel and such other terms and conditions which may apply based upon funding agency or technical requirements. It is anticipated that services under this Agreement will include Pre-design, Design, Bid, and possibly Construction phase services.

The initial Scope of Services will be in accordance with Task Order No. 1, attached hereto as Attachment "A."

1.2. The ENGINEER may perform contract administration services as a part of this Agreement and as more fully defined in subsequent Task Orders, and shall make a warranty inspection of the Project at least thirty (30) days before the expiration of the Contractor's and Surety's one-year warranty period contained in the construction contract documents and the performance bond and submit a report to Owner.

1.3. Services of the ENGINEER shall commence upon receipt of a Notice To Proceed from the OWNER. ENGINEER understands and agrees that time is of the essence and that all phases of this Agreement are to be completed within the times indicated in the attached Task Order No. 1 and subsequent Task Orders issued under this Agreement. The OWNER will grant an extension of time in the event of delays which the OWNER reasonably determines are beyond the control of the ENGINEER, or the ENGINEER's subconsultants, employees or his agents. Failure to complete any Task Order under the Agreement within the times indicated therein will constitute a material breach of the Agreement.

1.4. ENGINEER shall promptly correct any defective designs or specifications furnished by ENGINEER at no cost to OWNER. OWNER's approval, acceptance, use of, or payment for all or any part of ENGINEER's services hereunder, or of the Project itself, shall in no way alter ENGINEER's obligations or OWNER's rights hereunder.

1.5. ENGINEER understands and agrees that its final opinion of probable construction costs will establish a fixed limit of budgeted construction costs as a mandatory condition of contract. ENGINEER agrees it will use its best efforts to develop construction documents that will result in bids that fall within this fixed limit. Since the ENGINEER has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, the ENGINEER's opinions of probable total project costs and construction cost provided for herein are to be made on the basis of the ENGINEER's experience and qualifications and represent the ENGINEER's best judgement as an experienced and qualified professional engineer, familiar with the construction industry; but the ENGINEER cannot and does not guarantee that proposals, bids or actual total project or construction costs will not vary from opinions of probable cost prepared by the ENGINEER. Provided, however, nothing herein shall relieve the ENGINEER of any liability for negligence in preparing its final estimate of probable construction costs hereunder or its obligations to the OWNER under Section 5 hereof.

If the Bidding Phase has not commenced within six (6) months after the completion of the Design Phase, the established probable construction cost limit will not be binding on the ENGINEER.

If the lowest bona fide bid or the latest probable construction cost estimate exceeds such fixed limit of the budgeted probable construction cost by ten percent (10%) or more, the OWNER may either (1) give written approval of the increase from such fixed limit and (2) authorize rebidding of the project within a reasonable time, or (3) cooperate in revising the project scope or quality as required to reduce probable construction costs and re-bid the project. In the case of (3) the ENGINEER shall use its best efforts to modify the specifications and the drawings as necessary to bring the construction costs down within the original final estimate or within any new fixed limit subsequently authorized by the OWNER. In the case of (2) or (3), in lieu of other compensation for services in making such modifications, the OWNER shall pay the ENGINEER, ENGINEER's cost of such services, all overhead expenses reasonably related thereto and reimbursable expenses, but without profit to the ENGINEER on account of such services.

Provided, however, not withstanding anything to the contrary herein, if the ENGINEER is found to be negligent in the preparation of the opinion of probable construction costs, it shall modify the construction documents to bring the construction cost within any reasonable fixed limit subsequently authorized by the OWNER, without any additional charge to the OWNER.

If the OWNER receives bids for the Projects(s) and does not award a contract, the ENGINEER's total fee earned and to be paid shall be based on the cost incurred for the level of effort expended. After the OWNER notifies the ENGINEER it will not award a contract, the ENGINEER will negotiate a reduction of its cost and fee based upon the deletion of services under this Agreement. The ENGINEER shall cease all services associated under the contract not awarded immediately upon receipt of the notice.

1.6. The personnel identified in ENGINEER'S proposal and Exhibit "D" in Task Orders issued under this Agreement are identified as key personnel to the Project and will be assigned to the Project in reasonable accordance with the proposal and the effort estimated herein. Diversion of key personnel from Project will not be made without prior written approval of the OWNER. The resume of the proposed substitute shall be submitted for consideration by OWNER.

1.7. **Items to be Furnished by Owner:** Available reports, tests, measurements, shop drawings, and record drawings and any other related information which is available to the OWNER. OWNER will use its best efforts to provide copies of all its project information requested by the ENGINEER within two (2) calendar weeks of ENGINEER's request.

1.8. Should the ENGINEER write or plan to present any paper or article with reference to this, or any other Utility project, clearance will be obtained from the President/CEO prior to any such writing or presentation.

1.9. **Changes:** In the normal course of administration of the work under this Agreement, the Owner may give directives to the ENGINEER, either written or verbal, which may constitute a change to the Scope of Work or the Schedule. If an instruction, directive, or decision is given that the ENGINEER considers to be a material change in the Scope of Work or the Schedule, he shall notify the OWNER within seven (7) calendar days of

receiving the directive or instruction. This notice shall state the general nature of the change, a projection of anticipated cost and the anticipated impact to time. A detailed cost estimate and impact to the schedule shall be provided as soon as reasonably quantifiable, but shall not exceed thirty (30) days from the date of the original written notice by ENGINEER. ENGINEER understands OWNER's budget restraints and acknowledges its responsibility to provide a projection of costs timely, pending negotiation of final price for the change.

Failure to give timely written notice relieves the OWNER from any obligation to adjust the contract amount, Scope, or Schedule as an Amendment to the Agreement for Services. Amendments to the Scope of Work or the Schedule, as well as changes to other terms and conditions, shall be processed as provided under other applicable terms and conditions of this Agreement.

SECTION 2 PAYMENT TO THE ENGINEER

2.1. In consideration for providing the services referred to in Section 1 and related attachments, the OWNER shall pay the ENGINEER as agreed upon and set out in Task Order No. One and such Task Orders as may subsequently be issued under this Agreement. In no event shall ENGINEER be paid greater than _____ during the term of this Agreement.

2.2. Provided, however, in no event shall the ENGINEER ever be paid more than the total amount of services performed as of the date the ENGINEER is notified that the OWNER does not wish to proceed with all or any portion of the project, or award the contract(s), or otherwise terminates this Agreement in accordance with the termination clause contained in Section 6. Provided further that ENGINEER agrees and declares, in accordance with the requirements of the Texas Professional Services Procurement Act (Chapter 2254 of the Texas Government Code), that the professional fees charged under this Agreement are fair and reasonable and are not higher than the applicable professional association's, if any, and do not exceed the maximum provided by any state law.

2.3. The ENGINEER may bill the OWNER monthly for Task Orders issued on a Cost Plus Fixed Fee or a Not to Exceed basis, by the twentieth (20^{th}) of the month, indicating the services performed within the period invoiced and the direct labor cost of such services, for actual hours per individual, that total times an approved indirect overhead rate plus a negotiated profit; reimbursable expenses at direct cost; and subconsultant costs expended by the ENGINEER. Invoices shall indicate the ENGINEER's monthly payroll hours for each employee assigned to the project, plus the costs for outside consultants with copies of their invoices as backup, and other direct costs authorized at cost. For Lump Sum Fee Task Orders, invoices shall be submitted based on ENGINEER's opinion of the percentage of the Project's completion and the OWNER'S concurrence with that estimate. Each invoice, regardless of contract type, shall contain a summary indicating the budget, the current invoiced amount and the billed to date figure. Budgets shall not be exceeded without a properly executed Amendment.

Each invoice shall be accompanied by a progress report in such detail as requested by the OWNER. Progress reports shall be submitted by the tenth (10th) of each month, whether or not an invoice is submitted. They shall include, but not be limited to, a description of

progress achieved by task, the percent complete for each and all tasks net, and the percent of time elapsed against the Project's baseline schedule established in each Task Order. The progress report shall be accompanied by an update to the schedule.

OWNER agrees to pay invoices for all services satisfactorily performed in accordance with the terms of this Agreement within thirty (30) days of their receipt. Payment of an approved invoice not received by the ENGINEER within thirty (30) days of receipt by the OWNER shall be considered delinquent and subject to a finance charge of one percent (1%) per month for each month unpaid after the date of receipt, unless the invoice is a disputed invoice. ENGINEER may suspend services should an undisputed invoice remain delinquent for more than seventy-five (75) days from date of receipt of the invoice.

2.4. All notices, invoices and payment shall be made in writing and may be given by personal delivery or by mail. Notices, invoices and payments sent by mail shall be addressed to the designated responsible person or office:

TO OWNER:
Rose Guevara, Senior Purchasing Agent
El Paso Water Utilities - Public Service Board
1154 Hawkins Boulevard
El Paso, TX 79925 Email: RGuevara@epwu.org

TO ENGINEER:
[ ] Email: [ ]

and, when so addressed, shall be deemed given upon deposit in the United States mail, postage prepaid. In all other instances, notices, invoices, and payments shall be deemed given at the time of actual delivery.

Changes may be made in the names and addresses of the responsible person or office to whom notices, invoices and payments are to be sent, provided reasonable notice is given.

SECTION 3 MISCELLANEOUS

3.1. The ENGINEER shall perform services with the professional skill and care ordinarily provided by competent engineers practicing in the City and County of El Paso, Texas, and under the same or similar circumstances and professional license. ENGINEER shall perform its services as expeditiously as is prudent considering the ordinary professional skill and care of a competent engineer. If the OWNER determines that the work of the ENGINEER is unsatisfactory, or in the event the work of the ENGINEER fails to meet the requirements of the Agreement, the OWNER shall retain the right to negotiate a good faith adjustment of compensation with the ENGINEER.

3.2. Documents, drawings, plans, specifications, cost estimates, original survey field notes, inspector's logs, maps, and other original engineering documents prepared or obtained under the terms of this Agreement are instruments of service and OWNER shall retain ownership and property interest therein. If this Agreement is terminated at any time for any reason prior to payment to the ENGINEER for all work under the appropriate Phase

or Task Order, all documents, drawings, inspector's logs, plans, specifications, original survey field notes, maps and other original engineering documents prepared or obtained under the terms of the Agreement shall, upon termination, be delivered to and become the property of the OWNER without restriction on their use, per the requirements of Section 6, or additional compensation to the ENGINEER. All such documents will be turned over to the OWNER, whether the Agreement is terminated or by virtue of its completion, as a part of the close out process. The OWNER, in acquiring ownership of the above listed documents, hereby releases the ENGINEER from all responsibility in connection with their use on any project other than their use on the Project referenced herein and in the specific Task Orders. The ENGINEER will be allowed to place restrictive statements on drawings as follows for completed work:

> "These Contract Documents have been prepared specifically and exclusively for the Design of (Insert Name of Project); is not responsible for their use on any other project or application." And, for work not completed: "These Contract Documents are incomplete. The design was terminated prior to completion. is not responsible for their use."

SECTION 4 INSURANCE

4.1. ENGINEER shall maintain in effect at all times during performance of the services described in this Agreement at least the coverage and limits of insurance with insurers satisfactory to OWNER set forth in this Section. Certificates of such insurance and evidence of policy endorsement for additional insured(s) and waiver of subrogation requirements, executed by the insurer in form satisfactory to OWNER, shall be furnished to OWNER immediately upon execution of this Agreement and prior to ENGINEER commencing work. Electronic copies of the policy documents associated with the insurance policies covered in this Section 4 shall be forwarded to OWNER no more than (5) days from the commencement of work.

4.2. Certificates of insurance shall, without any qualification thereto, contain the following statement relative to cancellation:

> "Should any of the described policies be canceled or changed before the expiration date thereof, the issuing company will mail thirty (30) days written notice to the named Certificate Holder and the OWNER".

4.3. Worker's Compensation and Employer's Liability shall be provided in accordance with the statutory limits required by law and include the following endorsement:

> "The policy is endorsed to provide that insurer waives any right of subrogation it may acquire against the OWNER, its partners, agents and employees by reason of any payment made on account of injury, including death resulting therefrom, sustained by any employee of the insured."

4.4. The following liability policies, except the Professional Liability policy, shall be endorsed to provide that the OWNER be named as additional primary insured(s) thereunder, and such policies shall contain each of the following types of insurance indicated:

4.4.1. Commercial Liability Insurance required as set forth below:

4.4.1(a) Bodily injury and property damage coverage in limits not less than $1,000,000.00 Combined Single Limit for one occurrence.

4.4.1(b) Coverage shall be at least as broad as the standard ISO occurrence, CG 00-01 and specifically include independent contractor and products/completed operations coverages.

4.4.2. Automobile Liability required as set forth below:

4.4.2(a) Bodily Injury and Property Damage coverages in limits not less than $1,000,000.00 Combined Single Limits per accident.

4.4.2(b) Policy shall be in a comprehensive form including coverage for all owned, hired, leased or non-owned vehicles.

4.4.3. If ENGINEER is to use watercraft or aircraft in the performance of his Agreement, the craft must be insured for liability limits not less than $1,000,000.00 Combined Bodily Injury and Property Damage per occurrence.

4.4.4. Professional Liability insurance shall be required with limits at $1,000,000, on a claims made basis.

4.5. The above insurance policies shall be endorsed to include a requirement that the insurer will provide OWNER with thirty (30) days written notice prior to the effective date of any cancellation or change in the insurance and, with the exception of the Professional Liability and Workers Compensation policies, shall be endorsed to name OWNER as an additional insured. Policies written on a claims-made form (along with required endorsements) shall be kept in force during and for three (3) years following work done under this Agreement. ENGINEER shall submit certificates for each of the above insurances to the OWNER before commencing work.

SECTION 5 LEGAL RELATIONS

5.1. INDEMNIFICATION - OWNER shall not be subject to any obligations or liabilities of the ENGINEER incurred in the performance of this Agreement.

5.1.1 **Indemnification for General Liability/Non-Professional Negligence.**

ENGINEER shall defend, indemnify and hold harmless OWNER, its officers, employees, principals, and affiliated entities (the "Indemnitees") from and against damages, liability, losses, costs and expenses, including reasonable attorneys' fees, arising out of or resulting from the negligence of the ENGINEER, its employees, agents, subcontractors or others for whom the ENGINEER is legally liable provided that such damage, liability, loss, cost or expense is:

5.1.1(a) Attributable to personal injury, death, disease, property damage, intellectual property infringement or other harm for which recovery of damages is sought, suffered by any person or persons, entity or entities, that may arise out of or result from ENGINEER's breach of any of the terms or covenants contained in this Agreement;

5.1.1(b) Not the result of ENGINEER's professional negligence.

This indemnity obligation shall survive the completion of work and termination of this Agreement.

5.1.2 **Indemnification for Professional Negligence.**

ENGINEER shall indemnify and hold harmless Indemnitees from and against damages, losses and judgments arising from claims by third parties, including reasonable attorneys' fees and expenses recoverable under applicable law, but only to the extent they are caused by the negligent acts or omissions of ENGINEER, its employees and any of its subconsultants in the performance of professional services under this Agreement.

Solely and exclusively for Professional Liability Claims, ENGINEER shall have no obligation to undertake the defense of Indemnitees in a Professional Liability Claim prior to the determination of liability in such Professional Liability Claim. If ENGINEER is a party to the Professional Liability Claim at its conclusion, then upon conclusion of the Professional Liability Claim either through settlement, or by the issuance of an arbitration award, judgment or other final determination of liability, ENGINEER shall promptly reimburse Indemnitees for a proportionate share of Indemnitees' defense attorney's fees, investigation costs, court or arbitration costs, and expenses incurred in defending any claim, demand, action, lawsuit, arbitration, or other proceeding relating to such Professional Liability Claim, in an amount proportionate to the percentage of liability allocated to ENGINEER in any such settlement agreement, arbitration award, judgment or other final determination of liability. ENGINEER shall not have any obligation to indemnify, defend or reimburse Indemnitees for Professional Liability claims arising by reason of the sole negligence or willful misconduct of Indemnitees.

This indemnity obligation shall survive the completion of work and termination of this Agreement.

5.2. The ENGINEER shall not be subject to any obligations or liabilities of the OWNER incurred in the performance of this Agreement. To the extent allowed by law, the OWNER expressly agrees to indemnify and hold harmless the ENGINEER for any and all liabilities and obligations incurred in connection with this Agreement due to the negligence of the OWNER and his employees, officers, agents, subcontractors, or agencies; or the negligent acts, or omission, breaches of contract, or other defalcations of the OWNER or his employees, officers, agents, subcontractors, or agencies.

5.3. The ENGINEER shall not sublet or assign any of the services covered by this Agreement, except with the prior, written approval of the OWNER.

5.4. The OWNER shall make freely available to the ENGINEER for examination and copy, all directly pertinent books, documentation, papers, and records of the OWNER involving transactions related to this Agreement.

5.5. ENGINEER shall not be responsible for the means, methods, techniques, sequences, or procedures of construction selected by contractors or the safety precautions and programs incidental to the work of contractors and will not be responsible for contractor's failure to carry out work in accordance with the contract documents. Provided, however, nothing herein shall operate to relieve ENGINEER of its responsibility to the OWNER under normal Construction Phase Services or Resident Project Representative Services or under any other provision of this Agreement.

5.6. If the project involves construction of any kind, whether or not the ENGINEER is retained to perform construction services, ENGINEER will ensure that the bid documents include a requirement that the OWNER shall be indemnified by the contractor to the fullest extent permitted by law for all claims, damages, losses and expenses arising out of or resulting from contractor's performance of the work under the contract documents, including injury to any worker on the job site. A waiver of subrogation on behalf of the OWNER shall be provided and OWNER shall be named as additional primary insured, and ENGINEER as additional insured as their interests may appear, by contractor's General Liability and Builders All Risk insurance policies without offset and all construction documents and insurance certificates shall include such wording. General Liability shall include explosion, collapse and/or underground coverage, where applicable.

SECTION 6 TERMINATION OF AGREEMENT

6.2. This Agreement shall terminate the earlier of either _____ years from the Effective Date or upon reaching the Agreement's maximum dollar amount as defined in Section 2.1.

6.3. In connection with the work outlined in this Agreement and subsequent Task Orders, it is agreed and fully understood by ENGINEER that OWNER may cancel or indefinitely suspend further work hereunder or terminate this Agreement or any Task Order upon two (2) weeks written notice to ENGINEER, with the understanding that immediately upon receipt of said notice, all work and labor being performed under this Agreement shall cease. Before the end of such two week period, ENGINEER shall invoice OWNER for all work satisfactorily completed and shall be compensated in accordance with the terms of this Agreement.

All plans, inspectors daily logs, field survey maps, cross sections and other data or work related to the Project shall become the property of the OWNER upon termination of this Agreement either by cancellation or by expiration of the contract period of performance as part of the normal close out procedure.

6.4. This Agreement may be terminated in whole or in part in writing by either party in the event of substantial failure by the other party to fulfill its obligations under this Agreement

through no fault of the terminating party; providing that no such termination may be effected unless the other party is given (1) written notice (delivered by certified mail, return receipt requested) of intent to terminate, and not less than thirty (30) calendar days to cure the failure, and (2) an opportunity for consultation with the terminating party prior to termination.

6.5. If this Agreement is terminated in whole or in part by the OWNER for reasons of default by ENGINEER, the parties shall use their best efforts to arrive at a negotiated adjustment in the price provided for in this Agreement; however, no amount shall be allowed for anticipated profit or unperformed or unsatisfactory services. If termination for default is effected by the ENGINEER, the negotiated adjustment shall include a reasonable profit. The equitable adjustment for any termination, other than a termination by default, shall provide payment to the ENGINEER for services satisfactorily rendered and expenses incurred prior to the termination, in addition to termination settlement costs reasonably incurred by ENGINEER relating to obligations and commitments as a result of entering into this Agreement. Notwithstanding the above, the ENGINEER shall not be relieved of liability to the OWNER for damages sustained by the OWNER by virtue of any breach of the Agreement by the ENGINEER, and the OWNER may withhold any payment to ENGINEER for the purpose of setoff until such time as the exact amount of damages due the OWNER from ENGINEER is determined.

Nothing contained herein or elsewhere in this Agreement shall require the OWNER to pay for any work which is unsatisfactory or which is not submitted in compliance with the terms of this Agreement.

SECTION 7 ENTIRE AGREEMENT

7.2. This Agreement, including attachments incorporated herein by reference, represents the entire Agreement and understanding between the parties and any negotiations, proposals, or oral agreements are intended to be integrated herein and to be superseded by this written Agreement. Any supplement or amendment to this Agreement to be effective shall be in writing and signed by the OWNER and the ENGINEER.

SECTION 8 MISCELLANEOUS

8.2. For the purpose of determining place of agreement and the law governing same, this Agreement is entered into in the City and County of El Paso, State of Texas, and shall be governed by the laws of the State of Texas. Venue and jurisdiction of any suit or right or cause of action arising under or in connection with this Agreement shall be exclusively in a court of competent jurisdiction sitting in El Paso County.

8.3. The ENGINEER shall comply with all Federal, State, and local laws and ordinances applicable to the work covered hereunder and all applicable rules and regulations promulgated by all local, state and national boards, bureaus and agencies.

8.4. The captions of this Agreement are for information purposes only, and shall not in any way affect the substantive terms and conditions of this Agreement.

8.5. Approval by the OWNER shall not constitute nor be deemed release of the responsibility and liability of the ENGINEER, his employees, subcontractors, agents and consultants for the accuracy and competency of their designs, working drawings, specifications or other documents and work; nor shall such approval be deemed to be an assumption of such responsibility by the OWNER for any defect in the designs, working drawings, and specifications or other documents prepared by ENGINEER, his employees, subcontractors, agents and consultants.

8.6. The Sections, paragraphs, sentences, clauses, and phrases of this Agreement are severable and, if any phrase, clause, sentence, paragraph, or Section of this Agreement should be declared invalid by a final decision of a court of competent jurisdiction, such invalidity will not affect any of the remaining provisions of the Agreement.

8.7. This Agreement shall be binding upon and inure to the benefit of the parties hereto and their respective heirs, executors, administrators, legal representatives, successors and assigns, where permitted by this Agreement.

8.8. The ENGINEER does not boycott Israel and will not boycott Israel during the term of this Agreement.

[*SIGNATURES BEGIN ON THE FOLLOWING PAGE*]

IN WITNESS WHEREOF, duly authorized representatives of the parties have signed in confirmation of this Agreement with the Effective Date being the date all parties have signed this AGREEMENT, as evidenced by the dates below their signatures.

ENGINEER

_____
_____
_____

Date: _____

_____
Federal ID Number

OWNER
EL PASO WATER UTILITIES
PUBLIC SERVICE BOARD

_____
_____
_____

Date: _____

APPROVED AS TO FORM

_____
_____
_____

ATTACHMENT "A"
TASK ORDER #1

[REMAINDER OF PAGE INTENTIONALLY BLANK]

APPENDIX G

This Agreement is made and entered into as of the ____ day of _____, 20_____ ("Date of Execution") by and between the:

"Owner"
El Paso Water Utilities – Public Service Board
1154 Hawkins Blvd.
El Paso, Texas 79925
915.594.5500

and

"Design-Builder"
[NAME OF DESIGN-BUILDER]
[ADDRESS]
[CITY STATE ZIP]
[PHONE]
[FAX[

for the following Project:

[PROJECT NAME]

ARTICLE 1 – GENERAL PROVISIONS

1.01 ***Owner's Criteria***:

A. This Agreement is based on the Owner's Criteria set forth in this Section 1.01.

B. The Owner's program for the Project: Design and Construction of **[PROJECT NAME]**.

C. The Owner's design requirements for the Project and related documentation attached to this Agreement as Exhibits 2 through 3.

D. The Project's physical characteristics.

To the extent available, the Owner has provided Design-Builder all geotechnical and other survey data in its possession. If no geotechnical data is available and provide to the Design-Builder, Design-Builder shall be required to retain a geotechnical engineer to perform geotechnical analysis. If geotechnical data is available and provided to the Design-Builder by Owner, the Design-Builder may, at its election, retain its own geotechnical firm and a registered professional land surveyor to generate any data that Design-Builder will require for the performance of its work. Costs for such consultants may be included in the Cost of the Work as described herein.

E. The Owner's budget for the Work to be provided by the Design-Builder is $**[AMOUNT]**.

F. The Owner's design and construction milestone dates in accordance with the approved construction schedule.

G. The Owner requires the Design-Builder to retain the following Consultants and Contractors at the Design-Builder's cost:

1. Engineer: **[ENGINEER01]**; **[ENGINEER02]**; and **[SURVEYOR/GEOTECH/SPECIALIST]**.

2. Consultants: **[ENGINEER01]**.

3. Contractors: **[NAME OF DESIGN-BUILDER]** & **[CONTRACTOR]**.

H. The Design-Builder shall confirm that the information included in the Owner's Criteria complies with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities.

I. If the Owner's Criteria conflicts with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Design-Builder shall notify the Owner of the conflict.

J. If there is a change in the Owner's Criteria, the Owner and the Design-Builder shall execute a Modification in accordance with Article 6.

K. If the Owner and Design-Builder intend to transmit Instruments of Service or any other information or documentation in digital form, they shall endeavor to establish necessary protocols governing such transmissions.

1.02 ***Project Team***

A. The Owner identifies the following representative in accordance with this agreement: **[OWNER'S REP]**.

B. The persons or entities, in addition to the Owner's representative, who are required to review the Design-Builder's Submittals are the Utility Engineering Division Manager or Designee.

C. The Owner will retain the following consultants and separate contractors:

D. The Design-Builder identifies the following representative in accordance with this agreement: **[DESIGN-BUILDER'S REPRESENTATIVE]**

E. Neither the Owner's nor the Design-Builder's representative shall be changed without ten days' written notice to the other party. The Design-Builder's representative may be replaced only with Owner's approval, but such approval shall not be unreasonably withheld, delayed or conditioned.

1.03 ***Binding Dispute Resolution***

Disputes will be resolved in accordance with the General Conditions.

1.04 ***Definitions***

Unless otherwise stated in this Section, the Terms used in this Agreement will have the meanings indicated in the General Conditions.

A. ***Design-Build Documents***

The Design-Build Documents consist of this Agreement between Owner and Design-Builder and its attached Exhibits (hereinafter, the "Agreement"); the General Conditions; other documents listed in this Agreement; the _____% Completed Design and Geotechnical Baseline Report provided, and, Modifications issued after execution of this Agreement. A Modification is (1) a written amendment to the Contract signed by both parties or (2) a Change Order.

B. ***The Contract or Design-Build Agreement***

This Design-Build Agreement (or "the Agreement") is being executed after the Design-Builder has completed the design phase of services and has provided the Owner with a Design-Build Proposal. Owner and Design-Builder have agreed upon the Design-Build Proposal. This Agreement establishes the Lump Sum Contract Price and Contract Time and sets forth the agreed upon design documents and other information upon which the Contract Sum and Contract Time are based. The Design-Build Documents form the Contract. The Contract represents the entire and integrated agreement between the parties and supersedes prior negotiations, representations or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Design-Build

Documents shall not be construed to create a contractual relationship of any kind between any persons or entities other than the Owner and the Design-Builder.

C. ***The Work***
The term "Work" means the design completion, construction and related services required to fulfill the Design-Builder's obligations under the Design-Build Documents, whether completed or partially completed, and includes all labor, materials, equipment and services provided or to be provided by the Design-Builder. The Work may constitute the whole or a part of the Project.

D. ***The Project***
The Project is the total design and construction of which the Work performed under the Design-Build Documents provided in the proposal solicitation.

E. ***Instruments of Service***
Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Design-Builder, Contractor(s), and Consultant(s) under their respective agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, digital models and other similar materials.

F. ***Submittals***
A Submittal is any submission to the Owner for review and approval demonstrating how the Design-Builder proposes to conform to the Design-Build Documents for those portions of the Work for which the Design-Build Documents require Submittals. Submittals include, but are not limited to, shop drawings, product data, and samples. Submittals are not Design-Build Documents unless incorporated into a Modification.

G. ***Owner***
The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Design-Build Documents as if singular in number. The term "Owner" means the Owner or the Owner's authorized representative.

H. ***Design-Builder***
The Design-Builder is the person or entity identified as such in the Agreement and is referred to throughout the Design-Build Documents as if singular in number. The term "Design-Builder" means the Design-Builder or the Design-Builder's authorized representative.

I. ***Consultant***
A Consultant is a person or entity providing professional services for the Design-Builder for all or a portion of the Work, and is referred to throughout the Design-Build Documents as if singular in number. To the extent required by the relevant jurisdiction, the Consultant shall be lawfully licensed to provide the required professional services.

J. ***Contractor***
A Contractor is a person or entity performing all or a portion of the construction, required in connection with the Work, for the Design-Builder. The Contractor shall be lawfully

licensed, if required in the jurisdiction where the Project is located. The Contractor is referred to throughout the Design-Build Documents as if singular in number and means a Contractor or an authorized representative of the Contractor.

K. ***Engineer***
The Engineer is a person or entity providing design services for the Design-Builder for all or a portion of the Work, and is lawfully licensed to practice engineering in the applicable jurisdiction. The Engineer is referred to throughout the Design-Build Documents as if singular in number.

L. ***Lump Sum Price***
The Lump Sum Price ("LSP" or "Contract Price") has been determined through the Design-Builder's proposal and subsequent negotiations between Owner and Design-Builder. Design-Builder and Owner have agreed upon the Lump Sum Payment of $**[AMOUNT]** to Design-Builder in return for the construction and delivery of The Project.

ARTICLE 2 – THE WORK OF THIS CONTRACT

2.01 Design-Builder shall perform all design, engineering, procurement, construction, start-up and performance testing services, and provide all material, equipment, tools and labor, necessary to complete the Project, including all the work described in and reasonably inferable from the Contract Documents. All performance items described herein shall be referred to as the "Work".

The Contract Documents for this Project include this Standard Form of Agreement and the following documents, if applicable:

- Addenda issued by Design-Builder
- General Conditions attached to this Agreement as Exhibit 8
- Performance and Payment Bonds
- Insurance Rider
- Request For Qualifications and Contract Forms
- Technical Specifications
- Drawings

ARTICLE 3 – GENERAL REQUIREMENTS OF THE WORK OF THE DESIGN-BUILD CONTRACT

3.01 General

A. The Design-Builder shall comply with any applicable licensing requirements in the jurisdiction where the Project is located.

B. The Design-Builder shall designate in writing a representative who is authorized to act on the Design-Builder's behalf with respect to the Project.

C. The Design-Builder shall perform the Work in strict accordance with the Design-Build Documents. This obligation shall be absolute. The Design-Builder shall not be relieved of the obligation to perform the Work in accordance with the Design-Build Documents by the activities, tests, inspections or approvals of the Owner.

1. The Design-Builder shall perform the Work in compliance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities. If the Design-Builder performs Work contrary to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities, the Design-Builder shall assume responsibility for such Work and shall bear the costs attributable to correction.

2. Neither the Design-Builder nor any Contractor, Consultant or Engineer shall be obligated to perform any act which they believe will violate any applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities. If the Design-Builder determines that implementation of any instruction received from the Owner, including those in the Owner's Criteria, would cause a violation of any applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Design-Builder shall notify the Owner in writing. Upon verification by the Owner that a change to the Owner's Criteria is required to remedy the violation, the Owner and the Design-Builder shall execute a Modification in accordance with Article 6.

D. The Design-Builder shall be responsible to the Owner for acts and omissions of the Design-Builder's employees, Engineer, Consultants, Contractors, and their agents and employees, and other persons or entities performing portions of the Work.

1. Standard of Care: The ENGINEER (member of the Design-Build team) shall perform services with the professional skill and care ordinarily provided by competent engineers practicing in the City and County of El Paso, Texas, and under the same or similar circumstances and professional license. ENGINEER shall perform its services as expeditiously as is prudent considering the ordinary professional skill and care of a competent engineer. If the OWNER determines that the work of the ENGINEER is unsatisfactory, or in the event the work of the ENGINEER fails to meet the requirement of the Agreement, the OWNER shall retain the right to negotiate a good faith adjustment of compensation with the ENGINEER.

E. ***General Consultation***
The Design-Builder shall schedule and conduct progress meetings with the Owner, on a weekly basis, or as mutually determined between Owner and Contractor, to review matters such as procedures, progress in design and/or construction, coordination, and scheduling of the Work.

F. When applicable law requires that services be performed by licensed professionals, the Design-Builder shall provide those services through qualified, licensed professionals in accordance with the Texas Occupations Code and all applicable legal standards of care applicable to design professionals.

G. The Design-Builder, with the assistance of the Owner, shall prepare and file documents required to obtain necessary approvals of governmental authorities having jurisdiction over the Project.

H. ***Progress Reports***

1. The Design-Builder shall keep the Owner informed of the progress and quality of the Work. On a monthly basis, or otherwise as agreed to by the Owner and Design-Builder, the Design-Builder shall submit written progress reports to the Owner, showing estimated percentages of completion and other information identified below:

    a. Work completed for the period;
    b. Project schedule status;
    c. Submittal schedule and status report, including a summary of outstanding Submittals;
    d. Responses to requests for information to be provided by the Owner;
    e. Approved Change Orders;
    f. Pending Change Order and Change Directive status reports;
    g. Tests and inspection reports;
    h. Status report of Work rejected by the Owner;
    i. Status of Claims previously submitted in accordance with Article 14;
    j. Cumulative total of the Cost of the Work to date including the Design-Builder's compensation and Reimbursable Expenses, if any;
    k. Current Project cash-flow and forecast reports; and
    l. Additional information as agreed to by the Owner and Design-Builder.

2. In addition, where the Contract Price is the Cost of the Work, the Design-Builder shall include the following additional information in its progress reports:

    a. Design-Builder's work force report;
    b. Equipment utilization report; and
    c. Cost summary, comparing actual costs to updated cost estimates.

I. ***Design-Builder's Schedules***

The Design-Builder, promptly after execution of this Agreement, shall prepare and submit for the Owner's information and approval a schedule for the Work. The schedule, including the time required for design and construction, shall not exceed time limits current under the Design-Build Documents, shall be revised at appropriate intervals as required by the conditions of the Work and Project, shall be related to the entire Project, shall provide for expeditious and practicable execution of the Work, and shall include allowances for periods of time required for the Owner's review and for approval of submissions by authorities having jurisdiction over the Project. In no circumstance shall the preparation and presentation of a schedule extending the completion beyond the time limits contained in the Design-Build Documents entitle the Design-Builder to an extension of time absent a fully executed change order extending such contract time.

The Design-Builder shall perform the Work in general accordance with the most recent schedules submitted to the Owner. The schedule shall be updated regularly and in advance

of periodic Project meetings with the Owner and Owner's Engineer. Such schedules shall be posted at the Project meetings in a convenient location for review and approval by the Owner.

J. ***Certifications***

Upon the Owner's written request, the Design-Builder shall obtain from the Engineer, Consultants, and Contractors, and furnish to the Owner, certifications with respect to the documents and services provided by the Engineer, Consultants, and Contractors (a) that, to the best of their knowledge, information and belief, the documents or services to which the certifications relate (i) are consistent with the Design-Build Documents, except to the extent specifically identified in the certificate, and (ii) comply with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities governing the design of the Project; and (b) that the Owner and its consultants shall be entitled to rely upon the accuracy of the representations and statements contained in the certifications.

K. ***Design-Builder's Submittals***

1. Prior to submission of any Submittals, the Design-Builder shall prepare a Submittal schedule, and shall submit the schedule for the Owner's approval. The Owner's approval shall not unreasonably be delayed or withheld. The Submittal schedule shall (1) be coordinated with the Design-Builder's schedule provided in this Section, (2) allow the Owner reasonable time to review Submittals, and (3) be periodically updated to reflect the progress of the Work. If the Design-Builder fails to submit a Submittal schedule, the Design-Builder shall not be entitled to any increase in Contract Price or extension of Contract Time based on the time required for review of Submittals.

2. By providing Submittals the Design-Builder represents to the Owner that it has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, and (3) checked and coordinated the information contained within such Submittals with the requirements of the Work and of the Design-Build Documents.

3. The Design-Builder shall perform no portion of the Work for which the Design-Build Documents require Submittals until the Owner has approved the respective Submittal.

4. The Work shall be in accordance with approved Submittals. Work done in compliance of an approved Submittal does not relieve the Design-Builder of its responsibility to perform the Work consistent with the requirements of the Design-Build Documents and the design intent if the Work subject to an approved Submittal fails or is deemed defective by the Owner. The Work may deviate from the Design-Build Documents only if the Design-Builder has notified the Owner in writing of a deviation from the Design-Build Documents at the time of the Submittal and a Modification is executed authorizing the identified deviation. The Design-Builder shall not be relieved of responsibility for errors or omissions in Submittals or by the Owner's approval of the Submittals.

5. All professional design services or certifications to be provided by the Design-Builder, including all drawings, calculations, specifications, certifications, shop drawings and other Submittals, shall contain the signature and seal of the licensed design professional preparing them. Submittals related to the Work designed or certified by the licensed design professionals, if prepared by others, shall bear the licensed design professional's written approval. The Owner and its consultants shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals.

L. ***Warranty***
The Design-Builder's warranty obligations, not including those professional design services required to complete the design, shall be governed in accordance with Paragraph 7.17 of the General Conditions.

M. ***Royalties, Patents and Copyrights***
The Design-Builder's royalty, patent, and copyright obligations shall be governed in accordance with Paragraph 7.07 of the General Conditions.

N. ***Indemnification***
The Design-Builder's indemnify obligations shall be governed in accordance with the General Conditions.

ARTICLE 4 – WORK PRIOR TO EXECUTION OF THE DESIGN-BUILD AGREEMENT

4.01 ***General***

A. Any information submitted by the Design-Builder, and any interim decisions made by the Owner, shall be for the purpose of facilitating the design process and shall not modify the Owner's Criteria unless the Owner and Design-Builder execute a Modification.

B. The Design-Builder shall advise the Owner on proposed site use and improvements, selection of materials, and building systems and equipment. The Design-Builder shall also provide the Owner with recommendations, consistent with the Owner's Criteria, on constructability; availability of materials and labor; time requirements for procurement, installation and construction; and factors related to construction cost including, but not limited to, costs of alternative designs or materials, preliminary budgets, life-cycle data, and possible cost reductions.

ARTICLE 5 – WORK FOLLOWING EXECUTION OF THE DESIGN-BUILD AGREEMENT

5.01 ***General***
Unless otherwise specified herein, all work performed pursuant to this Article shall be governed in accordance with the General Conditions.

5.02 ***Construction Documents***

A. Upon the execution of the Design-Build Agreement, the Design-Builder shall prepare

Construction Documents. The Construction Documents shall establish the quality levels of materials and systems required. The Construction Documents shall be consistent with the Design-Build Documents.

B. The Design-Builder shall provide the Construction Documents to the Owner for the Owner's information and approval. If the Design-Builder has included any deviations between the Construction Documents and the Design-Build Documents, the Design-Builder shall notify the Owner of such deviations in writing. The Construction Documents shall not modify the Design-Build Documents unless the Owner and Design-Builder execute a Modification. The failure to notify the Owner of any such deviations shall not relieve the Design-Builder of the obligation to perform the Work in accordance with the Design-Build Documents.

5.03 ***Construction***

A. ***Commencement***
Except as otherwise permitted in this Section, construction shall not commence prior to execution of the Design-Build Agreement.

B. If the Owner and Design-Builder agree in writing, construction may proceed prior to the execution of the Design-Build Agreement. However, such authorization shall not waive the Owner's right to reject the Design-Builder's Proposal.

ARTICLE 6 – CHANGES IN THE WORK

6.01 ***General***

A Change Order may accomplish a change or Modification in the Work after execution of the Contract, and without invalidating the Contract, subject to the limitations stated in the General Conditions.

ARTICLE 7 – OWNER'S RESPONSIBILITIES

7.01 ***General***
The Owner's responsibilities shall be governed in accordance with the General Conditions.

ARTICLE 8 – CONTRACT TIME AND COMPLETION

8.01 ***General***
The Design-Builder's obligations with respect to the Contract Time shall be governed in accordance with the General Conditions, unless otherwise stated in this Article.

A. Time limits stated in the Design-Build Documents are of the essence of the Contract. In all aspects of the Work, time is of the essence of the Contract. Additionally, time limits stated in the Design-Build Documents are of the essence. By executing the Design-Build Agreement the Design-Builder confirms that the Contract Time is a reasonable period for performing the Work.

B. The Design-Builder shall not, except by agreement of the Owner in writing, commence the Work prior to the effective date of insurance, other than property insurance, required by this Contract. The Contract Time shall not be adjusted as a result of the Design-Builder's failure to obtain insurance required under this Contract.

C. The Design-Builder shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

D. The date of commencement of the Work shall be stated in a Notice to Proceed issued in writing by the Owner.

E. The Contract Time shall be measured from the date of commencement.

F. ***Substantial Completion*.**
The Design-Builder shall achieve Substantial Completion of the entire Work not later than (**[NUMBER]**) calendar days from the date of commencement subject to and adjustments of this Contract Time as provided in the Contract Documents and Change Orders modifying and extending this Agreement. It is specifically understood and agreed to by and between Owner and Design-Builder that time is of the essence in the substantial completion of the Work, and that failure to substantially complete the Work within the designated period, or as it may be extended, shall be construed as a breach of this Agreement.

8.02 ***Delays and Extensions of Time***
Unless otherwise set forth in this Section, Project delays shall be governed in accordance with the General Conditions.

A. Claims relating to time shall be made in accordance with applicable provisions of Article 12 of the General Conditions.

B. This Section 8.02 does not preclude recovery of damages for delay by Owner or Design Builder under other provisions of the Design-Build Documents.

C. Should the Design-Builder default on its obligations to make progress and complete the Work on time, as allowed in the Contract Documents, the Owner may withhold or deduct all costs and damages for compensable delay caused by the Design-Builder from the Contract Price. Such costs shall include any attorney's fees, and all other costs, expenses, and damages actually incurred by the Owner as a result of such delay. Owner's delay damages may be incidental to and not directly associated with the Project.

D. ***The procedure for the determination of time extensions for unusually severe weather.***
In order for the Owner to award a time extension under this clause, the following conditions must be satisfied.

1. The weather experienced at the Project site during the Contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for

the Project location during any given month.

2. The unusually severe weather must actually cause a delay to the completion of the Project.

E. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the Project location and will constitute the base line for monthly weather time evaluations. The Design-Builder's activity durations provided in the progress schedule must reflect these anticipated adverse weather delays in all weather-dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON FIVE (5) DAY WORK WEEK

JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)

F. For the duration of the Contract, the Design-Builder shall maintain in its daily reports an accurate and contemporaneous record of the occurrence of adverse weather and resultant impact to normally scheduled Work. Delay from adverse weather unless Work on the overall Project's critical activities is prevented for 50 percent or more of the Design-Builder's scheduled work day. The number of actual adverse weather days shall be calculated monthly. If the number of actual adverse weather delay days in a month exceed the number of days for that month as referenced above, the Owner upon notification by the Design-Builder, will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and a modification shall be issued in accordance with the Contract.

G. ***Liquidated Damages***
The Design-Builder acknowledges and recognizes that the Owner is entitled to full and beneficial occupancy and use of the completed work following expiration of the Contract Time. The Design-Builder further acknowledges and agrees that, if the Design-Builder fails to substantially, or cause the Substantial Completion of any portion of the Work within the Contract time, the Owner will sustain actual damages as a result of such failure. The exact amount of such damages will be difficult to ascertain. Therefore, the Owner and Design Builder agree that, if the Design-Builder shall neglect, fail, or refuse to achieve substantial completion of the Work by the Substantial Completion date, subject to proper extension granted by the Owner, then the Design-Builder agrees to pay the Owner the sum of **[$AMOUNT]** for each calendar day in which such Work is not completed, not as penalty, but as liquidated damages ("Liquidated Damages") , for the damages (Liquidated Damages) that would be suffered by Owner as a result of delay for each and every calendar day that the Design-Builder shall have failed to have completed the Work as required herein. Furthermore, if the Design-Builder shall neglect, refuse or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, the Design-Builder shall pay Owner **[$AMOUNT]** for each calendar day that expires after the time specified in the Agreement for completion readiness for final payment. The Liquidated Damages shall be in lieu of any and all other

damages which may be incurred by Owner as a result of the failure of Design-Builder to complete within the Contract Time.

ARTICLE 9 – CONTRACT PRICE

9.01 ***General***

Owner shall pay Design-Builder in accordance with the General Conditions a Contract Price equal to Design-Builder's Fee (as defined in this Article) plus the Cost of the Work (as defined in this Article), subject to the LSP established in Section **Error! Reference source not found.** hereof and any adjustments made in accordance with the General Conditions.

9.02 ***Cost of the Work***

The term Cost of the Work shall mean costs reasonably incurred by Design-Builder in the proper performance of the Work. In addition to the items listed in Exhibit 4; the Cost of the Work shall include only the following:

A. Fees for direct employees of Design-Builder performing the Work at the Site or, with Owner's agreement, at locations off the Site, calculated on the basis of those rates set forth on Exhibit 4 to this Agreement and assumed to be included in the Lump Sum Cost.

B. Fees for Design-Builder's supervisory and administrative personnel engaged in the performance of the Work and who are located at the Site or working off-Site to assist in the production or transportation of material and equipment necessary for the Work at the rates set forth on Exhibit 4 and assumed to be included in the Lump Sum Cost.

C. Fees for Design-Builder's personnel stationed at Design-Builder's principal offices, but only to the extent said personnel are identified in Exhibit 4 and performing the function set forth in said Exhibit and compensated in accordance with the rates set forth on Exhibit 4 and assumed to be included in the Lump Sum Cost.

D. The reasonable portion of the cost of travel, accommodations and meals for Design-Builder's personnel necessarily and directly incurred in connection with the performance of the Work.

E. Payments properly made by Design-Builder to Subcontractors and Design Consultants for performance of portions of the Work, including any insurance and bond premiums incurred by Subcontractors and Design Consultants.

F. Costs, including transportation, inspection, testing, storage and handling, of materials, equipment and supplies incorporated or reasonably used in completing the Work.

G. Costs less salvage value of materials, supplies, temporary facilities, machinery, equipment and hand tools not customarily owned by the workers that are not fully consumed in the performance of the Work and which remain the property of Design-Builder, including the costs of transporting, inspecting, testing, handling, installing, maintaining, dismantling and removing such items.

H. Costs of removal of debris and waste from the Site.

I. The reasonable costs and expenses incurred in establishing, operating and demobilizing the Site office, including the cost of facsimile transmissions, long-distance telephone calls, postage and express delivery charges, telephone service, photocopying and reasonable petty cash expenses.

J. Rental charges and the costs of transportation, installation, minor repairs and replacements, dismantling and removal of temporary facilities, machinery, equipment and hand tools not customarily owned by the workers, which are provided by Design-Builder at the Site, whether rented from Design-Builder or others, and incurred in the performance of the Work.

K. Premiums for insurance and bonds purchased specifically for this Project as required by this Agreement or the performance of the Work.

L. All fuel and utility costs incurred in the performance of the Work.

M. Sales, use or similar taxes, tariffs or duties incurred in the performance of the Work. Provided that if the Owner is exempt from such taxes and provides a tax exemption certificate or certificates to Design-Builder that effect, no such taxes shall apply.

N. Costs for permits, royalties, licenses, tests and inspections incurred by Design-Builder as a requirement of the Contract Documents.

O. Deposits which are lost, except to the extent caused by Design-Builder's negligence or default under this Agreement.

P. Costs incurred in preventing damage, injury or loss in case of an emergency affecting the safety of persons and property, except to the extent caused by Design-Builder or anyone performing Work on its behalf.

Q. Accounting and data processing costs related to the Work.

R. Other costs reasonably and properly incurred in the performance of the Work to the extent approved in writing by Owner.

S. Costs incurred by Design-Builder to provide the payment and performance bonds, warranties and guarantees with respect to the Work as provided herein.

9.03 *Non-Reimbursable Costs* The following shall be excluded from the Cost of the Work:

A. Compensation for Design-Builder's personnel stationed at Design-Builder's principal or branch offices.

B. Overhead and general expenses, except as provided for in Section 9.02 hereof, or which may be recoverable for changes to the Work.

C. The cost of Design-Builder's capital used in the performance of the Work.

D. If the parties have agreed on a Lump Sum Cost, costs that would cause the Lump Sum Cost, as adjusted in accordance with the Contract Documents, to be exceeded.

E. Any and all costs incurred by Design Builder, including but not limited to costs for project management and costs to comply with the General Conditions, to the extent that such costs would cause the Lump Sum Cost to be exceeded.

ARTICLE 10 – COMPENSATION AND PROGRESS PAYMENTS

10.01 ***General***

Payments to Design-Builder are governed in accordance with this Article and the General Conditions.

A. Design-Builder shall submit to Owner on the tenth (10th) day of each month, beginning with the first month after the Date of Commencement, Design-Builder's Application for Payment in accordance with the General Conditions.

B. Owner shall make payment within thirty (30) days after Owner's receipt of each properly submitted and accurate Application for Payment in accordance with the General Conditions, but in each case less the total of payments previously made, and less amounts properly withheld under the General Conditions.

C. All payments to Design-Builder exclusive of those made directly by Owner to any vendor to Design Builder will be made by electronic transfer to Design Builder's bank account. Design- Builder shall promptly provide Owner with wire transfer instructions for the making of such wire transfers to Design-Builder's bank account.

10.02 ***Retainage on Progress Payments***

Owner will retain five percent (5%) of each Application for Payment. Upon Substantial Completion of the Work, the retainage shall be reduced in accordance with the Design-Build Agreement.

10.03 ***Interest***

Timeliness and interest due or payments to the Design-Builder are subject to and controlled by Chapter 2251 of the Texas Government Code.

10.04 ***[INTENTIONALLY DELETED]***

10.05 ***Contract Price and Payment for Work Performed After Execution of Design-Build Agreement***

A. For the Design-Builder's performance of the Work after execution of the Design-Build Agreement, the Owner shall pay to the Design-Builder the Contract Price in current funds as agreed in the Design-Build Agreement. Notwithstanding any terms to the contrary, the provisions of this Article and the General Conditions shall control the obligations of the Parties with respect to payments made pursuant to the Design-Build Documents.

10.06 ***Construction Trust Funds***

A. Contractor shall comply with the provisions of the Texas Trust Fund Act, Chapter 162 of the Texas Property Code. With respect to payments made by the Owner, such funds are considered Trust Funds and shall be safeguarded and used as represented by Design-Builder to pay any consultants and subcontractors that may be due payment pursuant to the schedule of values.

ARTICLE 11 – PAYMENT APPLICATIONS

11.01 After execution of the Design-Build Agreement this Article shall be governed by the General Conditions unless specified otherwise herein. To the extent there is a conflict between the terms of this Agreement and the terms of the General Conditions, this Agreement shall prevail.

11.02 ***Contract Price***
The Contract Price is $**[AMOUNT]**.

11.03 ***Applications for Payment***
Applications for Payment shall be governed in accordance with the General Conditions.

11.04 ***Progress Payments***
Progress Payments shall be governed in accordance with the General Conditions.

A. After the Owner has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time limits required by the General Conditions.

B. The Design-Builder shall pay each Engineer, Consultant, Contractor, and other person or entity providing services or work for the Design-Builder no later than the time period required by the General Conditions.

11.05 ***Failure of Payment***
Failure of payment by Owner within the time limits required by the General Conditions shall entitle the Contractor to the remedies contained in Article 16 of the General Conditions.

ARTICLE 12 – FINAL COMPLETION

12.01 Final completion shall be governed in accordance with the General Conditions, except as otherwise set forth in this Article.

A. Timely final completion is an essential condition of this contract. Design-Builder agrees to achieve final completion of the Work within 30 days of the designated or extended substantial completion date subject to any extension of time set forth in approved Change Orders. The date of Substantial Completion shall be fixed by this Agreement, unless modified by Change Order, and memorialized by a Certificate of Substantial Completion as provided in the General Conditions.

ARTICLE 13 – OWNERSHIP OF WORK PRODUCT, COPYRIGHTS AND LICENSES

13.01 General Drawings, specifications, and other documents furnished by the Design-Builder, including those in electronic form, are Instruments of Service. As part of the total compensation which Owner has agreed to pay Design-Builder for the professional services to be rendered under this Contract, Design-Builder agrees that all finished and unfinished "Instruments of Service" including but not limited to documents, data, studies, surveys, drawings, specifications, field notes, maps, models, photographs, preliminary reports, reports, bid packet/construction contract documents/advertisement for bids incorporating any Owner standard provisions provided by Design-Builder, all of which are produced by Design-Builder and paid for by Owner are, and will remain, the property of the Owner. Architect will furnish Owner with electronic copies in .PDF format, to the extent they are available, of all of the foregoing to facilitate coordination; however, ownership of the underlying work product shall remain the intellectual property of the Design-Builder. Design-Builder shall have the right to use such work products for Design-Builder's purposes on this Project. However, such documents are not intended to be suitable for reuse by Owner or others. The above notwithstanding, Design-Builder shall retain all rights in its standard drawing details, designs, specifications, databases, computer software and any other proprietary and intellectual property information provided pursuant to this Contract.

13.02 The Design-Builder and the Owner warrant that in transmitting Instruments of Service, or any other information, the transmitting party is the copyright owner of such information or has permission from the copyright owner to transmit such information for its use on the Project.

A. The Design-Builder shall obtain non-exclusive licenses from the Engineer, Consultants, and Contractors, that will allow the Design-Builder to satisfy its obligations to the Owner under this Article 13.

B. In the event the Owner alters the Instruments of Service without the author's written authorization, the Owner releases the Design-Builder, Engineer, Consultants, Contractors and any other person or entity providing services or work for any of them, from all claims and causes of action arising from to such alteration. The terms of this Section shall not apply if the Owner rightfully terminates this Agreement for cause

ARTICLE 14 – CLAIMS AND DISPUTE RESOLUTION

14.01 General Claims and dispute resolution will be governed in accordance with the General Conditions.

ARTICLE 15 – BONDS AND INSURANCE

15.01 ***Insurance***

Design-Builder shall procure the insurance coverages set forth in Exhibit 5 attached hereto and in accordance with Article 6 of the General Conditions. Limits of Professional Liability to be limited to level of Professional Liability Insurance required under the Contract.

15.02 ***Bonds and Other Performance Security***

In accordance with Article 6 of the General Conditions and Texas Government Code chapter 2253, Design-Builder shall provide performance bond and labor and material payment bonds.

ARTICLE 16 – MISCELLANEOUS PROVISIONS

16.01 ***Governing Law***

The Contract shall be governed by the law of the state of Texas.

16.02 ***Venue***

This Agreement is entered into and performed in El Paso County, Texas, and the Design-Builder and the Owner agree that mandatory venue for any legal action related to this contract shall be in the District Courts of El Paso County, Texas.

16.03 ***Successors and Assigns***

The Owner and Design-Builder, respectively, bind themselves, their partners, successors, assigns and legal representatives to the covenants, agreements and obligations contained in the Design-Build Documents. Neither party to the Contract shall assign the Contract in whole or in part without the express written consent of the other. If either party attempts to make such an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract and the attempted assignment shall be of no legal force or effect as to the other party.

16.04 ***Written Notice***

Written notice shall be deemed to have been duly served if delivered in person to the individual, to a member of the firm or entity, or to an officer of the corporation for which it was intended; or if delivered at, or sent by registered or certified mail or by courier service providing proof of delivery to, the last business address known to the party giving notice. Written notice sent or transmitted by electronic mail or facsimile must be actually received to be considered delivered and to comply with notice requirements herein. Transmission alone by electronic mail or facsimile does not constitute delivery.

16.05 ***Rights and Remedies***

A. Duties and obligations imposed by the Design-Build Documents, and rights and remedies available thereunder, shall be in addition to and not a limitation of duties, obligations, rights and remedies otherwise imposed or available by law.

B. No action or failure to act by the Owner or Design-Builder shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

16.06 ***Divestment from Israel***

Design-Builder does not boycott Israel and will not boycott Israel during the term of the Agreement.

16.07 ***Interpretation***

Unless otherwise stated in the Design-Build Documents, words which have well-known technical or construction industry meanings are used in the Design-Build Documents in accordance with such recognized meanings.

This Agreement is entered into as of the day and year written above ("The Date of Execution"):

OWNER	**DESIGN-BUILDER**
EL PASO WATER UTILITY	**[NAME OF DESIGN-BUILDER]**
_____	_____
John E. Balliew	**[NAME OF SIGNATORY]**
President / CEO	**[SIGNATORY TITLE]**
_____	_____
Date	Date
APPROVED AS TO FORM:	APPROVED AS TO CONTENT:
_____	_____
Juan S. Gonzalez	Gilbert Trejo
Assistant General Counsel	Chief Technical Officer

Exhibit 1 – Lump Sum Cost

In entering into this Agreement, it is the understanding of the parties that Owner is relying on the engineering, design, and construction expertise of Design-Builder and its team of subcontractors to use their collective professional expertise to complete the design from the __% design provided by Owner to build and construct the Project according to the terms and conditions of this Agreement and its Exhibits or Attachments.

The Lump Sum Cost for this Project is $**[AMOUNT]**.

Exhibit 2 – Project Schedule

Design Period as submitted by the Design-Builder and agreed upon by the Owner.

Design Period starts once the Agreement has been fully executed.

Construction Period as submitted by the Design-Builder and agreed upon by the Owner.

Construction Period starts once Construction Notice to Proceed ("NTP") has been issued. The Construction Schedule has been attached to this Exhibit 2 and incorporated to this Agreement for all purposes as Exhibit 2-A. Modifications, Amendments, or Revisions to the Construction Schedule shall be added to this Exhibit 2-A and titled as the next, sequential letter (e.g. – Exhibit 2-B, Exhibit 2-C, etc.); subject to prior, written agreement upon by both Design-Builder and Owner.

Construction NTP will be issued once the Owner agrees that the design effort has reached a satisfactory level and is adequate for construction.

Exhibit 2-A

[Construction Schedule]

Exhibit 3 –Design Submitted by Owner to Design-Builder

Owner has provided to Design-Builder various drawings, plans and specification representing the Owner's expectations for meeting the Owner's Project Criteria. The Design has been attached to this Exhibit 3 and incorporated to this Agreement for all purposes as Exhibit 3-A. Modifications, Amendments, or Revisions to the Design shall be added to this Exhibit 3-A and titled as the next, sequential letter (e.g. – Exhibit 3-B, Exhibit 3-C, etc.); subject to prior, written agreement upon by both Design-Builder and Owner.

Exhibit 3-A

[Design]

Exhibit 4 – Project Cost Basis

[Design-Builder Proposal Attached]

Exhibit 5 – Insurance Requirements

1. At all times during the term of described in this Agreement at least the coverage and limits of insurance with insurers satisfactory to Owner set forth in this Exhibit as those required by Article 6 of the General Conditions. Should a conflict arise between the limit requirements of this Exhibit and the General Conditions, the higher limit of the two shall apply. Certificates of such insurance and evidence of policy endorsement for additional insured(s) and waiver of subrogation requirements, executed by the insurer in form satisfactory to Owner, shall be furnished to Owner immediately upon execution of this Agreement and prior to Design-Builder commencing work. Electronic copies of the policy documents associated with the insurance policies covered in this Exhibit 5 and Article 6 of the General Conditions shall be forwarded to OWNER no less than (5) days from the commencement of work.

2. Commercial Liability Insurance required as set forth below:

    2.1. Bodily injury and property damage coverage in limits not less than $**[AMOUNT]** Combined Single Limit for one occurrence.

    2.2. Coverage shall be at least as broad as the standard ISO occurrence, CG 00-01 and specifically include independent contractor and products/completed operations coverages.

3. Automobile Liability required as set forth below:

    3.1. Bodily Injury and Property Damage coverages in limits not less than $**[AMOUNT]** Combined Single Limits per accident.

    3.2. Policy shall be in a comprehensive form including coverage for all owned, hired, leased or non-owned vehicles.

4. Worker's Compensation and Employer's Liability shall be provided in accordance with the statutory limits required by law.

5. Professional Liability insurance shall be required with limits at $**[AMOUNT]**, on a claims made basis.

6. Policies written on a claims-made form (along with required endorsements) shall be kept in force during and for 3 years following work done under this Agreement.

7. The above insurance policies shall be endorsed to include a waiver of subrogation, a requirement that the insurer will provide owner with 30 days written notice prior to the effective date of any cancellation or change in the insurance, and, with the exception of the Professional Liability and Workers Compensation policies, and name Owner as an additional insured. Policies written on a claims-made form (along with required endorsements) shall be kept in force during and for 3 years following work done under this Agreement. Design-Builder shall submit certificates for each of the above insurances to the Owner before commencing work.

8. Design-Builder will provide electronic versions of the above insurance policies to Owner no more than 5 days after commencing work under this Agreement.

9. Owner reserves the right to demand that Design-Builder provide and furnish all applicable insurance policies which evidence the above insurance coverages at any point in time during the Work performed and for three (3) years following the completion of the Work.

Exhibit 6 – List of Owner's Permits

None. Owner shall not have any duty to obtain any permits in connection with the Work. All required permits and other government authorizations required in connection with the Project are to be obtained by Design-Builder in the performance of the Work.

Exhibit 7 – Forms of Payment Bond and Performance Bond

(Attached)

Exhibit 8 – General Conditions

APPENDIX H

SECTION 26 05 15 - ELECTRIC MOTORS

PART 1 - GENERAL

1.1 SUMMARY

A. This section describes materials, installation and testing of induction motors and applies to motors which are generally provided as part of equipment specified in other sections. The Supplier shall provide motors, accessories and appurtenances complete and operable in accordance with the individual driven equipment specifications.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Complete motor data shall be submitted, including:
1. Machine name and specification number of driven machine.
2. Motor manufacturer.
3. Motor type or model and dimensional drawing, including weight.
4. Horsepower nominal.
5. Guaranteed minimum full load efficiency. Also, nominal efficiencies at 1/2 and 3/4 load.
6. Full load speed.
7. Full load current at rated horsepower for application voltage.
8. Service factor, minimum 1.15.
9. Voltage, phase and frequency rating.
10. Winding insulation class.
11. Temperature rise class.
12. Frame size.
13. Enclosure.
14. NEMA design.
15. Thermal protection or over temperature protection.
16. Wiring diagram for devices such as temperature switches, space heaters and motor leak detection as applicable.
17. Bearing data, including recommendation of lubricants.
18. Inverter duty motor for all motors connected to variable frequency drive controllers. Include minimum speed at which motors may be operated.
19. Power factor at 1/2, 3/4 and full load.
20. Complete nameplate data, rating and characteristics.
21. Mounting arrangement, size and location of conduit entries, including lugs.
22. Factory test results for each motor.

1.3 QUALITY ASSURANCE

A. Provide routine (short commercial) test data complying with NEMA MG 1-12.51 and MG 1-23.46.

B. Test thermally protected motors in accordance with NEMA MG 1 winding temperature and trip current tests.

C. Comply with NEMA MG 1.

D. Motors for applications in hazardous locations shall bear the UL label listing its use in accordance with the NEC.

1.4 COORDINATION

A. Furnish reviewed shop drawings from motor controller manufacturer for coordination and sizing of the controller.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Unless otherwise specified or specifically required by the manufacturer of the equipment to be driven, all motors shall be single speed, squirrel cage, a-c induction type motors. Electric motors shall be NEMA Design B constant speed squirrel cage induction motors having normal starting torque with low starting current except for motors controlled by variable speed operation and other special motors. In no case shall starting torque or breakdown torque be less than the value specified in ANSI/NEMA MG 1. In all cases, motors shall be suitable for the indicated starting method.

B. Stator winding shall be copper.

C. The maximum motor loading of each motor shall not exceed its nameplate horsepower rating (exclusive of service factor) under any operating condition.

D. Motors shall be sized to start and accelerate the design loading and operate the full range of driven equipment without exceeding any of the specified design requirements. Motors that fail to meet these requirements shall be replaced at no additional cost to the Owner.

E. All three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated without exceeding Class B temperature rise limits stated in ANSI/NEMA MG1-12, 42. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated with variable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dt as defined in NEMA MG 1-31.

F. All motors shall have a minimum service factor of 1.15.

G. All motors shall be inverter duty rated when use with variable frequency drive.

H. Motors for use in hazardous locations shall have enclosures suitable for the classification of the location. Such motors shall be UL listed and stamped.

I. Motors larger than 50 HP installed outdoors or in unconditioned spaces shall have 120-volt AC space heaters and temperature sensors.

J. Resistance Temperature Detectors (RTDs)

Provide motors 200 horsepower and larger with a minimum of six (6), three-wire, 100-ohm, platinum RTDs, two (2) per phase, spaced equally around the circumference of the stator. Include three (3) additional spare RTD’s, one (1) per phase, as spares and label as SPARE.

Provide motors 200 horsepower and larger with three-wire, 100-ohm, platinum RTDs, one (1) per bearing.

K. Unless otherwise specified, motors shall have no-load sound power levels not to exceed the values specified in NEMA MG 1-12.53.3.

L. Premium Efficiency Motors:
   1. Motors with a nameplate rating of 1 horsepower and larger shall be premium efficiency type motors as determined by the testing set forth in ANSI/IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators, Method B. Motors shall be stamped with the efficiency on the nameplate with the caption “NEMA Nominal Efficiency.”
   2. Efficiency index, nominal efficiency and minimum efficiency shall be defined in accordance with ANSI/NEMA MG1-12.59 – Efficiency Levels of Energy Efficient Polyphase Squirrel-Cage Induction Motors. All three values are required to be indicated in the submittal.

2.2 MOTOR BEARINGS

A. All motors greater than 2 horsepower shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

B. Motors less than 2 horsepower shall be provided with sealed, permanently lubricated ball bearings.

C. Horizontal motors over 2 horsepower shall be shielded open-type bearing installed with labyrinth sealed end bells with pipe plugs. Bearings shall be regreasable and have provisions for purging old grease.

D. Vertical motors over 2 horsepower shall be provided with relubricatable ball, spherical, roller or plate type trust bearings. Lubrication shall be per manufacturer’s recommendation for smooth operation and long life of the bearing. Drains shall be provided to prevent over lubrication.

2.3 MOTOR THERMAL PROTECTION

A. All single phase motors shall have integral thermal overload protection or shall be current limited.

B. Winding thermostats or RTDs shall be provided in accordance with NEMA MG-1. Thermostats shall be snap action, bi-metallic, temperature actuated type switches and shall be provided with a normally closed contact. Thermostats shall be precalibrated by the manufacturer and shall be series connected.

2.4 ACCESSORIES

A. All vertical motors and horizontal motors 3 horsepower and larger shall have split-type conduit boxes with a gasketed moisture seal between the conduit box and motor frame. Motors less than 3 horsepower shall have the manufacturer’s standard conduit boxes. Motors other than open drip-proof shall be gasketed.

B. All motors shall have suitable lifting eyes for installation and removal.

C. Motor grounding lugs shall be provided and shall be suitable for terminating ground wires.

D. All motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data.

E. Refer to equipment specifications for special requirements such as space heaters or motor winding thermal protection.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. Protect motors from exposure to elements for which they are not designed. Install and energize temporary electrical service to motors with electrical heaters.

B. Store motors in an air-conditioned, ventilated or protected environment similar to or better than the destination environment.

END OF SECTION

SECTION 26 29 33 SOLID STATE REDUCED VOLTAGE STARTERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes
   1. Solid State Reduced Voltage Starter

B. Related Sections
   1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 QUALIFICATIONS

A. Manufacturer
   1. The manufacturer shall have a minimum of 15 years experience in the manufacturer of solid-state reduced voltage controllers.

B. Support
   1. The manufacturer shall maintain factory trained and authorized service facilities within 100 miles of the project and shall have a demonstrated record of service for at least the previous ten years.
   2. Support personnel are to be direct employees of the manufacturer.
   3. The manufacturer shall provide all required start-up and training services.

C. Certification
   1. To ensure all quality and corrective action procedures are documented and implemented all manufacturing locations shall be certified to the ISO-9001 Series of Quality Standards.
   2. Third party manufacturers and brand labeling shall not be allowed.

1.3 REFERENCES

A. The controller shall be designed to meet the applicable requirements of:

B. EN
   1. IEC
   2. UL
   3. CSA
   4. NEMA
   5. IEEE
   6. VDE

C. These standards shall include:
   1. Creep distances and clearances 600V (UL/CSA) and 690V (IEC)
   2. Power terminal markings per EN 50005 and EN 60947
   3. Dielectric withstand per UL508 and IEC947
   4. Noise and radio frequency (RF) immunity per NEMA ICSA1-109
   5. Surge withstand per IEEE587 and IEC 801-5

1.4 ENVIRONMENTAL REQUIREMENTS

A. Confirm to specified service conditions during and after installation of products

B. Maintain area free of dirt and dust during and after installation of products

1.5 PRE-MANUFACTURE SUBMITTALS

A. Shop Drawings
   1. Elevation drawings showing dimensional information
   2. Structure Descriptions showing
      a. Enclosure ratings
      b. Fault ratings
      c. Other information as required for approval
   3. Conduit locations
   4. Unit Descriptions including amperage ratings, frame sizes, trip settings, pilot devices, etc.
   5. Nameplate Information
   6. Schematic wiring diagrams

B. Product Data
   1. Publications on solid state reduced voltage controller.
   2. Data Sheets and Publications on all major components
      a. Contactors
      b. Circuit Breaker and Fuse information including time current characteristics
      c. Control Power Transformers
      d. Pilot devices
      e. Relays

C. Specification Response
   1. Detailed response to this specification showing where in the literature each requirement is satisfied.
   2. All clarifications and exceptions must be clearly identified.

D. Testing and Test Reports
   1. Testing shall be per manufacturer's standard.
   2. A copy of the test reports shall be provided as part of the Closeout documentation.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Division 01 Section 01 77 00, CLOSEOUT PROCEDURES for procedure on submittal of closeout documentation.

B. Contractor shall provide certification that the solid-state reduced voltage controller has been installed in accordance with the manufacturer's instructions.

C. The Contractor shall provide certification that the Contractor has properly adjusted any timing devices required in the starting circuitry.

D. Final Drawings. The manufacturer shall provide final drawings reflecting the "As-Shipped" status of the installed equipment. The contractor shall be responsible for making any changes to the "As-Shipped" drawings from the manufacturer to reflect any field modifications.

E. Maintenance Data
   1. Solid state reduced voltage controller installation instructions and User Manual
   2. Installation / Operation instructions for major components such as circuit breakers, contactors, etc.
   3. Parameter Listing
   4. Field Service report from start-up service
   5. Solid state reduced voltage controller spare parts listing and pricing
   6. Include name and phone number for a local distributor for the spare parts.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall coordinate the shipping of equipment with the manufacturer.

B. Contractor shall store the equipment in a clean and dry space.

C. The contractor shall protect the units from dirt, water, construction debris and traffic.

D. During storage the contractor shall connect internal space heaters (if specified) with temporary power.

1.8 FIELD MEASUREMENTS

A. The Contractor shall verify all field measurements prior to the fabrication of the solid state reduced voltage controller.

1.9 SPARE MATERIALS

A. Provide one (1) set of (3) of each size power fuse utilized.

B. Provide spares equal to 10 percent of the installed quantity for primary and secondary control power fuses.

C. Provide one (1) spare control relay for each unique relay utilized on the project.

1.10 WARRANTY

A. The manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.

B. The manufacturer shall confirm this warranty as part of the submittal.

C. This warranty applies only to stand alone solid-state reduced voltage controllers.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Rockwell Automation; Allen-Bradley Co.

2.2 RATINGS

A. The solid-state reduced voltage controller shall accept an input voltage of 480 VAC, three phase plus or minus 10 percent

B. Environmental Ratings
   1. Storage ambient temperature range: -20 to 75 degrees C.
   2. Operating ambient temperature range: 0 to 50 degrees C.
   3. The relative humidity range: 5% to 95% non-condensing.
   4. Operating elevation: up to 2000 Meters.

C. Definitions

1. The Solid-State Reduced Voltage Controller Unit shall refer to the actual controller unit that will be mounted within the specified enclosure.
2. The Solid-State Reduced Voltage Controller System shall refer to the controller unit and all items specified under Controller System Options.

2.3 SOLID STATE REDUCED VOLTAGE CONTROLLER UNIT DESIGN

A. The open-type controller device shall be modular, consisting of a power structure and a logic component.

B. Power Structure
1. The power structure shall include an SCR bypass.
2. The power structure shall include a built-in overload.
3. For ratings 1 Amps to 1250 Amps, the power structure shall consist of three power poles with integral heatsinks.
4. Power poles are to be modular in design that each is easily replaceable.
5. Back-to-back SCR pairs shall be the only power switching semiconductor means acceptable. Diode-SCR (Silicon Controlled Rectifier) combinations shall not be acceptable.
6. SCRs shall have the following minimum repetitive peak inverse voltage ratings.
   a. 1400V for units rated 200 to 480V
   b. 1600V for units rated 200 to 600V
   c. 1800V for units rated 230 to 690V

C. Logic Component
1. The logic component shall be a self-contained control module, compatible with the full range of power structures. The control module shall mount directly to the power structure.
2. The control module shall provide digital microprocessor control and supervision of all controller operation, including pulse firing of the SCRs.
3. The control module shall consist of the following.
   a. Self-tuning power supply accepting control power input from 100 to 240 VAC or 24V AC/DC, 50/60 Hz.
   b. Logic control circuitry incorporating a latch circuit for three-wire control.
   c. SCR firing circuitry that incorporates an RC snubber network to prevent false firing.
   d. Input / output circuitry
   e. Digital programming keypad
   f. Backlit LCD display
   g. DPI communication port.
4. The control module shall be easily removed from the power structure, without the need to disassemble associated printed circuit board assemblies.
5. The control terminals shall be easily accessible and located on the front top of the device. The terminals shall be UL rated for 300 Volts, 10 Amps maximum and accept a maximum of two wires rated number 18 to number 14 AWG.

2.4 CONTROLLER UNIT FEATURES

A. Starting Modes
1. The controller shall provide the following starting modes as standard.
   a. Soft Start with Selectable Kickstart
      1) Programmable initial torque value of 0 to 90 percent of locked rotor torque
      2) Programmable acceleration ramp time from 0 to 30 seconds
      3) A selectable kickstart, or boost, shall be provided at the beginning of the voltage ramp. The kickstart shall provide a current pulse of 550 percent of the full load current. The kickstart time shall be adjustable from 0 to 2 seconds.
   b. Current Limit Start

1) Provides means of limiting the maximum starting current
2) Programmable for 50 to 600 percent of full load current

c. Full Voltage Start
1) Provides across the line starting.
2) Ramp time shall be less than 0.25 seconds.

d. Dual Ramp Start
1) Provides two separate soft start profiles with separately adjustable ramp times and initial torque settings.
2) Programmable acceleration times from 0 to 30 seconds.
3) Programmable initial torque values from 0 to 90 percent of locked rotor torque.

Soft Stop
4) The Soft Stop option shall provide a voltage ramp-down for an extended motor stopping time.
5) Soft Stop shall be initiated by a dedicated Soft Stop input. A coast-to-rest stop shall still be possible with a separate stop input.
6) Programmable voltage ramp down time from 0 to 60 seconds.
7) The load shall stop when the motor voltage drops to a point where the load torque is greater than the motor torque.

e. Preset Slow Speed
1) Provides a slow speed for applications requiring a slow speed
2) The Preset Slow Speed option shall provide two jog speeds in the forward direction: high (15 percent of base speed) and low (7 percent of base speed).
3) The Preset Slow Speed option shall provide two jog speeds in the reverse direction: high (20 percent of base speed) and low (10 percent of base speed). Reverse operation of the motor shall be available in the jog mode without the use of a reversing contactor.
4) The starting current for the slow speed operation shall be user adjustable from 0 to 450 percent of the motor's full load current rating.
5) The running current for the slow speed operation shall be user adjustable from 0 to 450 percent of the motor's full load current rating.

2. The controller shall provide options for the following mutually exclusive starting and stopping modes. Refer to the system specifications for the option (if any) required.

a. Pump Control
1) The Pump Control option shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomena commonly referred to as "water hammer." Methods utilizing Soft Start with Soft Stop shall not be acceptable.
2) Closed loop control shall be achieved without using external sensors or feedback devices.
3) Pump Stop shall be initiated by a dedicated Pump Stop input. A coast-to-rest stop shall still be possible with a separate stop input.
4) Programmable starting time from 0 to 30 seconds.
5) Programmable stopping time from 0 to 120 seconds.

B. LCD Display
1. An alphanumeric, backlit LCD display shall be provided for controller set-up, diagnostics, status and monitoring. The display shall be four-line, 16 characters minimum.
2. Digital parameter adjustment shall be provided through a keypad. Analog potentiometer adjustments are not acceptable.

C. Overload Protection
1. Shall meet applicable standards as a motor thermal protective device.
2. Shall utilize three-phase current sensing. The use of two current transformers shall be unacceptable.

3. Selectable trip classes of 10, 15, 20 and 30 shall be provided as standard.
4. Electronic thermal memory shall provide enhanced motor protection.

D. Digital I/O
1. A minimum of four auxiliary contacts shall be provided for customer use.
2. The contacts shall be rated for 240 Volts AC maximum.
3. Contact configuration shall be programmable and contain the following configurations:
   a. Normal Operation (N.O. or N.C.)
   b. Up-to-Speed Indication (N.O. or N.C.)
   c. External Bypass
   d. Fault Indication (N.O. or N.C.)
   e. Alarm Indication (N.O. or N.C.)
   f. Network Controlled Output (N.O. or N.C.)

E. DPI Serial Communication Port
1. A DPI serial communication port shall be provided as standard.
2. A communication protocol interface module for connection to Ethernet shall be provided.

F. Monitoring
1. The controller shall provide the following monitoring functions indicated through the LCD display:
   a. Three-phase current
   b. Three-phase voltage
   c. Power in kW
   d. Power usage in kWh or mWh
   e. Power factor
   f. Motor thermal capacity usage
   g. Elapsed time

G. Protection and Diagnostics
1. The following protection shall be provided as standard with the controller:
   a. Pre-start line fault advising of shorted SCR or missing load connection with phase indication
   b. Running line fault advising power loss, shorted SCR or missing load connection.
   c. Pre-start power loss with phase indication
   d. Over-temperature
   e. Open Gate with phase indication
2. The following programmable protection shall be provided as standard with the controller:
   a. Underload
   b. Undervoltage
   c. Overload
   d. Overvoltage
   e. Voltage Unbalance
   f. Excessive Starts Per Hour
   g. Phase Reversal
   h. Stall
   i. Jam
3. When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.
4. Fault diagnostics shall be indicated in descriptive text on the LCD display. The exclusive use of fault codes is unacceptable.
5. An auxiliary contact that is programmable for fault indication shall be provided for customer use.

2.5 SOLID STATE REDUCED VOLTAGE CONTROLLER SYSTEM FEATURES

A. Enclosure
1. NEMA 12 enclosure for indoor use to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids. They shall be designed to meet drip, dust and rust resistance tests. No ventilation openings shall be allowed.
2. Paint: ANSI 49 Gray
3. Unless indicated differently, provide top entry and bottom exit for power cables
4. Provide a 6.25" x 2" door mounted white lamacoid nameplate with black letters (message to be defined during submittal).
5. UL Label

B. Transient Protection Modules
1. Transient protection with separately mounted protective modules.
2. Protective modules shall consist of metal oxide varistors (MOVs) in combination with capacitors to protect the power components from electrical transients and / or electrical noise. The capacitors shall be provided to shunt noise energy away from the controller's electronics.
3. The MOVs and capacitors shall be encapsulated in a clear material for easy inspection.
4. The protective modules shall be mounted so that they will not cause damage to the power components upon absorbing an electrical transient.
5. The MOVs shall be rated for a minimum of 220 joules.

C. Input Isolation Contactor
1. An input contactor between the AC line and the controller shall be provided.
2. The contactor shall have three N.O. and three N.C. auxiliary contacts.

D. Bypass Contactor
1. A bypass contactor with overload shall be provided.
2. The contactor shall have four N.O. auxiliary contacts.

E. Control Power Transformer
1. Provide a control power transformer mounted and wired inside of the system enclosure.
2. The transformer shall be rated for an additional 100 VA for customer use.
3. The transformer shall be provided with fused primary and secondary protection.

F. Selector Switches
1. Provide selector switches, mounted on the enclosure door, for the following operations:
    a. Local/Off/Remote mode
    b. Vibration Alarm Enable/Disable
    c. Soft Start/Off/Bypass mode
    d. Motor Start Permissive Enable/Disable
2. The devices shall be Allen-Bradley Bulletin 800E pilot devices (22.5mm, NEMA Type 4/4X/13) mounted on the enclosure door.

G. Pushbuttons
1. Provide pushbuttons, mounted on the enclosure door, for the following operations:
    a. Local Start
    b. Local Stop
    c. Vibration Alarm Reset
    d. Soft Starter Fault Reset
2. The devices shall be Allen-Bradley Bulletin 800E (22.5mm, NEMA Type 4/4X/13) pilot devices mounted on the enclosure door.

H. Pilot Lights
1. Provide pilot lights, mounted on the enclosure door, for indication of:

a. Test Run Mode
b. Motor Space Heater On
c. Vibration Alarm Disabled
d. Discharge Valve Closed
e. MPR Lockout
f. Motor Stopped
g. Running on Soft Starter
h. Running on Bypass
i. Vibration Alarm
j. Soft Starter Fault

2. Pilot lights shall be transformer type.
3. The devices shall be Allen-Bradley Bulletin 800E (22.5mm, NEMA Type 4/4X/13) pilot devices mounted on the enclosure door.

I. Pump Control Option
1. For pumping applications provide the Pump Control option.

J. Human Interface Module
1. Provide a door mounted Human Interface Module with integral display and programming keys.
2. The display shall show operating conditions, adjustments and fault indications.
3. The display shall be backlit LCD and shall consist of four lines of 16 characters alphanumeric.

K. Multifunction Protection Relay: Motor protection shall be provided by a microprocessor-based relay equipped with the following protection monitoring, control, automation and reporting functions. Self-checking functions shall be included. Specific requirements are as follows:
1. The relay shall include the following protection functions:
Motor Thermal Overload Model (49)
1) Provides integrated thermal protection for locked rotor starts, running over-load, imbalance current/negative sequence current heating, and repeated or frequent starting
2) Processes the stator and rotor models simultaneously
3) Supports high-inertia starts (requires voltage option and full-load slip setting)
4) Has settable or learned motor-stopped cooling time constant
5) Allows settable or learned starting thermal capacity
6) Provides ambient temperature biasing via external RTD input
a). Phase, neutral, residual, and negative-sequence overcurrent elements (50P/50N/50G/50Q)
b). Phase, residual, and negative-sequence time-overcurrent elements (51P/51G/51Q)
c). Motor differential current (87)
d). Current imbalance (46)
e). Over- and under frequency (81)
f). Phase reversal (47)
g). Load-loss (undercurrent) (37)
h). Load-jam
i). Anti-backspin timer protection
j). Starts-per-hour (notching or jogging device) (66)
k). Minimum-time-between-starts (66)
l). Start motor timer
m). Star-Delta starting
n). Two-speed motor protection
o). Forward/Reverse start protection
p). Speed switch input (stall)
q). Breaker/Contactor failure

2. When voltage inputs are specified, the relay shall provide the following protection elements:
    a. Over- and undervoltage (59, 27)
    b. Underpower (37)
    c. Reactive power (VAR)
    d. Power factor (55)
    e. Voltage-based over- and underfrequency (81)
    f. Loss of potential (60)
3. The relay shall offer the following temperature input features:
    a. Availability of as many as 12 RTD inputs in an external module (SEL-2600) or 10 RTD inputs with an internal card, which, when included, shall have the following features:
        1) Optical fiber transmission of RTD temperatures (using SEL-2600) to relay: range of up to 1000 m
        2) Separately field-selected RTD types: Pt100, Ni100, Ni120, or Cu10
        3) Noise immunity (50 Hz and higher) on RTD inputs up to 1.4 Vac peak
        4) One contact input (with SEL-2600)
    b. RTD inputs to the motor relay shall support the following:
        1) Thermal overload model biasing
        2) Temperature alarms and trips (49)
        3) RTD open- or short-circuit indication
    c. Capability of one PTC (positive temperature coefficient) thermistor input (49)
4. The relay shall offer the following programmable automation features:
    a. 32 local control logic points, 32 remote control logic points, 32 latching logic points, 32 counters, 32 math variables, 32 logic variables, and 32 timers
    b. SELOGIC® programming language with Boolean and math equations capability for logic and control capability
5. Communications/integration support shall include the following:
    a. ASCII, Modbus® RTU, DeviceNet, Telnet, FTP, Modbus® TCP/IP, and IEC 61850 protocols
    b. Digital Relay-to-Relay Communications. The relay shall have eight transmit and eight receive logic elements for dedicated relay-to-relay communications. These elements shall be available for use in control logic.
    c. One front-panel EIA-232 port and one rear-panel EIA-232 or EIA-485 port, one fiber-optic serial port, and single or dual-redundant, copper or fiber-optic Ethernet port
    d. Capability for an additional rear-panel EIA-232 or EIA-485 port
    e. Windows®-based PC software for settings and retrieving reports
6. The relay shall offer the following front-panel visualization features:
    a. The front panel shall be capable of displaying measured values, calculated values, I/O status, device status, and configuration parameters on a front-panel LCD display.
    b. The display shall have a capability to show rotating custom messages and data. Thirty-two display messages shall be provided.
    c. The front panel shall also have a minimum of six user-programmable LEDs and four user-programmable pushbutton controls with eight programmable LEDs.
7. Monitoring and reporting hardware functions shall offer the following:
    a. Motor start reports (up to as many as five of the latest starts)—Start data including currents, voltages (option), calculated percent slip, and percent rotor thermal capacity used are sampled at a settable rate for 720 sets of the motor start data
    b. Motor start trends—Starting time, maximum start current, minimum start voltage (option), and maximum start percent rotor thermal capacity use averages for each of the past 18 months, together with number of starts in each month
    c. Load-Profile Monitoring—Provide periodic snapshot (selectable rate from every 5 to 60 minutes) of as many as 17 selectable analog quantities.

d. Motor operating statistics—Starts, running time, peak/average data, and trip/alarm counters
e. Event summaries—Fault type and trip data including time of tripping
f. Event reports—15-cycle length (as many as 19 reports) or 64-cycle length (as many as 4 reports) with 16-samples/cycle resolution
g. Sequential Events Recorder (SER)—As many as 1024 time-tagged, most recent input, output, and element transitions
h. Data stored in nonvolatile, flash memory

8. Hardware features shall offer the following:
   a. Operating temperature range of –40° to +85°C
   b. Power supply input operating voltage range of 24–48 Vdc, 110–250 Vdc, or 110–240 Vac
   c. Demodulated IRIG-B time synchronization input capability or PTC input capability
   d. Optional 10 internal RTD inputs or 12 external RTD inputs
   e. 5 A or 1 A, ac current inputs IA, IB, IC, and IN with optional 2.5 mA sensitive IN input
   f. 300 V maximum, three ac voltage inputs and three phase motor differential current inputs
   g. Flexible, configurable I/O including digital I/O and analog I/O
   h. Electromechanical or fast, high-current interrupting (optional) digital outputs
   i. Optoisolated digital inputs
   j. Jumper-selectable current (up to ± 20 mA range) or voltage (up to ± 10 volts range) analog inputs
   k. Jumper-selectable current (up to ± 20 mA range) or voltage (up to ± 10 volts range) analog outputs
   l. Relay front panel shall meet the requirements of NEMA12/IP65
   m. Conformally coated circuit boards
   n. Class 1, Division 2 hazardous locations applications

PART 3 - EXECUTION

3.1 MANUFACTURER'S FIELD SERVICES

A. The service division of the manufacturer shall perform all start-up services. The use of third party supplier start-up personnel is not allowed.

B. Start-up personnel shall be direct employees of the manufacturer and shall be degreed engineers.

C. Provide a minimum of (2) hours of on-site start-up service for each controller (4 hours minimum).

D. At a minimum, the start-up service shall include:
   1. Pre-Power Check
      a. Megger Motor Resistances: Phase to Phase and Phase to Ground
      b. Verify system grounding per manufacturer's specifications
      c. Verify power and signal grounds
      d. Check connections
      e. Check environment
   2. Power-up and Commissioning
      a. Measure Incoming Power Phase-to-Phase and Phase-to-Ground
      b. Measure DC Bus Voltage
      c. Measure AC Current Unloaded and Loaded
      d. Measure Output Voltage Phase-to-Phase and Phase-to-Ground
   3. Record all measurements
   4. Tune for system operation

5. Provide Parameter Listing

3.2 TRAINING

A. Manufacturer to provide a quantity of (1) two hour session of on-site instruction.

B. The service engineer shall perform training.

C. The instruction shall include the operational and maintenance requirements of the controller.

D. The basis of the training shall be the installed controller, the engineered drawings and the user manual. At a minimum, the training shall:
   1. Review of the engineered drawings identifying the components shown on the drawings.
   2. Review starting / stopping options for the controller.
   3. Review operation of the Human Interface for programming and monitoring of the controller.
   4. Review the maintenance requirements of the controller.
   5. Review safety concerns with operating the controller.

END OF SECTION

SECTION 44 42 18 – INTEGRALLY GEARED SINGLE STAGE CENTRIFUGAL BLOWERS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification is intended to be used by El Paso Water Utilities (Owner) for the procurement of three (3) integrally geared single stage centrifugal blowers with local control panel and appurtenances as specified herein. The installation (both mechanical and electrical) of the blower equipment will be performed by the selected Design-Build Contractor. The installation location is the Blower Building located at the John T. Hickerson Water Reclamation Facility (JTHWRF), 701 Executive Center Blvd, El Paso, TX 79936.

B. These blowers will be used for supplying a variable volume of air to the EPW Hickerson WRF aeration basins. These three (3) new blowers will be installed in place of the three (3) existing blowers at the plant. The blowers, once installed and control system programmed, shall be able to operate in any combination of one (1), two (2), or three (3) blowers.

C. All equipment components shall be new. Both workmanship and materials shall be of the very best quality and conform to all applicable sections of these specifications. It shall be understood that components specified herein establish minimum requirements only.

D. Section includes integrally geared singe stage centrifugal blower including all related equipment, material, and appurtenances.

E. Related sections:
   1. Specification Section 26 05 15 “Electric Motors”

F. Equipment Number(s) and Tagging: Each item of equipment and each part shipped separately shall be tagged and identified with permanent markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.
   1. Blower Tag Numbers: **Blower No. 1**
      Blower No. 2
      Blower No. 3

G. Like items of equipment provided hereinafter shall be the end products of one manufacturer to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer’s services.

H. Unit Responsibility: The integrally geared single stage centrifugal blowers shall be provided complete with all accessories and appurtenances (including, but not necessarily limited to, electric motor, flexible coupling and guard for motor connection, blow off valves, discharge check valve, discharge isolation valve, pressurize oil lubrication system, vibration monitors, bearing temperature monitors, and control panels) be the end product of one Responsible System Supplier (RSS). The RSS shall furnish all components and accessories of the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment in operation in conformance with the specified performance, features, and functions.

I. It is possible that equipment arrangement may be modified by recommendations of the RSS to suit the project locations as long as the equipment fits within the allocated space and all code clearances are maintained. Modifications must be reviewed and approved by the Owner seven (7) days prior to the Bid (Proposal) Opening Date.

J. Governing Standards: Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances,

laws, and regulations, which pertain to such work. In case of a conflict between these specifications and any state law or local ordinance, the latter shall govern.

1.2 SUBMITTALS

A. General: Administrative, shop drawings, samples, quality control, and submittals shall conform to the requirements of request for quotations and the purchasing agreement.

B. In addition to the requirements of request for quotations and the purchasing agreement, the supplier shall submit the following additional specific information:

1. Equipment Submittals and Shop Drawings:
    a. Make, model and weight of each equipment assembly, including but not limited to: Blower, electric motor, flexible coupling and guard for motor connection, oil lubrication system, vibration monitors, and bearing temperature monitors.
    b. Manufacturer's catalog information, descriptive literature, specifications and identification of materials of construction with accompanying compatibility data.
    c. Detailed mechanical and structural drawings (drawn to scale) showing the equipment fabrications, all plans, elevations and cross section details of construction, dimensions and anchor bolt locations and interface with other items. Include: Dimensions, size and locations of connections to other work and weights of equipment associated therewith.
    d. Predicted Maximum Noise Levels: Sound pressure level in dBA at each octave band measured in shop, 6 feet from blower.
    e. Complete wiring diagrams, elementary or control schematics, including coordination with other electrical control devices such as the motor control centers. Suitable control panel outline drawings shall be furnished for approval before proceeding with manufacture. Standard preprinted sheets or drawings marked to indicate applicability to this purchase will not be acceptable.
    f. Performance data showing compliance with specification requirements.
    g. Motor characteristics and specifications:
        1). Descriptive bulletins
        2). Nameplate data
        3). Service factor of motor
        4). Efficiency at ½, ¾ and full loads
        5). Power Factor at ½, ¾ and full load
        6). Special features including instrumentation
2. Quality Control Submittals:
    a. Current ISO 9001-2008 certificate and UL/ULC certificates to accompany submittals.
    b. Certified copies of the results of all Factory Functional and Field Performance Test reports.
        1). Submit for the Owner's approval a copy of the proposed blower start-up testing log sheet.
    c. Certified copies of Factory Blower Performance at Primary(100%) and Turndown Design Points (with unit serial numbers indicated) in accordance with this Section and including the following:

1). Inlet Flow (scfm)
2). Inlet Pressure (psi)
3). Inlet Temperature (Deg F)
4). Inlet Relative Humidity (%)
5). Discharge Pressure (psi)
6). Brake Horsepower
7). Speed (rpm)
8). Surge conditions and Pulsating Range
9). Adiabatic Efficiency
10). Wire – to – Air Efficiency (kW Draw)

d. Complete factory performance curves showing discharge pressure versus capacity, and bhp at project site conditions specified herein and various vane positions.
e. Special shipping, storage and protection and handling instructions.
f. Manufacturer's printed installation instructions.
g. Manufacturer's Certificate of Proper Installation.
h. Operation and maintenance manual.

3. Pre-Shipment Submittals:
   a. Letter from factory confirming blower package is fully shop assembled and will meet the performance requirements specified herein.
4. Procurement Closeout Submittals: Service records for maintenance performed during start-up.

1.3 QUALITY CONTROL

A. Factory performance tests shall be conducted for the Blower/Motor unit furnished under this Section. Blower/motor unit shall be operated to test the preprogrammed parameters and the functionality of the blower protection devices i.e. surge, motor overload, bearing temperature and vibration monitoring devices, alarms and shutdowns and the blower factory mounted sensors.

B. Factory performance tests shall be witnessed by the Ownerat the Owner's cost. The manufacturer shall notify Owner at least 6 weeks prior to factory performance tests to allow for scheduling.

C. Tests shall be in accordance with the latest applicable ASME Power Test Code-10.

D. Tests shall determine actual air deliveries, differential pressures, speeds and electrical input energy requirements for the conditions described.

E. Sufficient test point readings shall be made to establish the head-capacity, efficiency, and brake horsepower curves for the Blower.

F. Submit certified Blower Performance Curves to the Owner for approval.

1.4 OPERATION AND MAINTENANCE (O&M) DATA

A. Furnish two bound (2) hard copies and one (1) electronic (.pdf file) of the complete O&M Manuals to the Owner.

B. O&M Manuals shall contain the following for The Unit (or Common Units) and System:
   1. Product Data:
      a. Include only those sheets that are pertinent to specific product.
      b. Clearly annotate each sheet to:

1). Identify specific product or part installed.
2). Identify data applicable to installation.
3). Delete references to inapplicable information.

c. Function, normal operating characteristics, and limiting conditions.
d. Performance curves, engineering data, nameplate data, and tests.
e. Complete nomenclature and commercial number of replaceable parts.
f. Original Manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
g. Spare parts ordering instructions.
h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, and terminals).

2. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
   a. Format:
      1). Provide reinforced, punched, binder tab; bind in with text.
      2). Reduced to 8-1/2" x 11", or 11" x 17" folded to 8-1/2" x 11".
      3). Where reduction is impractical, fold and place in 8-1/2" x 11" envelopes bound in text.
      4). Identify Specification section and product on Drawings and envelopes.
   b. Relations of component parts of equipment and systems.
   c. Control and flow diagrams.
   d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
3. Instructions and Procedures: Within text, as required to supplement product data.
   a. Format:
      1). Organize in consistent format under separate heading for each different procedure.
      2). Provide logical sequence of instructions for each procedure.
      3). Provide information sheet for Owner's personnel, including:
      4). Proper procedures in event of failure.
      5). Instances that might affect validity of guarantee or Bond.
   b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
   c. Operating Procedures:
      1). Startup, break-in, routine, and normal operating instructions.
      2). Test procedures and results of factory tests where required.
      3). Regulation, control, stopping, and emergency instructions.
      4). Description of operation sequence by control Manufacturer.
      5). Shutdown instructions for both short and extended duration.
      6). Summer and winter operating instructions, as applicable.
      7). Safety precautions.
      8). Special operating instructions.
   d. Maintenance and Overhaul Procedures:
      1). Routine maintenance.
      2). Guide to troubleshooting.
      3). Disassembly, removal, repair, reinstallation, and re-assembly.
4. Warranty, Guarantees and Service Agreement

C. Content for Each Electric or Electronic Item or System:
   1. Description of Unit and Component Parts:
      a. Function, normal operating characteristics, and limiting conditions.
      b. Performance curves, engineering data, nameplate data, and tests.
      c. Complete nomenclature and commercial number of replaceable parts.
      d. Interconnection wiring diagrams, including control and lighting systems.
   2. Circuit Directories of Panelboards:
      a. Electrical service.
      b. Controls.

c. Communications.
3. List of electrical relay settings, and control and alarm contact settings.
4. Electrical interconnection wiring diagram, including control and lighting systems.
5. As-installed control diagrams by control Manufacturer.
6. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Sequences required.
   c. Safety precautions.
   d. Special operating instructions.
7. Maintenance Procedures:
   a. Routine maintenance.
   b. Guide to troubleshooting.
   c. Adjustment and checking.
   d. List of relay settings, control and alarm contact settings.
8. Manufacturer's printed operating and maintenance instructions.
9. List of original Manufacturer's spare parts, Manufacturer's current prices, and recommended quantities to be maintained in storage.

D. Maintenance Summary:
1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format: Use only 8-1/2" x 11" size paper.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
4. Recommended Spare Parts and Pricing:
   a. Data to be consistent with Manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
   b. "Unit" is the unit of measure for ordering the part.
   c. "Quantity" is the number of units recommended.
   d. "Unit Cost" is the current purchase price.

1.5 DATA FOR MATERIALS AND FINISHES

A. Content for Applied Materials, and Finishes:
1. Manufacturer's data, giving full information on products:
   a. Catalog number, size, and composition.
   b. Color and texture designations.
   c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
   a. Manufacturer's recommendation for types of cleaning agents and methods.
   b. Cautions against cleaning agents and methods that are detrimental to product.
   c. Recommended schedule for cleaning and maintenance.
3. Content for Moisture Protection and Weather Exposed Products:
4. Manufacturer's data, giving full information on products:
   a. Applicable standards.
   b. Chemical composition.
   c. Details of installation.
5. Instructions for inspection, maintenance, and repair.

1.6 WIRE-TO-AIR EFFICIENCY

A. Certified test methods shall be submitted to the Engineer for approval prior to testing. Testing shall conform to ASME PTC10, but results shall show electrical kW meter data from a certified power meter, and air flow from an orifice plate flow meter with a factory calibration certification. Each blower will be tested completely with its respective Motor, valves, base plate, coupler, and

all other system components furnished with the blower system that will affect performance, without exception. Certified test results, along with the certified calibration certificates of the test equipment, shall be submitted to the engineer for evaluation prior to shipment to the job site. Test results will show direct power consumption in kW and air flow in SCFM. If penalties must be assessed, they will be assessed to the Contractor in the form of a change order (reduction) to the purchase agreement. The change order must be acknowledged and notarized prior to releasing the units for shipment to the job site.

1.7 WARRANTY

A. 5-year warranty on the entire base package, including motor, skid-mounted LCP, and skid-mounted instruments, and complete compressor core (including all internal parts of the core), beginning on the commissioning date, not exceeding 3 months after equipment delivery. The warranty shall stipulate that the equipment furnished is suitable for the purpose intended and free from defects of material and workmanship for the duration of the warranty. In the event the equipment fails to perform as specified, the RSS will promptly repair or replace the defective equipment without additional cost to the Owner.

B. For the duration of the 5-year warranty, inspection visits will be made by the blower manufacturer's factory service technician the on the first and third years, and by RSS's certified service technician for the second, fourth and fifth years.

C. During the fourth year of the warranty period or after 25,000 hours of operation (whichever comes first) preventative maintenance services will be carried out by blower manufacturer's factory service technician, including wearable and consumable parts, and Class A cleaning.

D. Spare or replacement parts identified within this specification shall not be used to address warranty repairs.

E. Parts availability shall be guaranteed from the manufacturer for 10 years after purchase. Should replacement parts not be available from the manufacturer, said manufacturer must replace all parts needed to bring the unit to an acceptable working condition.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Where a Manufacturer's standard equipment name and/or model number is listed, the equipment shall be provided as modified to conform to the performance, functions, features, and materials of construction as specified herein.

B. Manufacturers of components and accessories specified herein shall be as follows:
   1. Integrally Geared Singe Stage Centrifugal Blower with modulating inlet guide vanes and modulating diffuser vanes
      1) Howden (Turblex)

2.2 GENERAL REQUIREMENTS

A. All equipment shall be supplied complete. Parts shall have liberal strength, stability and stiffness and shall be especially adapted for the intended service. Ample room and facilities shall be provided for inspection, repairs, and adjustments.

B. Stainless steel nameplates giving the name of the Manufacturer, the serial number, model number, horsepower, speed, and any other pertinent data shall be attached to the blower and motor.

2.3 PERFORMANCE REQUIREMENTS

A. Each of the three (3) integrally geared single stage centrifugal blowers shall be furnished for the design operating points and conditions as follows:

1. The integrally geared single stage centrifugal blowers and associated electrical gear will be located indoors and shall be designed in accordance with Technical Specification Section 44 42 18.10 – Single-Stage Centrifugal Blower Data Sheet, which is included at the end of this specification.

B.
B.

B. The blower shall be capable of operating continuously and satisfactorily at any point between the minimum and maximum flows without surge, vibration, hunting, or excessive heating of the bearings.

2.4 INTEGRALLY GEARED SINGLE STAGE CENTRIFUGAL BLOWER

A. General
1. The blower shall be of the single-stage, centrifugal type with integral speed increasing gears. The gearbox input shaft of the gears shall be direct connected to the drive motor by means of a flexible coupling. The rotating element of each blower shall have a moment of inertia such that it can be accelerated and brought up to operating speed when the drive motor is started.

B. Blower Casing
1. Blower casings shall be constructed of Cast iron ASTM A48, Class 25 minimum, shall be smooth and free from all projections and shall be hand finished whenever necessary to obtain a high degree of smoothness. Casings shall be accurately machined to gauge, where necessary, to ensure interchangeability of all parts.
2. Eyebolts or lugs for lifting shall be provided in the casing as required to ensure easy handling.

C. Integral Gearbox
1. Each blower unit shall be provided with heavy-duty, industrial type, speed increasing gears integral with the blower designed to match the output speed of the motor to the speed of the blower.
2. Gears shall be helical, parallel shaft type and shall be made of case hardened alloy steel forgings with the gear teeth precision ground. All gears shall be manufactured in accordance with the American Gear Manufacturers Association “Standard Specification for Measurement of Sound on Enclosed Helical, Herringbone and Spiral Bevel Gear Drives” (AGMA 6025-C90) to a minimum AGMA quality number no less than 12, as specified in AGMA 2000/A88. Service factor used to size the gearbox shall be at least 1.8.
3. The gearbox housing shall be of close-grained cast iron ASTM A48, Class 30B, sufficiently rigid to maintain the shaft positions under maximum loads.

D. Seals
1. Restrictive type seals shall be provided between the casings and the shaft. Seals shall be of the labyrinth type design. Seals shall be machined for minimum clearance and minimum maintenance and shall be readily replaceable. The shaft seals shall be of a non-contact, multi-point labyrinth type and operated dry. A vented space between air and oil seals shall be provided. Any leakage shall be minimized by having small clearances between female and male parts. The female part shall be made of aluminum or bronze to avoid damage to the shaft in the event of a seal rub. Numerous slinger rings (diameter

changes) on the shaft shall be provided in the sealing area to ensure oil is centrifugally slung off the shaft. Uniform shaft diameter without multiple slinger rings in each sealing area will not be acceptable.

E. Shaft
1. The shaft shall be of sufficient diameter to operate at a minimum of twenty (20) percent below first critical speed and shall be machined from heat-treated, forged alloy steel and suitably ground. Any torsional resonances of the package shall be at least ten (10) percent from the normal operating speed.

F. Bearings
1. Hydrodynamic oil-lubricated bearings shall be of bronze construction.
2. Slow-speed-shaft radial bearings shall be of the cylindrical journal-type.
3. High-speed-shaft radial bearings shall be of a multi-segment, Babbitt-type and designed to suppress hydrodynamic instabilities and provide sufficient dampening to limit rotor vibrations.
4. Thrust bearings shall be multi-segment and designed for thrust in both directions.
5. Bearings shall be sized for a minimum expected AFBMA L-10 bearing life of 100,000 hours at design rated pressure and flow rate.
6. Bearings shall be fitted with temperature and vibration sensors compatible with the blower local control panels specified and installed by the manufacturer.

G. Oil Lubrication System
1. A water-cooled, pressure oil lubricating system shall be furnished and installed for each blower complete with all appurtenances necessary for a complete working installation as described herein. Each lubricating system shall have adequate capacity for effectively lubricating the blower bearings and gears.
2. A sufficient quantity of oil to flush and fill all blower lubricating systems shall be supplied, plus 5 gallons for makeup.
3. Each lubricating system shall consist of a blower shaft driven primary oil pump, auxiliary electric motor-driven oil pump, oil reservoir, oil cooler (heat exchanger), oil filter, piping, and miscellaneous indicating and control equipment.
4. All oil piping shall be cleaned and pickled in the shop. Any piping requiring field connections shall be sealed in the shop to prevent contamination.
5. The complete blower lubrication system shall be mounted to the blower skid.
6. The complete oil lubrication system shall be powered and controlled from the local blower control panel.
7. RSS shall provide a list of acceptable type and manufacturer of oil, and shall supply the oil required.

H. Impeller
1. The impeller shall be of the open radial flow type, with backward leaning blades and milled from forged aluminum alloy. Impellers constructed of any other method or material shall not be acceptable. The impeller must withstand corrosion up to 10 ppm of H_2S. The impeller shall be statically and dynamically balanced

I. Thrust Collar
1. Same as shaft material.

J. Flexible Couplings
1. The horsepower rating of each coupling is to be not less than 1.5 times the motor nameplate horsepower when the misalignment is within the coupling manufacturer's tolerance limit.
2. Coupling shall absorb shock and vibration and compensate for misalignment.
3. Couplings shall be dynamically balanced.

4. Coupling shall be designed and spacers provided to allow for inspection and removal of the drive end bearing without moving the blower, motor, or piping.
5. Provide a suitable coupling guard in compliance with OSHA standards. Coupling guard shall be painted “Safety Yellow”

K. Equipment Base and Mounting
1. The blower manufacturer shall furnish a single full-length structural steel base of adequate size to support the blower, gearbox, motor, and accessories.
2. Base shall be provided with rounded corners, machined support pads, and dowels for alignment of blowers and motors.
3. All seams and contact edges between steel plates and shapes shall be continuously welded and ground smooth.
4. Steel plates and shapes for base shall be ASTM A36 steel.
5. Detailed Drawings of the base shall be submitted to the Owner for review
6. The units shall be factory aligned on the base prior to shipment
7. The base shall designed for mounting on the project site’s existing concrete inertia block.
8. The blower unit shall be supplied with an anchorage system / hardware components (i.e. epoxy embedded anchors) provided by the manufacturer that is suitable for mounting to the project site’s existing concrete inertia block

L. Vibration Isolators
1. Furnish vibration isolators designed for a transmissibility of less than 2%.
2. Spring type with ¾” diameter tie down bolts.

M. Variable Vanes
1. Modulating inlet guide vanes and modulating diffuser vanes
    a. Each blower shall regulate flow with inlet guide vanes, variable diffuser vanes or both. The purpose of the inlet guide vane and variable discharge diffuser system shall be to facilitate turndown of each blower from 100% to 45% of capacity, while maximizing efficiency over the entire turndown range.
    b. If both sets of vanes are employed, the inlet guide vanes shall modulate simultaneously with the diffuser vanes to continuously optimize efficiency based on the three variables of discharge temperature, differential pressure, and machine capacity. The Manufacturer shall demonstrate in submittals and testing, the simultaneous efficiency optimization based on these three variables
    c. Variable inlet guide vanes shall be provided for capacity control and designed to obtain the highest efficiency over the entire regulating range. Vanes shall be aerodynamically shaped for maximizing efficiency
    d. Each variable vane assembly shall include a skid mounted 24 VDC linear actuator with built-in position feedback and continuous position transmitter. Power for the actuator shall come from the local control panel (LCP).
    e. The position of each set of vanes, from fully open to fully closed, shall be transmitted to the LCP via an analog signal. Position of both sets of vanes shall be indicated by an adjustable manual lever arm and calibrated dial on the blower, per set. The inlet guide vane, and the diffuser vane position shall be indicated on the LCP.
    f. Adjustable stops shall be provided to limit the minimum and maximum opening of the vanes. A mechanical pointer shall be provided for local indication of vane position. Limit switches to indicate opened and closed position and to interlock with the motor starting circuit shall be furnished. Switches shall be rated 120 volts ac, 10 amperes. A continuous position transmitter with a 4-20 mA output shall be provided to monitor vane position from minimum to full open. Vane position shall be indicated at the blower LCP.

N. Blower Monitoring Instrumentation
1. Provide the following factory mounted instrumentation for each blower:

a. Inlet air temperature gauge
b. Inlet air temperature transmitter (4-20 mA)
c. Surge switch
d. Discharge air pressure gauge
e. Differential pressure (inlet/discharge) transmitter (4-20 mA)
f. Oil temperature transmitter
g. Oil temperature gauge
h. Oil low pressure switch
i. Oil filter differential pressure switch
j. Vibration monitoring switches on Blower (2 each) and Motor (2 each)
k. Bearing temperature transmitters on slow and fast shaft (4-20 mA)
l. Bearing RTD's
m. Variable diffuser position transmitter
n. Inlet guide vane position transmitter

O. Motor
1. Provide squirrel-cage ac induction motor meeting the requirements of 26 05 15 – Electric Motors, and as specified herein.
2. Motor horsepower shall be 400HP or less for each blower.

P. Shop Coatings and Painting
1. Exposed metal surfaces including; motors, gear reducers, and drive assembly shall be factory prepared and primed and finish coated in with the manufacturer's standard painting system suitable for corrosive environments.

Q. Lifting Provisions
1. Provide lifting eyes on blowers, motors, and baseplate so that each major component of the blower system or entire unit may be removed.

R. Sound Enclosure
1. Blowers shall be provided such that sound enclosures, designed to limit ambient noise to 80 dB at 6-feet from the blower frame, can be added after installation of the blowers.
2. Design-Build Contractor shall coordinate dimensions with Manufacturer to ensure spacing is adequate to add future blower sound enclosures.
3. Enclosure shall be carbon steel and coated to prevent corrosion during prolonged use at a wastewater treatment facility.

2.5 ELECTRICAL COMPONENTS AND ACCESSORIES

A. General:
1. Conform with Division 26, ELECTRICAL.
2. Provide all necessary electrical components for a complete, functional system.
3. All electrical control panels and motor controllers shall be rated for operation in ambient conditions up to 122 degrees F.

2.6 INSTRUMENTATION AND CONTROLS

A. The Supplier shall provide a local blower control system to achieve the methods of control described herein. Each local blower control system shall be capable of connecting to a master blower control panel to be controlled as one system. The Specifications depict the minimum functional requirements of the control system to be provided. Provide all items not specifically called out which are required to implement the functions described herein. The Supplier shall provide all instrumentation and controls necessary to provide a safe and operable system. The specific control system proposed shall be subject to the approval of the Owner.

B. Local Blower Control Description

1. Each blower shall be capable of operating in a local or remote control mode through the use of a physical Local-Off-Remote selector switch located on the local blower control panel.
    a. Local: An operator shall be capable of starting and stopping the blower via both physical pushbuttons and interface with the OIT screen. The control panel shall send a signal to start and stop the reduced voltage soft starter (RVSS) based on the operator input.
    b. Remote: An operator shall be capable of starting and stopping the blower from the plant SCADA system and Master Blower control panel.
    c. Off: The blower shall stop and the local control panel shall send a signal to the plant SCADA system and Master Blower control panel indicating that the blower is in the off position.
2. The RVSS shall interface with the blower control panel for automated start and stop control. The RVSS shall include a hand-off-auto switch for local control of the RVSS or control through the blower control panel. Refer to the RVSS specification for additional RVSS control requirements.
3. Each blower shall provide control and monitoring of the motorized discharge and bypass valves as part of the complete blower control package.
    a. The bypass valve shall be controlled as required to provide unloaded start-up and stop functionality.
    b. The discharge valve includes an existing differential pressure switch measuring the pressure across the valve. The system shall monitor the contact from the pressure switch and open the discharge valve when the pressure switch contact is made.
    c. The existing valves include open and closed limit switches that shall be monitored by the blower local control panels.
4. The blowers shall start under an automatic sequence initiated by the local start signal. Upon signal to start, the PLC shall confirm that the inlet guide vanes and variable diffuser vanes are at a minimum, the bypass valve is open, and the discharge valve is closed. If components are not properly positioned, they shall move to their respective positions automatically via the PLC logic. Once all pre-start permissive signals are confirmed, the blower motor shall be started. A feedback signal from the RVSS shall be provided to confirm the RVSS has been energized. When the blower reaches operating speed, the PLC shall open the inlet guide vanes and discharge valve, close the bypass valve, and control the inlet guide vanes and variable diffuser vanes for automated flow control. Provide sequence fail alarm and trip if any portion of the start, run, or stop sequence is not properly executed.

C. Local Blower Control Panel

1. General:
    a. The control panel shall continuously monitor blower operation and stop the blower as required to prevent damage from mechanical failure, surge or improper manual operation. Time delays shall be provided to prevent nuisance alarms while starting the blowers and to prevent the re-start of rotating blowers. Blower shutdown for surge and overload shall be implemented following start-up override time delays. All blower protection functions shall be fully operable in both Local and Remote operating modes.
    b. The control panel enclosure shall be rated NEMA 12 and be constructed following UL standards.
    c. Power: 480 VAC, three-phase, 60 Hz, ampacity as required.
    d. The control panel shall include power distribution components, protective devices, and starting components for the auxiliary oil pump and electrically actuated modulating diffuser vanes.

e. The control panel shall include power distribution components, protective devices, and starting components for 480V, 3 phase power circuits for the existing discharge and bypass valve actuators.
f. Provide panel with 480V, 3 phase main circuit breaker, and provide main circuit breaker disconnect handle interlocked with control panel door handle.
g. Provide a control power transformer integral to the panel for providing 120VAC control power.
h. Provide an Uninterruptible Power Supply (UPS) for a minimum 1-hour operation of control panel components in the event of utility outage.
i. Surge protective devices (SPD) shall be provided to protect the electrical and control components from excessive voltage and current: type 2 SPD to protect the 120V loads. The SPD locations shall be strategically selected to have surge immunity and the MCOV shall be not less than 115% of nominal voltage.
j. Programmable Logic Controller (PLC):
    1) The PLC shall be pre-programmed with logic as required for performing and coordinating all specified control and communications functions further specified herein.
    2) PLC I/O for each card type shall provide 25% additional spares available.
    3) The PLC shall be capable of Ethernet I/P communication with the Blower Master Control Panel and plant SCADA system.
    4) PLC shall be Allen-Bradley CompactLogix.
k. Operator Interface Terminal (OIT):
    1) The OIT shall be capable of Ethernet communications.
    2) The interface shall include features to allow for equipment status monitoring, process data monitoring, setpoint adjustment, alarm notification, alarm viewing, and alarm acknowledgement and reset. Displays shall include intuitive, user friendly fault menus for ease of monitoring diagnostics and troubleshooting.
    3) OIT shall be Allen-Bradley PanelView Plus 7 with a minimum 10” screen size.
l. Equipment and controls furnished by other manufacturers shall be provided in accordance with their instructions, where applicable.

2. Local Blower Control Panel Operator Interfaces:
a. Hand Switches and Other Controls: Provide the following physical switches and buttons on the face of the panel:
    1) Local-Off-Remote Selector Switch
    2) Blower Start
    3) Blower Stop
    4) Alarm Reset
    5) Alarm Silence
b. Status Indication Lights: Provide the following physical lights on the face of the panel:
    1) General Alarm
    2) Blower Running
c. Operator Interface Terminal (OIT):
    1) Color graphic screens shall be provided at the OIT for the blower setpoints, operating control mode selections, and operating parameters. Each programmed screen shall provide equipment status and current process data.
    2) All operator control inputs and value displays not specifically identified herein shall be provided as an object on an appropriate screen of the OIT.
    3) A graphic screen showing the blower individually shall be provided to display blower status and a minimum of current process data including:
        a) Blower control mode
        b) Motor running horsepower
        c) Run/startup/coast down status

d) Alarm/warning status

4) An additional graphic screen showing each blower individually shall be provided to display:
   a) Motor current feedback.
   b) Motor horsepower.
   c) Motor temperature warning setpoint and feedback.
   d) Motor vibration warning setpoint and feedback.
   e) Blower vibration warning setpoint and feedback.
   f) Slow and fast shaft bearing temperature warning setpoint and feedback.
   g) Oil temperature warning setpoint and feedback.
   h) Inlet air temperature warning setpoint and feedback.
   i) Differential pressure warning setpoint and feedback.
   j) Oil filter differential pressure warning.
   k) Variable diffuser position.
   l) Inlet guide vane position.
   m) Surge and OL setpoint and feedback.
   n) Startup/coast down time delay setpoint and feedback.
   o) All other required setpoints.
   p) Blower/Motor protection setpoint adjustments shall only be made available through password protection.

5) A graphic screen shall be provided to indicate the cause of each blower related alarm or warning.

6) Setpoint entry and control mode selection:
   a) All setpoints, operating control mode selections, and tuning parameters used by the blower system during operation shall be entered directly on the OIT. All required setpoints for selecting and controlling the blowers shall be operator adjustable without program modification.
   b) All operator adjustable parameters shall be made in English units.

7) OIT shall incorporate the following graphic color standards:
   a) Gray shall indicate equipment is turned off.
   b) Green shall indicate equipment is turned on and running.
   c) Red shall indicate equipment has faulted or in an alarm condition.

3. Local Blower Control Panel External Interfaces: The local blower control panel shall interface with the existing discharge and bypass valves through digital inputs and outputs. Interface with the plant SCADA system and Blower Master control panel shall be through a network communication connection utilizing Ethernet/IP protocol and digital and analog I/O. The blower local control panel shall also be configured to monitor and control the blower Reduced Voltage Soft Starter (RVSS). The following identifies required external interfaces to items outside of the scope of supply of the blower system.

   a. Dry Contact Inputs:
      1) Bypass valve opened
      2) Bypass valve closed
      3) Discharge valve opened
      4) Discharge valve closed
      5) Discharge valve differential pressure switch
      6) Blower RVSS fault
      7) Blower RVSS running
      8) Blower RVSS auto-manual switch position
      9) Blower RVSS emergency stop pushbutton
      10) Blower Out of Service (OOS) from SCADA

   b. Dry Contact Outputs:
      1) Start signal to RVSS
      2) Blower local-off-remote switch in Off to plant SCADA

3) Blower local-off-remote switch in Local to plant SCADA
4) Blower general alarm to plant SCADA
5) Blower vibration and temperature alarms to plant SCADA
6) Motor vibration and temperature alarms to plant SCADA
7) Oil pressure and temperature alarms to plant SCADA
8) Blower RVSS fault to plant SCADA
9) Blower RVSS auto-manual switch position to plant SCADA
10) Open command to discharge valve
11) Close command to discharge valve
12) Open command to bypass valve
13) Close command to bypass valve
14) Blower Out of Service (OOS) to SCADA

c. Analog Inputs (4-20mA):
1) Total air flow rate from plant SCADA

d. Analog Outputs (4-20mA):
1) Variable diffuser vane position to plant SCADA
2) Inlet guide vane position to plant SCADA
3) Inlet air temperature to plant SCADA
4) Differential pressure to plant SCADA
5) Bearing temperature (slow and fast shafts) to plant SCADA

e. Ethernet communication
1) The local blower control panel shall interface with the plant SCADA system and Blower Master Control Panel via Ethernet I/P. Provide a complete data register of available data points for remote monitoring and controlling.

4. Alarms and Warnings:
a. All blower alarms and warnings shall be active in both local and remote modes of operation.
b. Alarms shall be identified for each blower/motor protection monitored parameter. Alarms resulting in blower shutdown shall be identified for any condition that may cause damage to the blower, motor, or related equipment. When any control loop or device failure activates an alarm, it shall be displayed on an alarm screen of the OIT.
c. Time delays shall be provided to prevent nuisance alarms and warnings during operation and while starting blowers.

5. Other Instrumentation and Controls: Provide all items not specifically called out which are required to implement the functions described herein.

D. The PLC and OIT shall be accessible for future program monitoring and revisions. If password protection of any kind is implemented, the vendor shall supply all passwords or other security information to the Owner and the Engineer.

E. The vendor shall furnish the Owner final as-built copies of documented PLC and OIT programs, on electronic media, suitable for future troubleshooting or modifications by others.

F. The vendor shall furnish the Owner two complete copies of the operations and maintenance manuals for all PLC and OIT components detailed in this specification.

2.7 TOOLS AND SPARE PARTS

A. Tools: The work includes furnish one complete set of special tools per blower, as recommended by the manufacturer, for maintenance and repair of each separate type of equipment; tools shall be stored in tool boxes, and identified with the equipment number by means of stainless steel or solid plastic name tags attached to the box.

B. Spare Parts:

1. All equipment shall be furnished with the specified manufacturers spare parts, as indicated in the individual equipment sections. Provide spare parts for the blower furnished.
2. Spare parts shall be tagged by project equipment number and identified as to part number, equipment manufacturer, and subassembly component (if appropriate). Spare parts subject to deterioration such as ferrous metal items and electrical components shall be properly protected by lubricants or desiccants and encapsulated in hermetically sealed plastic wrapping. Spare parts with individual weights less than 50 pounds and dimensions less than 2 feet wide, or 18 inches high, or 3 feet in length shall be stored in a wooden box with hinged wooden cover and locking clasp. Hinges shall be strap type. The box shall be painted and identified with stenciled lettering stating the name of the equipment, equipment numbers, and the words "spare parts." A neatly typed inventory of spare parts shall be taped to the underside of the cover.
3. At a minimum, provide the following spare/replacement for each blower furnished in substantial boxes with identifying labels and delivered to the vicinity of the project site or the Owner as directed:

Qty	Item
1	Set of all blower bearings
2	Oil filters
2-yr Supply	All oil lubricants. Oil and lubricants shall include summer and winter grades with reference to equal products of other manufacturers including lubricant requirements such as viscosity, AGMA #'s, etc.

4. At a minimum, provide the following spare parts for the control panel furnished:

Qty	Item
1	PLC processor
1	PLC I/O module of each type installed
1	Operator Interface Terminal (OIT) screen
2	Fuse of each type installed

PART 3 - EXECUTION

3.1 ASSEMBLY AND PREPARATION FOR SHIPMENT

A. The blower, including motor, shall be completely factory assembled, aligned, and securely crated for shipment. Accessory equipment which cannot be shipped assembled to the unit, such as shafts, baseplates, impellers, spare parts, and anchorage materials, shall be separately crated, clearly marked as to the contents, and shipped on the same shipment as the blowers.

B. Provide shipment weight of each crate, skid, or item to Owner at least 5 working days in advance of delivery.

C. For shipment, exposed surfaces subject to rust, such as mounting flange faces, etc., shall be covered with a rust-preventive compound such as Kendall No. 5, or equal.

3.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery of Materials: Products shall be delivered in original, unbroken packages, containers, or bundles bearing the name of the manufacturer.

B. Storage: Products shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.

C. Protection of Equipment: Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry at all times. Pumps, motors, drives, electrical equipment, and other equipment with anti-friction or sleeve bearings shall be stored in weather-tight and heated storage facilities prior to installation. For extended storage periods, plastic equipment wrappers shall not be used to prevent accumulation of condensate in gears and bearings.

3.3 INSTALLATION

A. Supplier shall provide three (3) hard copies of the Manufacturer’s installation instructions.

B. The Blower base shall be provided with suitable vibration isolators.

3.4 FIELD QUALITY CONTROL

A. After installation of all equipment has been completed, and as soon as conditions permit, the supplier shall provide a factory qualified technician to conduct an acceptance test of the Blower/Motor unit under actual operating conditions to determine that the operation is satisfactory and free from excessive vibration and noise.
   1. The tests for the Blower shall consist of 6 hours of operation, during which time the base load shall be carried by the Blower for a period of 3 hours. Submit for the Owner's approval a copy of the proposed log sheet on which shall be recorded all pertinent data.
   2. Readings shall be taken and recorded at 30 minute intervals during the 6 hour test period. The Manufacturer’s field service technician shall be present during the field test. All expenses for a satisfactory field test shall be paid by the Equipment Supplier. The test shall be performed in the presence of the Owner.
   3. Submit for the Owner's approval a copy of the proposed log sheet on which shall be recorded all pertinent data.
      a. The data shall include the following at a minimum:

1). Time of day
2). Power frequency
3). Power voltage
4). Power amperage
5). Kilowatts drawn
6). Inlet pressure
7). Inlet temperature
8). Discharge pressure
9). Discharge temperature
10). Capacity
11). Speed
12). Noise level (dBA)
13). Vibration level of motor and blower

4. At least 30 days prior to the scheduled testing, submit test procedures to the Owner for review and approval. Furnish all power, water, facilities, labor, supplies and test instruments required to conduct final acceptance tests. All alarm and shutdown devices shall be tested and calibrated during the acceptance test.

3.5 MANUFACTURER'S SERVICES

A. A manufacturer's representative for the equipment specified herein shall be present at the jobsite for the minimum person-days listed for the services herein under, travel time excluded:
   1. Installation, Startup and Testing Services:
      a. 2 person days for installation assistance, inspection, and certification of Proper Installation.
      b. 1 person-day for commissioning and functional performance testing.
      c. Provide Qualifications of Manufacturer's Representative.
   2. Training Services:
      a. 2 person days of prestart classroom or jobsite training of Owner's personnel.
         1). Day 1 for Owner's Operations staff
         2). Day 2 for Owner's Maintenance staff
      b. Training of Owner's personnel shall be at such times and at such locations as required and approved by the Owner.
   3. Automation & Control Programming Services:
      a. 3 person days of programming changes of LCP components as requested by the Owner.
   4. Provide letter from Manufacturer certifying the blowers were properly installed.

3.6 COMMISSIONING DATE

A. The commissioning date shall be defined as the first date in which each blower is placed in to beneficial use by the Owner.

3.7 FINAL ACCEPTANCE

A. The Owner shall provide a letter of Final Acceptance to the RSS when the following conditions are met:
   1. Installation, Startup and Testing Services have been completed.
   2. Training Services have been completed.
   3. On-site Automation &Controls Programming has been completed.
   4. Owner has received certification of proper installation letter from Manufacturer.
   5. Each blower has had at least 720 hours of satisfactory runtime under normal operating conditions.

END OF SECTION

SECTION 44 42 18.10 – SINGLE-STAGE CENTRIFUGAL BLOWER DATA SHEET

Equipment	CENTRIFUGAL BLOWER SINGLE-STAGE
Application	Wastewater Treatment Plant - Aeration Diffuser System
Blower Type	Single-Stage, Integrally-Geared Centrifugal
Installed Site City	El Paso, TX
Equipment Location	☒Indoor ☐Outdoor ☒Heated ☐Unheated ☐Roof over motor

BLOWER PERFORMANCE REQUIREMENTS

Capacity, SCFM measured at 14.7 psia, 68F, 36%RH	7,000				
Design Ambient Pressure	12.73 psia				
Gas Properties	Air at ambient conditions				
Installation Data: Elevation	3800 ft.	Latitude	31.795543	Longitude	-106.522865
Ambient Temperature	Minimum °C	-8 (17°F)		Maximum °C	40 (104°F)
ASHRAE Extreme Temp n=20 year (DB)	Minimum °C	-13 (8°F)		Maximum °C	44 (111°F)
Humidity	Minimum %	5		Maximum %	85
Design Discharge Pressure	8.0 psig (20.73 psia)				
Compressor Turndown % Capacity	100% to 45%				

100% Blower Capacity Curve Design Points

Design Point	Flow (scfm)	Discharge Pressure (psig)	Inlet Temp (F)	Relative Humidity (%)
1	7000	7.8	68	60
2	7000	7.3	68	60
3	7000	7.8	104	85
4	7000	7.8	36	10

BLOWER DRIVER

Blower Driver	Electric Motor as Specified in Section 26 05 15		
Horsepower – By Manufacturer	400	RPM	3600
Speed	☒Fixed ☐Adjustable		
Torque	☒Variable ☐Constant		
Volts	480	3-phase, 60 Hz.	
Starting Method	☒Reduced voltage Soft Starter (RVSS)		

BLOWER MOUNTING

Blower Mounting	Horizontal
Baseplate	Integral blower, driver baseplate with attached control panel
Blower Discharge Position	Horizontal
Blow-off Position	Auto, Vertical discharge with silencer

OIL COOLING

Oil cooler	☐Air-Cooled Radiator ☒Water-Cooled Heat Exchanger
Cooler Location	☒ Integral to Bower, ☐Remote _____
Cooler Design Load	BTU/Hr,

Air Properties	
Water Properties	Plant Water at 70°F Inlet, Allowable 20°F Temp Rise

WARRANTY

☐Standard ☐24-month 36-month ☐48-month ☒60-month ☐+6-month shelf