E-4

DATE SUBMITTED 09/27/2017

SUBMITTED BY Public Services Dir.

DATE ACTION REQUIRED 10/04/2017

Agenda Item No

CITY COUNCIL ACTION (X)
PUBLIC HEARING REQUIRED ( )
RESOLUTION ( )
RDINANCE 1ST READING ( )
ORDINANCE 2ND READING ( )
CITY CLERK'S INITIALS

IMPERIAL CITY COUNCIL
AGENDA ITEM

SUBJECT: **DISCUSSION/ACTION: PRESELECTION OF THE MAJOR EQUIPMENT RELATING TO THE WASTEWATER TREATMENT PLANT UPGRADE PROJECT.**

1. AUTHORIZATION TO SEEK RFP TO PRESELECT THE MAJOR EQUIPMENT TO BE UTILIZED AS PART OF THE WASTEWATER TREATMENT PLANT (WWTP) UPGRADE PROJECT.

DEPARTMENT INVOLVED: Public Services – Wastewater Treatment

BACKGROUND/SUMMARY
This equipment RFP allows the City to preselect the major equipment to be utilized as part of the Wastewater Treatment Plant (WWTP) Upgrade Project by soliciting firm proposals from various manufacturers. The equipment proposals will be evaluated based upon the criteria listed in the RFP, which includes capital cost, O&M costs, experience, warranty, local service, and operability. This process allows the City Staff and Design Team the opportunity to evaluate and select equipment that best fits the City's needs rather than accepting whatever equipment the low bid contractor includes with their bid. Once the equipment evaluations are complete, the vendors will be notified that their equipment has been preselected and will move forward as the basis of design. The Design Team will then utilize the information to complete the design specific to the equipment, which leads to a more complete and detailed design. The improvements in the design reduces the potential for change orders and delays during construction. The equipment will not be prepurchased by the City but rather preselected and included in the bid documents for construction. All purchase orders for the equipment will be issued by the successful contractor.

FISCAL IMPACT:

STAFF RECOMMENDATION: City Council authorizes staff/consultant to seek RFP.

MANAGER'S RECOMMENDATION: MANAGER'S INITIAL

MOTION:

SECONDED:
AYES:
NAYES:
ABSENT:

APPROVED ( ) REJECTED ( )
DISAPPROVED ( ) DEFERRED ( )

REFERRED TO:

City of Imperial
Wastewater Treatment Plant Upgrade Project

Equipment Procurement – Request for Proposals

Prepared for
City of Imperial, California

September 2017

ALBERT A. WEBB ASSOCIATES

AQUA ENGINEERING

Date: September 25th , 2017

To: All Prospective Suppliers

Re: Request for Proposals
FURNISH EQUIPMENT FOR
CITY OF IMPERIAL, CALIFORNIA
WASTEWATER TREATMENT PLANT UPGRADE

The purpose of this correspondence and enclosed materials is to invite your firm to submit a proposal for the City of Imperial, California (OWNER) for the effort described in the enclosed Scope of Work to furnish equipment in accordance with the enclosed **Request for Proposal (RFP) - Equipment for City of Imperial Wastewater Treatment Plant (WWTP) Upgrade**, General Conditions, and instructions for Suppliers.

A digital copy of your proposal must be received by the City no later than 3:00 pm Pacific Standard Time on November 1st, 2017. Proposals received after that time and date will be considered a late proposal and will be rejected without receiving any further consideration in the Award. Proposals must be clearly marked **Proposal - Equipment for City of Imperial California Wastewater Treatment Plant Upgrade.** The proposals will not be opened publicly at this time. Proposals will be analyzed based on the requirements herein. Notification of the OWNER'S decision to proceed with the equipment procurement will be given to all parties as soon as possible.

The project is subject to requirements of the American Iron and Steel (AIS) provisions. It is the responsibility of the supplier to provide proof of compliance with AIS requirements when submitting a proposal for this procurement.

Please contact the Design Engineer representatives, noted below to ask technical questions. Submitted written questions asked, and the written responses to questions, will be provided to all bidders via Addendum. Questions submitted less than five (5) business days before the due date may not be addressed.

Design Engineer representatives to contact for RFP copies or technical questions:

Justin Logan, PE
AQUA Engineering, Inc
JustinL@aquaeng.com
801-299-1327
533 W 2600 S
Bountiful, UT 84010

Brian Knoll, PE
Albert A. Webb Associates
Brian.Knoll@webbassociates.com
951-248-4279
3788 McCray Street
Riverside, CA 92506

Boris Petkovic, P.E.
AQUA Engineering, Inc
BorisP@aquaeng.com
801-299-1327
533 W 2600 S
Bountiful, UT 84010

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CITY OF IMPERIAL
Imperial, California

REQUEST FOR PROPOSALS

FURNISH EQUIPMENT FOR
WASTEWATER TREATMENT PLANT (WWTP) UPGRADE

INTRODUCTION

CITY OF IMPERIAL WASTEWATER TREATMENT PLANT (WWTP) hereby known as "**OWNER"** solicits interested and qualified firms to submit proposals for **furnishing and delivery of equipment for the City of Imperial WWTP Upgrade Project.** Furnish all permits, labor, materials, equipment, transportation, tools, supplies, onsite services, and appurtenances for satisfactory completion of all work.

I. GENERAL TERMS AND CONDITIONS

A. Proposal Submission

Proposal submittals are to be delivered on a flash drive and entitled, **Proposal - Equipment for City of Imperial California - Wastewater Treatment Plant Upgrade,** and are to be received no later than 3:00 p.m. Pacific Standard Time, November 1st, 2017 by the City:

Jackie Loper
420 South Imperial Avenue
Imperial, CA 92251
760-355-3336

Proposals will not be accepted in hardcopy or via Fax machine. Proposals must be in a fully searchable PDF file and must be in the format presented in Section VIII – Proposal Format. Proposal title should read **Proposal – Equipment for City of Imperial California – Wastewater Treatment Plant Upgrade.** Time is of the essence and any proposal or addenda pertaining to the RFP received after the announced time in accordance with the Pacific Standard Time clock(s) on Owner's computers and date for submittal will be rejected. It is the sole responsibility of the Supplier for ensuring that their proposals are acknowledged as received by Owner before the deadline. Proposals and/or any addenda pertaining thereto received after the announced time and date will be rejected. However, nothing in this RFP precludes the OWNER from requesting additional information at any time during the procurement process before or after the bid opening date and time.

Nothing herein is intended to exclude any responsible firm or in any way restrain or restrict competition. On the contrary, all responsible firms are encouraged to submit proposals. The OWNER reserves the right to award in part or in whole or to reject any or all proposals.

The EQUIPMENT SUPPLIER shall be experienced, reputable and qualified in the manufacture of the equipment to be furnished and unless noted otherwise in the technical specifications (Exhibit Two) must have supplied at least ten (10) systems of comparable size and complexity in the United States within the last (5) five years.

Any proposal submitted must include the Signature Sheet that has been signed by an individual authorized to bind the Supplier. All proposals submitted without such signature may be deemed non-responsive.

B. RFP Process

Suppliers are to submit written proposals, which present the Supplier's qualifications and understanding of the work performed. The Supplier's proposal should be prepared simply and economically and should provide all the information that it considers pertinent to its qualifications for the project and which respond to the Scope of Services and Evaluation Criteria listed herein. Emphasis should be placed on completeness of services offered and clarity of content.

Questions or objections to specifications, design criteria or other aspects of the RFP process must be received and acknowledged by the Design Engineer at least five (5) business days before the date and time at which proposals are scheduled to be received. Questions or exceptions furnished after this time may not be addressed or answered.

II. SPECIFIC TERMS AND CONDITIONS

A. Appropriations

The continuation of the terms, conditions, and provisions of this contract beyond the fiscal year is subject to approval and ratification by the City of Imperial and appropriation by them of the necessary money to fund said project/contract for each succeeding year.

B. Termination of Contract

It shall be the sole right of OWNER to terminate any contract upon written notification to the Supplier.

C. Insurance

The Supplier shall purchase and maintain in force, at their own expense, such insurance as specified in OWNER's Agreement for Equipment Purchase. The Supplier shall furnish a copy of an original Certificate of Insurance, naming OWNER as an additional insured. The Supplier shall furnish insurance in satisfactory limits, and on forms and of companies, which are acceptable to OWNER and shall require and show evidence of insurance coverage on behalf of any subcontractor (if applicable, before entering into any agreement to sublet any part of the work to be done under this agreement).

D. American Iron and Steel Provisions

The project is subject to requirements of the American Iron and Steel (AIS) provisions. It is

the responsibility of the supplier to provide proof of compliance with AIS requirements when submitting a proposal for this procurement.

III. PROJECT DESCRIPTION

The Imperial WWTP is located at 612 E. 14th Street, Imperial, California. The plant is owned by the City of Imperial. The plant receives and treats domestic, commercial, and industrial wastewater generated within the City of Imperial.

The plant produces secondary disinfected water and intends to produce recycled water meeting Title 22 requirements for unrestricted reuse in the future. The existing WWTP includes influent screening, oxidation ditches, clarification and UV disinfection. Solids from the treatment plant are placed on drying beds at the existing WWTP facility

The upgrades of the existing City of Imperial Wastewater Treatment Plant (WWTP) will include the modifications and upgrades to several of existing unit processes. Specifically, the WORK will include removal of one oxidation ditch and construction of a new Membrane Bio-Reactor (MBR) building with an overhead bridge crane and process basins plus installation of the MBR system, construction of external anoxic and aeration tanks and installation of aeration equipment. Existing fine screens will be modified to meet 2 mm screening requirements. The existing Headworks will be expanded to accommodate a new grit removal system and fine screen, and an overhead bridge crane will be incorporated into the Headworks awning. A new dewatering building will be constructed to house new dewatering equipment. The dewatering building will include an awning with a truck bay for solids collection. Dewatered solids will be placed on the existing drying beds.

The intent of this proposal is to obtain competitive pricing from qualified vendors for furnishing and delivery of the following pieces of equipment to meet specifications herein:

- Item #1 – One (1) Vortex Grit Removal System and one (1) Grit Washer
- Item #2 – One (1) Eductor Tube Mixing System for Anoxic Basin Mixing
- Item #3 – One (1) Fine Bubble Diffuser System (for Aeration Basins)
- Item #4 – One (1) Process and One (1) Membrane Scour Air Blower System
- Item #5 – One (1) Solids Dewatering System

IV. SCOPE OF WORK

A. General

The Supplier shall provide to OWNER all listed equipment, maintenance, and training. The Supplier shall assist the Design Engineer during the design process with technical information, dimensions, installation requirements / clearances, and other details to help ensure an adequate and efficient design suitable for the equipment.

B. Loss or Damage to Equipment

During shipment, Supplier shall assume all responsibility for loss or damage. Vendor shall be present during unloading of equipment and installation to ensure no damage is caused during those activities.

C. Training

The Supplier will provide, at their expense, all training required for the operation of any equipment. An instructional manual is to be provided for the equipment.

D. Follow Up Training/Inspections

The supplier will provide, at their expense, one additional trip to be onsite for two days at the six-month after equipment start-up date to provide an inspection of the equipment, additional operator training and to assist the operator with reviewing and performing operations and maintenance.

E. Award of Contract and Performance

Purchase of equipment may proceed only after being approved by OWNER and upon the Supplier receiving notice of such approval and written notification to proceed with submittals, production and delivery.

F. Delivery Timeline

Supplier's proposal shall include guaranteed times for submittals and delivery upon receipt of written notification of approval.

The work shall be completed within the number of calendar days listed in the Contract Completion Schedule below commencing on the date of written Notice to Proceed issued to supplier. Time of delivery will be considered in evaluating the Bids, thus, the Bidder may list below an alternate number of calendar days for completion of work. Bidder shall consider and include in the calendar days listed the time necessary for shop drawing review.

G. Contract Completion Schedule

Item of Work	Calendar Days for Completion: Contract Completion Time	Calendar Days for Completion: Bidder's Completion Time
1. Receipt by Owner of complete Submittal Package (includes 15 days for Engineer's review).	60*	_____
2. Delivery of equipment to the project site: Complete and Operable Equipment Ready for Delivery	225**	_____

* Commencing on Date of "Notice to Proceed" issued by Owner during the design phase of the project. Owner will transmit a "Notice to Proceed" to Equipment Supplier upon receipt by Owner of an executed Agreement, including insurance. Thereafter, the Equipment Supplier shall commence with the preparation of the Submittal Package.

**Commencing on Date of "Notice to Proceed" issued by the Contractor during the construction phase of the project.

Work shall be completed per the Contract Completion Time, unless Alternate Completion Times, herein references as "Bidder's Completion Time", is proposed by Bidder, as set forth herein, and is approved by Owner.

V. CONTRACT MANAGER AND EQUIPMENT

A. Contract Manager

The Supplier shall provide one Contract Manager who shall be responsible for the performance of the work. The name of this person and an alternate who shall act for the Supplier when the Manager is absent shall be designated in writing as part of this Proposal. The Contract Manager or alternate shall have full authority to act for the Supplier on all contract matters relating to the daily operation of this contract.

B. Equipment

REFERENCE ADDITIONAL REQUIREMENTS IN EXHIBIT ONE AND TECHNICAL SPECIFICATIONS IN EXHIBIT TWO

Supplier shall provide "New" equipment as defined as newly assembled for first-time use with new components. It must be eligible for the minimum warranty period required for each item.

VI. EVALUATIONS AND SELECTION PROCESS

A. Evaluation Criteria

The following criteria will be utilized in the evaluation of bids:

Operability – This criterion addresses the relative ease of operating and maintaining the system. Analysis is based mainly on the equipment provided in the bid and the operation & maintenance costs associated with the equipment. Equipment operability will be evaluated on the method for operation of the equipment as well as scheduled preventative maintenance. The Seller shall detail equipment operation and routine maintenance in their respective proposal. Key items that will be considered for this criterion are as follows:

- Energy efficiency
- Equipment that can be easily deciphered for operation and has controls and alarms that is easy to navigate and understand.
- Equipment that requires minimal preventative maintenance to maintain system performance.
- Equipment that allows for easy access for plant personnel to perform routine tasks without disrupting plant operation and without placing the personnel in harm's way.
- A lower cost for providing recommended spare parts.

Installed Capital Cost – Compares the actual cost of the equipment as well as basin/building footprint size and other factors that affect the total installation cost associated with the equipment. Each piece of equipment is inherently different,

and the Supplier shall provide as much information as possible to assist OWNER in determining final installation cost.

O&M Costs – Compares the estimated annual operating expenses and long-term maintenance/capital outlay expenses such as:

- Power consumption
- Chemical use (if applicable)
- Typical routine maintenance hours (per year)
- Costs for wear/replacement parts annual and over 20-year period.
- Other normal periodic costs such as major overhauls anticipated over 20-year period.

Experience – Used to compare the experience of the suppliers on facilities of similar size, complexity, and type of installation. Higher score will be assigned to the supplier that can demonstrate experience in facilities of similar size, complexity, and type of installation.

Lead Time – Lead time to receive submittals and lead time for delivery of equipment upon approval of submittals.

Local Service – Addresses the location of the nearest service center and their ability to assist with questions and potential problems. Detailed information should be provided on the capabilities of this service center and what parts are stocked there.

Warranties – Evaluate the warranty provided and any differences between vendor warranties. Favorable results will be given to suppliers that provide the following:

- Warranties of extended duration.
- Warranties that are not limited by proration.
- Warranties that also include service.
- Warranties that cover all parts and components of a system.

References – OWNER and Design Engineer will contact the references furnished with the RFPs and consider this input in the evaluation.

Owner's Preference – OWNER will provide input on the system that best fits its needs.

The following table indicates the established, weighted rating system:

Evaluation Criteria	Weighted Value
Operability	3
Installed Capital Cost	5
O&M Costs	5
Experience	4
Lead Time	2
Local Service	3
Warranties	3
References	2
Owner's Preference	4

B. Selection Process

Design Engineer will evaluate each item proposed using the evaluation criteria. A rating score between 1 and 5 will be assigned for the evaluation criteria for each proposed item. The score will be multiplied against the weighted value for each item to produce a total score. These scores will be totaled and the proposed item with the highest score will be recommended to OWNER for selection. Any information that will assist Design Engineer in evaluating the proposals based on the criteria listed above is encouraged. The technical proposal should address all the above items or the proposal will be considered non-responsive. OWNER reserves the right to reject any and all bids for the items associated with this RFP.

C. References

Unless noted otherwise in the Technical Specifications, supplier shall include a list of a minimum of five (5) references, from similar projects only, who could attest to the firm's knowledge, quality of work, timeliness, diligence, flexibility, and ability to meet budget constraints, include names, contact persons, and phone numbers of all references.

References may or may not be reviewed or contacted at the discretion of OWNER. Typically, only references of the top ranked shortlist of supplier or suppliers are contacted. OWNER reserves the right to contact references other than, and/or in addition to, those furnished by a supplier.

Inability to contact references due to erroneous or outdated reference contact information may impact the rating score for this evaluation criterion.

VII. BASIS FOR AWARD

A. General

Information and/or factors gathered during interviews, negotiations and any reference checks, in addition to the evaluation criteria stated in the RFP, and any other information or factors deemed relevant by OWNER, shall be utilized in the final award.

B. No Contact Policy

After the date and time established for receipt of proposals by OWNER, any contact initiated by any supplier with any OWNER representative concerning this request for proposals is prohibited. Any such unauthorized contact may be grounds for the disqualification of the supplier from this procurement transaction.

C. Request for Further Information

Questions which may arise as a result of this RFP may be directed to the Design Engineer Representative with a copy to the Design Engineer.

Design Engineer Representative:
Boris Petkovic, PE
AQUA Engineering, Inc.
borisp@aquaeng.com
533 W 2600 S #275
Bountiful, UT 84010
801-299-1327

Design Engineer Project Manager:
Brian Knoll, PE
Albert A. Webb Associates
brian.knoll@webbassociates.com
3788 McCray Street
Riverside, CA 92506
951-248-4279

D. Bid Awards

The Installation Contractor is scheduled to be selected and awarded in the third quarter of 2018 at which point the agreement including costs, scope of supply, and other services will be executed through the installation contractor.

VIII. PROPOSAL FORMAT

A. General

Proposals must be submitted in the format listed below and include fully completed Exceptions, References, and Signature Sheet as well as the Cost Proposal. **Failure to furnish the information required in this section may be cause for rejection of the bid. Exceptions to any design criteria, specifications or other requirements listed in this RFP must be specifically listed and stated in the RFP on the enclosed Exceptions form.** It is also highly encouraged that any exceptions be discussed with the Design Engineer prior to bid opening.

B. Required Proposal Format

1. Section 1 – Contract Manager

Provide name and contact information for a Contract Manager who will serve as the primary Supplier contact.

- Name:
- Title:
- Office address:

- Office Phone Number:
- Mobile Phone Number:
- E-Mail Address:

Name and address of manufacturer and manufacturer's primary contact (if different from that of seller).

2. Section 2 - Forms

The proposal must include all the required forms included as listed below:

- Completed Bid Form
- Completed Exceptions Form
- Completed Signature Form
- Completed References Form
- Completed Contract Completion Schedule
  - Lead time to prepare and deliver technical submittals and drawings.
  - Lead time to manufacture and deliver equipment to the job site upon receipt of approved submittals.
- Statement of Compliance with AIS requirements

3. Section 3 - Technical Literature and Information

- Detailed descriptive literature for all equipment being offered must be included with the proposal.
- Technical Specifications for proposed equipment (Three Part Specifications).
- Complete Bill of Materials identifying the scope of supply and materials of construction and protective coatings.
- Cut sheets for proposed equipment including motors and instrumentation.
- Drawings depicting:
  - Relevant dimensions,
  - Specific footprint and space requirements (including maintenance and service areas),
  - Appropriate cross sections,
  - Location of utility and/or ancillary service or equipment connections.
  - Electrical and instrumentation wiring drawings and requirements.
- Basic description of equipment controls and operation.
- List of optional cost adders (credits) for alternate materials of construction, instrumentation, and other accessories.
- List of spare parts and special tools included (the price for which is provided as a separate line item in the bid form).
- Any additional information and completed Information Tables specifically requested in the Technical Specifications.

4. Section 4 - Warranty and Service

- Warranty information meeting or exceeding the requirements listed in the technical specifications.
- Description and cost of any available extended warranties.
- Local service availability and/or nearest service center.

5. Section 5 - Preventative Maintenance Schedule and Cost

- The manufacturer's recommended preventative maintenance schedule for a 20-year service life for each piece of equipment proposed must be included with the proposal in the following format:
    - Maintenance Activity.
    - Specify if the activity can be completed "in house" or at the manufacturer's facility.
    - Frequency of Activity (Daily, Monthly, Annually, etc.).
    - Estimated Manhours required to complete the activity.
    - Cost of any replacement parts required to complete the activity.
- Estimate of annual power, chemical and/or any other consumable cost associated with the equipment operation.

6. Section 6 - Additional Bid Package Contents

In addition to the general and cost proposal items listed above, proposal packages must provide the following information:

- Any additional Information deemed pertinent for the evaluation criteria listed above.
- Additional Requirements identified and listed in Exhibit One.
- Specific requirements identified in Exhibit Two – Technical Specifications
- Statement acknowledging that the scope of supply will include design and calculations for equipment anchoring.

Proposal bonds are <u>not</u> required for this procurement.

C. Cost Proposal

All suppliers must utilize the format below to complete the bid forms and complete any other informational forms or tables furnished in the RFP packet. These forms will facilitate OWNER and Design Engineer's review of the proposals.

IX. BID SHEET AND ASSOCIATED SIGNATURE SHEET

BIDDING SHEET #1 – VORTEX GRIT REMOVAL CHAMBER SYSTEM AND WASHER

The undersigned hereby proposed to furnish and deliver the following items of equipment to OWNER, all in strict accordance with the attached and/or incorporated Additional Requirements, Technical Specifications, and Drawings, for the following Bid prices:

Bid Item A - Furnish one (1) vortex grit removal chamber system, to include any necessary pump(s):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for equipment.

Bid Item B - Firm Price for the supply of submittals and manufacturer's shop drawings **(Not to exceed 5% of Equipment price above. This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Taxes are not applicable for professional services.

Bid Item C - Firm Price for the supply of the manufacturer's recommended spare parts not included in the price above (attach list showing individual components and costs): (**This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for spare parts.

Bid Item D - Furnish one (1) grit washer:

$ _____ *
(Figures)

$ _____ *
(Written)

Bid Item E - Firm Price for the supply of submittals and manufacturer's shop drawings

(**Not to exceed 5% of Equipment price above. This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Taxes are not applicable for professional services.

Bid Item F - Firm Price for the supply of the manufacturer's recommended spare parts not included in the price above (attach list showing individual components and costs): (**This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for spare parts.

*** The above prices must include any applicable taxes by reason of this contract.**

Suppliers must include **all** proposed costs for performance under the contract, to include 8.0% taxes for equipment and spare parts as noted above. Suppliers must provide all personnel and other resources required to complete the contract. Suppliers are solely responsible for start-up and transition expenses. Any costs that cannot be determined, based on the available information, should be indicated and explained.

Does Proposed Equipment meet **All** of the Specifications? _____

If No, please make notations on Exceptions sheet.

SIGNATURE SHEET

I hereby certify that I am authorized to sign as a Representative for the Firm:

Name of Firm: _____

Address: _____

Fed ID No.: _____

Name: _____

Title: _____

Telephone (____) _____

Fax No. (_____) _____

Email: _____

Date: _____

My signature certifies that the proposal as submitted complies with all Terms and conditions as set forth in RFP.

_____

Representative Signature

My signature also certifies that this firm has no business or personal relationships with any other companies or persons that could be considered a conflict of interest or potential conflict of interest to OWNER, pertaining to any and all work or services to be performed as a result of this request and any resulting contract with OWNER.

To receive consideration for award, this signature sheet must be included with the bid form for each item.

BIDDING SHEET #2 – EDUCTOR TUBE MIXING SYSTEM FOR ANOXIC BASINS

The undersigned hereby proposed to furnish and deliver the following items of equipment to OWNER, all in strict accordance with the attached and/or incorporated Additional Requirements, Technical Specifications, and Drawings, for the following Bid prices:

Bid Item A - Furnish eductor tube mixer system for anoxic basins:

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for equipment.

Bid Item B - Firm Price for the supply of submittals and manufacturer's shop drawings (**Not to exceed 5% of Equipment price above. This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Taxes are not applicable for professional services.

Bid Item C - Firm Price for the supply of the manufacturer's recommended spare parts not included in the price above (attach list showing individual components and costs): (**This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for spare parts.

*** The above prices must include any applicable taxes by reason of this contract.**

Suppliers must include **all** proposed costs for performance under the contract. Suppliers must include **all** proposed costs for performance under the contract, to include 8.0% taxes for equipment and spare parts as noted above. Suppliers must provide all personnel and other resources required to complete the contract. Suppliers are solely responsible for start-up and transition expenses. Any costs that cannot be determined, based on the available information, should be indicated and explained.

Does Proposed Equipment meet **All** of the Specifications? _____

If No, please make notations on Exceptions sheet.

SIGNATURE SHEET

I hereby certify that I am authorized to sign as a Representative for the Firm:

Name of Firm: _____

Address: _____

Fed ID No.: _____

Name: _____

Title: _____

Telephone (____) _____

Fax No. (_____) _____

Email: _____

Date: _____

My signature certifies that the proposal as submitted complies with all Terms and conditions as set forth in RFP.

_____

Representative Signature

My signature also certifies that this firm has no business or personal relationships with any other companies or persons that could be considered a conflict of interest or potential conflict of interest to OWNER, pertaining to any and all work or services to be performed as a result of this request and any resulting contract with OWNER.

To receive consideration for award, this signature sheet must be included with the bid form for each item.

BIDDING SHEET #3 – FINE BUBBLE DIFFUSER SYSTEM

The undersigned hereby proposed to furnish and deliver the following items of equipment to OWNER, all in strict accordance with the attached and/or incorporated Additional Requirements, Technical Specifications, and Drawings, for the following Bid prices:

Bid Item A - Furnish one (1) fine bubble diffuser system for aeration basins:

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for equipment.

Bid Item B - Firm Price for the supply of submittals and manufacturer's shop drawings (**Not to exceed 5% of Equipment price above. This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Taxes are not applicable for professional services.

Bid Item C - Firm Price for the supply of the manufacturer's recommended spare parts not included in the price above (attach list showing individual components and costs): (**This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for spare parts.

*** The above prices must include any applicable taxes by reason of this contract.**

Suppliers must include **all** proposed costs for performance under the contract, to include 8.0% taxes for equipment and spare parts as noted above. Suppliers must provide all personnel and other resources required to complete the contract. Suppliers are solely responsible for start-up and transition expenses. Any costs that cannot be determined, based on the available information, should be indicated and explained.

Does Proposed Equipment meet **All** of the Specifications? _____

If No, please make notations on Exceptions sheet.

SIGNATURE SHEET

I hereby certify that I am authorized to sign as a Representative for the Firm:

Name of Firm: _____

Address: _____

Fed ID No.: _____

Name: _____

Title: _____

Telephone (____) _____

Fax No. (_____) _____

Email: _____

Date: _____

My signature certifies that the proposal as submitted complies with all Terms and conditions as set forth in RFP.

_____

Representative Signature

My signature also certifies that this firm has no business or personal relationships with any other companies or persons that could be considered a conflict of interest or potential conflict of interest to OWNER, pertaining to any and all work or services to be performed as a result of this request and any resulting contract with OWNER.

To receive consideration for award, this signature sheet must be included with the bid form for each item.

BIDDING SHEET #4 – PROCESS AIR AND MEMBRANE SCOUR AIR BLOWER SYSTEM

The undersigned hereby proposed to furnish and deliver the following items of equipment to OWNER, all in strict accordance with the attached and/or incorporated Additional Requirements, Technical Specifications, and Drawings, for the following Bid prices:

Bid Item A – Furnish process air and MBR scour air blower systems:

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for equipment.

Bid Item B - Firm Price for the supply of submittals and manufacturer's shop drawings (**Not to exceed 5% of Equipment price above. This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Taxes are not applicable for professional services.

Bid Item C - Firm Price for the supply of the manufacturer's recommended spare parts not included in the price above (attach list showing individual components and costs): (**This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for spare parts

*** The above prices must include any applicable taxes by reason of this contract.**

Suppliers must include **all** proposed costs for performance under the contract, to include 8.0% taxes for equipment and spare parts as noted above. Suppliers must provide all personnel and other resources required to complete the contract. Suppliers are solely responsible for start-up and transition expenses. Any costs that cannot be determined, based on the available information, should be indicated and explained.

Does Proposed Equipment meet **All** of the Specifications? _____

If No, please make notations on Exceptions sheet.

SIGNATURE SHEET

I hereby certify that I am authorized to sign as a Representative for the Firm:

Name of Firm: _____

Address: _____

Fed ID No.: _____

Name: _____

Title: _____

Telephone (____) _____

Fax No. (_____) _____

Email: _____

Date: _____

My signature certifies that the proposal as submitted
complies with all Terms and conditions as set forth in RFP.

_____
Representative Signature

My signature also certifies that this firm has no business or personal relationships with any other companies or persons that could be considered a conflict of interest or potential conflict of interest to OWNER, pertaining to any and all work or services to be performed as a result of this request and any resulting contract with OWNER.

To receive consideration for award, this signature sheet must be included with the bid form for each item.

BIDDING SHEET #5 – SOLIDS DEWATERING SYSTEM

The undersigned hereby proposed to furnish and deliver the following items of equipment to OWNER, all in strict accordance with the attached and/or incorporated Additional Requirements, Technical Specifications, and Drawings, for the following Bid prices:

Bid Item A - Furnish solids dewatering system:

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for equipment.

Bid Item B - Firm Price for the supply of submittals and manufacturer's shop drawings (**Not to exceed 5% of Equipment price above. This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Taxes are not applicable for professional services.

Bid Item C - Firm Price for the supply of the manufacturer's recommended spare parts not included in the price above (attach list showing individual components and costs): (**This price is *not* to be included in the equipment price above**):

$ _____ *
(Figures)

$ _____ *
(Written)

*Applicable tax rate is 8.0% for spare parts

*** The above prices must include any applicable taxes by reason of this contract.**

Suppliers must include **all** proposed costs for performance under the contract, to include 8.0% taxes for equipment and spare parts as noted above. Suppliers must provide all personnel and other resources required to complete the contract. Suppliers are solely responsible for start-up and transition expenses. Any costs that cannot be determined, based on the available information, should be indicated and explained.

Does Proposed Equipment meet **All** of the Specifications? _____

If No, please make notations on Exceptions sheet.

SIGNATURE SHEET

I hereby certify that I am authorized to sign as a Representative for the Firm:

Name of Firm: _____

Address: _____

Fed ID No.: _____

Name: _____

Title: _____

Telephone (____) _____

Fax No. (_____) _____

Email: _____

Date: _____

My signature certifies that the proposal as submitted complies with all Terms and conditions as set forth in RFP.

_____

Representative Signature

My signature also certifies that this firm has no business or personal relationships with any other companies or persons that could be considered a conflict of interest or potential conflict of interest to OWNER, pertaining to any and all work or services to be performed as a result of this request and any resulting contract with OWNER.

To receive consideration for award, this signature sheet must be included with the bid form for each item.

X. PAYMENT SCHEDULE

Payment for the work will be based on the Bid price and will be paid in accordance with the following schedules:

100% of the submittals bid item will be paid upon receipt and approval of the Submittal Package by OWNER and Engineer. This bid item will be paid by OWNER and should not be included in the other bid items.

The Installation Contractor will be assigned the remainder of the contract and will pay the Vendor as follows:

Item	Percent of Bid Price
Delivery of All Equipment to the Project Site	75%
Submission of Installation Certificate to OWNER	10%
Successful Equipment Start-Up, Test, and Training	10%
Final Payment (35 days after OWNER files Notice of Completion)	5%

Award of Construction Contract and Start of Construction for the project are scheduled to occur in the third quarter of 2018. All bid items that are awarded as part of this contract, will be assigned to the contractor and written into the construction bid documents. The proposed startup and operation of the project is scheduled to commence Fourth Quarter 2019. It is not the intent to withhold the Equipment Supplier's payment due to installation problems which are beyond his control.

XI. EXCEPTIONS

Please state below any and all exceptions that you are taking to any portion of this Request for Proposals. If not addressed below, OWNER then assumes that the vendor will adhere to all terms and conditions as contained in the proposal document. Vendor is responsible to reconcile, at vendor cost, any exceptions not listed in this section. Please provide additional lines or sheets as required.

XII. REFERENCES

Must list facilities of similar size with equipment of similar capacity.

Please list below name of business, address, telephone number, and contact person.

1._____

2._____

3._____

4._____

5._____

EXHIBIT ONE – ADDITIONAL REQUIREMENTS

for
EQUIPMENT FOR
CITY OF IMPERIAL
WASTEWATER TREATMENT PLANT UPGRADE

A. THE REQUIREMENT

Supplier shall furnish and deliver to the project site equipment as awarded and in accordance with this RFP. In addition, submittal packages, technical services during installation, instruction on operation, startup services, operational maintenance manuals, and all other items as hereinafter specified. The equipment shall be delivered to the site by Vendor (Supplier) where it will be unloaded, stored, and installed by the Installation Contractor.

B. LOCATION OF PROJECT SITE

The Plant's address is 612 E. 14th Street, Imperial, CA 92251.

C. DEFINITIONS

“OWNER” or “Owner” shall mean CITY OF IMPERIAL.

“Vendor” or “Seller” or “Supplier” or "Equipment Supplier" or "Equipment Manufacturer" or "Manufacturer" shall mean the successful Bidder entering into a contract with the “Installation Contractor” for furnishing of material, equipment, and/or services specified herein and in the Agreement.

The phrase "Installation Contractor" shall mean the construction contractor entering into a Contract with OWNER to purchase, receive, unload, store, and install the equipment furnished by the Supplier.

“Design Engineer” shall mean Albert A. WEBB Associates and AQUA Engineering.

D. RESPONSIBILITY OF EQUIPMENT SUPPLIER

Supplier shall accept risk of loss responsibility until all of the following have been completed: (i) the equipment is delivered to the Project site and examined by Owner, Installation Contractor, and Supplier's representative; (ii) the equipment is found to be in suitable condition and properly prepared for storage; and (iii) the equipment is formally accepted by OWNER as set forth herein.

The Equipment Supplier shall obtain at his expense all licenses, permits and other approvals necessitated by his operations.

In accordance with generally accepted practices for the type of work to be performed by the Supplier, the Supplier will be solely and completely responsible for conditions of the job site for which the Supplier is responsible, including safety of all persons and property during performance of the work.

Equipment being furnished and delivered, including components, materials, fabrication, and delivered product, shall be subject to rigid inspection by Owner and Installation Contractor. Owner may at Owner's expense visit the manufacturing facility to inspect the equipment during fabrication. Equipment Supplier shall maintain a current monthly schedule of fabrication and be prepared for unannounced inspection by Owner. Equipment Supplier shall cooperate with Owner to readily permit said rigid inspection by Owner.

E. GENERAL DESIGN CRITERIA

Equipment shall be designed based on the following criteria and specific performance requirements specified in the Equipment Technical Specifications (EXHIBIT TWO). The following design parameters are given to provide a design, sizing, and performance basis for the required equipment. It is the responsibility of the bidder to guarantee compliance with these specifications and the operation of the equipment for its intended use.

1. PROCESS DESCRIPTION

   The treatment plant is designed as a membrane bio-reactor (MBR) facility and will include fine screening and grit removal. Anoxic and aerobic basins will be constructed for conventional activated sludge treatment. Eductor tube mixers will be used for mixing in the anoxic basins. Fine bubble diffusers will be installed to provide mixing and oxygen transfer in the aerobic basins. Flow from primary treatment facilities (screening and grit removal) will mix with the Return Activated Sludge (RAS) and will be pumped into the anoxic basins. From the anoxic basins, the flow will pass through aerobic basins and will gravity flow into a MBR influent channel, then to the MBR tanks, to an effluent channel and then 1Q will be released for disinfection while 4Q will gravity return to the process tanks. Permeate from the MBR modules will be disinfected in a UV system. Effluent from the UV system will flow to the plant outfall and released to Dolson Drain. In the future, the UV system will be upgraded to meet Title 22 reuse requirements and the effluent will be pumped to an appropriate reuse system. Waste Activated Sludge (WAS) removed from the MBR process will be pumped to dewatering. Following dewatering, solids will be disposed off-site. A preliminary site layout is provided in drawing C-1 included in EXHIBIT THREE.

2. SITE CHARACTERISTICS*

Site Elevation:	59.1 feet BELOW sea level
Maximum Temperature:	124° F
Minimum Temperature:	16° F
Average Annual Max. Temperature:	88.1° F
Average Annual Min. Temperature:	57.8° F
Average Annual Precipitation:	2.84 inches

   *From Western Regional Climate Center, wrcc.dri.edu, Imperial, CA General Climate Summary (1901-2012)

3. INFLUENT FLOW CHARACTERISTICS

General: The flow entering the Imperial WWTP can be classified as standard domestic municipal waste with less than 10% from commercial and industrial connections. The following characteristics shall apply:

Influent Characteristics:

BOD	300 mg/L
TSS	300 mg/L
TKN	50 mg/L
Design Average Daily Flow	2.4 MGD
Design Peak Hourly Flow	5.3 MGD
Design Peak Day Flow	4.2 MGD
Future Average Daily Flow	3.0 MGD
Future Peak Hourly Flow	6.3 MGD
Future Peak Day Flow	5.25 MGD

Required Effluent Characteristics:

BOD	< 5 mg/L
TSS	< 5 mg/L
TN	< 8 mg/L
Ammonia-Nitrogen	< 5 mg/L
Current - UV UVT	65%
Current – UV dosage	24 mJ/cm2
Current – 30 day geo mean	126 E. Coli
Future - Turbidity	< 2 NTU
Future - Total Coliform	< 2.2 MPN/100 mL

Minimum Liquid Design Temperature = 15°C

1. EARTHQUAKE (LATERAL) AND WIND DESIGN

All equipment, its major components, anchorage parts, and bolts shall withstand stresses caused by ground movement (seismic forces) in accordance with 2016 California Building Code (CBC) and ASCE 7-10 Seismic Parameters for Site Class D, essential facilities in any horizontal direction and vertical direction. Safety factor for overturning shall be 1.5:1. Seismic coefficients are based on 2013 CBC.

The following factors shall be utilized as defined by said CBC:

S_s - 1.889 g
S_1 - 0.714 g
F_a - 1.00 g
F_v - 1.50 g
S_{MS} - 1.889 g
S_{M1} - 1.071 g

Seismic Importance Factor for anchorage of mechanical and electrical equipment I = 1.25.

Calculations and anchorage details shall be prepared by a State of California licensed structural engineer and submitted in accordance with the "Submittals" for all anchorage systems.

Wind design: Designs shall take in account wind speeds of 115 mph and exposure "C".

F. ADDITIONAL REQUIREMENTS

1. **Scope:**
   Bidders shall furnish complete equipment packages as described in the RFP and in the Bid Schedule with all associated equipment for a complete and functional system.

2. **Acceptable Suppliers:**
   Acceptable suppliers are listed under the specific Bid Item. This should in no way preclude others from bidding.

3. **Field service:**
   At a minimum, the equipment supplier shall provide the service of qualified representatives for two (2) trips and six (6) days to inspect the equipment installation, assist in start-up/initial operations, and instruct plant personnel in the proper operation and maintenance of the equipment. If more time is anticipated, indicate how many additional trips and additional man-days of field service should be added and provide an adder cost in the "Exceptions" table provided above. Likewise, if less time is recommended the supplier may provide a cost credit and description of the reduced service scope in the "Exceptions" table. **However, all service included in the proposal bid price shall be based on these minimum requirements**.

4. **Follow Up Training/Inspections:**
   The supplier will provide, at their expense, one additional trip to be onsite for two days at the six-month date after facility start-up to provide an inspection of the facility, additional operator training and to assist the operator with reviewing and performing operations and maintenance.

5. **Installation:**
   The Supplier shall provide written instructions and recommendations with the equipment, and approved shop drawings for the Installing Contractor's use in installing the equipment. Additionally, the Supplier shall provide the services of a qualified field representative employed by the Supplier to visit the project site to instruct the Installing Contractor's personnel, inspect, and insure that the installation is performed in accordance with their specifications. The Supplier shall furnish a certificate stating the equipment has been tested and is correctly installed, properly aligned and ready to be placed in regular operation.

6. **Start-up, field testing and operator training:**
   Shall be specified in the proposal and included in the purchase price. The Supplier shall provide the services of a factory trained representative of the Supplier to

provide training classes for the City's personnel in proper operation and maintenance procedures of the system.

7. **Codes and Standards:**
   In addition to specific standards and codes noted in technical specifications, the Equipment Supplier shall comply with the latest editions of the following codes and standards as the minimum when furnishing the work covered under these specifications:

   i. American National Standards Institute (ANSI)
   ii. American Society of Civil Engineers (ASCE)
   iii. American Society for Testing and Materials (ASTM)
   iv. American Water Works Association (AWWA)
   v. Hydraulic Institute Standards (HI)
   vi. American Society of Mechanical Engineers (ASME)
   vii. American Welding Society (AWS)
   viii. National Electrical Code (NEC)
   ix. Underwriters Laboratories, Inc. (UL)
   x. Institute of Electrical and Electronic Engineers (IEEE)
   xi. National Electrical Manufacturers Association (NEMA)
   xii. California Building Code (CBC)

G. DRAWINGS (FIGURES)

Supplier shall furnish relevant preliminary design drawings to help establish the available space and general design intent for the project.

H. WARRANTY/GUARANTEE

The Supplier shall provide to Owner, the warrantees, extended warranties/guarantees, and license agreements as specified in the Technical Specifications. Where not specified in Technical Specifications, the Supplier shall provide a minimum 12-month warranty. All materials comprising the system shall be warranted against premature failure when the system is operated in conformance with the EQUIPMENT SUPPLIER's written instructions. The warranty period shall start at the time of final payment per the payment schedule included in the Bidder's Proposal Documents. The EQUIPMENT SUPPLIER will describe the warranty offered, including any additions or options.

I. EQUIPMENT PERFORMANCE GUARANTEE

Supplier shall guarantee the performance of the equipment as specified in the Equipment Technical Specifications.

If the equipment does not meet the performance requirements, Supplier shall modify the equipment as necessary to achieve performance requirements per Equipment Technical Specifications. The Supplier shall be responsible for all costs associated with removals, replacement, and modifications required herein.

J. PROJECT SCHEDULE

Schedules for submittal of shop drawings and delivery of equipment are specified in the Completion Schedule. It is anticipated that award of a construction contract for project construction and installation of equipment will be made to the Installation Contractor in the Third Quarter of 2018.

K. PERMITS, CERTIFICATES, LAWS, ORDINANCES, FEES, AND ROYALTIES

Supplier shall, at his own expense, procure all permits, certificates, and licenses required of him by law for the execution of the work. He shall comply with all Federal, State, and local laws, ordinances, or rules and regulations relating to the performance of said work.

Supplier shall pay all royalty or license fees for use of patented devices or systems and shall protect OWNER from patent infringement litigation thereon.

L. SUBMITTALS

Supplier shall provide submittals, including shop drawings, erection instructions, and operation and maintenance manuals as specified. Payment for these submittals will be covered within the Construction contract.

Within 45 calendar days after date of award (or based on an accepted time proposed by the supplier in the Contract Schedule Form of this RFP), the Supplier shall submit to Owner for approval complete shop drawings and complete technical submittals. Shop drawings and submittals shall include, but not be limited to, the following:

i. Plans and elevations showing details, sizes and dimensions of all equipment, and locations of sole plates, anchor bolts, jacking devices, supports, anchor tie rods, turnbuckles, and all other devices used for supporting and anchoring the equipment and components.

ii. Drawings, weights, static and dynamic loads, and all other information necessary for the design of the equipment foundations, structures, and connections for lubricating, cooling, and piping required for equipment furnished.

iii. Usage, size, type, manufacturer, and complete description of all electric motors, gear drives, impellers, gates, and mounting details.

iv. Wiring diagrams showing required external connections. All wiring terminations shall be identified with terminal numbers. Interconnect diagrams for all equipment and filter controls.

v. Required control signal inputs and outputs.

vi. Detailed instructions for unloading, storing, and protecting all equipment during storage.

vii. Details, sizes, and locations of all connections for external piping, wiring, and conduit.

viii. Detailed description of controls and operation.

ix. Anchoring requirements and anchor bolt calculations developed and stamped by a professional structural engineer licensed in the State of California.

x. Equipment specific loadings and reactions required for foundation and support structure design.

xi. Materials used for the fabrication of the various components of the equipment to be furnished including thickness and ASTM designation where applicable.

xii. Surface finishes and protective coatings.

Additional drawings, instructions, or information which may be requested by Owner for erection, operation, and maintenance of the equipment or to determine compliance with the Agreement shall likewise be submitted for approval.

The drawings shall fully demonstrate that the equipment to be constructed will comply with the provisions of these Specifications and shall furnish a true and complete record of the equipment as manufactured and delivered.

If the drawings contain information which does not pertain to the equipment being furnished, Contractor shall either delete the information which is not applicable or plainly identify the pertinent information.

Shop drawings and data will be incorporated by the Owner as part of Contract Documents for installation of equipment.

M. ERECTION INSTRUCTIONS

Erection drawings shall be furnished as part of the formal submittal package.

Erection instructions shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment to be furnished and shall not include inapplicable instructions. Photographs, photocopies, and similar types of reproductions shall not be attached to pages. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book. Erection instructions shall include, but not be limited to, the following information:

i. Information pertinent to the erection of the equipment, including lifting requirements.

ii. Sequence of assembly and erection of component parts.
iii. Instructions including necessary drawings for unloading, storing, uncrating, and preparing equipment for erection and assembly.
iv. Instructions including necessary drawings for the erection, assembly, and alignment of equipment component parts.
v. Torque requirements for all bolts, nuts, and fasteners.

N. INFORMATION REQUIRED PRIOR TO DELIVERY OF EQUIPMENT

Supplier shall furnish Owner and Installation Contractor with the information listed below 45 days prior to scheduled delivery of the equipment:

i. Required unloading and lifting requirements.
ii. Complete shop drawings showing all equipment and components including complete wiring diagrams.
iii. Specific and detailed sequential operating steps required for startup of the equipment, including alignment and lubrication.
iv. Estimated net weights of parts of the equipment as they will be packaged for shipment; location of packages and estimated shipping times. Information shall be complete to permit the Installation Contractor to determine necessary unloading equipment.
v. Operation and maintenance information necessary for installation.

O. ENGINEERING SERVICES FURNISHED BY SUPPLIER

Owner shall have the right and option at any time up to final completion and acceptance of the Work to require Supplier to furnish, for the time stipulated in the Proposal and additional time at the daily prices quoted in the Proposal, a competent service engineer (Equipment Supplier's or Manufacturer's representative) to provide technical direction for the assembly, installation, startup, and testing of the equipment and their components.

The service engineer shall not assume executive charge of such work but shall provide technical direction so that Owner (to the extent that Owner follows the recommendations of the service engineer) will be relieved of claims that failure is due to improper work of installation. Supplier shall provide adequate written erection instructions from the Equipment Manufacturer for use by Installation Contractor and Owner. Equipment Manufacturer shall provide a Certification of Installation to Owner as specified herein.

Equipment Supplier shall include in the Proposal the cost of said service engineer to be at the Project site the number of man-days listed herein under Section F. “Additional Requirements.” Costs shall include travel and subsistence.

During startup and testing, the service engineer shall provide detailed instructions to Owner's personnel for operation of the equipment. These training services shall include post startup classroom and onsite instruction.

The service engineer shall be knowledgeable of construction safety practices and conduct himself in a safe manner when on the project site.

The service engineer shall be able to speak, write, and understand the English language and shall be completely familiar with the foot-pound-second system of measurement.

P. RIGHT TO OPERATE UNSATISFACTORY EQUIPMENT

If the operation of the equipment after installation proves to be unsatisfactory to Owner, Owner shall have the right to operate equipment until it can be taken out of service without injury to Owner for the correction of defects, errors, or omissions, provided the period of such operation pending the correction of defects, errors, or omissions shall not exceed one year without written consent of Owner and Contractor.

Q. OPERATION AND MAINTENANCE MANUALS

At the time of completion of delivery of all equipment, Equipment Supplier shall submit to Owner three (3) hard copy sets (bound) and one (1) electronic copy of detailed operation and maintenance manuals for all equipment and components furnished and operation of the equipment. These manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for starting up, operating, and maintaining the equipment. All illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment and components furnished and shall not include instructions that are not applicable. Photographs, photocopies, and similar types of reproductions shall not be attached to pages. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.

Owner will inform Equipment Supplier in writing within 60 calendar days after receipt that the manuals are approved as submitted or that revisions are required. If revisions are required, one set will be returned to Equipment Supplier with the required revisions indicated. The required revisions shall be promptly incorporated in the manuals. When approved, a total of four complete, identical sets of such revised manual shall be furnished to Owner. One manual will be provided to the Installation Contractor for his use. After startup and test, all revisions needed to make the manuals conform to the equipment as finally completed shall be made by the Equipment Supplier and sent to Owner for insertion into the four manuals to provide four complete manuals to Owner for final distribution.

Manuals shall include start-up, operation, shut down, trouble shooting, and other operating information for operator training and maintenance.

R. LOCATION OF EQUIPMENT AND ENVIRONMENTAL CONDITIONS

The equipment will be installed in various locations on the site (refer to drawing C-1 included in EXHIBIT THREE) and subject to varying environmental conditions. Equipment shall be specifically designed to function satisfactorily under project conditions. Supplier's Shop Drawings shall include specific details on portions of the equipment that are sensitive to any project-specific conditions.

S. SHIPPING, DELIVERY AND STORAGE

Equipment shall be fabricated, shipped, and delivered by Supplier to the Project site where unloading and storage will be performed by the Installation Contractor. The Supplier shall be responsible for and make good any and all damage until equipment is delivered to the jobsite. The Supplier shall fabricate and deliver materials to the jobsite to conform with the Installing Contractor's construction schedule, so as to minimize handling and onsite storage of the equipment. Supplier shall be responsible to notify Owner and Installation Contractor at least 10 working days prior to delivery and again 24 hours prior to arrival of equipment or components thereof to the Project site. The 24-hour notification shall include exact components being delivered and hour and date of arrival. Supplier shall coordinate all details of delivery with the Installation Contractor. Supplier's representative shall be present at time of unloading major equipment components to ensure that unloading is properly performed, components delivered are complete, and components are properly stored. Supplier shall provide complete written storage requirements, including any required maintenance during storage.

Shipments for equipment items which require forklifts or cranes for unloading shall be completed within five (5) working days commencing on a Monday through Friday. Since equipment will require a crane or forklift for unloading, ample notice to Installation Contractor is required. Unloading shall be performed between 7:00 AM and 4:00 PM. Equipment Supplier shall include, in his Bid for furnishing and delivery of equipment, standby costs for shippers to permit unloading as specified herein.

All shipments shall be properly boxed, crated, packed, or otherwise protected to prevent damage in transit, handling, unloading and storage. All parts shall be prepared for shipment so that slings for handling can be readily attached while the parts are on the truck. Where it is unsafe to attach slings to boxes, boxed parts shall be packaged with slings attached to the parts so that attachments can be readily made.

Before shipment, all painted surfaces shall be suitably wrapped or otherwise protected from damage. All pipe flanges shall be protected by flange protectors bolted on, metal plugs shall be screwed into all tapped holes, and all other openings shall be adequately protected to prevent entrance of dirt and moisture during shipment.

Shipments involving sea transportation shall be crated with dry materials, shall be packed with a desiccant, shall be sprayed or treated with a fungicide or given equivalent treatment, and shall be otherwise protected to ensure delivery with no fungus growth, rust, or other damage due to such transportation.

Supplier shall obtain all necessary permits required to transport the equipment to the delivery point and shall provide a representative to supervise the unloading and storage of the equipment on the Project site. Supplier shall repair or replace any equipment components or equipment damaged during shipment.

Each package shall be plainly marked with the following in a moisture-proof envelope and securely fastened to the outside of the container:

i. An identifying number, which also shall appear on the bill of lading and other documents relating to shipment.
ii. Name and address of Owner and Supplier.

iii. Sufficient information to identify the contents and, when possible, the name of the machine or equipment of which the contents form a part.
iv. Shipping weight.

Each package shall contain a detailed packing list containing package numbers and a description of the contents including quantities, part or unit identification, and part numbers if applicable.

Spare parts shall not be packaged with other material.

All equipment delivered by truck shall be capable of being unloaded from the truck bed with a forklift loader or from above with an overhead crane.

Copies of the packing lists and bills of lading shall be sent to Owner on or before the packages are shipped.

T. INVENTORY AND STORAGE

After equipment has been delivered and ready for storage, Supplier's representative shall perform an inventory inspection, with Owner and Installation Contractor present, of equipment delivered to the site to confirm that delivery is, in fact, complete. The Equipment Supplier's representative shall also check storage and certify in writing that equipment is stored properly. Once complete, the Equipment Supplier shall provide Owner with written notice that the equipment has been delivered, is complete, and is stored properly. The responsibility for the equipment thereafter becomes the Installation Contractor's, except for defective or missing equipment discovered during installation and startup.

U. INSTALLATION CERTIFICATION

Prior to startup, the Equipment Supplier's service engineer shall certify in writing to the Owner that the equipment has been installed in- accordance with the Equipment Supplier's recommendations and inspected by an Equipment Supplier's authorized representative, and serviced with the proper lubricants, that applicable safety equipment has been properly installed, that the proper electrical and mechanical connections have been made, and that the equipment is ready for startup and initial operation.

V. SAFETY REQUIREMENT

The equipment shall comply with the applicable requirements of the Safety Orders of the Division of Industrial Safety of the State of California. Copies of the Safety Orders are available at the Printing Division, Documents Section, State of California, Sacramento, California 95814.

W. LUBRICATION

Adequate provision shall be made for lubrication of bearing surfaces of all moving parts.

Before shipment, Supplier shall properly lubricate all moving parts of the equipment to ensure protection against corrosion during shipment, storage, and installation. Lubricants furnished shall conform to the Equipment Supplier's printed recommendations. Safeguards shall be provided where necessary to prevent operation of the equipment without proper lubrication.

All locations on the equipment which require grease lubrication shall be provided with Alemite lubrication fittings. All lubrication fittings shall be readily accessible. The grease passages and ports shall be designed so that grease is forced into the normally loaded sides of the bearings.

Supplier's engineering representative shall check all lubrication prior to start up. Equipment Supplier shall furnish lubricants for initial lubrication for protection of wearing surfaces during shipment and storage.

Supplier shall provide list of all lubricants necessary for operation to the Installation Contractor.

X. FOUNDATION

All equipment to be furnished under these Specifications shall be furnished with all necessary embedment items, anchor bolts, nuts, washers, soleplates, structural steel supports, anchor tie rods, turnbuckles, jacking pads, leveling jacks, and other material necessary for anchoring the equipment to the foundations. Supplier shall furnish loading and anticipated reactions for equipment to allow Engineer to properly design foundation and support structures.

Y. NOISE

The equipment furnished under these Specifications shall operate as quietly as practical design considerations permit and the design and construction shall be such as to reduce the noise to a minimum.

EXHIBIT TWO – TECHNICAL SPECIFICATIONS

BID ITEM #1 – VORTEX GRIT REMOVAL EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The supplier shall provide one (1) vortex grit trap mechanism, grit pump and one (1) grit washer for removal and dewatering of grit from a municipal wastewater stream. The grit trap mechanism, pump, and washer are to be installed outside exposed to the elements. The supplier shall provide all components and ancillary equipment for a complete and operable system. Piping between the grit pump and the classifier shall be provided by the installing contractor.
    1. Equipment for vortex grit trap shall include motors, drive head, impeller, impeller drive tube, bridge walkway, controls, and connection points to tie the grit trap into grit removal lines.
    2. The grit pump(s) shall include suction piping into the lower chamber, foot valves (if required), pump isolation valves, priming system and controls.
    3. The grit washer shall include the tank, spiral conveyor, motor, auger, trough, concentrator, and controls.
B. All equipment shall be provided by a single supplier. However, the Owner may select a different manufacturer for the grit trap mechanism and the grit washer if it is deemed to be in the best interest of the Owner.
C. Wastewater into the grit trap will have passed through 2 mm fine screens. All equipment specified herein is intended to be standard equipment capable of removing grit from raw wastewater. Equipment shall meet the design requirements listed in Part 1.5.
D. In the event that the grit removal systems is offline, the flow will be conveyed to a bypass channel.
E. An approximate area of 30 by 20 feet is available for grit trap installation. Grit trap systems with flexible installation layouts (influent and effluent channel configurations) may be preferred.
F. The EQUIPMENT SUPPLIER shall be experienced, reputable and qualified in the manufacture of the equipment to be furnished and must have supplied at least five systems of comparable size and complexity in the United States within the last five years. Equipment of comparable size and complexity shall have the following characteristics: grit removal system in activated sludge process for a municipal wastewater treatment plant having an average capacity of 5 MGD or greater.

1.2 ACCEPTABLE MANUFACTURERS:

A. Hydro International
B. Smith & Loveless
C. Huber Technologies
D. Or equal

1.3 SPECIFICATIONS AND STANDARDS

A. ASTM A36 – Carbon Structural Steel
B. ASTM A48 – Gray Iron Castings
C. ASTM A322 – Carbon and Alloy Steel Bar
D. ASTM A507 – Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled
E. ASTM A536-84 – Ferritic Ductile Iron Castings
F. ASTM A743 – Stainless Steel Casting
G. AISI 303 Stainless Steel
H. AISI 304 Stainless Steel
I. AISI 316 Stainless Steel
J. AISI 4130 Heat Treated Alloy Steel
K. AISI 4140 Heat Treated Alloy Steel
L. AISI 8620 Heat Treated Alloy Steel
M. AISI 17-4 Stainless Steel
N. ANSI 9 – Load Ratings and Fatigue Life for Ball Bearings
O. ANSI 11 – Load Ratings and Fatigue Life for Roller Bearings
P. American Institute of Steel Construction (AISC)
Q. American Welding Society (AWS)
R. American Structures Painting Council (ASPC)

1.4 ADDITIONAL SUBMITTAL REQUIREMENTS

A. In addition to submittal requirements specified in the general sections of this RFP, the EQUIPMENT SUPPLIER shall submit following information:

1. Complete Information Table included at the end of this Specification.
2. Standard field testing and operations and maintenance description and schedule.
3. Certified performance test data for the system proposed that the stated removal is achievable. The stated performance must be proven in full scale field testing utilizing certified grit removal efficiency test procedures as performed by qualified personnel.

1.5 DESIGN CRITERIA

Vortex Grit Trap Design Parameter	Units	Value
Required Capacity for Removal – Average Day	MGD	3.0
Required Hydraulic Capacity – Peak Hour	MGD	6.3
Minimum Removal of 2.65 SG Material @ 4.2 MGD	%	95% of 140 mesh particles
Minimum Turndown	-	5:1
Minimum Grit Concentrator Capacity	gpm	250
Maximum Organics Content in Dewatered Grit	%	10%
Maximum Water Content in Dewatered Grit	%	10%

1.6 PERFORMANCE GUARANTEE

A. The EQUIPMENT SUPPLIER shall provide performance test data showing through previous certified tests the stated grit removal efficiency of 95% down to 140-mesh (105 microns) in particle size. The stated performance must be proven in full scale field testing utilizing certified grit removal efficiency test procedures as performed by qualified personnel who have at least one (1) year experience performing the test.
B. At the six-month site visit, the SUPPLIER shall conduct testing of wastewater influent and effluent to the grit system to verify removal of grit in accordance with the requirements in Part 1.5. Testing shall be in accordance with the requirements specified in "Guidelines for Grit Sampling and Characterization", published by the Water Environment Federation in 2017. Where the system is not removing grit at the amount required, the SUPPLIER shall, at his own cost, provide solutions to achieve the grit removal indicated.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components of the grit collection equipment shall be amply proportioned for all stresses that may occur during fabrication, erection and intermittent or continuous operation.
B. Design and fabrication of structural steel shall be in accordance with AISC and AWS Standards.
C. The NFPA classification of the area where equipment is to be installed shall be Class 1, Division 2 where installed above the channel within a 10-foot envelope. All equipment installed below channel shall be Class 1 Division 1 and all pertinent equipment shall be designed for such an area.

2.2 VORTEX GRIT TRAP

A. The design of the grit trap shall direct inorganics to the storage hopper at the bottom of the grit chamber for removal by the grit pump. The supplier shall include in the proposal the required dimensions of the concrete structure, including inlet and outlet configurations and lengths, upper and lower chamber diameters and depths, as well as any other structural components that are to be provided by others. The trap shall be equipped with an impeller which shall be designed to suspending organic material to prevent it from entering the lower chamber.
B. The grit removal drive mechanism shall consist of an electrical motor, reduction units and bearings as required. The drive mechanism shall be sized with a service factor of 2.0 or greater and shall be designed for heavy duty 24-hour per day service.
C. The drive tube, which is driven by the main gear, shall have a minimum thickness of ¼" and shall be constructed of stainless steel.
D. The paddle assembly shall be constructed of stainless steel. A collar for affixing the assembly shall allow adjustment of the blade assembly in either an upward or downward position to ensure maximum grit removal.

E. Where required, inlet flow control baffles shall be provided, along with all mounting and anchorage hardware. Baffles and hardware shall be stainless steel.
F. Where a lower grit chamber fluidizing system is required or recommended, supplier shall provide all necessary valves, vanes, pumps and controls. Non-potable water will be available.

2.3 GRIT PUMPS

A. The grit trap shall be supplied with a single grit pump. Pump shall be designed specifically for pumping grit and shall both optimize wear resistance and maintain hydraulic performance as wear occurs. All internal clearances shall provide for the passage of a 4" spherical solid.
B. Bidders may elect to propose a self-priming or vacuum priming pumps. Pumps shall be installed above the grit trap. Supplier shall include all necessary appurtenances, including valves, air compressors, instrumentation and controls.
C. Pump impeller shall be a recessed design to reduce wear on the impeller. Pump parts exposed to abrasive wear shall be of all Ni-Hard or Hi-Chrome Iron material. Bearing housing shall be sealed at both ends to prevent the entrance of foreign matter.
D. The static head to from the water level in the grit trap to the slab on which the grit washer/classifier is to be mounted is approximately 15 feet, and the grit slurry will be pumped through approximately 50 feet of 6" pipe.

2.4 GRIT WASHER

A. The grit slurry from the pumps shall be pumped into the washer through a grit concentrator positioned near the settling pool. The conveyor shall wash and dewater the grit while lifting it from the hopper to a higher point of discharge. The washer shall remove organics out of the grit to meet the requirements specified in Part 1.5.
B. All wetted parts shall be constructed from stainless steel. Bearings, electrical devices, motor and gear reducer shall be of the manufacturer's standard materials.
C. Shop fabrication and welding of structural members shall be in accordance with the latest edition of the "Structural Welding Code", AWS D1.1, of the American Welding Society. All welded connections shall develop the full strength of the connected elements and all joined or lapped surfaces shall be completely seal welded. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adherence. All steel design shall be in accordance with the AISC Manual of Steel Construction, latest edition, and the California Building Code (CBC), latest edition.
D. Screw shaft bearings shall be designed to prevent the entry of grit and shall have a calculated L10 life of 20 years under typical operating conditions.
E. The classifier drive unit shall be designed for 24 hour a day operation under normal moderate shock loadings. Speed reducers shall be manufactured to AGMA standards. The speed reducer shall have a service factor of 1.25. The motor shall be a TEFC unit of ample power for starting and operating the mechanism without overload, with a service factor of 1.15. Power supply to the equipment shall be

460/230 volt, 60 hertz, 3 phase. The motor shall be suitable for an outdoor installation.

F. There shall be furnished one (1) grit concentrator. The concentrator shall be capable of degritting the slurry influent with intermittent operation. The operating range shall be compatible with the total grit removal system but shall not be less than specified in section 1.5. The concentrator shall be constructed of abrasion-resistant materials. Where wear liners are provided, they shall be easily removable and replaceable. Supplier shall provide stainless steel supports for mounting the concentrator above the classifier.

G. Discharge Bagging Device: The end of the discharge section will be equipped with a type 304 stainless steel transition piece and continuous bagging device to capture the dewatered grit. The bagging device shall be supplied with a replaceable magazine of continuous plastic hose.

H. All structural fasteners and anchor bolts shall be a minimum of 1/2" diameter and made of type 316 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

2.5 ELECTRICAL/CONTROLS

A. Equipment shall meet the requirements of the following specifications, as attached in Appendix A:
   1. Section 260513 – Common Motor Requirements for Equipment
   2. Section 409000 – Instrumentation Control for Process Systems
   3. Section 409513 – Process Control Panels and Hardware

B. The motor controller and controls for the grit trap, grit pumps and grit washer will be provided by others. If bidders elect to propose a self-priming system for the grit pumps, the controls for this system shall be provided in a NEMA 4X stainless steel enclosure. The priming system shall include provisions for monitoring the system for proper operation with associated signals that would be routed to the plant PLC.

C. If provided with a priming system, the enclosure shall include all required gear, including disconnects, circuit breakers, motor starters, transformers, transient voltage surge suppressors, terminal blocks, dry contacts, E-stops, selector switches, system reset, and indicator lights as required.

D. Sequence of Operations: The grit vortex impeller shall operate continuously. Grit pumps shall operate based on an adjustable timer. The washer shall be activated by the operation of the grit pumps. While the pump is operating, the washer shall cycle on and off by the settings of a repeat cycle timer. Once the pump completes operation, the washer shall run for an adjustable off delay time.

2.6 SPARE PARTS

A. Provide a list of standard spare parts including wear items with typical replacement period.

B. Provide a cost for an additional (on the shelf) grit pump.

2.7 PROTECTIVE COATINGS

A. Equipment supplier shall ensure that the following protective coatings are included for all equipment supplied:
   1. All ferrous Metal surfaces in dry and wet wells or in immediate vicinity of corrosive environments and all other submerged or partially submerged ferrous metal surface shall be coated with System H (or equal) as specified in section 098000 – Protective Coatings included in APPENDIX B.
   2. Interior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere shall be coated with System G (or equal) as specified din section 098000 – Protective Coatings included in APPENDIX B.

PART 3 - EXECUTION

3.1 TESTING

A. Supplier shall conduct factory testing and verification of equipment prior to shipment. Testing shall demonstrate correct alignment, smooth operation and freedom of excessive vibration and noise of all equipment. Test period shall demonstrate accurate measurement of sensors and function of run sequences.

3.2 INFORMATIONAL TABLES

IMPERIAL- RFP VORTEX GRIT CHAMBER		
Motor Size		HP
Maximum Hydraulic Capacity		MGD
Minimum Hydraulic Capacity		MGD
Estimated Removal @ Maximum Hydraulic Capacity (6.3 MGD)		% of 140 mesh grit
Estimated Removal @ Design Average (3.0 MGD)		% of 140 mesh grit
Estimated Removal @ Minimum Capacity		% of 140 mesh grit
Fluidizing Water Requirements (where needed)		gpm
		psig
IMPERIAL- RFP GRIT PUMP		
Type		--
Capacity (per pump)		gpm
		feet
Motor Size		HP
Pump Efficiency		%
Suction Head Available at Design Flow		feet
Priming Method		--

IMPERIAL- RFP GRIT WASHER		
Design Flow to Concentrator		gpm
Required Inlet Pressure to Concentrator		psig
Underflow to Washer		gpm
Utility Water Requirements		gpm
		psig
Estimated Frequency of Utility Water Cycle		minutes per hour or day
Estimated Duration of Utility Water Cycle		minutes
Motor Size		HP
Estimated Moisture Content of Degritted Material		%
Estimated Organics Recovery		%

BID ITEM #2 – EDUCTOR TUBE MIXERS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The WORK of this section includes furnishing three (3) eductor tube mixing systems as described below:

1. Anoxic Basins: The EQUIPMENT SUPPLIER shall provide eductor tube mixers sufficient to perform proper mixing and maintain solids in suspension while minimizing air entrainment to maintain anoxic conditions for each of three anoxic basins. Manufacturer shall confirm the placement location, configuration, quality and size of the mixers necessary for each basin. Preliminary drawings (ABS-1) are furnished in Exhibit 3 for reference.

   Anoxic basins will receive flow which has passed through a grit trap and 2 mm fine screens. Eductor tube mixer design shall be such that the intermittent bubble produces an induced flow of anoxic basin mixed liquid which is essentially continuous through the entire length of the channel.

B. All equipment shall be furnished complete with all accessories, connections, supports and controls necessary for a workable system and shall conform to all applicable codes and standards. The eductor tube system shall be defined as starting from the main air header on top of the tanks, excluding the air header itself, through the individual eductor tube mixers.
C. The WORK requires providing eductor tube mixers. The mixing system will be installed by the GENERAL CONTRACTOR under the direction of the EQUIPMENT SUPPLIER.
D. The EQUIPMENT SUPPLIER shall be experienced, reputable and qualified in the manufacture of the equipment to be furnished and must have supplied at least five systems of comparable size and complexity in the United States within the last five years. Equipment of comparable size and complexity shall have the following characteristics: eductor tube mixing system in activated sludge process for a municipal/industrial wastewater treatment plant having an average capacity of 5 mgd or greater.

1.2 ACCEPTABLE MANUFACTURERS:

A. JDV
B. WesTech
C. Or equal.

1.3 REFERENCE STANDARDS

Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

A. AISI 304L Stainless Steel
B. AISI 316 L Stainless Steel
C. ASTM A 240 Heat-resisting Chromium and Chromium -Nickle Stainless Steel Plate, and strip for Pressure Vessels.

1.4 SUBMITTALS

In addition to submittal requirements specified in the general sections of this RFP, the EQUIPMENT SUPPLIER shall submit the following information:

A. A specific layout of eductor tube mixers indicating location and number of mixers in each anoxic basin with pertinent details included.
B. The recommended design air flows per eductor tube.
C. Supply air pressure requirements.
D. In addition to the general information required in the bid forms and for the proposal, please complete the information table furnished for eductor tube mixers provided at the end of this section.

1.5 DESIGN CRITERIA:

A. The eductor tube mixing system will receive air supply from high speed turbo blowers located in the MBR process building.

Design Parameter	Units	Value
Number of Basins	Number	3
Dimension of each basin (L x W)	ft x ft	35 x 30
Operating Liquid Depth	ft	18
Basin Volume (each)	gal	141,500
Volume (total)	gal	424,500
MLSS Concentration (min)	mg/L	8,000
MLSS Concentration (max)	mg/L	12,000
Design temperature of wastewater in summer	°C	15
Altitude of the site BELOW MSL	ft	-59.1
Atmospheric pressure at the site	Psia	14.66

1.6 PERFORMANCE GUARANTEE

A. The eductor tube system shall be capable of complete and uniform mixing and suspension of mixed liquor suspended solids at specified MLSS concentration throughout the anoxic basin.

PART 2 - PRODUCTS

2.1 GENERAL

A. Eductor tube shall be furnished with threaded (for connections less than 2-inch) or flanged (for connections 2-inches and larger) air connection points to connect to piping from blowers furnished by others.
B. The eductor shall be fabricated from 1/8" thick 316 stainless steel plate. All welds shall be continuous. Facing surfaces of bolted joints shall be shop primed if not fabricated from stainless steel. Facing surfaces of field welded components shall be beveled and match marked.
C. Stainless steel shall pickled and passivated
D. Eductor tube shall be fabricated from AISI 316 stainless steel. Stainless steel components shall be furnished unpainted.
E. Edge Grinding – Sharp corners of all cut and sheared edges shall be made smooth by a power grinder.
F. Fasteners. All bolts, nuts washers and other fasteners shall be 316 stainless steel.

2.2 PROTECTIVE COATINGS

A. Equipment supplier shall ensure that the following protective coatings are included for all equipment supplied:
    1. All ferrous Metal surfaces in dry and wet wells or in immediate vicinity of corrosive environments and all other submerged or partially submerged ferrous metal surface shall be coated with System H (or equal) as specified in section 098000 – Protective Coatings included in APPENDIX B.
    2. Interior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere shall be coated with System G (or equal) as specified din section 098000 – Protective Coatings included in APPENDIX B.

2.3 TOOLS

A. The EQUIPMENT SUPPLIER shall supply two complete sets of special tools necessary for the assembly, adjustment and dismantling of the equipment. All tools shall be furnished in labeled tool boxes of suitable design.

PART 3 - EXECUTION

3.1 FIELD INSTALLATION TESTING

A. Leak and Level Testing: After all the eductor tube mixer equipment and appurtenances have been installed in a basin, it shall be tested by the GENERAL CONTRACTOR for mounting, levelness, air uniformity and leakage. The EQUIPMENT SUPPLIER's field engineer shall be present to observe this testing. Prior to initiating the field testing, all piping shall be inspected for proper joints, supports, tiedowns, plugs, etc. The anoxic basin shall be flooded with water to the top of the eductors. The level of the eductors shall be checked and ensured that they are the same elevation as specified within the approved submittals. After completion of the leveling test, water shall be introduced into the aeration basin by the GENERAL CONTRACTOR until the eductors have been covered with minimum recommended submergence height. Air shall be released through the

eductors, and operation of the eductors shall be checked. The EQUIPMENT SUPPLIER's field representative shall identify any leaks for the GENERAL CONTRACTOR to repair.

3.2 INFORMATION TABLE

IMPERIAL – RFP EDUCTOR TUBE MIXERS		
Type		–
Units Required per Basin		each
Eductor Tube Diameter		inches
Eductor Tube Height		inches
Minimum Required Submergence from Top of Unit		feet
Maximum Allowed Submergence from Top of Unit		feet
Anticipated Allowed Submergence from Top of Unit		feet
Required Air Flow per Unit		scfm
Required Inlet Pressure at Unit		psig
Air Connection Pipe Size		inches

BID ITEM #3 – FINE BUBBLE DIFFUSER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The WORK of this section includes furnishing a fine bubble diffuser system as described below:

1. **Aeration Basins:**
Provide a fine bubble diffuser system for three (3) identical, rectangular concrete basins, each capable of handling up to 1.2 MGD average day flow (ADF) to provide pre-aeration to the MBR system. As shown in drawing ABS-1 included in Exhibit 3, each aeration (oxic) basin is 30 feet wide by 90 feet long with a design 18-foot side water depth (SWD). Anoxic zone will not have diffusers in it.

B. All equipment shall be furnished complete with all accessories, connections, supports and controls necessary for a workable system and shall conform to all applicable codes and standards. The fine bubble diffuser system shall be defined as starting from a Van Stone style flange with a 150 lb. bolt pattern at the main air header on top of the tanks, excluding the air header itself, through the individual diffusers. The following alternative diffusers are specified in this Section:

1. EPDM membrane disc diffusers,
2. EPDM membrane tube diffusers
3. Aerostrip polyurethane membrane diffusers, and
4. Ceramic disc diffusers

C. The WORK requires providing fine bubble diffusers using one of the alternative diffusers. The manufacturer may bid more than one alternative diffuser systems as long as separated design parameters and calculations are provided. The diffuser system will be installed by the GENERAL CONTRACTOR under the direction of the EQUIPMENT SUPPLIER.

D. The WORK also requires that one SUPPLIER be made responsible for the WORK of this section including drop pipes, isolation valves, if required, pressure measuring system (local readout pressure gauge on drop pipes), distribution pipes, bleed valves and pipes for air purge system if required by the manufacturer's system, diffusers, and other accessories as required and recommended by the SUPPLIER for a complete, workable system. All components of the air distribution system shall be rated for the appropriate temperature range to which the system will be subjected to.

E. The EQUIPMENT SUPPLIER shall be experienced, reputable and qualified in the manufacture of the equipment to be furnished and must have supplied at least ten (10) systems of comparable size and complexity in the United States within the last (5) five years. Equipment of comparable size and complexity shall have the following characteristics: fine bubble air diffusion system for MBR process

(preferable) or air activated sludge process for a municipal treatment plant having an average capacity of 5 MGD or greater with an equal or greater number of diffuser grids than required for this application.

1.2 ACCEPTABLE MANUFACTURERS:

A. Environmental Dynamics, Inc.
B. Sanitaire (Xylem)
C. Or equal.

1.3 REFERENCE STANDARDS

Except as otherwise indicated, the current editions of the following apply to the WORK of this Section:

A.	ASCE 18-96	Standard Guidelines for In-Process Oxygen Transfer Testing
B.	ASTM A 240	Heat-resisting Chromium and Chromium -Nickle Stainless Steel Plate, and strip for Pressure Vessels.
C.	ASTM D 1785	Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
	ASTM D 1869	Rubber Rings for Asbestos-Cement Pipe
D.	ASTM D 2466	PVC Plastic Pipe and Fittings, Schedule 40
E.	ASTM D 2564	Solvent Cements for PVC Plastic Pipe and Fittings
F.	ASTM D 3034	Type PSM PVC Sewer Pipes and Fittings
G.	ASTM D 2855	Practice for Making Solvent Cemented Joint with PVC Pipe and Fittings
H.	ANSI B 16.5	Pipe Flanges and Flanged Fittings
I.	ASTM D 1248	Polyethylene Pipe

1.4 SUBMITTALS

In addition to submittal requirements specified in the general sections of this RFP, the EQUIPMENT SUPPLIER shall submit following information:

A. A complete system description with number of diffuser assemblies.
B. Drawings indicating system and individual grid layouts in plan and section with pertinent details included.
C. The recommended minimum, design, and maximum air flows (flux rate scfm/sqft) per diffuser.
D. Calculations for:
    1. Oxygen Transfer
    2. Headloss
    3. Heat Transfer
E. A curve showing headloss for the system versus air flow rate for the system from the manufacturer's point of responsibility for the diffusers assembly over the full range of operation in mixed liquor for new diffusers and for diffusers that have been in operation for 5 and 10 years. The supplier shall provide supporting documentation for claims made for headloss across the diffusers in applications with MLSS concentrations of specified range.

F. The SUPPLIER shall supply shop testing procedures and data from an independent testing laboratory showing the performance characteristics of the diffusers in clean water.
    1. Minimum lab oxygen transfer efficiency will be as offered at the specified side water depth and design airflow conditions.
    2. This test data must include data from a depth similar to the design operating depth with similar diffuser density, or an appropriate interpolation may be made between test points. The test data should be developed in conformance with the general procedures set forth in the ASCE Clean Water Standards.

1.5 DESIGN CRITERIA:

SYSTEM 1 – Aeration Basins

A. The fine bubble diffuser system will receive air supply from high speed turbo blowers located in the MBR process building. The entire airflow will be distributed through a main header conveying the process air from the blowers to the aeration basins. Each aeration basin will receive air supply from one of three (3) parallel air headers.
B. The fine bubble diffusers system shall be capable of complete and uniform mixing and suspension of mixed liquor suspended solids at specified MLSS concentration throughout the aerobic zone.

Table 1: Design criteria for Aeration Basins fine bubble aeration system

	Units	Value
Number of Basins	Number	3
Dimension of each basin (L x W)	ft x ft	90 x 30
Operating Liquid Depth	ft	18
Actual Oxygen Required per basin (AOR) - Peak*	lb O2/day/basin	6,600
- Average	lb O2/day/basin	4,500
- Minimum	lb O2/day/basin	2,500
Minimum Standard Oxygen Transfer Efficiency (SOTE)	%	2.0
MLSS (min)	mg/l	8,000
MLSS (max)	mg/l	12,000
Design Alpha (α) factor		0.6
Beta (β) factor		0.95
Average D.O. in the basins	mg/L	2.0
Design temperature of wastewater in summer	°C	25
Altitude of the site **BELOW MSL**	Ft	59.1
Atmospheric pressure at the site	Psia	14.7
Estimated Discharge Air Temperature @ Blowers	°F	<250

*Peak Condition Assumes that one Train is offline.

1.6 PERFORMANCE GUARANTEE

A. The EQUIPMENT SUPPLIER shall demonstrate their system's ability to deliver the required oxygen by supplying actual data (from systems at other plants having similar configurations) collected and analyzed by independent laboratories. Further, the EQUIPMENT SUPPLIER shall hire an independent laboratory/agency/consultant to conduct a witnessed clean water oxygen transfer test per latest ASCE standards at their manufacturing facility or at a third party independent test facility, paid for by the EQUIPMENT SUPPLIER.
B. A failure of the test shall cause the EQUIPMENT SUPPLIER to add additional diffusers and related accessories and retest, at the EQUIPMENT SUPPLIER's cost, the system with modified layout and configuration until the measured performance is at least equal to the assumed performance. In such case, additional diffusers tested to meet the requirements shall also be provided by the EQUIPMENT SUPPLIER at full scale, at no additional cost to the OWNER.

PART 2 - PRODUCTS

2.1 GENERAL

A. The EQUIPMENT SUPPLIER shall furnish complete diffuser systems for three (3) pre-aeration basins. This shall include all necessary drop pipes, header pipes, distribution pipes, supports, air diffusers, hold-downs, and accessories. The system shall be designed to withstand the design air discharge pressures noted in Table 1.

2.2 DROP PIPE AND MANIFOLD

A. Size and Material: Each drop pipe shall extend from the air main piping system, running on top of the tanks along the length of the tanks, above the water surface all the way to the submerged air manifold. The EQUIPMENT SUPPLIER shall recommend optimum number of drop pipes for each basin to maximize transfer efficiency and mixing efficiency to minimize solids deposition between air diffusers but no less than five (5) drop pipes shall be included per basin. Drop pipes shall be stainless steel Type 304L Schedule 10 from top to manifold connection.
B. Expansion and Contraction: The submerged air manifold shall include an expansion-contraction system consisting of fixed supports, intermediate supports and expansion joints. Fixed supports shall anchor the manifold against longitudinal and lateral movement at the support. Intermediate supports shall allow longitudinal movement through the support. Expansion joints shall allow for longitudinal expansion and contraction within the joint. The entire system shall allow for expansion and contraction over a range of 125 degrees F.
C. Supports: Each section of the submerged air manifold shall be properly supported and braced to withstand all potential stresses and loads. Manifold supports shall meet the expansion-contraction system requirements as required and/or recommended by the EQUIPMENT SUPPLIER. Manifold supports shall include manifold hold-down, adjusting and locking mechanism, cradle, cross, tee, and supporting structure as needed and recommended by the EQUIPMENT SUPPLIER. Minimum 3/8" Stainless style (316) type anchor bolts shall secure the stainless steel stand to the basin floor. Each manifold support shall have a cradle with a bearing surface contoured to fit a minimum of the bottom 90 degrees of the air distribution manifold. All supports shall include a mechanism to provide for a minimum of ±2 inches vertical and ±0.5-inch lateral adjustment for alignment of

the manifold. One support for each manifold section shall include an integral device for longitudinal rotational adjustment of the manifold. All adjusting devices and mechanisms shall lock to maintain the manifold in position after the final adjustments have been made.

D. Special Connections: Special expansion connections or couplings shall be provided, as required, along the bottom centerline of the submerged air manifold for connection to the air distribution headers. These special couplings shall prevent stress concentrations in distribution piping.

E. Welded Parts: All welded parts and assemblies including drop pipes, fabricated supports, flanged joints and expansion joints shall be fabricated from sheets and plates of Type 304L stainless steel with a finish conforming to AISI Type 304L and ASTM 240.

F. Welding: All welding 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. Interior weld beads shall be smooth, evenly distributed with an interior projection not exceeding 0.0625- inch beyond the ID of the air header or fitting. The outside weld area shall be wire brushed. Brushes shall be of stainless steel and used only on stainless steel. All discoloration and deposits left by welding shall be removed by pickling.

G. Pickling: After fabrication, all stainless steel assemblies and parts shall be passivated by immersion in a pickling solution of 6 percent nitric acid and 3 percent hydrofluoric acid at 140 degrees 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.

2.3 DISTRIBUTION PIPE (HEADERS) AND FITTINGS

A. Size and Material: Distribution headers and fittings manufactured of PVC shall have ultraviolet protection. Headers of PVC shall be Schedule 40 Type 1120, or better, and shall conform to ASTM D 1785. SDR-rated PVC piping and SDR-rated PVC diffuser holders are not allowed for this project. Expansion joints, diffuser holders, and retaining rings shall have a minimum wall thickness of 0.125 inches.

B. Fabrication: No field solvent welding shall be permitted. Diffuser elements and expansion joints shall be factory installed on the distribution header.

C. Expansion and Contraction: The air distribution system shall include a means for expansion-contraction of the system and shall include expansion joints, fixed supports and intermediate sliding supports. The expansion-contraction joint shall be designed to allow for a total movement of 3 inches over a temperature range of 125 degrees F.

D. Couplings: Couplings between segments of the PVC distribution pipe shall be constructed from 304 Stainless Steel.

E. Header Supports: Each header section shall be held in place by at least two anchor supports. Intermediate supports shall allow longitudinal and rotational movement of the header section. Stands shall be adjustable to permit leveling up to 6 inches and rotating of the distribution header with the header in place. All adjusting devices shall lock in place after the headers have been installed and leveled. Each

support shall be secured to the basin floor by means of a Type 316 stainless steel type anchor bolt designed for 10 times the calculated normal uplift forces. All header supports shall have a vertical adjustment of ±6 inches. The fixed supports shall be designed to anchor the header against longitudinal movement at the support. The fixed support shall be attached to the header in such a manner to prevent movement at this point. The supports shall be located at the expansion joints and at the ends of the header pipe. Any expansion-contraction must take place in the expansion joints. For solids holding tank (System 2) installation, supports shall be designed to allow installation on the existing, sloped floor.

F. Diffuser Assemblies: Diffuser assemblies shall be designed for installation along the distribution header. These shall be of proper design complete with all required parts and supports.

G. Purge System: Each header pipe shall have a removable end cap or plug to allow purging. For disc diffusers, a properly designed air lift moisture blowoff system shall be furnished, by the EQUIPMENT SUPPLIER, with each aeration grid. The system shall be properly supported and provided with any necessary expansion joints for a temperature range of 125 degrees F. The valve in any blowoff system shall be easily accessible above the water surface adjacent to the wall. The Aerostrip system and the tubular membrane system suppliers shall address this issue in their proposal as to whether a purge system is or is not required. The cost of providing a purge system or an equivalent recommended system shall be included with the respective system bid.

2.4 DIFFUSER ASSEMBLIES

The diffuser assemblies shall be shipped totally assembled by the EQUIPMENT SUPPLIER, ready for installation by the GENERAL CONTRACTOR.

Records of factory quality control test for material use and production of aeration diffusers for this project shall be maintained at the EQUIPMENT SUPPLIER's facility for a period of five years. Test results shall be made available upon the ENGINEER's request. Diffusers shall be easily removable from the header system without special tools or procedures.

A. EPDM MEMBRANE DIFFUSERS

1. The design shall allow a complete flexing cycle to be performed to maintain the membrane and its perforations in a clean state. Membranes shall be replaceable in the field without the need to remove the diffuser from the basin. Aeration diffusers shall be cross- referenced to membrane production run number upon production. Improper bubble size or distribution shall be a reason for rejection of the specific aeration diffuser system as determined by the ENGINEER.
2. Disk diffuser assemblies shall consist of a nominal 9 or 12 -inch diameter EPDM membrane diffuser with integral O-ring, a PVC or polypropylene retainer ring, and a diffuser baseplate. The diffuser cross-section shall be thickened at the center and at the periphery near the O-ring to resist stretching. The retainer ring shall be made of PVC with ultra-violet protection. The retainer ring shall have a minimum of 2.5 complete threads for effective sealing. The threads shall be buttress-type for maximum holding strength and to minimize stress concentration. The diffuser

baseplates shall be factory solvent welded to the PVC diffuser header and shall be manufactured of PVC with ultra-violet protection. The welding contact area between the baseplate and the header shall be a minimum of 24 square inches to provide a structurally sound connection. The baseplates shall be centered on the crown of the pipe with the angular variation of all the baseplates on a header not to exceed ± 1.0 degree. Each baseplate shall incorporate a factory-drilled orifice sized to give minimum headloss while assuring uniform air distribution under the horizontal surface of the diffuser membrane.

3. Tubular diffuser assemblies shall consist of two diffuser tubes mounted to a tee- shaped mounting connection or a single tube with "clip-in" type connection. Each tube shall consist of a tubular EPDM or silicone membrane fully supported over full length and circumference of a PVC or Polyproplylene (PP) membrane support frame. Tubular diffuser membranes shall be extruded into a one piece flexible membrane and the membrane shall be perforated per EQUIPMENT MANUFACTURER's standards to provide optimum mixing and oxygen transfer. Two stainless steel clamps shall hold the diffuser membrane in place. The diffuser mount saddle assembly shall fully encompass the air distribution header pipe. All PVC components shall contain integral ultra-violet protection.
4. Diffuser membranes shall be composed of EPDM elastomer OR silicone based compound and shall be resistant to attack by common compounds present in wastewater. EPDM material shall meet the requirements of ASTM D 573. Diffuser membranes shall be free of voids, tears, bubbles, creases or other structural defects. Membranes shall have a uniform distribution of air release across the entire perforated surface area when submerged and operating at appropriate air discharge rates. The non-perforated area of the membrane shall provide the necessary sealing capabilities and backflow prevention when air supply to the diffuser is interrupted. Membrane material shall have a durometer of 55 ± 5, Shore A, with a minimum tensile strength of 1375 psi, and a minimum elongation of 500 percent at break.
5. Supports and Anchors: All nuts, bolts, washers, and other fasteners shall be of 316L stainless steel or better. Anchors shall be of 316L stainless steel threaded rod. Anchors shall be suitable for insertion into concrete slab with epoxy adhesive and have a margin of safety for pullout of 10 to 1 against calculated buoyant forces.

B. AEROSTRIP DIFFUSERS

1. The design shall allow a complete flexing cycle to be performed to maintain the membrane and its perforations in a clean state. Membranes shall be replaceable in the field without the need to remove the diffuser from the basin. Aeration diffusers shall be cross- referenced to membrane production run number upon production. Improper bubble size or distribution shall be a reason for rejection of the specific aeration membranes as determined by the ENGINEER.
2. Fine bubble strip aerators shall be a flat strip design using a flexible membrane installed on the basin floor to utilize the full side water depth.
3. The strip aerator membrane shall be a homogenous thermoplastic material from the polyurethane family. The membrane must be manufactured as a

seamless calendared sheet without defects or repairs. The surface of the membrane must be smooth to prevent biological growth from attaching. Air flow shall be uniform across the entire membrane surface, at all design conditions. All membranes furnished shall have the same slit size, and orientation.

4. Frame: The frame shall provide structural support for the strip aerator membrane and be structurally self-sufficient. In addition to securing the entire perimeter of the membrane with an airtight sealing mechanism, the frame shall provide the necessary mechanism for even distribution of air. No fasteners shall be allowed to penetrate the membrane. All structural components shall be made from 316 SS. The base plate shall be made from 316 SS and the membrane shall be fastened to the plate using side profiles. The base plate shall be made from PVC, extruded one piece for structural integrity. The air feed fitting shall be compression type made of PP. The aerator shall be anchored directly on the basin floor by strip fastener plates made of 316L stainless steel.
5. Supports and Anchors: All nuts, bolts, washers, and other fasteners shall be of 316L stainless steel or better. Anchors shall be of 316L stainless steel threaded rod. Anchors shall be suitable for insertion into concrete slab with epoxy adhesive and have a margin of safety for pullout of 10 to 1 against calculated buoyant forces.

C. CERAMIC DISC DIFFUSERS
1. Manufacture circular ceramic diffuser discs composed of crystalline fused alumina (aluminum oxide) with a ceramic bonding material fired at a minimum kiln temperature of 2200° F. Resin bond material is not acceptable.
2. Produce diffuser free of loose or unbonded material, cracks, chips, spalling or other structural defects or any material soluble in wastewater.
3. Manufacturer diffuser to allow re-firing at 2,000° F for removal of organic material.
4. Design and test diffuser to support a vertical load of 750 lbs applied to the center 1-inch diameter of the diffuser when the edges are supported in a fixture similar to the diffuser holder.
5. Furnish diffuser O-ring gasket of polyisoprene with a Shore A durometer of 40 ± 5.

D. ELASTOMERIC GASKETS
1. All necessary gaskets shall be furnished for the aeration system. Gaskets shall be suitable for withstanding the effects of wastewater and for temperatures up to 250°F.

2.5 PROTECTIVE COATINGS

A. Equipment supplier shall ensure that the following protective coatings are included for all equipment supplied:
1. All ferrous Metal surfaces in dry and wet wells or in immediate vicinity of corrosive environments and all other submerged or partially submerged ferrous metal surface shall be coated with System H (or equal) as specified in section 098000 – Protective Coatings included in APPENDIX B.

2. Interior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere shall be coated with System G (or equal) as specified din section 098000 – Protective Coatings included in APPENDIX B.

2.6 TOOLS

A. The EQUIPMENT SUPPLIER shall supply two complete sets of special tools necessary for the assembly, adjustment and dismantling of the equipment. All tools shall be furnished in labeled tool boxes of suitable design.

2.7 SPARE PARTS

A. The EQUIPMENT SUPPLIER shall provide 2% spare parts of each component of the system (i.e., diffusers complete with holders, gaskets, O-rings, retainer rings, membrane fasteners, etc.).

PART 3 - EXECUTION

3.1 FIELD INSTALLATION TESTING

A. Leak and Level Testing: After all the diffused aeration equipment and appurtenances have been installed in a basin, it shall be tested by the GENERAL CONTRACTOR for mounting, levelness, air uniformity and leakage. The EQUIPMENT SUPPLIER's field engineer shall be present to observe this testing. Prior to initiating the field testing, all piping shall be inspected for proper joints, supports, tiedowns, plugs and drain relief valves. The aeration basin shall be flooded with water to the top of the diffusers. The level of the diffusers shall be checked and ensured that they are the same elevation as specified within the approved submittals. After completion of the leveling test, water shall be introduced into the aeration basin by the GENERAL CONTRACTOR until the diffusers have been covered with 6-12 inches of water. Air shall be released through the diffusers, and operation of the diffusers shall be checked. The surface of the water above the diffusers shall be then visually inspected to ensure that air flow is uniformly distributed across the basin, as well as uniformly distributed across the diffusers. Submerged piping shall be inspected for leaks. The EQUIPMENT SUPPLIER's field representative shall identify any leaks for the GENERAL CONTRACTOR to repair.

3.2 INFORMATION TABLE

IMPERIAL- EQUIPMENT RFP FINE BUBBLE DIFFUSERS		
No of Diffuser Grids (Drop Pipes) per Basin		each
No. of Diffusers per Basin		each
Submergence to Top of Diffusers		feet
Ratio of Diffuser Area to Basin Area		%
Air Flow/Diffuser Area		
Peak		$scfm/ft^2$
Average		$scfm/ft^2$
Minimum		$scfm/ft^2$
Air Flow/Diffuser		
Peak		scfm
Average		scfm
Minimum		scfm
Standard Oxygen Transfer Efficiency		
Peak		%
Average		%
Minimum		%
Pressure Loss Across Diffuser Assembly		
New		in.w.c.
Used/Plugged		in.w.c.
System Design Pressure*		psig
***Total pressure loss at maximum flow through the entire diffuser assembly (from the drop leg connection to main air header through the distribution piping and across the diffusers)**		

BID ITEM #4 – PROCESS AND MBR SCOUR AIR BLOWERS

PART 1 - GENERAL

1.1 DESCRIPTION:

A. The WORK of this section includes furnishing two (2) high speed turbo blower systems to provide process and mixing air for the aerobic basins and scour air for the MBR equipment.

1. **System 1 – Process Air**

a. The Equipment supplier shall furnish a complete blower system to supply variable volumes of air for three aerobic basins.

b. The proposed system shall have a minimum of two (2) duty and one (1) standby blower.

c. The aerobic basins may experience fluctuations in flow and loading conditions. Therefore, the equipment supplier shall note that the turndown and precise control of blower capacity is critical for this system application.

d. A VFD shall be provided to vary the blower speed to provide continuous flow and power optimization according to the changes in process air flow and differential pressure automatically without operator interface when the controls are in the remote mode.

e. It is assumed that the system will be controlled based on DO set point controls. The control system integration, instrumentation and control valves shall be the responsibility of OTHERS.

f. A common air header will serve all three (3) aerobic basins (see drawing ABS-1 included in Exhibit Three for preliminary air piping layout)

2. **System 2- MBR Scour Air**

a. The equipment supplier shall furnish a complete blower system to supply variable volume of air for MBR equipment scour.

b. The proposed system shall have a minimum of two (2) duty and one (1) standby blower.

c. A VFD shall be provided to vary the blower speed to provide continuous flow and power optimization.

d. A common air header will serve all four (4) MBR basins.

e. It is expected that the scour air will be supplied to the MBR continuously.

B. Each system shall be designed to meet the design criteria noted below and to provide a maximum efficiency and turndown capacity. A minimum of one standby blower shall be provided for each system.

C. The SUPPLIER may propose as an alternative a single blower system that would meet the performance requirements of both systems as listed below. In this case, a single standby blower may be proposed.

D. The blowers will be installed inside of a building in an unclassified room which will provide protection from the elements but it will not be air conditioned (See drawing PBA-1 included in Exhibit 3 for preliminary blower room location).

E. All equipment shall be furnished complete with all accessories, connections, supports and controls necessary for a workable system and shall conform to all applicable codes and standards.
F. The blowers will be installed by the GENERAL CONTRACTOR under the direction of the EQUIPMENT SUPPLIER.
G. The EQUIPMENT SUPPLIER shall be experienced, reputable and qualified in the manufacture of the equipment to be furnished and must have supplied at least ten (10) systems of comparable size and complexity in the United States within the last five years.

1.2 ACCEPTABLE MANUFACTURERS:

A. Neuros, Inc.
B. Sulzer (ABS)
C. Or equal.

1.3 RELATED WORK

A. SUPPLIER Shall review and comply with following specification sections included in Appendix A:

1. Section 260513 – Common Motor Requirements for Equipment
2. Section 262923 – Variable - Frequency Drives
3. Section 409000 – Instrumentation Control for Process Systems
4. Section 409433 – Humane – Machine Interfaces
5. Section 409443 – Programable Logic Controllers
6. Section 409513 – Process Control Panels and Hardware
7. Section 409600 – Process Control Software

1.4 SUBMITTALS

In addition to submittal requirements specified in the general sections of this RFP, the EQUIPMENT SUPPLIER shall submit following information:

A. List of optional cost adders (or credits) for alternate materials of construction, sound attenuation, instrumentation, and other accessories.
B. Dimensional drawings and inlet air intake options.
C. Complete Blower Performance Data developed for design points included in the information table across the full range (combination) of environmental factors (temperature and humidity) including:
D. Complete Information Table included at the end of this Specification.
E. Standard field testing and operations and maintenance description and schedule.

1.5 DESIGN CRITERIA:

A. General Site Conditions:
   1. Site elevation 59.1 ft BELOW sea level
   2. Average Relative Humidity: 39.6%
   3. Average High Humidity: 82%

4. Average Low Humidity: 32%
5. Relative Humidity (design) 85%
6. Maximum Intake Air Temperature: 123º F
7. Minimum Intake Air Temperature: 16º F

Table 1 - Design Criteria for System 1 - Process Air Blowers

Design Parameter	Units	Value
Total Delivered Air Flow (Maximum)	SCFM	3,600
Total Delivered Air Flow (Average)	SCFM	2,600
Total Delivered Air Flow (Minimum)	SCFM	1,300
Discharge Pressure	Psig	9.5
Noise (measured at 3 feet from the device)	dBA	<80

Table 2 - Design criteria for System 2 – MBR Scour Air Blowers

Design Parameter	Units	Value
Total Delivered Air Flow (Maximum)	SCFM	3,450
Total Delivered Air Flow (Minimum)	SCFM	900
Discharge Pressure	Psig	6.0
Noise (measured at 3 feet from the device)	dBA	<80

1.6 PERFORMANCE GUARANTEE

A. The EQUIPMENT SUPPLIER shall provide data establishing that the blower meets design flows and pressures at the design temperatures and humidity levels listed above. Specifically, the SUPPLIER shall provide performance curves indicating that the blower is capable of providing the full operating flow range at the discharge pressures listed above and the range and combination of environmental factors listed above.

B. Each proposal shall include a performance guarantee stating that the supplied blower(s) will operate at the flow rates and associated power draw indicted in the proposal for the design conditions presented in this RFP.

C. The EQUIPMENT SUPPLIER shall submit guaranteed wire to air kW values for each blower. The wire to air kW shall include all losses associated with the blower unit at all specified operating points. The wire to air power must include all motor, thermal, mechanical and electrical losses of the turbo blower as well as losses of all auxiliary equipment.

D. The manufacturer shall provide wire to air kW values by completing included tables below and also include a specific curve for each point at site conditions. The completed table will be considered the basis of Power Guarantee.

E. In the event the tested wire to air power draw (as tested per section 2.13) is in excess of the guaranteed wire to air power draw from listed in the tables the units shall be adjusted, modified, or reconstructed by the EQUIPMENT SUPPLIER and

re-tested at no additional cost to the OWNER, until they comply with the specifications.

F. The performance guarantee shall be in place for a period of 12 months, during which the blower performance will be evaluated at the installation site and the actual turn down capacity and power draw confirmed. During this period, the Supplier shall be required to repair, update, replace, refund, or otherwise compensate the OWNER in the case that their equipment fails to perform as indicated in their proposal.

G. Operating the blowers in the design range indicated in the proposal shall not cause excessive maintenance, repairs, or wear and tear on the equipment beyond the typical maintenance and repair schedule for the submitted equipment.

PART 2 - PRODUCTS

2.1 BLOWER UNITS

A. Blowers shall operate satisfactorily over a flow range of 50% to 100% design flow at specified discharge pressure through the specified inlet temperature and humidity range without being in surge and overloading the motor.

B. Blowers shall be capable of variable speed operation.

C. Heated air from the motor and inverter shall not be mixed with intake fresh air.

D. Vibration levels shall be low enough that it shall not require any floor anchoring for adequate operation.

E. No special foundations shall be required for installation.

F. The rated HP of each blower motor shall not be more than 400 HP.

G. Blowers under 400 HP shall not require oil or lubricants or water for adequate operation.

H. Each blower shall be certified by NRTL (National Recognized Testing Laboratory) with appropriate UL standards.

2.2 BEARINGS

A. The bearing installed in the high speed turbo blowers shall be non-contact type and shall be either magnetic or air foil bearings.

B. There shall be no mechanical contact between moving surfaces, no friction and no wearing of parts.

2.3 MOTOR

A. The motor shall be high efficiency, high frequency, permanent magnet motor which is directly connected with stainless steel impeller and shall provide a smooth vibration-free variable rotation speed.

B. The motor shall be 460 V, 60 Hz, 3 Phase inverter duty and shall comply with the requirements of Section 26 05 13.

C. The motor shall be able to start under 5% of electric current at design condition.

D. There shall be no physical frequency sensor on rotor system to prevent unexpected crash by the defect of these sensors. Frequency sensing shall be sensor-less.

2.4 INLET FILTER

A. Each blower shall be provided with an inlet filter system consisting of filters and filter housing adequately sized for the flow rate of each blower. The filter shall be a reusable, washable filter mounted to the air blower enclosure. Maximum pressure drop across a dirty filter shall be less than 0.2 psig. A pressure sensor shall be provided to alert maintenance of clogged filter elements.

2.5 DISCHARGE SILENCER

A. An adequately sized discharge silencer with flanged end connections shall be provided for each turbo blower. The outlet silencer shall be constructed of 304 SS, with adequate operating pressure and sound attenuation not less than 20dB.

2.6 DISCHARGE CHECK VALVE

A. Each blower shall be provided with a flanged or wafer style end discharge check valve of the dual plate double leaf type with center hinge and spring closure to prevent back flow into the blower. The valve shall have a cast iron body, epoxy coated, 316 SS plates with 316 SS springs and rated for temperatures up to 300 degrees F. Check valves shall be appropriate for vertical or horizontal pipe mounting.

2.7 BLOW-OFF VALVE

A. Each blower shall be provided with a cast iron body (epoxy coated) flanged blow-off valve. The blow off valve shall be an integral part of the turbo blower system for protection during startup and shut down conditions and shall be controlled by each turbo blower internal control system. The blow off valves shall be adequately sized to handle flow and pressures seen during start-up and shut-down.

2.8 BLOW-OFF VALVE SILENCER

A. Galvanized or Epoxy Coated carbon steel blow-off silencer shall be provided for each blower, designed to the same specifications as the discharge silencer. Design flow shall be based on blower flow at start-up conditions.

2.9 EXPANSION JOINTS

A. Provide each blower with an EPDM discharge and suction (if applicable) joint capable of withstanding the vacuum, pressure and temperature under all operating conditions. The expansion joint shall be included with control rods (if required) and SS flanges drilled for ANSI B16.5 Class 150 bolt pattern.

2.10 BLOWER CABINET/ENCLOSURE

A. Each blower shall be provided with a skid mounted Cabinet that is an integral part of the blower. The cabinet shall include the blower assembly, instrumentation, and a Local Control Panel (LCP).

B. Blower Enclosure shall be a minimum 12 gauge steel enclosure with gasketed and hinged doors.
C. The enclosure shall at a minimum receive the following treatment/coatings:
   1. Phosphate treatment
   2. Zinc chromate oxide primer
   3. Baked rust inhibiting enamel
D. All equipment and wiring shall be neatly mounted and organized and allow for easy access.
E. All louvers shall be fitted with forced air cooling as determined by the EQUIPMENT SUPPLIER suitable for conditions specified in this RFP. Enclosure shall have a minimum NEMA 4 rating.

2.11 INSTRUMENTATION AND CONTROLS

A. The EQUIPMENT SUPPLIER shall provide instruments and controls in each pre-packaged skid.
B. In addition to the requirements set forth herein, the instrumentation and control panels to be furnished under this section shall meet with the applicable requirements of Section 40 94 43 Programmable Logic Controllers attached in Appendix A.
C. The EQUIPMENT SUPPLIER shall provide all control panel components including the programmable logic controller (PLC), PLC inputs/outputs (I/O), PLC power supply, Profibus and Ethernet communication modules, Ethernet switch and uninterruptible power supply (UPS).
D. The EQUIPMENT SUPPLIER shall provide the instrumentation listed below, as a Minimum:
   1. Each blower shall be equipped with an integral human-machine interface (HMI)/keypad display and integral variable frequency drive (VFD) for motor speed control. All PLC controls, alarms, and monitoring shall be accessible through the HMI/keypad.
   2. Instrumentation for each blower shall include, as a minimum:
   a. Inlet air temperature gauge
   b. Inlet air temperature transmitter 4–20 mA
   c. Inlet air filter differential pressure sensor
   d. Inlet Pressure transmitter 4–20 mA
   e. Discharge Temperature transmitter 4–20 mA
   f. Discharge air pressure gauge
   g. Discharge air pressure transmitter
   h. Differential pressure (inlet/discharge) transmitter 4–20 mA
   i. Blow off valve limit switches (open/closed)
   j. Discharge valve limit switch (open/closed)
   k. Motor and VFD temperature sensor
   l. Bearing temperature sensor (if applicable)
   m. Blower vibration sensor

E. Master Control Panel – The master control panel will be provided by others. The vendor shall coordinate with the Owner's System Integrator for the integration of the turbo blowers into the master control panel.

F. Local Control Panel:

1. Each blower skid shall be provided with a Local Control Panel (LCP) The LCP shall contain the PLC, PLC I/Os, terminal strips for connection to the skid mounted instruments, UPS, and 24 VDC power supply. Provide separate panel access between 120 VAC and 480 VAC equipment or provide separate panels. Segregation between signal wiring and 120 VAC wiring shall also be provided. The enclosure shall be NEMA 12 and shall carry a UL label certifying the assembled enclosure complies with UL 508.
2. The LCP shall start and shut down the blower in a programmed sequence, monitor blower operation and control operating variables. The LCP shall also contain a program for continuous optimization of blower efficiency with respect to changes in capacity, inlet temperature, and differential pressure across the blower.
3. LCP Operator Interfaces: At a minimum, provide the following functions on the face of the local control panel (LCP):

a. Hand Switches:
   (i) Hand-Off-Auto
   (ii) Start-Stop.
   (iii) Alarm RESET (following an Alarm condition, the blower shall Be locked out until reset is issued).

b. HMI/Keypad Display: The turbo-blower functions shall be monitored continuously during operation and communicated to the HMI/keypad display. At a minimum, the following functions shall be accessible from the HMI/keypad:
   (i) Output pressure
   (ii) Inlet Pressure
   (iii) Operating time in days/hours
   (iv) Differential pressure at inlet air filter
   (v) Motor current draw
   (vi) Motor winding and bearing temperature
   (vii) VFD temperature
   (viii) Inlet air temperature

c. Faults and Alarms: The turbo-blower system shall be continuously monitored for proper operation of the blower and its associated control system. In the event of a blower malfunction, either an alarm or a fault message shall appear on the control panel display. If the fault is critical to the safe operation of the turbo-blower the blower shall be automatically shut down until the fault is acknowledged through the HMI/keypad and/or corrected.

d. The control system shall automatically monitor the following conditions:
   (i) Power Supply Status:
      (a) Over voltage in main power supply
      (b) Under voltage in main power supply
      (c) One phase missing
   (ii) Process Air Inlet and Outlet:
      (a) Blockage in the inlet or outlet air piping
      (b) Overpressure

(c) Inlet air temperature too high (surge)

(iii) Cooling Air Inlet and Outlet:

(a) Blockage in the inlet or outlet air piping
(b) Cooling air over temperature
(c) Motor temperature
(d) VFD temperature
(e) Bearing temperature (if applicable)

A. Aeration Basins Field Instrument Requirements - The required control valves, flowmeters, and dissolved oxygen probes shall be provided by OTHERS. The installation and electrical connections of the instruments to the master control panel shall be the responsibility of the GENERAL CONTRACTOR.

2.12 VARIABLE FREQUENCY DRIVES (VFD's)

A. Each blower shall include a factory mounted, constant torque variable frequency drive.
B. Harmonic filters shall be provided with an isolation contactor that engages the capacitors in the filter only when the blower is up to speed.
C. Requirements of technical specification section 26 29 23 shall be met.

2.13 PROTECTIVE COATINGS

A. Equipment supplier shall ensure that the following protective coatings are included for all equipment supplied:
   1. All ferrous Metal surfaces in dry and wet wells or in immediate vicinity of corrosive environments and all other submerged or partially submerged ferrous metal surface shall be coated with System H (or equal) as specified in section 098000 – Protective Coatings included in APPENDIX B.
   2. Interior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere shall be coated with System G (or equal) as specified din section 098000 – Protective Coatings included in APPENDIX B.

2.14 FACTORY TESTING

A. Each blower motor shall be shop tested in accordance with the most recent IEEE test procedures.
B. Each blower shall be tested in accordance with the most recent ASME Power test Code for Centrifugal Compressors and Exhausters, PTC-10. The test shall include determination of the surge point and verification of guarantee points. Flow and discharge pressure shall be guaranteed with no negative tolerance. Test and calculation tolerance shall not exceed 0+/-. All test equipment shall be calibrated and certified no more than twelve (12) months prior to test date.
C. Prior to delivery, each blower and motor shall be functionally tested with the local control panel (LCP) connected to all skidded instruments. All start/stop sequences, operator interfaces, safety systems and alarms shall be tested by simulating starting, running and stopping of the blower motor. All LCPs shall be functionally

tested for proper operation of all logic circuits. All set point shall be set and verified. All instruments shall be calibrated for the proper range of operation.

2.15 TOOLS

A. The EQUIPMENT SUPPLIER shall supply any special tools necessary for the assembly, adjustment and dismantling of the equipment. All tools shall be furnished in labeled tool boxes of suitable design.

PART 3 - EXECUTION

3.1 TESTING

A. Supplier shall conduct factory testing and verification of equipment prior to shipment. Testing shall demonstrate correct alignment, smooth operation and freedom of excessive vibration and noise of all equipment. Test period shall demonstrate accurate measurement of sensors and function of run sequences.

3.2 INFORMATION TABLE

IMPERIAL WWTP-EQUIPMENT RFP SYSTEM 1 - PROCESS AIR BLOWERS INFORMATION TABLE							
Design Point	**No. of Blowers (duty + standby)**	**Total Air Flow (SCFM)***	**Air Flow per blower (SCFM)***	**Inlet Temperature (F°)**	**Discharge Temperature (F°)**	**Guaranteed Wire to Power Air Draw (kW) per Blower**	**Guaranteed Wire to Power Air Draw (kW) for System**
100%				123			
75%				80			
50%				16			
Min SCFM:							
Max SCFM:							
Noise (dBA) at 3 feet from Blower:							
Maximum Allowable Intake Temperature:							
IMPERIAL WWTP-EQUIPMENT RFP SYSTEM 2 - MBR SCOUR AIR BLOWERS INFORMATION TABLE							
Design Point	**Number of Blowers (duty + standby)**	**Total Air Flow (SCFM)***	**Air Flow per blower (SCFM)***	**Inlet Temperature (F°)**	**Discharge Temperature (F°)**	**Guaranteed Wire to Power Air Draw (kW) per Blower**	**Guaranteed Wire to Power Air Draw (kW) for System**
100%				123			
75%				80			
50%				16			
Min SCFM:							
Max SCFM:							
Noise (dBA) at 3 feet from Blower:							
Maximum Allowable Intake Temperature:							

* SCFM measured at 14.7 PSIA, 68 degrees F, 36% RH

BID ITEM #5 – SOLIDS DEWATERING SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The supplier shall provide an adequate number of dewatering units to dewater waste activated sludge (WAS) from a membrane bio-reactor treatment process. Dewatering units shall be either centrifuges or screw presses. Belt or fan-type presses are not acceptable.
B. No redundant units are required.
C. The supplier shall provide all components and ancillary equipment for a complete and operable system, including but not limited to, dewatering units, polymer mixing and injection systems control panels and motor starters as required. All equipment will be installed indoors in an unclassified area. Dewatered sludge shall be discharged into a conveyor system (by others) for transport to an adjacent truck load out facility. Equipment shall meet the design requirements listed in Part 1.5 and shall be manufacturer's standard equipment for dewatering municipal sludge. Feed pumping of sludge shall be provided by others.
D. It is the intent of the design to have operators onsite for maintenance and oversight of equipment for one shift per day (8 hours), five days per week. As such, where manual start-up and shutdown of equipment is required or recommended, the equipment shall be sized to process the daily flow within this operator shift. Time required for startup/shutdown/cleaning shall be included within the operator shift.
E. The EQUIPMENT SUPPLIER shall be experienced, reputable and qualified in the manufacture of the equipment to be furnished and must have supplied at least ten (10) systems of comparable size and complexity in the United States within the last (5) five years. Equipment of comparable size and complexity shall have the following characteristics: dewatering system for waste activated sludge (WAS) in a wastewater treatment plant having an average capacity of 5 MGD or greater.

1.2 ACCEPTABLE MANUFACTURERS:

A. Alfa Laval
B. Andritz
C. Huber Technologies
D. Or equal

1.3 SPECIFICATIONS AND STANDARDS

A. ASTM A36 – Carbon Structural Steel
B. ASTM A48 – Gray Iron Castings
C. ASTM A322 – Carbon and Alloy Steel Bar
D. ASTM A507 – Drawing Alloy Steel, Sheet and Strip, Hot-Rolled and Cold Rolled
E. ASTM A536-84 – Ferritic Ductile Iron Castings
F. ASTM A743 – Stainless Steel Casting
G. AISI 303 Stainless Steel
H. AISI 304 Stainless Steel

I. AISI 316 Stainless Steel
J. AISI 4130 Heat Treated Alloy Steel
K. AISI 4140 Heat Treated Alloy Steel
L. AISI 8620 Heat Treated Alloy Steel
M. AISI 17-4 Stainless Steel
N. ANSI 9 – Load Ratings and Fatigue Life for Ball Bearings
O. ANSI 11 – Load Ratings and Fatigue Life for Roller Bearings
P. American Institute of Steel Construction (AISC)
Q. American Welding Society (AWS)
R. American Structures Painting Council (ASPC)

1.4 ADDITIONAL SUBMITTAL REQUIREMENTS

A. In addition to submittal requirements specified in the general sections of this RFP, the EQUIPMENT SUPPLIER shall submit following information:
   1. List of optional cost adders (or credits) for alternate materials of construction, instrumentation, and other accessories.
   2. Complete Information Table included at the end of this Specification.
   3. Standard field testing and operations and maintenance description and schedule.

1.5 DESIGN CRITERIA

A.	Dry Solids Wasted (Design),	5,900 lbs/day
B.	Dewatering System minimum capacity of:	1,050 lbs/hour
C.	Sludge Feed Concentration:	0.8% (+/-)
D.	Solids Capture Rate:	> 95%
E.	Minimum Sludge Cake Solids:	17%

1.6 PERFORMANCE GUARANTEE

A. At the six-month site visit, the SUPPLIER shall conduct testing of the system to verify cake solids. Where the system is not dewatering sludge to the percentage indicated above, the SUPPLIER shall, at his own cost, provide solutions (without increasing the polymer dose listed) to achieve the dryness indicated.

PART 2 - PRODUCTS

2.1 GENERAL

A. All components of the equipment shall be amply proportioned for all stresses that may occur during fabrication, erection and intermittent or continuous operation.
B. All components shall be balanced so that jamming at any point will not result in structural failure, but will cause the drive motor to stall. All components shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.
C. All stainless steel components and structures shall be submersed in a chemical bath of nitric acid and hydrofluoric acid (pickling bath) to remove any residues that may be present on the material as a result of forming, manufacture, or handling. After removal from the pickling bath, the equipment must be washed with a high-

pressure wash of cold water to remove any remaining surface debris and promote the formation of an oxidized passive layer which is critical to the long life of the stainless steel. No stainless steel components may be fabricated or assembled in a factory where carbon steel products are also fabricated, in order to prevent contamination by rust.

D. Design and fabrication of structural steel shall be in accordance with AISC and AWS Standards.
E. Manufacturer shall provide equipment, motors, gear reducers, controls, control panels and lifting attachments as a complete integrated package to ensure proper coordination, compatibility and operation of the system.

2.2 DEWATERING UNIT

A. General Requirements:
   1. All material shall consist of 304 stainless steel unless noted otherwise. Scope shall include drive motors, gear reducers, support legs, anchor bolts, flocculation reactor, injection ring, polymer station, piping, wiring, controls and all accessories required for a complete system. Each unit shall be provided with a dedicated polymer mixing unit.
   2. Proposal shall detail all connections including sludge inlet, polymer injection (i.e. the injection ring), and utility water connections.
   3. Proposal shall provide estimated polymer usage to achieve cake solids concentration.
   4. The unit shall be completely enclosed to prevent odor emission. Access panels and flanged connections for odor control piping shall be provided.
B. Screw Press Requirements
   1. Sludge dewatering press shall be manufactured from AISI 304L stainless steel shapes (rods, angles, and channels), pipes, and sheets. In particular, wedge wire basket, screw, shaft, support legs, fasteners and anchor bolts shall be made of this material. Wipers for helical screw flights shall be of wear resistant polyurethane (PU) material. Screw shall be shafted.
   2. Manufacturer shall supply details regarding all instrumentation that will be provided, including but not limited to pressure sensors, solenoids, proximity switches, and timers. Controls shall be capable of operating the screw press unit, all associated equipment, polymer feed system and sludge feed pumps.
C. Centrifuge Requirements
   1. Bowl and scroll shall be centrifugally cast duplex 2205 stainless steel. Frame and cover shall be stainless steel. O-rings and seals shall be nitrile rubber. Feed ports shall be protected from abrasion by field replaceable solid sintered tungsten carbide elements. Discharge ports shall be protected from abrasion by abrasion by field replaceable tungsten carbide wear saddles. The edge and face of the conveyor flights shall be protected against abrasion by a series of welded-on sintered tungsten carbide tile assemblies from two wraps beyond the feed zone through the solids discharge end.
   2. Flow through the centrifuge shall be counter current. Pond depth shall be readily adjustable via weirs that do not require removing the rotating assembly from the frame.

3. The scroll conveyor shall be designed such that the feed leaving the feed tube is accelerated in a feed zone. Feed material leaving the conveyor hub shall pass through hard-surfaced feed ports.
4. Vibration isolators for the drive motor and back-drive shall be supplied as required. Conduit boxes for all centrifuge mounted switches, except those specifically related to the main drive motor, shall be mounted on the base. Flexible connectors shall be provided.
5. A diverter gate to direct slop (wet sludge in the solids chute at startup) to the drain, along will actuators and motors, and programming shall be provided. Any wash water solenoids, such as for clean-in-place cycles, solids chute cleaning and slop washing, shall be provided and incorporated into the operational strategy.

2.3 POLYMER MIXING SYSTEM

A. The polymer station shall be self-contained with pumps, piping, fittings, and accessories, and shall be factory assembled and tested to eliminate field assembly work and therefore to minimize installation and start up time. The frame shall be 304 stainless steel and the piping SCH 80 PVC. The following mixing manufacturers are acceptable: VeloDyne, USA and Fluid Dynamics, PSG.
B. A polymer mixing chamber shall be provided. The mixing chamber shall have a translucent front cover. The mixing chamber shall be designed to produce variable intensity, back flow mixing action to optimize polymer performance without damaging polymer molecular structure.
C. Materials: Impeller - PVC; body of mixing device – PVC; cover – clear Lexan; fastener – 316 SS; seals – Viton; pressure rating – maximum 150 PSI.
D. The water piping connection to the polymer blend system shall include a minimum 1 in inlet (NPT female), an UL listed solenoid valve (rated IP65), and a flow meter with a rate adjusting valve and low pressure alarm switch.
E. A neat polymer metering pump with hose connector shall be provided and connected through a 1/2 in barbed hose to the polymer mixing device. The neat polymer pump shall be a progressive cavity type pump.
F. Control Panel: NEMA 4X FRP or SS enclosure.
G. Operator interface – discrete selector switch (system ON/OFF/REMOTE); mechanical mixer speed adjust potentiometer; stroke length / stroke speed adjustment at metering pump
H. Status / Alarm indicators: system running indication; LCD display of metering pump rate (on metering pump); low pressure switch alarm
I. Inputs: remote start / stop (discrete dry contact); pacing signal from main control panel (4-20 mA)
J. Outputs: system running (discrete dry contact); remote mode (discrete dry contact); low pressure alarm (discrete dry contact) ; low flow alarm (discrete dry contact)
K. The pressure side of the polymer system shall be connected through a minimum 1 in diameter PVC pipeline and a magnetic inductive flow meter to the polymer injection ring described above.

2.4 CONTROLS AND INSTRUMENTATION

A. Equipment shall meet the requirements of the following specifications, as attached in Appendix A:
   1. Section 260513 – Common Motor Requirements for Equipment
   2. Section 262923 – Variable Frequency Motor Controllers
   3. Section 409000 – Instrumentation Control for Process Systems
   4. Section 409433 – Human Machine Interfaces
   5. Section 409443 – Programmable Logic Controllers
   6. Section 409513 – Process Control Panels and Hardware
   7. Section 409600 – Process Control Software

B. The entire control system shall be provided by the supplier. The contractor shall provide wiring between all system components as required. Each dewatering unit shall be provided with a NEMA 4X stainless steel control panel. The enclosure shall be suitable for wall mounting, shall have hinged covers which swing horizontally and shall be held closed with 3-Point Latch, and shall include main disconnect switches, transformers, surge arresters, control switches, starters, sensors, PLCs, OITs, air conditioner and all other controls/instrumentation required for a complete and operable system.

2.5 PROTECTIVE COATINGS

A. Equipment supplier shall ensure that the following protective coatings are included for all equipment supplied:
   1. All ferrous Metal surfaces in dry and wet wells or in immediate vicinity of corrosive environments and all other submerged or partially submerged ferrous metal surface shall be coated with System H (or equal) as specified in section 098000 – Protective Coatings included in APPENDIX B.
   2. Interior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere shall be coated with System G (or equal) as specified din section 098000 – Protective Coatings included in APPENDIX B.

PART 3 - EXECUTION

3.1 TESTING

A. Supplier shall conduct factory testing and verification of equipment prior to shipment. Testing shall demonstrate correct alignment, smooth operation and freedom of excessive vibration and noise of all equipment. Test period shall demonstrate accurate measurement of sensors and function of run sequences.

3.2 INFORMATION TABLE

IMPERIAL- RFP DEWATERING UNIT		
Solids Capacity		lbs/hr
Hydraulic Capacity		gpm
Motor Size(s)		HP
Washwater Requirements		gpm
		psig
Frequency of Washing		minutes/day
Duration of Washing Cycle		minutes
Required Feed Pressure (including polymer mixing)		psig
Polymer Required		lbs/dry ton
Minimum Cake Solids		%
Estimated Power Draw @ Design Conditions		kWhr/day
Overhead Crane Lifting Capacity		tons
Compressed Air Requirements		scfm
		psig

EXHIBIT THREE - DRAWINGS

OVERALL SITE PLAN	C-1
PROCESS BASIN PLAN	ABS-1
PROCESS BUILDING MECHANICAL PLAN	PBA-1
DEWATERING BUILDING	DBA-1

EXISTING AERATION BASIN AND CLARIFIERS

EXISTING SLUDGE DRYING BEDS

EXISTING SLUDGE DRYING BEDS

DEWATERING BUILDING

MBR BUILDING

PROCESS BASINS

20'x30' GRIT REMOVAL AREA

EXISTING HEADWORKS

CITY OF IMPERIAL WASTEWATER TREATMENT PLANT

EXISTING DISINFECTION SYSTEM

EXISTING SLUDGE PUMPING STATION BUILDING

EXISTING OPERATIONS BUILDING

EXISTING SECONDARY CLARIFIERS

EXISTING OXIDATION DITCH

EXISTING INFLUENT PUMP STATION

GENERAL SITE PLAN

SCALE: 1"=30'-0"

0 30 60

Scale in Feet

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ORIGINAL			
NO.	DATE	DESIGN	DRAWN	CHECKED
0	–	–	–	–

REVISIONS

CITY OF IMPERIAL, CA

WWTP UPGRADE PROJECT
CIVIL
GENERAL SITE PLAN

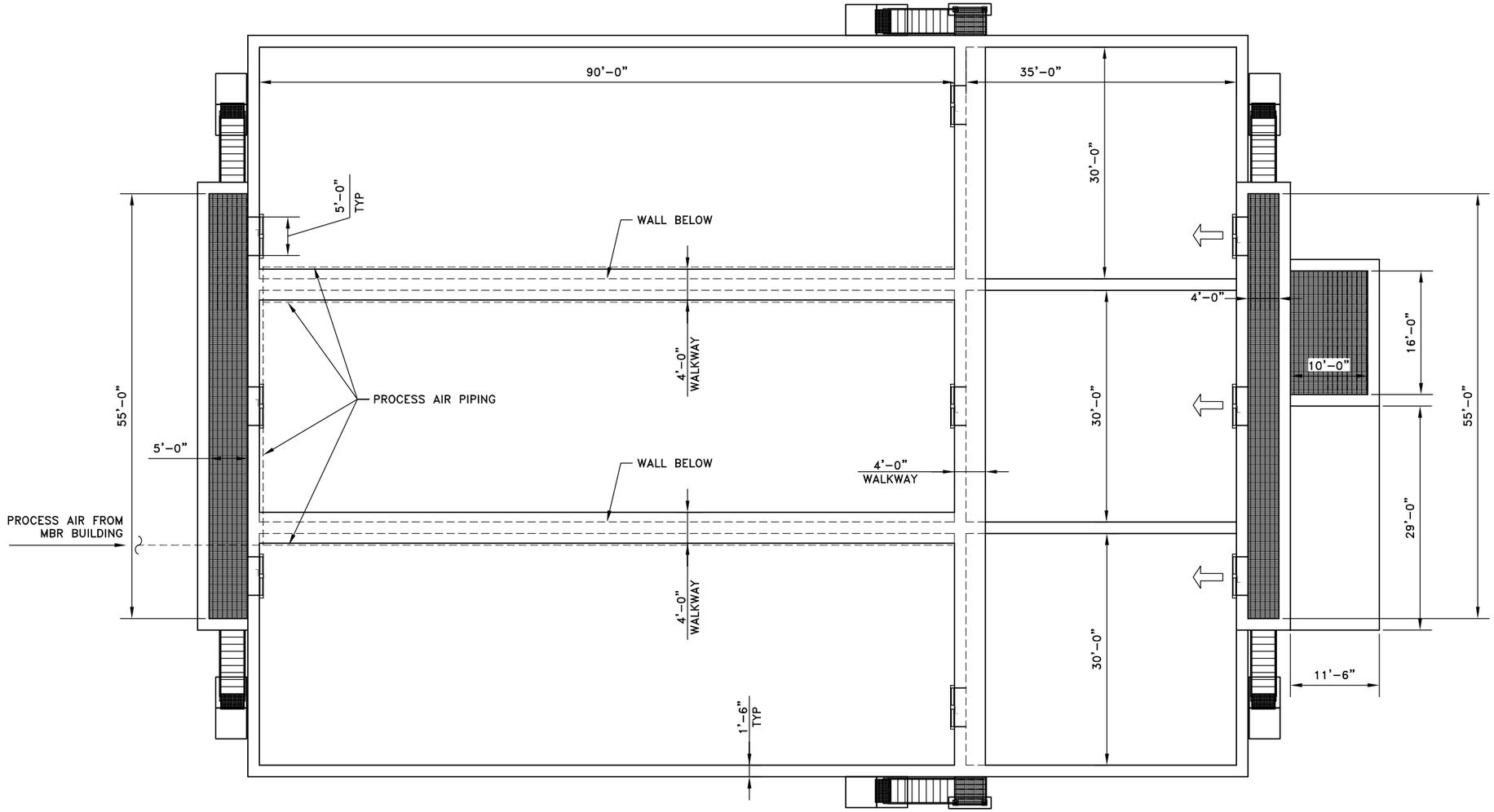
AQUA ENGINEERING
533 W 2600 S, SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

ALBERT A. WEBB ASSOCIATES
ENGINEERING CONSULTANTS
CIVIL ENGINEERS
3788 McCRAY STREET
RIVERSIDE, CA 92506
PH. (951) 686-1070
FAX (951) 788-1256

0 1/2 1

DRAWING IS TO SCALE IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

SHEET
C-1



STRUCTURAL PLAN

SCALE: 1/8"=1'–0"

0 8 16

Scale in Feet

ORIGINAL			
NO.	DATE	DESIGN	DRAWN	CHECKED
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REVISIONS

CITY OF IMPERIAL, CA

WWTP UPGRADE PROJECT
AERATION BASIN
STRUCTURAL PLAN

AQUA ENGINEERING
533 W 2600 S, SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

ALBERT A. WEBB ASSOCIATES
ENGINEERING CONSULTANTS
CIVIL ENGINEERS
3788 McCRAY STREET
RIVERSIDE, CA 92506
PH: (951) 686-1070
FAX (951) 788-1256

0 1/2 1

DRAWING IS TO SCALE
IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

SHEET

ABS-1

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ARCHITECTURAL PLAN

SCALE: 3/16"=1'-0"

0 4 8

Scale in Feet

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REVISIONS

CITY OF IMPERIAL, CA

WWTP UPGRADE PROJECT
MBR BUILDING
ARCHITECTURAL PLAN

AQUA ENGINEERING
533 W 2600 S, SUITE 275, BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

ALBERT A. WEBB ASSOCIATES
ENGINEERING CONSULTANTS
CIVIL ENGINEERS
3788 MCCRAY STREET
RIVERSIDE, CA. 92506
PH (951) 686-1070
FAX (951) 788-1256

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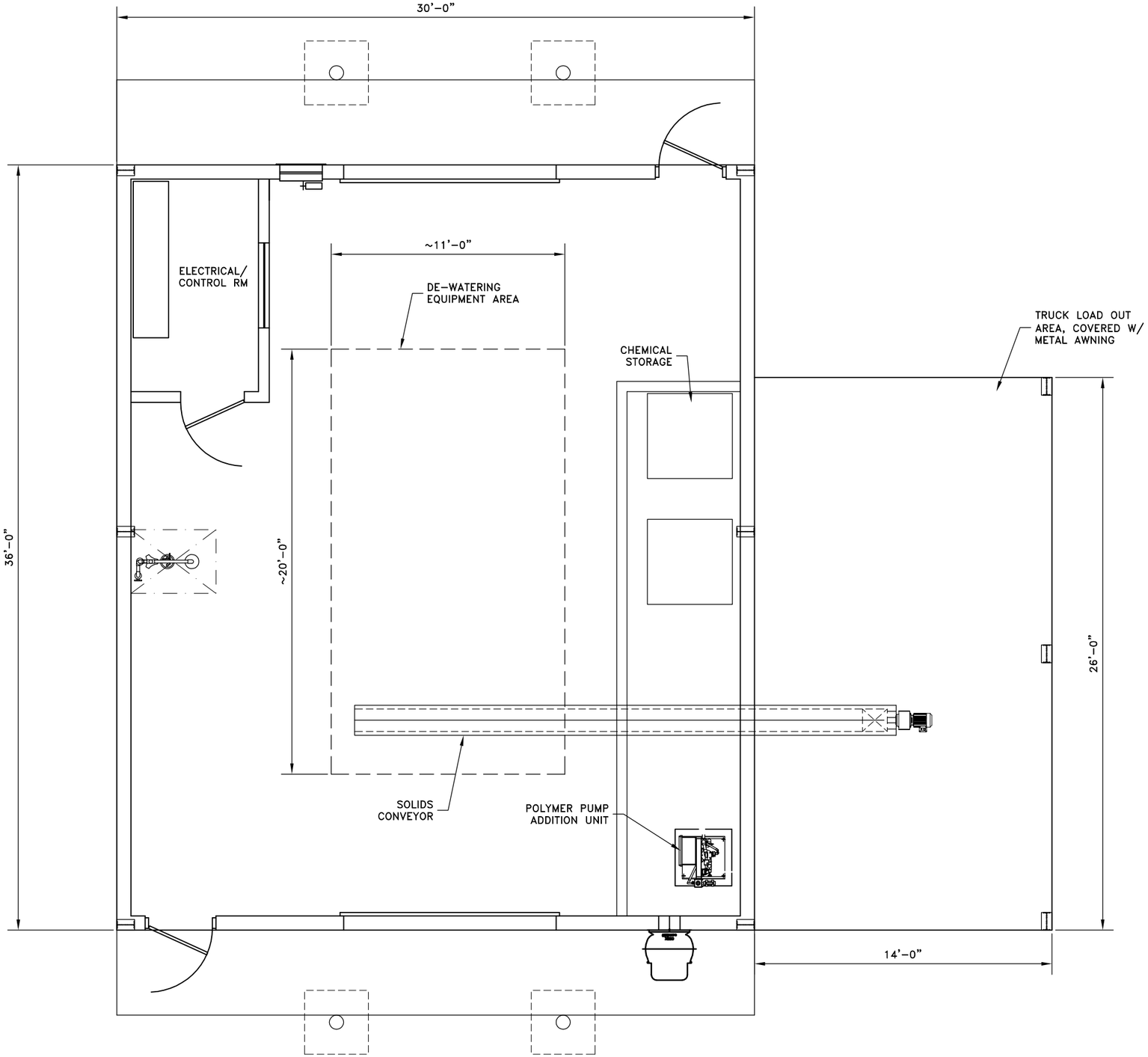
DRAWING IS TO SCALE
IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

SHEET

PBA-1



ARCHITECTURAL PLAN

SCALE: 3/8"=1'-0"

0 2 4
Scale in Feet

NO.	DATE	ORIGINAL DESIGN	ORIGINAL DRAWN	ORIGINAL CHECKED
0	-	-	-	-

REVISIONS

CITY OF IMPERIAL, CA

WWTP UPGRADE PROJECT
DE-WATERING BUILDING
ARCHITECTURAL PLAN

AQUA ENGINEERING
533 W. 2600 S. SUITE 275 BOUNTIFUL, UT 84010
PHONE (801) 299-1327 FAX (801) 299-0153

ALBERT A. WEBB ASSOCIATES
ENGINEERING CONSULTANTS
CIVIL ENGINEERS
3788 McCRAY STREET
RIVERSIDE CA. 92506
PH. (951) 686-1070
FAX (951) 788-1256

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DRAWING IS TO SCALE
IF BAR MEASURES:
1" = FULL SCALE
1/2" = HALF SCALE

SHEET
DBA-1

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APPENDIX A - ELECTRICAL AND CONTROLS SPECIFICATIONS

260513	Common Motor Requirements for Equipment
262923	Variable-Frequency Drives
409000	Instrumentation and Control for Process Systems
409433	Human-Machine Interfaces
409443	Programmable Logic Controllers
409513	Process Control Panels and Hardware
409600	Process Control Software

SECTION 260513 – COMMON MOTOR REQUIREMENTS FOR EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes AC induction electric motors to be provided with associated driven equipment. Motor voltage, speed and enclosures are specified in the equipment specifications. Unless otherwise specified, motors shall be provided by the manufacturer of the driven equipment under the provisions of the individual equipment specification.

1.2 MOTOR RATING

A. Motor horsepower ratings as shown on the drawings and noted on the specifications are estimates only and it is the responsibility of the CONTRACTOR and/or VENDOR to furnish motors, electric circuits, power feeds and other equipment whose ratings meet the requirements for the submitted horsepower and amperage.

B. This section applies to electric motors rated 480 V and below.

1.3 CODE AND STANDARDS

A. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC Articles 220, 250, and 430, as applicable to installation, and construction of motor controllers.

B. AFBMA Compliance: Comply with applicable requirements of AFBMA 9 & 11, "Load Rating and Fatigue Life for Ball and Roller Bearings."

C. UL Compliance: Comply with applicable requirements of UL 674, “Electric Motors and Generators, for Use in Division 1 Hazardous (Classified) Locations” and UL 1004, “Electric Motors”.

D. IEEE Compliance: Comply with recommended practices contained in IEEE Standard 112, "Standard Test Procedures for Polyphase Induction Motors and Generators," and IEEE Standard 841, “Standard for Petroleum and Chemical Industry – Totally Enclosed Fan Cooled (TEFC) Squirrel Cage Induction Motors – Up to and Including 500 HP”.

E. NEMA Compliance: Comply with applicable requirements of NEMA Standard ICS 2, "Industrial Control Devices, Controllers and Assemblies", NEMA Standard ICS 6, “Enclosures for Industrial Controls and Systems, ”Pub No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)" and NEMA MG 1, “Motors and Generators”.

1.4 MAINTENANCE DATA

A. Submit maintenance data and parts list for each motor and auxiliary component; including troubleshooting maintenance guide. Also, provide product data and shop drawings in a maintenance manual, in accordance with requirements of the Contract Documents.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's data and installation instructions for each motor in accordance with the individual equipment specification and Section 013300. As a minimum, the following information shall be provided:

1. Manufacturer name, type and model number
2. Motor outline, dimensions and weight
3. Manufacturer's general descriptive information relative to motor features
4. Type of bearing and method of lubrication
5. Rated size of motor and service factor
6. Temperature rise and insulation rating
7. Full-load rotative speed
8. Efficiency at full, ¾ and ½ load
9. Full load current
10. Locked-rotor current
11. Space heater wattage and voltage, if applicable
12. If a winding overtemperature device is required, provide a response curve for the temperature device, wiring diagram and specifications
13. If a moisture detection system is required, provide a typical wiring diagram and a moisture detection relay to be installed by the CONTRACTOR or VENDOR in the associated motor controller.

B. Shop Drawings: Submit shop drawings of electric motors showing accurately scaled equipment locations and spatial relationships to associated drive equipment.

C. Wiring Diagrams: Submit power and control wiring diagrams for electric motors showing connections to electrical power panels, feeders, and equipment.

D. Operations and Maintenance Data: Submit operation and maintenance information as required by Section 017823.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide electric motors and ancillary components that comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation.

2.2 SERVICE CONDITIONS

A. Unless specified otherwise, motors shall be suitable for continuous operation at an elevation of 0 to 3300 feet above mean sea level.

B. Unless specified otherwise, motors located outdoors shall be suitable for continuous operation from -25 to 50°C; motors located indoors shall be suitable for continuous operation from 0 to 50°C.

C. All motors shall be able to operate under power supply variations in accordance with NEMA MG 1 – 14.30.

2.3 NAMEPLATES

A. Motor nameplates shall be engraved or stamped stainless steel. Information shall include those items as enumerated in NEMA Standard MG 1, as applicable. Nameplates shall be permanently fastened to the motor frame and shall be visibly positioned for inspection.

2.4 CONSTRUCTION

A. All motors provided under this specification shall have the following features of construction:

1. Frames shall be steel for motors smaller than ½ horsepower and cast iron for motors ½ horsepower and larger.
2. Cast metal shrouds and covers for non-sparking fan blades.
3. Non-hygroscopic motor leads.
4. NEMA Design-B as standard design. Other designs if required must be submitted and approved in writing by the ENGINEER.
5. Motor Service Factor of 1.15 for Sine-Wave and 1.0 for Inverter Duty.
6. Grounding terminal
7. Windings shall be copper
8. Rotor cages shall be die cast aluminum or fabricated copper
9. Shafts shall be made from carbon steel.

2.5 MOTORS LESS THAN ½ HORSEPOWER

A. General:

1. Unless specified otherwise, motors less than ½ horsepower shall be squirrel cage, single phase, capacitor start, induction run type.
2. Single phase motors shall have class B insulation as a minimum.
3. Motors for fans less than 1/8 horsepower may be split-phase or shaded pole type.
4. Winding shall be copper.

B. Rating:

1. Unless specified otherwise, motors less than ½ horsepower shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1 – 10.35.

2. Dual voltage (115/230) rated motors are acceptable if all leads are brought out to the conduit box.
3. Motors shall be non-overloading at all points of the equipment operation.

2.6 MOTORS ½ HORSEPOWER AND LARGER

A. General:

1. Unless specified otherwise, motors ½ horsepower and larger shall be 3 phase, squirrel cage, full voltage start induction type.
2. Unless otherwise specified, motors shall have a NEMA MG 1-1.16 design letter B or C torque characteristic as required by the driven equipment's starting torque requirement.
3. Winding shall be copper.
4. Motors shall be equipped with a set of thermal overload switches with dry contacts available at the motor terminal box:

B. Rating:

1. Unless specified otherwise, motors ½ horsepower and larger shall be rated for operation at 460 volts, 3 phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1 – 10.35.
2. Dual voltage (230/460) rated motors are acceptable if all leads are brought out to the conduit box.
3. Motors for variable frequency systems shall not be required to deliver more than 80% of the motor's service factor rating by any load imposed by the driven machine at any specified operating condition or any condition imposed by the driven machine's performance curve at maximum operating speed.

C. Enclosures and Insulation:

1. Motors shall be classified as Type 1 (Process) or Type 2 (Explosion proof) based upon the location of the motor and the associated area classification.
2. Temperature rise for all motors shall not exceed that permitted by Note II, Paragraph 12.42 of NEMA MG 1.
3. Motor Insulation shall be non-hygroscopic.
4. Type 1 motors (Process):

    a. Type 1 motors shall be premium energy-efficient motors, totally enclosed, fan cooled (TEFC)
    b. All outdoor motors shall have Class H insulation with Class B temperature rise. Motors located indoors shall have Class F insulation with Class B temperature rise.
    c. All internal surfaces shall be coated with an epoxy paint.
    d. Motors shall be rated for corrosive atmosphere duty.

5. Type 2 Motors (Explosion Proof):

    a. Explosion proof motors shall be UL listed in accordance with UL 674 for Class I, Group D hazardous atmospheres.

b. Motors located outdoors shall have Class H insulation. Motors located indoors shall have Class F insulation.
c. A UL-approved Type 316 stainless steel breather/drain device shall be provided in the motor drain hole.
d. The motor shall be provided with a frame temperature thermostat which meets the UL frame temperature limit code T2A (280°C). The thermostat shall contain an automatically reset, normally closed contact rated 2 amperes at 230 VAC.

2.7 MOTORS FOR VARIABLE FREQUENCY DRIVES

A. Motors intended for use with variable frequency drives shall be compatible with the characteristics of the intended variable frequency inverter.

B. Motors shall be Type 1 or Type 2 as specified in 2.06C.

C. Motors shall be capable of withstanding a pulse voltage of at least 1750 volts with a rate of rise up to 750V per microsecond.

D. Motors shall be certified by the manufacturer as suitable for inverter duty and shall have as a minimum a 10:1 turndown ratio (6-60Hz).

E. Motors shall be capable of running above the rated RPM up to 70 Hz (116.67% of rated RPM) so long as the load current does not exceed the full load amps of the motor.

2.8 MOTOR EFFICIENCIES

A. Type 1 and Type 2 motors in accordance with NEMA MG 1 Table 12-11 and 12-12 and Type 2 in accordance with IEEE 841 Table 2 motor minimum nameplate efficiency for 900, 1200 and 1800 rpm motors, when operating on a sinusoidal power source shall conform to the following (in accordance with IEEE 112B testing procedures):

Motor Horsepower	Guaranteed Minimum Efficiency (%)		
	900 RPM	1200 RPM	1800 RPM
1	70.0%	78.5%	81.5%
1.5	72.0%	81.5%	82.5%
2	80.0%	81.5%	82.5%
3	81.5%	86.5%	84.0%
5	82.5%	86.5%	84.0%
7.5	82.5%	88.5%	88.5%
10	86.5%	88.5%	88.5%
15	86.5%	89.5%	89.5%
20	87.5%	90.2%	91.7%
25	87.5%	91.0%	91.7%
30	89.5%	91.0%	91.7%
40	89.5%	92.4%	92.4%

50	90.2%	92.4%	92.4%
60	90.2%	93.0%	93.0%
75	91.7%	93.0%	93.6%
100	91.7%	93.6%	94.1%
125	92.4%	93.6%	94.1%
150	92.4%	94.5%	94.5%
200	92.4%	94.5%	94.5%
250	93.6%	94.1%	94.1%

2.9 CONDUIT BOXES

A. Conduit boxes shall be sized based on the conduit number and conduit size indicated on the drawings. Provide over-sized boxes with the number of openings as required to accommodate the conduits required.

B. Conduit boxes shall be split construction with threaded hubs and shall conform to IEEE 841 for Type 1 and Type 2 motors. Motors shall be furnished with petroleum-resistant gaskets at the base of the conduit box and between the halves of the conduit box.

C. Conduit boxes shall be designed to rotate in order to permit installation in any of four positions 90 degrees apart.

2.10 BEARINGS

A. Bearings may be oil or grease lubricated ball or angle contact roller bearing rated for a minimum L-10 life of 100,000 hours in accordance with ABMA 9 or 100 at the ambient temperature specified. Motor designs employing cartridge type bearings will not be accepted. Bearings shall be fitted with lubricant fill and drain or relief fittings. Belt loads shall not exceed forces calculated from NEMA MG 1 Table 14-1.

2.11 LIFTING EYES

A. Motors weighing more than 50 pounds shall be fitted with at least one lifting eye and motors weighing over 150 pounds shall be fitted with two lifting eyes.

2.12 SPACE HEATERS

A. Motors that are located outdoors shall be equipped with Space Heaters to prevent condensation inside the motor enclosure after motor shutdown and maintain the temperature of the windings at not less than 5°C above outside ambient temperature.

B. Heaters shall be flexible wraparound type rated 120 volts, single phase, 60 Hz unless otherwise noted. The space heater rating in watts and volts shall be noted on the motor nameplate or on a second nameplate. Space heater leads H1 and H2 shall be brought to a separate terminal block or pigtails in the motor conduit box or separate conduit box with a threaded conduit opening.

PART 3 - EXECUTION

A. Install electric in accordance with equipment manufacturer's written instructions, and with recognized industry practices. Comply with applicable requirements of NEC, UL, and NEMA standards, to insure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

C. Ensure that the motor is properly grounded from the incoming motor leads and that the frame is bonded to the grounding electrode system.

D. Verify breather/drain fittings have been installed as specified.

E. Prior to energizing, check circuitry for electrical continuity, and for short-circuits. Winding insulation resistance for motors shall not be less than 10-megohms measured with a 1000-VAC megohmeter at 1-minute at or corrected to 40°C.

F. Check rotation of each motor for proper direction.

G. Upon completion of installation of motor controller equipment and electrical circuitry, energize controller circuitry and demonstrate functioning of equipment in accordance with requirements.

END OF SECTION 220513

SECTION 262923 - VARIABLE-FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes separately enclosed, pre-assembled, combination VFDs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. See Section 262419 "Motor-Control Centers" for VFDs installed in motor-control centers.

1.2 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).
B. CPT: Control power transformer.
C. EMI: Electromagnetic interference.
D. IGBT: Insulated-gate bipolar transistor.
E. LAN: Local area network.
F. LED: Light-emitting diode.
G. MCP: Motor-circuit protector.
H. NC: Normally closed.
I. NO: Normally open.
J. OCPD: Overcurrent protective device.
K. PCC: Point of Common Coupling
L. PID: Control action, proportional plus integral plus derivative.
M. PWM: Pulse-width modulated.
N. P&ID: Process & Instrumentation Diagram
O. RFI: Radio-frequency interference.
P. SCADA: Supervisory control and data acquisition.
Q. TDD: Total Demand Distortion
R. THD: Total Harmonic Distortion
S. VFD: Variable-frequency drive.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFDs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Product Data: For each type and rating of VFD indicated.

B. System Harmonics Analysis: For each VFD and for the distribution system as a whole.

C. Shop Drawings: For each VFD indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.

1. Show tabulations of installed devices, equipment features, and ratings.
2. Schematic and Connection Wiring Diagrams: For power, signal, communications, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFDs. Show VFD layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

B. Seismic Qualification Certificates: For VFDs, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

C. Product certificates.

D. Source quality-control reports.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

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

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test VFD according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Rockwell Automation, Inc.; Allen-Bradley Brand.
2. Square D; a brand of Schneider Electric.
3. Toshiba International Corporation.

B. General Requirements for VFDs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.

C. Application: Constant torque and variable torque.

D. VFD Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

E. 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.

F. Output Rating: Three-phase; 10 to 200 (60 as programmed default) Hz, programmable as voltage proportional to frequency throughout voltage range or with sensorless vector control; maximum voltage equals input voltage.

G. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFD input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 5 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFD frequency rating.

4. Minimum Efficiency: 97 percent at 60 Hz, full load.
5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: Equal to the rating of the gear feeding the drive. If not listed, 65 kA.
7. Ambient Temperature Rating: Not less than 14 deg F (minus 10 deg C) and not exceeding 122 deg F (50 deg C).
8. Ambient Storage Temperature Rating: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 158 deg F (70 deg C)
9. Humidity Rating: Less than 95 percent (noncondensing).
10. Altitude Rating: Not exceeding 3300 feet without de-rating. Up to 9850 feet with de-rating.
11. Vibration Withstand: Comply with IEC 60068-2-6.
12. Overload Capability: VFD system shall be rated for continuous operation at a minimum of 110% of motor load full load amps (FLA) times the motor service factor. Variable torque inverters shall be capable of delivering 110% of continuous rating for a minimum of 60 seconds. Constant torque inverters shall be capable of delivering 150% of continuous rating for a minimum of 120 seconds.
13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
14. Speed Regulation: Plus or minus 0.6 Hz.
15. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

H. Inverter Logic: Microprocessor based, VFD isolated from all power circuits.

I. Isolated Control Interface: Allows VFDs to follow remote-control electrical signal over a minimum 100:1 speed range.

J. 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: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

K. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
3. Under- and overvoltage trips.
4. Inverter overcurrent trips.
5. VFD and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFDs and motor thermal characteristics, and for providing VFD overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
6. Critical frequency rejection, with three selectable, adjustable deadbands.
7. Instantaneous line-to-line and line-to-ground overcurrent trips.

8. Loss-of-phase protection.
9. Reverse-phase protection.
10. Short-circuit protection.
11. Motor overtemperature fault.

L. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

M. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

N. Bidirectional Autospeed Search: Capable of starting VFD into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

O. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

P. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

Q. Integral Input Disconnecting Means and OCPD: NEMA AB 1, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFD input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFD input current rating, whichever is larger.

2.2 CONTROLS AND INDICATION

A. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. VFD Fault.
4. All other lights as shown on the design drawings

B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

C. Historical Logging Information and Displays:

1. Running log of total power versus time.
2. Total run time.
3. Fault log, maintaining last four faults with time and date stamp for each.

D. Indicating Devices: Digital display mounted flush in VFD door and connected to display VFD parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

E. Control Signal Interfaces:

1. Electric Input Signal Interface:

a. Speed Reference: The VFD drive shall be capable of being controlled locally by a speed potentiometer or remotely by a 4- to 20-mA dc signal. The 4- to 20-mA signal shall be galvanically isolated and input resistance shall not exceed 250 ohms.

b. A minimum of two programmable analog inputs shall be provided and would be typically used for PID process variable and set point. These signals shall be setup to accept a 4- to 20-mA dc signal. The 4- to 20-mA signal shall be galvanically isolated and input resistance shall not exceed 250 ohms.

c. A minimum of six multifunction programmable digital inputs. The drive shall be expandable to handle additional digital inputs if required. The digital inputs shall be programmable to perform functions including, but not limited to:

1) VFD Start/Stop Control (2 or 3 wire)
2) Forward/Reverse/Stop Control
3) Local/Remote. The VFD shall be programmable so that "Local" control may either be the keypad or by hard-wired start/stop and potentiometer. The VFD shall be programmable so that "Remote" control may either be hard-wired start/stop and 4- to 20mA speed control or via the communications network.
4) VFD Interlock/Enable. This input when de-energized will not allow the VFD to run the motor under any circumstance.
5) VFD External Fault. This input will trip the VFD and require a reset before allow the motor to run again.
6) Preset Frequencies. The VFD shall be programmable to run at pre-programmed frequencies with up to 6 different steps.

2. Output Signal Interface:

a. A minimum of two programmable analog output signals 4- to 20-mA dc, which can be configured for any of the following:

1) Output frequency (Hz).
2) Output current (load).
3) DC-link voltage (V dc).
4) Motor torque (percent).
5) Motor speed (rpm).
6) Set point frequency (Hz).
7) Motor power (kW)

b. A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following (the drive shall be expandable to handle additional digital outputs if required):

1) Motor running.
2) VFD ready.
3) Set point speed reached.
4) Fault and warning indication (overtemperature or overcurrent).
5) PID high- or low-speed limits reached.

F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.

1. Number of Loops: One.

G. SCADA Interface: Factory-installed hardware and software to enable the SCADA to monitor, control, and display VFD status and alarms and energy usage. Allows VFD to be used with an external system within a multidrop LAN configuration; settings retained within VFD's nonvolatile memory.

1. Network Communications Ports: Ethernet.
2. Embedded SCADA Protocols for Network Communications: Ethernet/IP; protocols accessible via the communications ports.

2.3 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: All new power distribution systems supplied shall be required to meet the requirements of IEEE 519-1992. Specifically, the system shall adhere to the TDD requirements of Table 10-3 of IEEE 519-1992. If the power distribution system is equipped with an Active Harmonic System, each VFD shall be equipped with a line reactor whose impedance is as recommended by the Active Harmonic System manufacturer (typically 3%). If no Active Harmonic System is part of the power distribution system, the following rules as a minimum shall define the input line conditioning for each VFD (unless further conditioning is required to meet the IEEE 519-1992 limits). With the Engineer's approval, the contractor may decide to supply an Active Harmonic System even if not shown on the drawings, with corresponding reactors and chokes (this would typically occur if it is more cost effective to meet IEEE 519 with a single system then multiple harmonic filters).

1. All VFD's sized for motors 50HP or larger shall be equipped with DC-link chokes.
2. All VFD's sized for motors 40HP and less shall be equipped with 5% line reactors unless specifically called out as otherwise on the drawings.

3. All VFD's sized for 50HP to 200HP motors shall be equipped with passive harmonic filters with DC Link Chokes.
4. All VFD's greater than 200HP shall have be setup to have less than 5% THD for both voltage and current. This would typically require that the drive is setup with an 18-pulse front end or with an active harmonic filter. The VFD assembly shall accept a single 3-phase input and shall contain all of the harmonic mitigation equipment as part of the assembly.

B. EMI/RFI Filtering: VFD's shall be CE marked and certify compliance with IEC 61800-3 for Category C2.

2.4 LOAD CONDITIONING

A. Load Conditioning: For VFD driven loads with conductor lengths between 200 and 1,000 feet, output dV/dt filters shall be provided as part of the VFD assembly. It is strongly recommended that VFD motor leads not be longer than 500 feet and alternative VFD locations should be considered. If absolutely necessary, loads with conductor lengths greater than 1,000 feet shall have output sine wave filters shall be provided as part of the VFD assembly. Voltage drop considerations shall be taken into account when selecting the motor's nameplate voltage.

2.5 LINE AND LOAD CONDITIONING EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Transcoil International (TCI).
2. Or approved equal.

B. Line Reactors: Reactors shall be part of the VFD assembly. They shall be sized based upon the VFD input power requirements. They shall be properly installed with appropriate spacing and ventilation for ambient temperatures up to 104°F. The reactor shall meet the following criteria:

1. The reactor shall be UL 508 listed.
2. Continuous current rating: 100% RMS.
3. Intermittent current ratings: 150% for 60 seconds; 200% for 10 seconds.
4. Altitude Rating: Not exceeding 3300 feet without de-rating. Up to 9850 feet with de-rating.
5. All wiring shall be copper.

C. Passive Harmonic Filters: Filters shall be part of the VFD assembly. They shall be sized based upon the VFD input power requirements. They shall be properly installed with appropriate spacing and ventilation for ambient temperatures up to 104°F. The filter shall meet the following criteria:

1. The filter shall be UL 508 listed.
2. The filter shall filter harmonics generated by the nonlinear VFD to satisfy the requirements of IEEE 519-1992 for individual and total harmonic voltage and current distortion at the input terminals of the filter.
3. The TDD of the current at the input terminals of the filter shall not exceed the limits defined in Table 10-3 of IEEE 519-1992.

4. Full load efficiency: 97% or greater
5. The filter shall not resonate with the power distribution system nor attract harmonics from other sources.
6. The harmonic filter shall be a passive series connected low pass filter consisting of an inductor capacitor network. Active electronic components shall not be used.
7. The harmonic filter shall be equipped with a contactor that will connect the capacitor(s) only when the motor is running, avoiding nuisance VFD over-voltage tripping.
8. All wiring shall be copper.

D. dV/dt Filters: Filters shall be part of the VFD assembly. They shall be sized based upon motor horsepower and required full-load current (including service factor). They shall be properly installed with appropriate spacing and ventilation for ambient temperatures up to 104°F. The filter shall meet the following criteria:

1. The filter shall be UL 508 listed.
2. Maximum peak motor terminal voltage with 500 feet of cable: 15% of bus voltage.
3. Maximum dV/dt: 200 Volts per microsecond.
4. The dV/dt Filter shall reduce common mode voltages by a minimum of 40%.
5. Continuous current rating: 100% RMS.
6. Intermittent current ratings: 150% for 60 seconds; 200% for 10 seconds.
7. Allowed inverter switching frequencies: 1kHz to 8 kHz.
8. Nominal inverter operating frequency: 60Hz; Minimum – 6 Hz; Maximum with de-rating: 120Hz.
9. Altitude Rating: Not exceeding 3300 feet without de-rating. Up to 9850 feet with de-rating.
10. Insertion loss: 3% of rated voltage maximum.
11. All wiring shall be copper.

E. Sine Wave Filters: Filters shall be part of the VFD assembly. They shall be sized based upon motor horsepower and required full-load current (including service factor). They shall be properly installed with appropriate spacing and ventilation for ambient temperatures up to 104°F. The filter shall meet the following criteria:

1. The filter shall be UL 508 listed.
2. Harmonic Voltage Distortion: 10% maximum
3. Continuous current rating: 100% RMS.
4. Intermittent current rating: 150% for 60 seconds.
5. Allowed inverter switching frequencies: 2kHz to 8 kHz.
6. Nominal inverter operating frequency: 60Hz; Minimum – 0 Hz; Maximum with de-rating: 90Hz.
7. The Sine Wave Filter shall reduce common mode voltages by a minimum of 40%.
8. Altitude Rating: Not exceeding 3300 feet without de-rating. Up to 9850 feet with de-rating.
9. Insertion loss: 6% of rated voltage maximum.
10. All wiring shall be copper.

2.6 BYPASS SYSTEMS

A. Provide Bypass Systems only if indicated on the drawings.

B. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.

C. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic control system feedback.

D. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.

1. Bypass Contactor: Load-break, NEMA-rated contactor.
2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
3. Isolating Switch: Non-load-break switch arranged to isolate power converter and permit safe troubleshooting and testing of the power converter, both energized and de-energized, while motor is operating in bypass mode; pad-lockable, door-mounted handle mechanism.

E. Bypass Contactor Configuration: Full-voltage (across-the-line) or reduced voltage soft-starter as shown on the drawings.

1. NORMAL/BYPASS selector switch.
2. HAND/OFF/AUTO selector switch.
3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFD while the motor is running in the bypass mode.
4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
    b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.

5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 VA.

6. Overload Relays: NEMA ICS 2.

2.7 ENCLOSURES

A. VFD Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry, Clean and Non-corrosive Indoor Locations: Type 1.
2. Outdoor or Corrosive Locations: Type 4X, stainless steel.

3. Wash-Down Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFD as "Plenum Rated."

2.8 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFD enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Maintained and/or momentary as required.
b. Pilot Lights: LED types; colors as shown on P&ID's; push to test.
c. Selector Switches: Rotary type.

B. Bypass contactor auxiliary contact(s) as required.

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

E. Supplemental Analog Meters:

1. Elapsed time meter.

F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4, 4X, and 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 4, 4X, 12 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

H. Cooling Fan and Exhaust System: For NEMA 250, maintaining enclosure NEMA rating; UL 508 component recognized: Supply fan, with non-corrosive intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

I. Air Conditioning System: For NEMA 250, maintaining enclosure NEMA rating; UL 508 component recognized; sized to maintain internal temperatures at or below 100°F.

2.9 SOURCE QUALITY CONTROL

A. Testing: Test and inspect VFDs according to requirements in NEMA ICS 61800-2.

1. Test each VFD while connected to its specified motor.
2. Verification of Performance: Rate VFDs according to operation of functions and features specified.

B. VFDs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Seismic Bracing: Comply with requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in each fusible-switch VFD.

D. Install fuses in control circuits if not factory installed.

E. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

F. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

G. Comply with NECA 1.

3.2 IDENTIFICATION

A. Identify VFDs, components, and control wiring.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFD with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.3 CONTROL WIRING INSTALLATION

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

B. Connect selector switches and other automatic control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Acceptance Testing Preparation:

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

D. Tests and Inspections:

1. Inspect VFD, wiring, components, connections, and equipment installation.
2. Test insulation resistance for each VFD element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFD locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
9. Perform voltage and current harmonic test with each VFD running at minimum and maximum speed. Submit test results for each VFD. Testing shall be witnessed by the Owner and the Engineer.

E. VFDs will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies the VFD and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.5 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

3.6 SPARE PARTS

A. The following spare parts shall be supplied with each type, or frame size, of VFD:
   1. 3 sets of all replaceable fuses
   2. 3 spare air conditioner or fan filters

END OF SECTION 262923

SECTION 409000 – INSTRUMENTATION AND CONTROL FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. General requirements which apply to all Instrumentation and Control for Process Systems (hereafter referred to as I&C).

1.2 REFERENCES

A. The installation and commissioning of the I&C System shall conform to all applicable codes, regulations, standards and specifications, including, but not limited to those listed below. These publications are referenced to by designation but not by edition. The latest edition accepted by the Authority Having Jurisdiction in effect at the time of bid shall govern.

1. State and Local Codes and Authority Having Jurisdiction (AHJ)
2. American National Standards Institute (ANSI)
3. American Petroleum Institute (API)
4. Federal Communications Commission (FCC)
5. Federal Occupational Safety and Health Act (OSHA)
6. International Society of Automation (ISA)
7. Institute of Electrical and Electronic Engineers (IEEE)
8. National Electric Code (NEC).
9. National Electrical Manufacturers Association (NEMA)
10. National Fire Protection Association (NFPA)
11. Underwriters Laboratories, Inc. (UL)

1.3 DEFINITIONS

A. The following definitions may be used throughout this section and subsections (refer to the contract drawings sheet GI-1 for instrumentation abbreviations):

1. CTC: Communications termination cabinet.
2. FAT: Factory acceptance test.
3. HMI: Human machine interface.
4. I&C: Instrumentation and control for process systems
5. IS: Instrumentation supplier.
6. LAN: Local area network.
7. LCP: Local control panel.
8. NC: Normally closed.
9. NO: Normally open.
10. OIT: Operator interface terminal.
11. OSI: Owner’s System Integrator.

12. PC: Personal computer.
13. PID: Control action, proportional plus integral plus derivative.
14. PLC: Programmable logic controller.
15. P&ID: Process and instrumentation diagram
16. RIO: Remote input/output
17. SCADA: Supervisory control and data acquisition.
18. UPS: Uninterruptible power supply.
19. VCP: Vendor control panel.
20. WAN: Wide area network

1.4 I&C SYSTEM REQUIREMENTS

A. Vendor Requirements

1. Vendors that are providing equipment for this project shall be responsible to the Owner for the implementation of a complete I&C system as it pertains to the equipment that is being provided by the vendor. The vendor shall provide all necessary coordination, material, and labor such that the entire system be complete and functional.
2. The OSI is responsible for the programming and implementation of plant PLC(s) and HMI hardware and software for a complete SCADA system. It is required that vendors coordinate with the OSI so vendor systems may be properly monitored and controlled through the SCADA system. Vendors shall be required to provide all programming files to the OSI prior to equipment being delivered to the job site. In addition, provide a comprehensive tag list with tags that are recommended to be shown on SCADA highlighted.
3. Where vendor equipment is to interface with Plant PLC's for interlocks, set points and/or start commands, the vendor is to coordinate with the OSI to properly configure the interface. Each such interface shall be achieved using Ethernet/IP and messaging in the PLC's. Each PLC (vendor and plant) shall have watchdogs implemented and associated programming to take the safest action in the event that communications between PLC's fails.
4. The vendor is responsible for participating in the FAT, installation, commissioning, calibration and scheduling for the associated vendor equipment.
5. All vendor systems shall provide loop drawings that are coordinated with the P&ID's for the project. Vendors shall assist the Engineer in the development of P&ID's for the project.

6. Vendor Submittals shall include the following:
   a. Instrumentation (including TR20 forms).
   b. Control panels design and equipment cut sheets.
   c. Loop drawings design.
   d. Recommended spare parts.

7. Following submittal approvals, do the following:
   a. Procure all instrumentation hardware and accessories.
   b. Procure hardware for and fabricate all control panels being provided.
   c. Perform FAT's for all control panels being provided.

8. Perform bench and field calibrations of instruments as required.

1.5 ACTION SUBMITTALS

A. General
   1. Submittals for Division 40 shall meet the following requirements:
      a. Submittals shall include bills of materials with quantities, makes, models, exact part numbers and descriptions.
      b. Edit all submittals such that only pertinent information is submitted. Neatly cross out information that does not apply, options that are not being supplied, etc.
      c. Show product dimensions, construction and installation details, wiring diagrams, and specifications.
      d. If there are exceptions to the Specifications, provide a list of exceptions with detailed explanations for the exceptions. The Engineer will review the list of exceptions and determine whether a solution may be determined or if the exception(s) will not be allowed.

B. Furnish TR20 instrumentation forms for each instrument using the forms outlined in ISA-TR20.00.01-2007. This requirement includes all instruments that are being installed as part of the project, whether they are Contractor, Owner and/or Vendor supplied. Show on each sheet who is the responsible party for supplying the instrument. The TR20 sheets should be provided electronically in Microsoft Word or Excel as well.

C. Provide instrument cut sheets for each instrument make and model being supplied for the project. Each cut sheet should have a list of instrument tag numbers that pertain to that particular cut sheet. The cut sheets should have enough information to verify that the instrument conforms to the Contract Drawings and Specifications.

D. Instrument installation drawings
   1. Provide instrument installation drawings for each make and model of instrument being supplied.
   2. Delineate what is being supplied by the IS and what is being supplied by other installers.
   3. Show overall dimensions, mounting locations and elevations.
   4. Show all cabling, conduit and piping locations.
   5. Show the ambient conditions of the location where the instrument is being installed which includes ambient temperature and humidity extremes, whether or not the atmosphere is corrosive and the area classification.
   6. Show mounting requirements, brackets, stands and anchoring.
   7. Show means for sun protection where required.

E. The Control Panel Bill of Materials and Design Data shall include information presented in association with the panel drawings. The Bill of Materials shall include all hardware inside or on the enclosure. The design data will include UPS and/or battery load calculations to show that the UPS is sized appropriately for load and for backup time. The design data will show panel weight, materials and finishes. HVAC design data shall be shown. Seismic criteria shall be shown if required by the Contract Documents.Panel Shop Drawings:

1. Show every internal wire and connection diagrammatically. Show all interfaces between the control panel and external equipment to be connected for power, controls, signal, communications, etc.
2. All shop drawings shall include a title block with the name of the firm designing the control panels. The title block shall also include project information, Owner information and/or logo, drawing number and description, revision fields and date.
3. All shop drawings shall be developed utilizing AutoCAD version 2008 or later. All shop drawings should be submitted in PDF and AutoCAD formats
4. Panel layout drawing(s):
    a. Each control panel shall have shop drawing(s) which depict the front, back, sides and top/bottom of the panel. This includes showing any hardware mounted on the inside or outside of the panel.
    b. Layout drawings should include subpanel and swing-out panel layouts.
    c. Layout drawings should show locations of panel penetrations for cutouts, conduit entry and/or access plates.
    d. Layout drawings should show all of the components and provide a reference to the bill of materials.
    e. Show the elevations of door devices from the finished floor.
5. AC and/or DC power distribution diagrams:
    a. Each panel shall show power distribution schematics that show how the panel receives power and feeds all of its internal loads as well as associated external loads.
6. Communications and/or Network diagrams:
    a. For panels that utilize any means of communications both internally and externally, provide a diagram depicting each communication connection.
7. Input/Output and/or Internal wiring diagrams
8. Terminal block diagrams

F. Provide panel hardware cut sheets for each make and model of equipment being supplied for the project. The cut sheets should have enough information to verify that the equipment conforms to the Contract Drawings and Specifications.

G. Loop Drawings Requirements:
1. All loop drawings shall include a title block with the name of the firm designing the loop drawings. The title block shall also include project information, Owner information and/or logo, drawing number and description, revision fields and date.
2. All loop drawings shall be developed utilizing AutoCAD version 2008 or later. All loop drawings should be submitted in PDF and AutoCAD formats.
3. Each loop drawing should have the following as a minimum:
    a. Six area divisions, from left to right which are:
        1) Field/Process Area (this area will show field and process equipment).
        2) Junction Boxes (this area will show any field junction boxes associated with the loop).
        3) Local Control Panel (this area will show any local control panels associated with the loop).
        4) Electrical Room (this area will show electrical equipment such as starters, VFD's, power feeders, etc. associated with the loop).
        5) Programmable Logic Controller (this area will show PLC Inputs/Outputs associated with the loop).
        6) SCADA (this area will show logical connections for the Inputs/Outputs from the PLC to the SCADA System).

4. Each loop drawing will show each instrument or field device associated with the loop and its wiring connections and wire labels.
5. Each electrical enclosure (junction box, local control panel, PLC panel, starter panel, etc.) will show terminal numbers and terminal block group references.
6. All wires to be installed by the Contractor shall be dashed while all wires installed by the panel shop should be solid.
7. Show continuation lines to associated loops that may interface with each loop.
8. Show all wiring associated for the loop including power, controls, signal and communications.

H. Recommended Spare Parts Submittal
1. Submit a list of spare parts for all of the equipment associated with the I&C System. The list of spare parts shall include list pricing for each item.
2. Provide the name, address and phone number for each manufacturer and manufacturer's local sales representative.
3. Indicate whether the spare parts are being provided under this contract or not.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.8 QUALITY ASSURANCE

A. All equipment supplied for this project shall meet the requirements of the National Electric Code (NEC) and shall be listed by and bearing the label of the Underwriters' Laboritories (UL).

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials provided under this Contract shall be new and free from defects.

2.2 MANUFACTURERS

A. All equipment provided for the I&C System shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the Shop Drawings unless otherwise required to match existing equipment.

B. Instruments which utilize a common measurement principle (for example, float switches) shall be furnished by a single manufacturer. Panel mounted instruments shall have matching style and general appearance. Instruments performing similar functions shall be of the same type, model, or class, and shall be from a single manufacturer.

2.3 OPERATING CONDITIONS

A. The I&C System shall be designed and constructed for satisfactory operation and long, low maintenance service under the following conditions:
   1. Environment: Wastewater Treatment Plant.
   2. Temperature Extremes: 11°F to 114°F (Outdoors); 50°F to 114°F (Indoors).
   3. Relative Humidity: 20% to 90%, non-condensing.

B. Indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designated in the Contract Documents. Heating, cooling, and dehumidifying devices shall be provided in order to maintain instrumentation devices 20 percent within the minimums and maximums of their rated environmental operating ranges. The Contractor shall provide power wiring for these devices. Enclosures suitable for the environment shall be furnished. Instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. After completion of shop assembly, factory test, and approval, equipment, cabinets, panels, and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving without removing protective covering. Boxed weight shall be shown on shipping tags together with instructions for unloading, transporting, storing, and handling at the Site.

B. Special instructions for proper field handling, storage, and installation required by the manufacturer shall be securely attached to each piece of equipment prior to packaging and shipment.

C. Each component shall be tagged to identify its location, instrument tag number, and function in the system. A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as given in the tabulation, shall be provided on each piece of equipment in the PCIS. Identification shall be prominently displayed on the outside of the package.

D. Equipment shall not be stored outdoors. Equipment shall be stored in dry permanent shelters, including in-line equipment, and shall be adequately protected against mechanical injury. If any apparatus has been damaged, such damage shall be repaired by the Contractor. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through tests as directed by the Engineer. If such tests reveal defects, the equipment shall be replaced.

3.2 MANUFACTURER'S SERVICES

A. Manufacturer's services shall be furnished for the following equipment:

1. Vendor supplied equipment that contain programmable controllers, operator interfaces and/or instrumentation that requires site calibration.

3.3 INSTALLATION

3.4 FACTORY ACCEPTANCE TESTING (FAT)

A. Vendors shall arrange to allow the Engineer and Owner to inspect and witness the testing of the equipment at the site of fabrication. Equipment shall include the cabinets, special control systems, and other pertinent systems and devices. A minimum of 10 days notification shall be furnished to the Engineer prior to testing. No shipments shall be made without the Engineer's approval.

B. For each FAT, the Vendor shall develop and submit a FAT Plan and Procedure Document within 10 days of the FAT. The FAT Plan and Procedure shall as a minimum shall have the following:
   1. Descriptions of test methods to be performed during the FAT.
   2. FAT Schedule and Procedure
   3. FAT Checklists that allow for sign-off and comments for each test method and procedure.

C. Control Panel Completion Test Methods: The following test methods should be performed during the FAT for each control panel:
   1. Completed Shop Drawings: Demonstrate that the control panel has been built according to the shop drawings and that the shop drawings are accurate.
   2. Panel Layout: Demonstrate that the control panel has been laid out as designed and as required by Division 40.
   3. Power Distribution: Demonstrate all power distribution circuits, including but not limited to AC power circuits, UPS operation, signals and circuits and DC circuits.
   4. Control Circuits: Demonstrate the correct installation of each control circuit. Using a signal generator or multi-meter, show the correct operation of each input, output, relay, barrier, buttons, switches, or any other control device. Demonstrate the proper functionality of any hard-wired interlocks that may be associated with each control circuit.
   5. Panel Networking/Communications: If any form of communications is associated with the control panel, verify the proper operation of each communication port and link.

D. Control Loop Test Methods: In order to demonstrate that the control panel will provide its function as intended, provide the following control loop test methods. If programming for the control panel is provided by others, coordinate with the programmer to have all programming completed and tested prior to the FAT. If needed, coordinate to have the programmer present for the FAT.
   1. Alarm Functions: Verify and/or simulate each alarm condition associated with each control loop.
   2. Local Manual and Auto Functions: Verify and/or simulate each Local Manual and/or Auto function associated with each control loop.
   3. Remote Manual and Auto Functions: Verify and/or simulate each Remote Manual and/or Auto function associated with each control loop.
   4. Control Loop Interlocks: Demonstrate the functionality of any software interlocks that may be associated with each control loop.

E. If the FAT does not pass and needs to be repeated, the vendor shall be responsible for additional per diem costs incurred by the Engineer and Owner.

F. All changes and/or corrections made during the FAT shall be noted on the checklists.

G. Following completion and approval of all FAT, provide the finalized checklists to the Engineer and as part of the equipment shop drawings.

3.5 CALIBRATION

A. Devices provided under Division 40 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.

B. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Standards and Testing.

C. Instruments that have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the Engineer.

D. Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.

E. Each analyzer system shall be calibrated and tested as a workable system after installation. Testing procedures shall be directed by the manufacturers' technical representatives. Samples and sample gases shall be furnished by the manufacturers.

F. For each instrument calibration, provide a calibration sheet and update the corresponding TR20 Instrument Form with the new calibration data. The Calibration sheet shall include the following as a minimum:
   1. Date of calibration
   2. Project Name.
   3. Tag Number.
   4. Manufacturer, model and serial number.
   5. Calibration data including range, input, output and measurement at each calibration point.
   6. Space for comments.
   7. Space for sign-off by party performing calibration.

G. A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the Engineer. The IS shall sign the tag when calibration is complete. The Engineer will sign the tag when the calibration and testing has been accepted.

3.6 LOOP TESTING

A. Each control loop shall have been installed according to the finalized loop drawing. Prior to the commencement of loop testing, the following pre-requisites should have been met:

1. All associated equipment, conduit and wire has been permanently installed, terminated and inspected.
2. All wiring has been properly pulled, terminated and labeled.
3. Each wire has been tested with a point-to-point test.
4. All control panels and electrical equipment have been checked out and tested.
5. All instrumentation has been appropriately installed and calibrated.
6. Loop Test Forms for each loop to be tested have been created and will be available during the loop testing.

B. Each loop test shall have a Loop Test Form prepared and ready prior to each loop test. The loop test form shall have the following:
   1. Loop Number and Description
   2. Check-Off List with room for sign-off and dated by the IS, Programmer, and Owner's Witness as well as room for comments. The list of items to be checked off for each loop should include but is not limited to the following:
      a. Each power distribution circuit.
      b. Each control circuit.
      c. Each alarm circuit.
      d. Each PLC input/output point.
      e. Each Local Manual, Local Auto, Remote Manual & SCADA Auto function.
      f. Each hard-wired and software interlock.

C. Issues that arise during loop testing should be addressed and fixed immediately. If it is not feasible to immediately fix the issues, the loop testing should be re-scheduled as soon as possible to avoid delays. Any costs associated with re-testing and requiring all parties to return to the site shall in no way be incurred to the Owner.

D. Following a successful loop test, the appropriate parties should sign and date the Loop Test Forms. All Forms shall be certified and submitted to the Engineer as part of the O&M Manuals.

E. Following loop testing, in no way should any parts of the loop be modified. In no way shall any wiring be re-routed or re-terminated. If any such work occurs, all affected loops shall be re-tested at no expense to the Owner.

3.7 COMMISSIONING

A. Commissioning shall commence after acceptance of wire test, calibration tests and loop tests, and inspections have demonstrated that the instrumentation and control system complies with Contract requirements. Pre-commissioning shall demonstrate proper operation of every system with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

B. Commissioning and test activities shall follow detailed test procedures and check lists accepted by the Engineer. Test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the Engineer, which include calculated tolerance limits for each step. Completion of system commissioning and test activities shall be documented by a certified report, including test forms with test data entered, delivered to the Engineer with a clear and unequivocal statement that system commissioning and test requirements have been satisfied.

C. Where feasible, system commissioning activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operating conditions in terms of applied process loads, operating ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under startup and steady state operating conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. Hardwired and software control circuit interlocks and alarms shall be operational. The control of final control elements and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady state operation of final control elements running under the control of field mounted automatic analog controllers or software based controllers shall be assured by adjusting the controllers as required to eliminate oscillatory final control element operation. The transient stability of final control elements operating under the control of field mounted, and software-based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any), and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.

D. Electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, experimentally, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured final control element position/speed values at 0, 25, 50, 75, and 100 percent of span and the results checked against indicated accuracy tolerances.

3.8 TRAINING

A. Develop a Training Plan and submit it to the Engineer for approval. Coordinate with the Engineer and Owner the time and locations of each training session. Schedule the trainings for after the equipment has been pre-commissioned.

B. Each training session shall include a written agenda.

C. The vendor shall train the Owner’s personnel on the maintenance, calibration and repair of instruments provided.

D. Within 10 days after the completion of each session, the Contractor shall submit the following:
   1. A list of Owner personnel who attended the training.
   2. A copy of the training materials used during the session with notes, diagrams and comments.

END OF SECTION 409000

SECTION 409433 – HUMAN-MACHINE INTERFACES

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the human-machine interfaces (HMI) used for control and monitoring as indicated on the Contract Documents. HMI's include the following:
   1. Operator Interface Terminals (OIT) or touch screens.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Hardware to be furnished under this section shall be the product of firms regularly engaged in the design and manufacturing of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functionality of the work.

B. Examine the Contract Documents and verify that HMI equipment and software being provided is compatible with the requirements. Provide all necessary accessories to the HMI equipment for a complete and operable system.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver the HMI hardware as a complete system in accordance with Section 409000.

PART 2 - PRODUCTS

2.1 OPERATOR INTERFACE TERMINALS

A. OITs shall be furnished with hardware to monitor and control equipment, as listed in the specifications, and shown on the Contract Drawings.

B. OITs shall be 10" color touch screens unless otherwise indicated in the RFP. Each OIT shall have the following features:
   1. Has serial and Ethernet ports with built-in communications protocols drivers as required by the project.
   2. Has associated software for programming the OIT and its screens, database, alarms, etc.
   3. Has a 640 x 480 minimum resolution with TFT color screen.
   4. Has at least 64MB of memory.

5. Has no limitations on the number of screens or tags that may be used as long as within the memory limitations of the OIT.

C. Acceptable Manufacturers
   1. Allen Bradley Panelview Plus 7

PART 3 - EXECUTION

3.1 INSTALLATION

A. OIT's shall be installed on the doors of control panels at an elevation that is coordinated with the Engineer and Owner. The control panel assembly and installation shall be as required by Section 409513.

B. OIT's shall be installed in accordance with the manufacturer's installation guidelines and instructions.

3.2 TRAINING

A. Provide training for the OIT hardware supplied for the project as required by Section 409000.

END OF SECTION 409433

SECTION 409443 – PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the programmable logic controllers (PLC) used for control and monitoring as indicated on the Contract Documents.

B. Provide one full version of PLC programming software that is applicable to the PLC hardware being supplied for the project. Include auxiliary software (such as communications software, drivers, networking configuration software, etc.) that may be required for a complete and operable system.

1.2 ACTION SUBMITTALS

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

B. Wiring diagrams showing connections to all devices; input and output (I/O), analog and discrete. The wiring diagrams shall indicate the I/O address point to be used in the PLC programs.

C. Submit calculations that show the following:
   1. PLC Power Supply Budget
   2. Calculated number of I/O quantities required
   3. Estimated PLC memory usage

1.3 QUALITY ASSURANCE

A. Hardware and software to be furnished under this section shall be the product of firms regularly engaged in the design and manufacturing of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functionality of the work.

B. Examine the Contract Documents and verify that PLC equipment and software being provided is compatible with the requirements. Provide all necessary accessories to the PLC equipment for a complete and operable system.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver the PLC hardware and software as a complete system in accordance with Section 409000.

PART 2 - PRODUCTS

2.1 GENERAL

A. PLCs shall be furnished with hardware and software necessary to monitor and control equipment, as listed in the specifications, and shown on the Plans.

B. Each field input and output shown as an I/O Point shall be connected as per the manufacturers' recommendations.

C. The Contractor shall provide the hardware, software, and installation necessary for connecting additional future equipment as indicated on the Plans. In addition to allocating for future I/O, each PLC shall be supplied with a minimum of 20% spare I/O of each type. In other words, the total I/O for each type shall be (current I/O + future I/O) * 120%. Provide enough panel space to install up to 200% of future I/O modules and/or PLC racks/bases.

D. The type of field input and output shall be defined as follows unless specified otherwise on the plans:
   1. Analog inputs and outputs: 4-20mA DC.
   2. Discrete inputs: I/O device shall be a dry contact, inputs shall be powered by the PLC at 24VDC (preferred) or 120VAC.
   3. Discrete outputs: Isolated dry contact outputs.

E. All PLC I/O shall have I/O modules that are installed and wired at a UL508 Panel Shop. All I/O points shall be wired down to terminal blocks. In no way should field wiring go to any part of the PLC assembly.

F. Vendor and Contractor supplied PLC's shall meet the requirements of this Section and of Division 40. Vendor supplied PLC's shall have a Factory Acceptance Test (FAT) performed by the Vendor as required by Section 409000. Contractor supplied PLC's shall have a FAT performed by the Contractor as required by Section 409000.

G. The PLC shall be capable of handling online program modifications without taking the system offline or requiring a download.

H. Brick style PLC's if available may be used when the installed I/O plus the 20% spare I/O is less than the capacity of the brick.

I. Acceptable Manufacturers
   1. Allen Bradley CompactLogix
   2. Allen Bradley ControlLogix

2.2 PROCESSORS

A. The PLC processor shall be a microprocessor based industrial controller with a temperature rating of 0 to 60 degrees C, and a humidity rating of 5 to 85% non-condensing, minimum.

B. The processor's memory shall be sized according to the number of I/O points and amount of logic required for the application. As a minimum, the memory shall be at least 1 megabyte.

C. The processor shall retain its memory and programming when power is removed.

D. The processor shall have tag-based memory.

E. Processors shall be the CompactLogix L3 or L4 Series or the ControlLogix L7 Series.

2.3 PLC POWER SUPPLY

A. The power supply shall provide power for the processor, and I/O modules. The power supply shall have built-in over voltage and under voltage detection circuitry, protection against overcurrent conditions, and automatic power-up sequence that enables outputs only when proper operating tolerances are reached.

2.4 COMMUNICATIONS NETWORKS

A. Each PLC shall be equipped with network ports (and corresponding network modules if necessary) as shown on the Contract Drawings. Each PLC shall be equipped with an Ethernet port for connection to the Plant SCADA System. Additional ports shall be provided for distributed I/O when utilized. Distributed I/O shall be installed on a separate network from the SCADA network. .

B. Ethernet ports shall be setup to communicate with the Allen-Bradley Ethernet/IP protocol.

C. The PLC shall be programmable through the Ethernet port or through a USB port.

D.

2.5 INPUT/OUTPUT MODULES

A. Analog I/O modules shall have a minimum of 12 bits of resolution and shall be setup as 4 to 20 mA signals unless indicated otherwise on the Contract Drawings. Analog inputs shall be setup to be connected to loop powered (2-wire) or self-powered (4-wire) signals. All analog inputs and outputs shall be protected by a fuse. 4 to 20 mA signals shall be protected by a 32mA fuse.

B. Each discrete I/O module shall be fused (fuse body shall be equipped with a blown fuse indicator). Each discrete output module shall have interposing relays for each point with form C relay contacts. Indicator lights shall also be provided on each I/O point to indicate status of each signal. Each individual input or output point shall be optically isolated to protect the controller I/O circuitry from high voltage transients.

PART 3 - EXECUTION

3.1 FACTORY ACCEPTANCE TESTING

A. All PLC assemblies shall be built up in control panels and shall be part of a Factory Acceptance Test as required by Section 409000.

3.2 INSTALLATION

A. The PLC assemblies shall be installed in control panels made specifically for the PLC. The control panel assembly and installation shall be as required by Section 409513.

B. The PLC assemblies shall be installed in accordance with the manufacturer's installation guidelines and instructions.

3.3 TRAINING

A. Provide training for the PLC hardware supplied for the project as required by Section 409000.

END OF SECTION 409443

SECTION 409513 – PROCESS CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the requirements for all control panels and associated hardware for the project. This includes, but is not limited to, vendor control panels, PLC panels, local control panels and instrumentation panels.

1.2 ACTION SUBMITTALS

A. Submit the Control Panels Submittal as required by Section 409000.

1.3 CLOSEOUT SUBMITTALS

A. Submit the operation and maintenance data, including record control panel drawings for all control panels as required by Section 409000.

1.4 QUALITY ASSURANCE

A. Referenced Standards:

1. National Electric Code (NEC).
2. American Society for Testing and Materials (ASTM).
3. Joint Industrial Council (JIC).
4. National Electrical Manufacturers Association (NEMA):
    a. ICS 4, Terminal Blocks for Industrial Use.
    b. ICS 6, Enclosures for Industrial Controls and Systems.
    c. 250, Enclosures for Electrical Equipment (1000 V Maximum).
5. Underwriters Laboratories Inc. (UL):
    a. 50, Enclosures for Electrical Equipment.
    b. 508, Industrial Control Equipment.
    c. 508A, Standard for Industrial Control Panels.

B. Hardware to be furnished under this section shall be the product of firms regularly engaged in the design and manufacturing of this type of equipment. Manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. All panels shall be assembled in and labeled by a listed UL 508A panel shop. However, this shall not be construed as relieving the Contractor from responsibility for the proper installation and functionality of the work.

C. Examine the Contract Documents and verify that control panel hardware being provided is compatible with the requirements. Provide all necessary accessories to the control panels for a complete and operable system.

D. The Contractor shall not place any conduit feeds for any control panel until the Control Panel Submittal has been approved. Once approved, conduits shall be placed strategically to best suit the layout of the control panel. Power entry and separation of power, controls and signal shall be considered.

E. All painted control panels shall have matching paint colors and tones.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver the control panel hardware as required by Section 409000.

PART 2 - PRODUCTS

2.1 GENERAL

A. All control panels shall have an overall NEMA rating suitable for withstanding the mechanical, electrical, thermal stresses, humidity and corrosion that the panel will be subjected to in its installed location.

B. The following rules shall be followed when determining the NEMA rating requirement for each control panel:

1. NEMA 1, 3 & 3R shall not be allowed for control panels.
2. NEMA 4 shall be utilized for outdoor or wet locations in non-corrosive, unclassified areas. NEMA 4 control panels shall be painted steel.
3. NEMA 4X shall be utilized in corrosive, unclassified areas. NEMA 4X enclosures shall be 316SS except for the following exceptions with which the enclosure shall be polycarbonate or fiberglass reinforced polyester (FRP):
    a. Chemical areas or rooms.
    b. Locations where stainless steel is incompatible.
    c. Where specifically noted on the Contract Drawings.
4. NEMA 7 shall be utilized for classified areas as required by NEC. NEMA 7 enclosures shall be constructed of cast aluminum.
5. NEMA 12 shall be utilized in dry, non-corrosive, unclassified areas. NEMA 12 control panels shall be painted steel.

C. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of external conductors. The SUPPLIER shall provide sufficient terminal blocks to connect 30 percent additional conductors for future use.

D. PLC Discrete outputs from the control panel shall be provided by electrically-isolated contacts rated for 10 amps at 120 VAC. Analog inputs and outputs shall be isolated 4 to 20 mA, 2 wire signals with power supply.

E. Control panel mounted devices shall be mounted a minimum of 3-feet above finished floor elevation. Touchscreens shall be mounted at a height of 66” from the finished floor to the

center of the touchscreen. All control panels will be situated on housekeeping pads, this is not considered the finished floor elevation.

2.2 ENCLOSURES

A. Enclosures shall be either freestanding, pedestal-mounted or equipment skid-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required.

B. It is the responsibility of the Contractor to design the size of all control panels. When sizing the control panels, adhere to the following criteria:
   1. Maximum panel depth is 24". If there are special reasons for a deeper enclosure, approval must first be obtained from the Engineer.
   2. The panel size shall provide space for all equipment, wire-ducts, wire, terminations, and space for future expansion.
   3. If the panel size needs to be enlarged, coordinate with the installing Contractor that there is adequate space for the larger size. If there is not space, coordinate with the Engineer to come up with a solution.

C. Materials
   1. Steel panel section faces shall be 12-gauge minimum thickness for free standing panels and 14-gauge minimum thickness for wall-mounted or pedestal-mounted panels. Materials shall be selected for levelness and smoothness.
   2. Structural shapes and strap steel shall comply with ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.
   3. Bolting Material: For outdoor, wet or corrosive areas, all bolting materials shall be 316SS. In dry, non-corrosive locations, carbon steel may be used. Commercial quality bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. Other bolts shall be hex end machine bolts. Nuts shall be hot pressed hex, American Standard, heavy. Standard wrought washers shall be used for foundation bolts and attachments to building structures. Other bolted joints shall have SAE standard lock washers.
   4. Control panels shall be structurally designed such that the completed and installed control panels shall safely withstand seismic requirements for the project. All equipment mounted within the panel shall be properly braced to prevent damage during a seismic event.

D. Acceptable Manufacturers
   1. Hoffman.
   2. Saginaw.
   3. Or Approved Equal.

2.3 CONTROL PANEL ASSEMBLY

A. General

   1. The following requirements must be met when mounting to the back panels or side panels of the control panel:
      a. Holes shall be drilled and tapped with less than 50% diminishment in thread.

b. Backpan shall be cleaned front and back after any drilling and tapping.
c. Tek Screws are not acceptable.
d. Any component mounted to a back panel or side panel shall be mounted at an exact square to the vertical and horizontal planes.
e. Any duct running between back panels and side panels shall align horizontally with no overlaps.
f. All DIN rail mounted to the panels shall have ½" stand-offs allowing for wires and other equipment to be routed beneath the rail if necessary.

2. Enclosure doors shall be flush fitting, gasketed, and be of the hinged lift-off type with lockable door handles. A common key shall be provided for the doors on each panel assembly. Removable access panels shall be provided with dished handle fasteners. Screw driver 1/4 turn or Dzus type fasteners are not acceptable.
   a. The flanged edges of panels shall be straight and smooth. Corners shall be welded and ground smooth.
   b. The face of the panel shall be true and level after flanging.
   c. Panel cutouts and holes may be cut or drilled by any standard method that does not cause deformation. Burrs shall be ground smooth.
   d. Adjacent panels shall assemble with faces flush. Gaps or cracks shall not be visible from the front of the assembled instrument board.
   e. Panels shall be self-supporting.
3. Control panels that are supplied with three phase power and/or are powering motor loads shall be supplied with a main feeder disconnect that is door operated. The door operator for the disconnect shall be defeat-able with a screwdriver. If the upstream overcurrent protection device feeding the control panel is not in the same room as the control panel, provide a main circuit breaker as part of the main disconnect assembly. Fused disconnects shall not be used unless specifically shown on the Contract Drawings.

B. Preparation of Bare Metal Panel Surfaces

1. Grind high spots, burrs, and rough spots.
2. Sand or sandblast to a smooth, clean, bright finish.
3. Every trace of oil shall be removed with a solvent.
4. Apply the first coat of primer immediately.

C. Panel Finishing

1. Repair damaged primer on inside surfaces.
2. Apply primer to the entire panel surface.
3. Apply 2 coats of satin finish lacquer enamel over the entire surface.
4. Colors shall match original paint color.

D. Instrument Finishing: The final coat applied to painted surfaces of instrument cases, doors, or bezels which are visible from the front of panels shall be manufacturer's standard unless otherwise indicated. Black japan or "crinkle" finishes on instrument cases are not acceptable.

E. Mounting of Instruments

1. The panel shop shall provide cutouts and shall mount instrument items indicated to be panel mounted, including any instruments indicated to be furnished by other vendors but installed in the panel.

2. The panel shop shall also mount behind the panels other instrument accessory items as required.
3. Equipment mounted at the rear of panel shall be installed to allow for commissioning adjustments, servicing requirements, and cover removal
4. Spare space shall be kept clear of wiring, etc., to give maximum space for future additions.
5. All equipment mounted with fasteners shall be mounted with grade 5 or greater Phillips head fasteners.

F. Electrical Requirements
1. Each panel shall be serialized with its own UL serial number and label.
2. Each terminal block shall have a printed label as shown on the panel drawings. Hand written labels in any location of the panel will not be accepted. Wiring shall be identified with printed tubular wire end markers.
3. Back panels and side panels shall have visible machine printed adhesive labels that detail the following items:
    a. Terminal block torque ratings for field connections.
    b. Terminal block sections as detailed in the panel drawings.
    c. All equipment within the panel including, but not limited to, PLCs, switches, circuit breakers, UPS, Power Supplies, and any other piece of equipment.
4. Screw torque shall not exceed 0.4 N*M (4.4 Lb*In) (7 Lb-In).
5. Wire duct for AC signals and wiring shall be light grey. All duct for DC signals shall be white. Wiring for AC circuits and DC circuits must be kept within their respective ducts.
6. Freestanding panels shall be provided with switched lighting as indicated in the panel drawings.
7. Freestanding panels shall be provided with a 15 amp, 120 volt, service outlet circuit within the back-of-panel area as shown in the panel drawings.
8. Wall-mounted or pedestal-mounted panels shall be sized to adequately dissipate heat generated by equipment mounted in or on the panel.
9. Outdoor panels shall be provided with thermostatically-controlled heaters to maintain inside temperatures between above 40°F.
10. Any panel with heat producing equipment such as a PLC, UPS or VFD shall have cooling capabilities to maintain the inside temperature below 104°F.
11. All outdoor panels equipped with heating and/or cooling shall be insulated with a minimum R value of 2.0.
12. Provide a laminated fuse list matrix detailing fuse numbers and sizes mounted on the inside of the enclosure door. The fuse list matrix must be easily visible and at minimum size 14 font. Hand written fuse matrices will not be accepted. See panel drawings approximate locations.
13. Provide a pocket mount on the inside of each panel door large enough to hold type 8.5 x 11 size paper. See panel drawings for approximate locations. Pockets must be accessible with no equipment obstructing the entrance of the pocket for at least ten inches above the pocket. The pocket mount shall be fastened. No adhesive type pockets allowed.
14. Where required crimped fork or ring terminals will be properly installed on the conductors for connection integrity.
15. Signal and Control Circuit Wiring
    a. Wire type and sizes: Conductors shall be flexible stranded tin machine tool wire, UL 1015 listed Type MTW, and shall be rated 600 volts. Wires for instrument signal circuits and alarm input circuits shall be 14 AWG. Other wires, including shielded cables, shall be 16 AWG minimum.

b. Wire Insulation Colors: Conductors supplying 120 VAC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor. Grounded circuit conductors shall have white insulation. Insulation for ungrounded 120 VAC control circuit conductors shall be red. Wires energized by a voltage source external to the control panel shall have yellow insulation. Insulation for DC conductors shall be blue.

c. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B 500 or equal, or shall be heat shrink plastic. Wire labels must be machine printed. All conductors within the control panel are to be permanently marked with wire labels at each end. Wire labels are to correspond to the labels on the approved shop drawings.

d. For case grounding, panels shall be provided with a ground lug complete with solderless connector for one no. 1 AWG bare stranded copper cable.

e. Panel doors shall be connected to panel ground.

f. Wire Fastening: Provision shall be made utilizing cable tie bases such as type CTM1 or equivalent, fastened inside the wire duct to allow for the fastening of the shop wire harnesses upon final installation.

16. Power Supply Wiring

a. Unless otherwise indicated, control power shall be 120 VAC. Where the electrical power supply to the control panel is something other than 120 VAC, the control panel shall be provided with a control panel transformer. Control conductors shall be provided in accordance with the indicated requirements.

b. At a location near the top of the panel (or bottom), the panel fabricator shall provide terminal box connections for the main power supply entry.

17. Signal Wiring

a. Signal wire shall be shielded twisted pair or triads. Cable shall be 18 AWG copper signal wires.

b. Color code for instrument signal wiring shall be as follows:

1) Positive (+) – Red or Clear

2) Negative (-) – Black

c. Multiconductor cables where indicated shall consist of no. 16 AWG copper signal wires twisted in pairs with 90-C, 600 V fault insulation. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.

d. RTD cabling shall be Belden 8770 cabling or equal.

e. Multi-conductor cables, wireways, and conduit shall be sized to allow for 25 percent spare signal wire.

18. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and be secured to the inside face of the panel using adhesive mounts.

19. Wiring to rear terminals on panel-mount instruments shall be in plastic wireways secured to horizontal brackets above or below the instruments in about the same plane as the rear of the instruments.

G. Labor and Workmanship: Panels shall be fabricated, piped, and wired by fully qualified workmen who are properly trained, experienced, and supervised.

2.4 CONTROL PANEL COMPONENTS

A. Nameplates and labels

1. All control components within the control panel shall be labeled with adhesive labels that have a thermal transfer type ink system on a UL-508A approved label. Labels shall be provided for marking wire ducts, terminal block sections, PLC modules, networking modules, signal isolators, intrinsic barriers, relays, breakers, power supplies, surge suppressors and all other pertinent components within the control panel.
2. All components on the exterior of the control panel shall have nameplates fabricated from black-letter, white-face laminated plastic engraving stock, Rowmark Ultramatte or equal. Engraved characters shall be block style with no characters smaller than 1/8 inch. Adhesive shall be high strength, low profile double strength, double sided as produced by Bron or Tessa or approved equal. Stainless steel fasteners shall be used in addition to the adhesive on all equipment where the fasteners do not derate the NEMA rating of the enclosure.

B. Pilot Devices

1. Provide pilot devices from a single manufacturer.
2. Pilot devices shall have NEMA ratings that match the overall control panel rating. They shall be 30mm in diameter and heavy duty.
3. All pilot devices shall have an associated nameplate that clearly describes the function of the device.
4. Pilot lights shall be LED and shall have colors as follows:
   a. The Contract Drawings shall take precedence for light colors. Refer to the P&ID's and schematics.
   b. On/Running/Opened: Green.
   c. Off/Stopped/Closed: Red.
   d. Power: White.
   e. Alarm/Fail: Red.
5. Acceptable Manufacturers
   a. Square D Types K (for NEMA 4 or 12) or Types SK (NEMA 4X).
   b. Allen-Bradley Types 800T (NEMA 4/12) or Types 800H (NEMA 4X, 7).
   c. Or Approved Equal.

C. Door Mounted Meters

1. Digital Process Meters
   a. Provide digital process meters to display a numeric process value as required by the Contract Drawings.
   b. The meter shall accept and re-transmit an analog input signal which is in proportion with the process value. The meter shall be capable of receiving the following signals:
      1) 0 or 4 to 20 mA current.
      2) 0 to 5 or 10 DC volts.
      3) RTD and Thermocouple type inputs.
   c. The meter shall be programmable to scale the numeric display to process engineering units. It shall be capable of showing up to three decimal points.
   d. The meter shall be capable of powering the input and re-transmitted signal.
   e. Acceptable Manufacturers:
      1) Precision Digital Trident Series.
      2) Red Lion PAX Series.
      3) Or Approved Equal.
2. Elapsed Time Meters (ETM)

a. Provide ETM's for each motor and/or machine provided for the project. Each ETM shall accumulate hours in tenths of an hour.
b. The ETM enclosure shall be panel mount, polycarbonate, shock resistant and totally sealed.
c. Acceptable Manufacturers:
    1) Hobbs 20000 Series.
    2) Or Approved Equal.

D. Terminal Blocks

1. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25 percent spares shall be provided in each terminal box. No more than 2 conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power and signal commons. Terminal blocks shall be U.L. rated for 600 Volts, and 30 Amps, minimum.
2. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive 2-color bodies yellow and green, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every 2 instrument cables terminated. Grounding terminal blocks shall be U.L. rated for 600 Volts, and 20 Amps, minimum.
3. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.
4. DIN mount fuse holders shall have blown fuse indicators for DC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be U.L. listed, and rated for 600 Volts. Fuse sizes shall not exceed the U.L. current rating for the fuse holders.
5. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.
6. Approved Manufacturers
    a. Phoenix Contact UT Series.
    b. Allen-Bradley 1492 Series.
    c. Or Approved Equal.

E. DIN Rail

1. DIN rail shall be prepunched, RoHS compliant, treated with galvanic zinc plating and passivation. Symmetrical DIN rail shall be 35 mm X 15 mm.
2. Acceptable Manufacturers
    a. Iboco Omega 3AF.
    b. Or Approved Equal.

F. Wire Ducts

1. Wire ducts shall have narrow slots (approximately every ½") to accommodate high-density terminal blocks and other hardware.
2. Wire ducts shall be made of lead-free PVC, shall be UL rated for continuous use up to 122°F, and shall be flame retardant.
3. Wire duct colors shall be as follows:

a. Light grey for all wiring 120V and higher.
b. White for all wiring 48V and lower.
c. Blue for all intrinsically safe wiring.

4. Acceptable Manufacturers
   a. Panduit Type F Series.
   b. Or Approved Equal.

G. Surge Protection Devices

1. Provide a Surge Protection Device (SPD) for power feeds which feed power to the control panel.
2. Each SPD shall have a short circuit current rating that exceeds the rating of the power feed that it is protecting.
3. All SPD's shall be properly grounded to the ground grid per NEC and per the SPD manufacturer's recommendations.
4. Three phase power feeds and single phase power feeds for non-sensitive loads.
   a. Provide a parallel, DIN rail mountable, SPD whose location is immediately downstream of the main panel disconnect or circuit breaker.
   b. Capable of handling a 10kA surge current.
   c. Acceptable Manufacturers
      1) Transtector 12R Series.
      2) Or Approved Equal.
5. Single phase power feeds for control panels with sensitive electronics
   a. Provide an inline, DIN rail mountable, SPD that also provides EMI filtering.
   b. The SPD shall be capable of handling a 10kA surge current.
   c. The inline SPD shall have a set of dry contacts that indicate when the unit is healthy and operating correctly.
   d. Acceptable Manufacturers
      1) Phoenix Contact SFP Series.
      2) Or Approved Equal.
6. Low Voltage Signals
   a. Provide surge protection for low-voltage signals where shown on the Contract Drawings.
   b. Acceptable Manufacturers
      1) Phoenix Contact Termitrab.
      2) Or Approved Equal.
7. Coaxial Transmission Lines
   a. For radio type systems, provide surge/lightning protection for all coaxial lines leaving the control panel.
   b. Surge/lightning protectors shall be rated for the frequency at which signals are to be transmitted on the cabling.
   c. Acceptable manufacturers
      1) Polyphaser.
      2) Or Approved Equal.

H. Circuit Breakers

1. Circuit breakers shall meet the requirements of Section 262816.
2. Provide a main circuit breaker with panel disconnect if required as described in 2.3.A.
3. All control panels fed by 120VAC shall have a main DIN rail mounted circuit breaker.
4. The following types of loads shall be individually fed by circuit breakers:

a. Panel mounted receptacles.
b. UPS equipment.
c. DC Power Supplies.

5. Circuit breakers shall be sized according to the loads they are powering.
6. Acceptable Manufacturers
   a. Square D.
   b. Cutler Hammer.
   c. Or Approved Equal.

I. Motor Controllers

1. All motor controllers shall be NEMA rated and shall be protected by a circuit breaker.

J. Uninterruptible Power Supplies (UPS)

1. All PLC and OIT equipment shall be protected by a UPS. The UPS shall be industrial and shall mount in the panel on DIN rail. It is preferred that the UPS is a 24DC UPS (this requires that all PLC, OIT and other critical loads are at 24VDC and not 120VAC).
2. UPS equipment intended to be installed in control panels shall meet the following criteria:
   a. The UPS shall be UL listed and shall maintain the UL listing of the control apnel.
   b. The UPS shall be properly mounted to withstand vibration and seismic requirements for the project.
   c. The UPS shall be sized for 200% of the calculated panel load.
   d. The UPS shall have a minimum backup time of 15 minutes unless specifically stated as otherwise on the Contract Drawings.
   e. For PLC panels, the UPS shall be equipped with dry contacts for monitoring the UPS for any alarm conditions and low battery.
3. UPS equipment shall provide surge, EMI
4. Acceptable Manufacturers
   a. .
   b. Sola.
   c. Or Approved Equal.

K. Power Supplies

1. Provide 24VDC Power Supplies or other DC voltages as required for the application.
2. All power supplies shall be oversized for a minimum 150% of the calculated load.
3. All power supplies shall be properly protected by a DIN rail mount circuit breaker whose trip rating is per the manufacturer's recommendation.
4. All power supplies shall have a set of dry contacts that indicate when the power supply is operating normally.
5. Where shown on the Contract Drawings, provide redundant power supplies and corresponding diodes.
6. Power supplies shall meet the following criteria:
   a. Input Voltage: 100 to 240VAC.
   b. Output Voltage: ±1% of rated output.
   c. Operating Temperature: 0°C to 60°C.
   d. Built in transient surge protection.
   e. DIN rail mountable, metal housing.
7. Acceptable Manufacturers

a. Phoenix Contact Quint Series.
b. Or Approved Equal.

L. Signal Isolators/Converters

1. Furnish signal isolators as required that optically isolate the input signal from the output signal. If output signal is to be a different type of signal than the output than the isolator shall convert the signal as required.
2. Isolators output shall be adjustable for zero and span.
3. If input signal is part of a Hart system, the isolator shall be made specifically to pass on the Hart signal.
4. Acceptable Manufacturers
   a. Phoenix Contact.
   b. Action Instruments.
   c. Or Approved Equal.

M. Intrinsically Safe Barriers

1. Provide intrinsically safe barriers wherever analog or discrete input signals are coming from classified areas.
2. Intrinsically safe barriers shall be located in their own enclosure whose assembly is UL rated. Install the barriers and field wiring as per the requirements of NEC and the manufacturer's installation guidelines.
3. If input signal is part of a Hart system, the isolator shall be made specifically to pass on the Hart signal.
4. Acceptable Manufacturers
   a. Phoenix Contact.
   b. Pepperl Fuchs.
   c. Or Approved Equal.

N. Relays

1. Provide relays whose contact ratings are sized according to the load requirements and size of the protection device associated with the circuit in which the contacts are wired. As a minimum contact ratings shall be 10A resistive up to 250VAC.
2. Provide relays whose coil voltage is as required by the application.
3. Relays with DC rated coils shall have a freewheel diode installed across the coil.
4. Relays with AC rated coils shall have a surge suppressor installed across the coil.
5. Relays shall have based with relays which plug into the base. Bases shall have screw-type connections.
6. Relays shall have an LED indicating when the relay is coil is energized.
7. Provide enough relay contacts for each relay as required by the application. If the number of contacts required exceeds the number of contacts on the relay, provide additional relay(s) to provide enough sets of contacts.
8. Acceptable Manufacturers
   a. Idec R Series.
   b. Allen-Bradley 700H Series.
   c. Or Approved Equal.

O. Time Delay Relays

1. Provide time delay relays to control on and off delay times as required by the application.
2. Time delay relays shall meet the requirements of relays as listed above with the following additional requirements:
    a. Time delay shall be adjustable from 0.1 seconds to 600 hours.
    b. Timers shall be multi-function and shall be capable of providing on-delay, off-delay, cycle timing and one-shot type timing control.
3. Acceptable Manufacturers
    a. Idec RTE Series.
    b. Phoenix Contact ETD Series.
    c. Or Approved Equal.

P. Panel HVAC Components
1. Provide heating, ventilation, and air conditioning, devices in order to maintain all components within the control panel within the acceptable range as specified in Section 409000.
2. HVAC equipment shall maintain the required NEMA rating for the control panel assembly.
3. Externally mounted HVAC equipment (such as air-to-air exchangers or air conditioners) shall be housed in an enclosure whose material matches the material of the control panel. Where in corrosive environments, all components that will come in contact with outside air shall be corrosion resistant for that environment.
4. All HVAC equipment shall be UL rated. For equipment mounted on the control panel, the equipment shall have a corresponding NEMA rating.
5. Provide power as required for the HVAC equipment. HVAC loads shall be included in feeder and control power transformer sizing calculations.
6. Panel Heating
    a. Heating shall be provided when ambient temperatures are expected to fall below the allowed range as specified in Section 409000. As a minimum, heating shall be sized to keep the panel temperature at or above 50°F.
    b. Except for small anti-condensating heaters, heating equipment shall have fans which distribute the heat throughout the enclosure. Heaters shall be installed according to the manufacturer's installation instructions. Provide enough space between the heating equipment and other components such that the other components to not experience abnormally high temperatures.
    c. Provide anti-condensating heaters for all outdoor enclosures which house electronics, instrumentation and/or motor controllers.
    d. All heaters shall be thermostatically controlled by a DIN rail mounted thermostat.
    e. Acceptable Manufacturers
        1) Hoffman.
        2) Or Approved Equal.
7. Panel Ventilation
    a. Where ventilation is determined to maintain the control panel's maximum temperature as required by Section 409000, the following requirements shall be adhered to:
        1) Ventilation shall maintain the required NEMA rating for the control panel assembly.
        2) For indoor, non-corrosive locations (panels with NEMA 12 ratings), conventional ventilation with fans and vents may be used.
        3) For corrosive or outdoor locations, side or top mounted air-to-air heat exchangers shall be used.

b. The fan(s) and corresponding vents or air-to-air heat exchangers shall be properly sized and located to move enough air through the panel to remove the generated heat as well as allow air flow across all heat generating equipment.
c. All ventilation shall be thermostatically controlled by a DIN rail mounted thermostat.
d. Acceptable Manufacturers
    1) Hoffman.
    2) Pfannenberg.
    3) Or Approved Equal.

8. Panel Air Conditioning
    a. Where it is deemed necessary to air condition a control panel to maintain the control panel's maximum temperature as required by Section 409000, the following requirements shall be adhered to:
        1) Air conditioners shall be side or top mounted and shall be sized based upon the heat generated within the control panel, the maximum outside air temperature, and the amount of sunlight the control panel may be exposed to. Air conditioners shall be oversized by a safety factor of 25%.
        2) Air conditioners shall be thermostatically controlled by a DIN rail mounted thermostat. In addition, the air conditioner shall turn off if the panel door(s) are not closed.
    b. Acceptable Manufacturers
        1) Hoffman.
        2) Pfannenberg.
        3) Thermal Edge.
        4) Kooltronics.

PART 3 - EXECUTION

3.1 FACTORY ACCEPTANCE TESTING

A. All control panels shall be factory acceptance tested (FAT) as required by Section 409000.

3.2 INSTALLATION

A. All control panels shall be installed according to the requirements of Section 409000.

B. All control panels shall be installed so that their surfaces are plumb and level.

C. All control panels shall be properly mounted so as to withstand the seismic requirements for the Site. Anchor panels securely to the wall or floor at each corner as a minimum.

D. Control panels shall have been designed according to locations for conduit entry. Floor mounted panels in electrical rooms shall have cutouts in the bottom of the enclosure that were cutout by the panel shop. All conduit holes shall be cut in the field.

E. Field wiring

1. Wires that are terminated in control panels after permanent panel installation are deemed as field wires. Field wiring shall be installed in the allocated wire ducts and shall be properly labeled and terminated.
2. All field wires shall be long enough to reach each corner of the enclosure. Neatly coil up extra wire length at the bottom of the enclosure. Do not use the wire ducts for storing extra wire length.

3.3 FIELD QUALITY CONTROL

A. Refer to Section 409000.

END OF SECTION 409513

SECTION 409600 – PROCESS CONTROL SOFTWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. PLC Programming Software
2. OIT Programming Software

B. Related Sections:

1. Refer to Section “409443 Programmable Logic Controllers” for PLC Hardware requirements.
2. Refer to Section “409433 Human Machine Interfaces” for OIT and SCADA System requirements.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Software to be furnished under this section shall be the product of firms regularly engaged in the design and manufacturing of this type of equipment.

B. Examine the Contract Documents and verify that Software being provided is compatible with the requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver the Software to the Owner prior to startup and commissioning.

PART 2 - PRODUCTS

2.1 PLC PROGRAMMING SOFTWARE

A. PLC Programming Software shall be provided by the OSI. In an attempt to make all PLC's at the facility the same, vendors shall coordinate with the OSI the PLC firmware version that is used for any vendor PLC.

2.2 OIT PROGRAMMING SOFTWARE

A. OIT Programming Software shall be provided by the OSI. In an attempt to make all of the OIT's at the facility the same, vendors shall coordinate the software version to be used for programming the OIT with the OSI.

END OF SECTION 409600

APPENDIX B – PROTECTIVE COATINGS SPECIFICATION

098000 Protective Coatings

SECTION 098000 - PROTECTIVE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and application of coating systems.
1. **System A:** Concrete – Immersion, Non-Potable, Corrosive Environment
2. **System B:** Concrete – Immersion in Acidic Liquids
3. **System C:** Concrete – Exposed Reinforcement Protection
4. **System D:** Concrete – Sealant (Non-Paint Finish)
5. **System E:** Concrete Masonry Unit (CMU) Sealer – Non-Paint Finish
6. **System F:** Ferrous Metal – Exterior, Non-Immersion excluding buried surfaces
7. **System G:** Ferrous Metal – Interior, Non-Immersion excluding buried surfaces
8. **System H:** Ferrous Metal – Immersion, Non-Potable
9. **System I:** Galvanized Steel and Non-Ferrous Metal – Non-Immersion
10. **System J:** Aluminum – Embedded or in contact with concrete
11. **System K:** Wood – Interior and Exterior
12. **System L:** PVC Pipe – Exterior and Interior Exposure
13. **System M:** Buried ferrous metal piping and fittings; miscellaneous surfaces requiring tar epoxy
14. **System N:** Hot-Dip Galvanizing
15. **System O:** Wall Board – Water and Light Chemical Exposure
16. **System P:** Ferrous Metal – Moderate to Severe Chemical Exposure Including H_2S Exposure.

1.2 DESCRIPTION

A. Scope of Work

1. The Contractor shall furnish all materials, labor, equipment, and incidentals required to provide a protective coating system for the surfaces listed herein and not otherwise excluded.

2. The work includes surface preparation and cleaning, painting and finishing of interior and exterior exposed items and surfaces such as ceilings, walls, floors, miscellaneous metal, doors, frames, construction signs, guardrails, posts, pipes, fittings, valves, equipment, and all other work obviously required to be painted unless otherwise specified herein or on the Drawings. The omission of minor items in the schedule of work shall not relieve the Contractor of his obligation to include such items where they come within the general intent of the Specifications as stated herein.

1.3 REFERENCES

A. American National Standards Institute:

1. ANSI/NSF Standard 61 Listing of Certified Drinking Water System Components - Health Effects.

2. ANSI Z53.1, Safety Color Code for Marking Physical Hazards.

B. ASTM International

C. Occupational Safety and Health Act (OSHA):

1. OSHA 1910.144, Safety Color Code for Marking Physical Hazards.

2. OSHA 1910.145, Specifications for accident prevention signs and tags.

D. The Society for Protective Coatings (SSPC):

1. Surface Preparation Specifications:

a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
b. PA 3, Guide to Safety in Paint Applications.
c. SSPC-SP 1, Solvent Cleaning.
d. SSPC-SP 2, Hand Tool Cleaning.
e. SSPC-SP 3, Power Tool Cleaning.
f. SSPC-SP 5, White Metal Blast Cleaning.
g. SSPC-SP 6, Commercial Blast Cleaning.
h. SSPC-SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
i. SSPC-SP 10, Near-White Blast Cleaning.
j. SSPC-SP 11, Power Tool Cleaning To Bare Metal.
k. SSPC-SP12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating.
l. SSPC-SP13, Surface Preparation of Concrete.
m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

E. NACE International (NDACE): RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

F. National Fire Protection Association (NFPA).

G. National Sanitation Foundation (NSF).

H. International Concrete Restoration Institute (ICRI).

1.4 DEFINITIONS

A. "Paint" as used herein means all coating systems, materials, including primers, emulsions, enamels, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. The term “exposed” as used in this Section shall mean all items not covered with concrete, masonry, or similar material.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include preparation requirements and application instructions.

1. Submit to the Engineer as provided in the General Conditions and Section 013300: Contractor Submittals, Working Drawings, and Samples; shop drawings, manufacturer's specifications and data on the proposed paint systems and detailed surface preparation, application procedures and dry film thickness (DFT).

2. Submit material manufacturer's technical information, including paint label analysis and application instructions for each material proposed

a. List each material and cross-reference to specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.
b. Submit copies of manufacturer's complete color charts for each coating system.
c. Provide certifications from manufacturers verifying that factory applied prime coats are compatible with specified finish coatings.
d. Pipe Markers and Safety Signs: Submit copies of manufacturer's technical brochure, including color chart and list of standard signs. Owner will set titles on pipe markers and safety signs.

B. Schedule:

1. The Contractor shall submit for approval to the Construction Manager, a complete typewritten Schedule of Painting Operations within 90 days after the Notice to Proceed. This Schedule is imperative so that the various fabricators or suppliers may be notified of the proper shop prime coat to apply. It shall be the Contractor's responsibility to properly notify and coordinate the fabricator's or suppliers' surface preparation and painting operations with these specifications. Record of notification shall be transmitted to the Construction Manager or be available for review. This Schedule shall include for each surface to be painted, the brand name, generic type, solids by volume, application method, the coverage and the number of coats in order to achieve the specified dry film thickness, and color charts. When the Schedule has been approved, the Contractor shall apply all material in strict accordance with the approved Schedule and the manufacturer's instructions. Wet and dry paint film gauges may be utilized by the Owner to verify the proper application while work is in progress.

2. It is the intent of this section that as much as possible all equipment and piping utilize coating systems specified herein supplied by a single manufacturer. All exceptions must be noted on the Schedule. For each coating system, only one (1) manufacturer's product shall be used.

3. Contractor is responsible for the compatibility of all shop primed and field painted items in this Contract. Furnish information on the characteristics of the finish materials proposed to use, to ensure that compatible prime coats are used. As directed by the Engineer, provide barrier coats over incompatible primers or remove and re-prime. Notify the Engineer in writing of anticipated problems using the coating systems as specified with substrates primed by others.

C. Color Samples: Manufacturer's standard color charts for color selection by Owner.

D. Samples – Painting:

1. Paint colors will be selected by Owner unless other standards are noted. Compliance with all other requirements is the exclusive responsibility of the Contractor.

E. Applicator Qualifications: Submit qualifications as specified under Quality Assurance article.

F. Closeout Submittals:

1. Submit certificate stating Work was properly prepared and painted in accordance with Specifications.

2. Submit manufacturer's certificate stating quantity of paint furnished was sufficient to properly coat all surfaces.

3. Maintenance Manual: Upon completion of work, furnish copies of a detailed maintenance manual including following information:

a. Product name and number.
b. Name, address and telephone number of manufacturer and local distributor.
c. Detailed procedures for routine maintenance and cleaning.
d. Detailed procedures for light repairs such as dents, scratches and staining.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Coatings: 5 percent, but not less than 1 gal. of each material and color applied.

1.7 QUALITY ASSURANCE

A. Provide the best quality grade of the various types of coatings suitable for use in corrosive water and wastewater treatment and pumping environments as regularly manufactured by approved paint materials manufacturers. Materials not displaying the manufacturer's identification as a standard, best grade product will not be acceptable.

B. Provide undercoat paint produced by the same manufacturer as the finish coats. Undercoat and finish coat paints shall be compatible. Use only thinners approved by the paint manufacturer and list the manufacturer, and use only within recommended limits as listed on the manufacturer’s product data sheets.

C. Painting shall be accomplished by experienced painters specializing in industrial painting familiar with all aspects of surface preparations and applications required for this project. Work shall be done in a safe and workmanlike manner.

D. Applicator Qualifications:

1. Successfully painted water and wastewater utility installations for at least five (5) years. Submit name and experience record of painting applicator to Engineer. A list of at least

five (5) utility installations painted within the last five (5) years, along with responsible officials, architects or engineers involved with the project, and the approximate contract price may be requested by the Owner or Engineer.

2. Painting applicators whose submissions indicate a lack of experience required to perform the work, or have performed work in an unsatisfactory manner, will not be approved.

E. Acceptable Manufacturers:

1. Tnemec Co. (Where noted otherwise in the coating specification use specified product or equal).

2. Or Equal. No substitutions will be considered that decrease film thickness, number of coats, surface preparation or generic type of coating specified. Furnish same color selection of substituted manufacturers as manufacturer specified, including accent colors in coating systems. Substitutions must meet the performance requirements of the materials selected.

1.8 DELIVERY, HANDLING AND STORAGE

A. Deliver, store and handle paint in accordance with manufacturer's recommendations, and as supplemented below.

B. Delivery of Materials:

1. Deliver materials to job site in original, new, and unopened packages and containers bearing manufacturer's name and label with following information:

a. Name or title of material.
b. Manufacturer's stock number, batch number and date of manufacture (shelf life).
c. Manufacturer's name.
d. Contents by volume, for major pigment and vehicle constituents.
e. Thinning instructions where recommended.
f. Application instructions.
g. Color name and number.

C. Storage of Materials:

1. Store only acceptable project materials on project site.
2. Store in a suitable location approved by Owner. Keep area clean and accessible.
3. Restrict storage to paint materials and related equipment.
4. Comply with health and fire regulations including the Occupational Safety and Health Act of 1970. Flammable materials shall be separated and stored in a suitable area as required.
5. Keep temperature of storage area above 50° F or manufacturer's recommended storage temperature, whichever is higher. Consult the manufacturer’s written literature for storage condition requirements.
6. Containers shall be clearly marked to indicate any hazards connected with the use of the paint and steps which should be taken to prevent injury to those handling the product.

1.9 WARRANTY AND GUARANTEES

A. All paint and coatings work performed under these specifications shall be guaranteed by the coatings applicator for 100 percent of the total coated area for both materials and labor against failures during the warranty period.

B. Failure under this warranty shall include flaking, peeling, or delaminating of the coating due to aging, chemical attack, or poor workmanship; but it shall not include areas which have been damaged by unusual chemical, thermal, or mechanical abuse.

1.10 SURFACES TO BE COATED

A. Design Requirements:

1. Ensure surfaces are properly prepared, proper primer applied to correct mil thickness, and finish coat is compatible with primer coat and applied to correct mil thickness. This requirement applies to all equipment and material, whether the total process is done in the shop, in the field, or partially in shop and partially in field.

2. Provide paint products supplied by one manufacturer unless otherwise approved by the Engineer.

B. Paint all exposed surfaces, except where natural finish of material is specifically noted as a surface not to be painted.

C. Where items or surfaces are not specifically mentioned, paint these the same as adjacent similar materials or areas.

D. The following items will not be painted unless otherwise noted.

1. Any code-requiring labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

2. Any moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts, unless otherwise indicated.

3. Aluminum except where in contact with dissimilar metals.

4. Fiberglass items including but not limited to handrails, walkways, toeboards, windows, louvers, fans, grating, and tanks.

5. Stainless steel, chromium plate/polished chrome, anodized aluminum, nickel and similar finished products.

6. Brass and bronze other than exposed utility tubing.

7. Flexible couplings, lubricated bearing surfaces, insulation and plastic pipe or duct interiors.

8. Plastic switch plates and receptacle plates.

9. Signs and nameplates.

10. Finish hardware.

11. Packing glands and other adjustable parts, unless otherwise indicated.

12. Portions of metal, other than aluminum, embedded in concrete. This does not apply to the back face of items mounted to concrete or masonry surfaces which shall be painted before erection. Aluminum to be embedded in, or in contact with, concrete shall be coated to prevent electrolysis.

13. Galvanized metals unless specifically noted otherwise.

14. Prefinished Items.

    a. Unless otherwise shown or specified, factory finishing such as baked-on factory porcelain, polyvinyl fluoride or other similar finish is specified for such items as, but not limited to, mechanical and electrical equipment such as instruments, light fixtures and distribution cabinets. Touch up factory finished items with paint supplied by the item manufacturer. As directed by Engineer, field paint damaged prefinished items or return them to the factory for repair and repainting.
    b. Any prefinished item not having generic type of paint or proper mil thickness to withstand corrosive atmosphere of water treatment plants, wastewater treatment plants and/or pumping stations shall be returned to the factory for painting or shall have additional coats applied in the field.

1.11 PROTECTION OF SURFACES NOT TO BE COATED

A. Protect surfaces and equipment which are not to receive coatings during surface preparation, cleaning and painting operations.

B. Remove mask, or otherwise protect hardware, lighting fixtures, switchplates, machines, surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting. Mask openings in motors and equipment to prevent abrasives, paint and other materials from entering.

C. Exercise care not to damage adjacent work during sandblasting operations. Conduct spray painting under controlled conditions. Promptly repair any damage to adjacent work or adjoining property occurring from sandblasting or spray-painting operations.

1.12 PROJECT CONDITIONS

A. Environmental Requirements:

1. Adhere to manufacturer's data on air and surface temperature limits and relative humidity during application and curing of coatings. Note that on some coatings for concrete, applications may be required during declining temperatures only.

2. Do not spray apply paint when wind velocity is above 15 mph.

3. Schedule coating work to avoid dust and airborne contaminants.

4. Apply exterior finishes during daylight hours only.

5. When painting in confined spaces, or because of unfavorable ambient conditions, longer drying times will be necessary.

6. Provide supplementary ventilation such as fans and blowers in confined or enclosed areas to carry off solvents during evaporation stage.

B. Existing Conditions:

1. Broom clean area before painting is started. Remove dirt and dust.

a. After painting operations begin, broom cleaning will not be allowed. Clean only with commercial vacuum cleaning equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All paint shall be manufactured by one of the suppliers listed in Paragraph 1.7 F., herein, and shall be their highest grade of paint.

B. The following coating systems list a product by name to establish a standard of quality; other products of the same generic types may be submitted to the Engineer for approval as described in Paragraph 1.7 F., herein. When other than the specified coating system is proposed, the Contractor shall submit on a typewritten list giving the proposed coatings, brand, trade name, generic type and catalog number of the proposed system and the requested test results for the Engineer's approval.

C. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Shop paint shall be of the same type and manufacturer as used for field painting by the Contractor.

D. Emulsion and alkyd paints shall contain a mildewcide and both the paint and mildewcide shall conform to OSHA and Federal requirements, including Federal specification TT-P-19.

E. Finish coats containing lead shall not be allowed.

F. Rags shall be clean painters rags, completely sterilized.

G. Provide paints, pipe marker and safety signs of durable and washable quality. Use materials which will withstand normal washing as required to remove grease, oil, chemicals, etc., without showing discoloration, loss of gloss, staining, or other damage.

2.2 COLORS AND FINISHES

A. Provide surface treatments and finishes as specified in paragraph 2.3 of this Section.

B. Color Schedule: Colors for painted surfaces will be selected by Owner or as shown on Drawings.

C. Piping Color Code: Colors for piping will be in accordance with Section 220553 “Identification for Plumbing Piping and Equipment”.

D. Use representative colors when preparing samples for Engineer's review. Final acceptance of colors will be from samples applied on the job.

E. Color Pigments: Pure, nonfading, applicable types to suit substrates and service indicated.

F. Paints specified for application on submerged metal in contact with potable water shall meet NSF 61 and be approved by the governing health and safety codes.

2.3 COATING SYSTEMS

General: Where exposures and/or coating are not specified or when two (2) classifications can apply, the worst-case condition shall be used to determine the coating system.

A. System A: Concrete - Immersion, Non-Potable:

1. Examples of application areas for this system include the following surfaces:

a. Interior walls of hydraulic structures with potential for H_2S exposure.

b. Floors and interior surfaces of concrete covers/slabs of hydraulic structures with potential for H_2S exposure.

c. Concrete exposed to corrosive environments.

d. Other immersed concrete areas.

2. Surface Preparation: All oil, grease, waste and chemical contaminants must be removed from the surface of the concrete prior to preparation in accordance with NACE SP0892 and SSPC-SP13/NACE 6. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP5. Existing concrete to receive protective coating system must be sound and capable of supporting the Protective Lining System.

3. Coating System (Use a, b, and c):

a. Surfacer/Filler: The appropriate cementitious repair mortar or epoxy cementitious resurfacer material shall be applied to the entire, prepared surface to level surface suitable for coating.

1) For concrete deteriorated greater than a depth of 1/4-inch: Tnemec Series 217 Mortarcrete - Trowelable grade, rapid-setting, cementitious repair

mortar and when recommended by the Manufacturer to rehabilitate and restore concrete and provide level substrate for application of the protective lining.

2) For new or existing concrete to a depth up to 1/4-inch: Tnemec Series 218 MortarClad Epoxy cementitious resurfacer shall be used for filling voids, bugholes, static cracks and joints, and for general concrete patching, and to provide a uniform, void free surface for Epoxy Lining application. The Series 218 shall be applied to the entire surface at a minimum thickness of 1/16 inch.

b. Epoxy Lining (basecoat): Tnemec Series 434 Perma-Shield H2S at 125 mils

c. Epoxy Lining Glaze Protective Lining (topcoat):: Tnemec Series 435 Perma-Glaze at 15 – 20 mils

B. System B: Concrete – Immersion in Acidic Liquids

1. Area of application: Odor Control System concrete slab.

2. Surface Preparation: All oil, grease, waste and chemical contaminants must be removed from the surface of the concrete prior to preparation in accordance with NACE SP0892 and SSPC-SP13/NACE 6. Surface preparation requirement is to expose a sound, uniform surface texture confirming to the minimum recommended ICRI-CSP5. Existing concrete to receive protective coating system must be sound and capable of supporting the Protective Lining System.

3. Coating System (Use a, b and c):

a. Surfacer/Filler: The appropriate cementitious repair mortar or epoxy cementitious resurfacer material shall be applied to the entire, prepared surface to level surface suitable for coating.

1) For concrete deteriorated greater than a depth of 1/4-inch: Tnemec Series 217 Mortarcrete - Trowelable grade, rapid-setting, cementitious repair mortar and when recommended by the Manufacturer to rehabilitate and restore concrete and provide level substrate for application of the protective lining.

2) For new or existing concrete to a depth up to 1/4-inch: Tnemec Series 218 MortarClad Epoxy cementitious resurfacer shall be used for filling voids, bugholes, static cracks and joints, and for general concrete patching, and to provide a uniform, void free surface for Epoxy Lining application. The Series 218 shall be applied to the entire surface at a minimum thickness of 1/16 inch.

b. Epoxy Lining (basecoat): Tnemec Series 434 Perma-Shield H2S at 125 mils

c. Epoxy Lining Glaze Protective Lining (topcoat): Tnemec Series 435 Perma-Glaze at 15 – 20 mils

C. System C: Exposed Reinforcement Protection

1. Area of Application: Exposed sawcut concrete face and exposed existing reinforcement.

2. Surface Preparation: According to manufacturer's recommendations.

3. Coating: Sika Armatec 110 EpoCem, or equal (Coverage per manufacturer's recommendations. Minimum 20 mil. thickness).

D. System D: Concrete Sealer – Non-Paint Finish

1. Area of application:

   a. Concrete Floors in the UV Disinfection Building, Electrical Building, Public Restrooms and Storage Building.
   b. Interior Concrete Floors not exposed to weather and corrosion.

2. Surface Preparation:

   a. Follow manufacturer's recommendations for surface preparation.

3. Product:

   a. Tnemec CT Densyfier Series 629 at 300 to 350 sf per gallon.

E. System E: Concrete Masonry Unit (CMU) Sealer: Non-Paint Finish

1. Area of application: All exterior and interior masonry, where paint or other coating is not specified in drawings.

2. Surface Preparation:

   a. Follow manufacturer's recommendations for surface preparation for each type of masonry.

3. Coating:

   a. Tnemec Prime A Pell H2O series 633 at 50-75 sf per gallon.

F. System F: Ferrous Metal: Exterior, Non-Immersion excluding Buried Surfaces:

1. Exterior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere. Examples of this classification include, but not limited to, the following surfaces:

   a. Exterior or Above Ground Pipe.
   b. Piping and valves inside below ground valve vaults.
   c. Pumps, Motors, Equipment.
   d. Steel plate and shapes.
   e. Doors and frames.

2. Surface Preparation:

a. For Structural Steel, Equipment, and steel tanks: SSPC-SP6 Commercial Blast Cleaning with a minimum angular profile of 1.5 mils.

b. For Ductile or Cast Iron Piping, Valves, Pumps: Prepare all surfaces as per NAPF 500-03 – Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.

3. Coating System

a. For Structural Steel, Equipment, and Steel Tanks:
   1) Primer: Hydro-Zinc Series 94 H20 at 2.5 - 3.5 mils dft
   2) Intermediate: Hi-Build Epoxoline II L69 at 3.0 – 5.0 mils dft
   3) Finish: Endura-Shield Series 1095 2.0 to 3.0 mils dft

b. For Ductile or Cast Iron Piping, Valves, Pumps:
   1) Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
   2) Intermediate: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
   3) Finish: Endura-Shield Series 1095 2.0 to 3.0 mils dft

G. System G: Ferrous Metal: Interior, Non-Immersion excluding Buried Surfaces:

1. Interior metal surfaces that are exposed to the atmosphere but which do not come into contact with water, wastewater, or corrosive atmosphere. Examples of this classification include, but not limited to, the following surfaces:

   a. Piping, valves, appurtenances and supports.
   b. Pumps, Motors, Equipment.
   c. Exposed surfaces of electric panels, conduit, ventilation fans, etc.

2. Surface Preparation:

   a. For Structural Steel, Equipment, and steel tanks: SSPC-SP6 Commercial Blast Cleaning with a minimum angular profile of 1.5 mils.
   b. For Ductile or Cast Iron Piping, Valves, Pumps: Prepare all surfaces as per NAPF 500-03 – Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.

3. Coating System

   a. For Structural Steel, Equipment, and Steel Tanks:
      1) Intermediate: Hi-Build Epoxoline II L69 at 3.0 – 5.0 mils dft
      2) Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
   b. For Ductile or Cast Iron Piping, Valves, Pumps:
      1) Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
      2) Intermediate: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

H. System H: Ferrous Metal - Immersion, Non-Potable:

1. Examples of this classification include, but not limited to, the following surfaces:

   a. Pipe.

b. Metal surfaces in dry and wet wells or in immediate vicinity of corrosive environments.
c. Other submerged or partially submerged ferrous metal.

2. Surface Preparation: SSPC-SP10 Near White Blast Cleaning with a minimum angular anchor profile of 1.5 mils.

3. Coating System:

a. Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
b. Intermediate: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
c. Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

I. System I: Galvanized Steel and Non-Ferrous Metal - Non-Immersion:

1. Examples of this classification include the following surfaces:

a. Galvanized steel pipe where specifically noted or specified.
b. Galvanized or zinc-coated steel fabrications where specifically noted or specified.
c. Aluminum fabrications where specifically noted or specified.
d. Aluminum or other non-ferrous pipe or tubing.
e. Copper pipe and tubing.

2. Surface Preparation: SSPC-SP16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals to achieve a uniform anchor profile of 1.0 – 2.0 mils

3. Coating System:

a. Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
b. Interior Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
c. Exterior Finish: Endura-Shield Series 1095 2.0 to 3.0 mils dft

J. System J: Dissimilar Metal Insulation: Aluminum embedded or in contact with concrete:

1. Examples of this classification include the following surfaces:

a. Aluminum embedded or in contact with concrete, Stainless steel in contact with Carbon Steel:
1) Portions of slide gate frames.
2) Portions of hatch cover frames.
3) Portions of stair stringers.
4) Portions of grating and floor plate frames.

2. Surface Preparation: SSPC-SP16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals to achieve a uniform anchor profile of 2.0 – 3.0 mils.

3. Coating System:

a. Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
b. Intermediate: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

c. Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

K. System K: Wood - Interior and Exterior:

1. Examples of this classification include the following surfaces:

a. Wood trim.
b. Wood Panels

2. Surface Preparation: Sand rough areas. Clean and dry.

a. Prime: Elasto-Grip FC Series 151-1051 at 0.7 – 1.5 mils dft
b. Intermediate: Enduratone Series 1028 at 2.0 – 3.0 mils dft
c. Finish: Enduratone Series 1028 at 2.0 – 3.0 mils dft

L. System L: PVC/CPVC Pipe

1. This classification includes exteriors of exterior and interior PVC/CPVC pipe, valves and accessories

2. Surface Preparation: As specified in Paragraph 3.3, herein.

3. Coating System:

a. Exterior Exposed:
   1) Primer: Hi-Build Epoxoline II L69 at 2.0 – 4.0 mils dft
   2) Finish: Endura-Shield Series 1095 2.0 to 3.0 mils dft
b. Interior Exposed:
   1) Primer: Hi-Build Epoxoline II L69 at 2.0 – 4.0 mils dft
   2) Finish: Hi-Build Epoxoline II L69 at 2.0 – 4.0 mils dft

M. System M: Buried ferrous metal piping:

1. Examples of this classification include the following surfaces:

a. Buried steel, ductile iron piping and appurtenances.

2. Surface Preparation:

a. Steel Surface Preparation: SSSPC-SP10 Near White Blast Cleaning.
b. Ductile Iron Surface Preparation: Ductile Iron Surface Preparation: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.

3. Coating System:

a. Steel Surface:
   1) Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
   2) Intermediate: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
   3) Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

b. Ductile Iron Surface:
    1) Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
    2) Intermediate: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
    3) Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

N. System N: Hot-Dip Galvanizing

1. This classification includes but is not limited to stair stringers, grating embeds, fasteners, support members, and interior structural members not epoxy coated per Systems "Ferrous Metal: Interior, Non-Immersion" and "Ferrous Metal - Immersion, Non-Potable".

2. Surface Preparation: The Fabricator shall remove all welding slag, splatter, anti-splatter compounds and burrs prior to delivery for galvanizing. Avoid unsuitable marking paints. Consult with the galvanizer about removal of grease, oil paint and other deleterious material prior to fabrication. Remove by blast cleaning or other methods surface contaminants and coatings, which would not be removable by the normal chemical cleaning process in the galvanizing operation.

3. Coating System:

    a. Pre-clean steelwork in accordance with accepted methods to produce an acceptable surface for quality hot-dip galvanizing.
    b. Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with ASTM A123. Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with ASTM A153.
    c. Safeguard products against steel embrittlement in conformance with ASTM A143.
    d. Handle all articles to be galvanized in such a manner as to avoid any mechanical damage and to minimize distortion.
    e. Coating Weight: conform with paragraph 5.1 of ASTM A123, Table 1 of A767, or Table 1 of ASTM A153, as appropriate.
    f. Surface Finish: Continuous, adherent, as smooth and evenly distributed as possible and free from any defect detrimental to the stated end use of the coated article.
    g. Adhesion: Withstand normal handling consistent with the nature and thickness of the coating and normal use of the article.

4. Testing:

    a. Inspection and testing of hot dip galvanized coatings shall include visual examination and tests in accordance with ASTM A123, A767 or A153 as applicable to determine the thickness of the zinc coating on the metal surface.
    b. Furnish Notarized Certificate of Compliance with ASTM Standards and Specifications herein listed. The Certificate must be signed by the galvanizer and contain a detailed description of the material processed. The Certificate shall include information as to the ASTM standard used for the coating.

5. Repair or Damaged Coating:

    a. The maximum area to be repaired is defined in accordance with ASTM A123 Section 4.6 current edition.

1) The maximum area to be repaired in the field shall be determined in advance by mutual agreement between parties.

b. Repair areas damaged by welding, flame cutting or during handling, transport or erection by one of the approved methods in accordance with ASTM A780 whenever damage exceeds 3/16" in width. Minimum thickness requirements for the repair are those described in ASTM A123 section 4.6 current edition.

O. System O – Wall Board, Water Resistant – Interior Wall Light Chemical Exposure

1. Examples of this classification include the following surfaces:

a. Wall board where exposed to Water and/or light chemicals.

2. Surface Preparation:

a. Clean & Dry
b. Surfacer/Filler for joints and screw holes: Surfacing Epoxy Series 215 and Series 273 Part D fiberglass tape

3. Coating System:

a. Primer: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft
b. Finish: Hi-Build Epoxoline II L69 at 4.0 – 6.0 mils dft

P. System P – Ferrous Metal – Immersion – Moderate Chemical Exposure including H_2S vapor exposure.

1. Examples of this classification include the following surfaces:

a. Primary Clarifier Mechanisms

2. Surface Preparation: SSPC-SP10 Near-White Blast Cleaning with a minimum angular anchor profile of 2.0 mils.

3. Coating System:

a. Primer: Tneme-Liner Series 61 at 10.0 – 12.0 mils dft
b. Finish: Tneme-Liner Series 61 at 10.0 – 12.0 mils dft

PART 3 - EXECUTION

3.1 SHOP PAINTING

A. Surface Preparation - All ferrous metal to be primed in the shop shall have all rust, dust and scale, as well as all other foreign substances, removed by sandblasting or pickling in accordance with SSPC-SP10. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Under no circumstances will cleaned metal be allowed to sit overnight before priming, or pretreatment and priming. All nonferrous metals shall be solvent cleaned

prior to the application of primer. In addition, galvanized surfaces which are to be topcoated shall first be degreased then primed. Refer to manufacturer's printed literature for the correct blast profile for the product used.

B. Materials Preparation:

1. Mix and prepare painting materials in strict accordance with manufacturer's recommendations and directions, stirring materials before and during application to maintain a mixture of uniform density, free of film, dirt and other foreign materials.

2. No thinners shall be used except those specifically mentioned and only in such quantity as directed by the manufacturer in his instructions. If thinning is used, sufficient additional coats shall be applied to assure the required dry film thickness is achieved. The manufacturer's recommended thinner or cleanup solvent shall be used for all clean-up. Application by brush, spray, airless spray or roller shall be as recommended by the manufacturer for optimum performance and appearance.

C. Applications:

1. All painting shall be done by skilled and experienced craftsmen and shall be of highest quality workmanship. Coating systems shall be as specified herein.

2. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the type of material being applied.

3. All paint and coatings materials shall be stored under cover and at a temperature within 10°F of the anticipated application temperature and at least 5°F above the dew point.

4. Apply additional coats when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

5. Paint shall be applied in a neat manner with finished surfaces free of runs, sags, ridges, laps and brush marks. Each coat shall be applied in a manner that will produce an even film of uniform and proper thickness.

6. Paint back sides of access panels and removable or hinged covers to match the exposed surfaces.

7. Equipment manufacturer or supplier shall provide touch-up paint for items with shop applied finish coats.

8. Where specified in the individual sections, primer coat(s) shall be applied in the shop by the equipment manufacturer. The shop coats shall be as specified and shall be compatible with the field coat or coats.

D. Certification: The Contractor shall obtain from the equipment manufacturer or supplier, prior to shipment of equipment, a written certification that surface preparation, coating brand, material, DFT and application method complied with this section.

3.2 EXAMINATION

A. Examine areas and conditions where painting work is to be performed. Notify Engineer in writing of conditions detrimental to proper and timely completion of Work. Do not proceed with Work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

C. Remove by blast cleaning to SSPC-SP 10 any bitumastic coating or improper primer on any material or equipment which is to be painted and arrives at the construction site with a bitumastic coating or a priming system not specified in paragraph 2.3 Coating Systems.

3.3 SURFACE PREPARATION

A. General:

1. Perform all preparation and cleaning procedures as specified and in strict accordance with paint manufacturer's instructions for each particular substrate and atmospheric condition.

2. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items not to be finish painted, or provide surface applied protection prior to surface preparation and painting operations. Following completion of painting of each space or area, reinstall removed items by workmen skilled in the trades involved or remove applied protection, if applicable.

3. Clean sand, dirt, dust and all other foreign matter from surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program cleaning and painting so that dust and other contaminants from cleaning process will not fall in wet, newly painted surfaces.

4. Prepare surfaces which were not shop painted or were improperly shop painted or damaged, and all abraded or rusted surfaces, which are to be painted, as specified under 3.2 C. and as follows.

5. Priming Blast Cleaned Metal: Prime blast cleaned metal within 24 hours or before any rust bloom occurs.

6. Primed surfaces, exposed to sunlight for 60 days or more, must be scarified by lightly sanding or whip blasting to assure proper adhesion of final coat(s). The surface to be painted shall be solvent cleaned by SSPC SP1 to remove any grease, dirt, etc. If structures which require painting have been near the coast and exposed to salt air, a salt remover such as Chlor-rid may be required before cleaning.

7. If there is a time period in excess of five (5) months from application of a shop or field primer coat to proposed date to apply the first field finished coat, first field finished coat will not be applied. Instead, blast clean primer completely off to obtain the SSPC-SP surface specified for particular application in Painting Systems. Then, reapply primer and

finish paint as specified. Cost of removing primer by blast cleaning and reapplying primer will be at no expense to Owner.

8. Terminate shop prime coats on steel six inches from edges that are to be field welded.

B. Ferrous Metal Surfaces:

1. Shop or Field Primed for Submerged or Intermittently Submerged in Liquid Service:

   a. Grind smooth to a rounded contour sharp edges and welds, and remove weld splatter.
   b. Except for insides of pipes, blast clean in accordance with SSPCSP10 Near-White Finish and to obtain a minimum blast profile of 1.5 mils.
   c. After blast cleaning, remove dust and spent sand from surface by brushing or vacuum cleaning.
   d. Apply prime coat before rust bloom forms or within 24-hours, whichever is earlier.
   e. Do not allow blast cleaned or bare surfaces to stand overnight before coating.

2. Not Shop Primed and Non-Submerged:

   a. Grind smooth to a rounded contour sharp edges and welds, and remove weld splatter.
   b. Solvent clean in accordance with SSPC-SP 1 so that all surfaces are free of oil and contaminants with a non-petroleum based solvent recommended by the coating manufacturer.
   c. Pressure wash all areas to be painted with a minimum 3000 psi pressure washer using potable water. Use a cleaner such as Chlor*Rid or equivalent to remove all dirt, salt, and contamination before proceeding and prevent any salts from being driven into the metal by blasting. Exercise caution around any operating electrical equipment.
   d. Sweep blast clean in accordance with SSPC- SP 7. On areas that have been removed to bare metal, taper back edges to tightly adhered coating. Protect all rotating equipment and concrete from the abrasive blasting. On interior metal surfaces where abrasive blasting may damage electrical components, rotating equipment, thin gauge conduit, etc., Power Tool Cleaning per SSPC-SP3 or Hand Tool Cleaning per SSPC-SP2 may be used if requested and approved by the Engineer prior to beginning.
   e. After blast or other cleaning, remove dust and spent sand from surface by brushing or vacuum cleaning.
   f. Apply prime coat before surface starts to rust or within 24-hours, whichever is earlier.
   g. Do not allow blast cleaned or bare surfaces to stand overnight before coating.

3. Not Shop Primed and Non-Submerged, Reservoir & Potable Water Storage Tanks:

   a. Grind smooth to a rounded contour sharp edges and welds, and remove weld splatter.
   b. Solvent clean in accordance with SSPC-SP 1 so that all surfaces are free of oil and contaminants with a non-petroleum based solvent recommended by the coating manufacturer.

c. Pressure wash all areas to be painted with a minimum 3000 psi pressure washer using potable water. Use a cleaner such as Chlor*Rid or equivalent to remove all dirt, salt, and contamination before proceeding and prevent any salts from being driven into the metal by blasting.
d. Commercial blast clean in accordance with SSPC- SP 6 to obtain a minimum 1.5 mils blast profile. Protect all rotating equipment and concrete from the abrasive blasting.
e. After blast cleaning, remove dust and spent sand from surface by brushing or vacuum cleaning.
f. Apply prime coat before surface starts to rust or within 24-hours, whichever is earlier.
g. Do not allow blast cleaned or bare surfaces to stand overnight before coating.

4. Shop Primed:

a. Immediately before paint application, clean sand, dust, mud, dirt and other foreign matter from shop coat.
b. Touch-up damaged or destroyed shop paint.
c. Surface preparation of surfaces to be touched-up must be as effective as those specified for shop painting. A minimum SSPC SP3 should be used. Immersion service will require abrasive blasting.

5. Ferrous metal surfaces previously exposed to sulfides shall be sandblasted, washed, and sandblasted again in accordance with the recommended surface preparation for the particular service in question.

6. Where blast cleaning is done in the field, only "virgin" sand, grit, or abrasive will be used.

7. Inaccessible areas, such as, behind tank rafters or skip-welded lap joints, or in between back-to-back angle iron bracing, shall be coated before assembly to prevent corrosive action from taking place in these in accessible areas. All surface voids shall be sealed-welded and back-toback bracing and tank rafters either coated before assembly or eliminated from the design and construction. Sharp corners and edges shall be ground to a smooth contour and welds prepared as described above.

C. Concrete Surfaces:

1. All concrete surfaces to be coated shall be clean and dry. "Dry" is defined for new concrete as free of moisture and fully cured which is a minimum of 28 days at 75ºF and 50 percent Relative Humidity or some equivalent cure time at other conditions (7 days minimum for stucco). Moisture content of concrete shall be checked by taping a one-foot square piece of 20 mil thick minimum plastic film on the surface (“plastic film tapedown test” ASTM D 4263). Test film should be placed at various locations that are likely to be slow drying out, such as below grade, low spots in floors, inside corners and lower wall areas. The film should be carefully sealed with tape to prevent the escape of any moisture or vapor that would be trapped behind the film. The film should be left in place over night or longer to allow sufficient time for moisture migration. After 48 hours remove and examine the backside for moisture condensation and inspect the concrete surface for darkened areas. The source of the moisture, if present, shall be located, and the cause corrected prior to coating. All oil, grease, dirt, etc., shall be removed either by

steam cleaning with detergent or by scrubbing with a hot trisodium phosphate solution consisting of 2 pounds of trisodium phosphate to each gallon of hot water (160□ F). Repeat the cleaning operation until the contamination is removed and flush the area with clean water to remove residual cleaning solution. Allow to dry thoroughly before coating.

2. Old paint and unremoved tar stains shall be solvent cleaned with naphtha, trichloroethylene, or perchloroethylene. Proper safety precautions shall be observed if this step is necessary. The surface shall be flushed with fresh water and dried.

3. Do not use form oils incompatible with coating, concrete curing agents or concrete hardeners on concrete surfaces to be coated.

4. Concrete and/or cinder block walls to receive a coating shall be air-blasted with 100 psi clean, dry, oil-free air to remove dust, etc., and wire brushed to remove all loose and/or weak mortar. See requirements for sumps, tanks and other water-bearing structures below. These surfaces may also be pressure washed with a minimum 3,000 psi.

5. Concrete floors shall be thoroughly swept clean and prepared in accordance with an ICRI CSP profile dependent on the material used. Contact the paint manufacturer for specific surface preparation requirements.

6. The floors or concrete sumps, tanks or other water-bearing structures should be prepared in accordance with the appropriate ICRI CSP standard for the system used (typically ICRI CSP3 or CSP5). Patch voids and cracks that will cause discontinuities in the coating or unsightly appearance using a patching compound compatible with the coating system.

D. Masonry and Precast Concrete:

1. Clean out cracks, loose mortar, chips, indentations and open pores.

2. Patch with mortar all depressions.

3. Perform work only on cured, dry and dust free masonry surfaces.

4. Apply surfacer recommended by paint manufacturer in accordance with manufacturer's procedures.

E. Wood Surfaces: Wood should be clean and dry. Remove surface deposits of sap or pitch by scraping and wiping clean with rags dampened with mineral spirits or VM & P Naphtha. Seal knots and pitch pockets with shellac reduced with equal parts of shellac thinner (denatured alcohol) before sandpaper finishing with fine grit and remove sanding dust. After the prime coat is dry, fill cracks and holes with putty or spackling compound. When filler is hard, sand flush with the surface using fine grit sandpaper. Sand lightly between coats with fine grit, open-coated sandpaper.

F. Stainless Steel:

1. Stainless steel will only be coated when so specified.

2. Stainless steel requires only solvent cleaning prior to coating using any one of the methods in SSPC-SP1. Only solvents and cleaning solutions containing less than 200 ppm of halogens should be used to prevent stress corrosion cracking.

3. Stainless steel may be shot-blasted to provide a surface profile to increase the mechanical bond of the coating system. The height of the profile and the texture required should be defined for the operator and as a standard for the acceptance of the work. Pictorial standards for the surface cleanliness of carbon steel are not applicable to stainless steel, since there are no corrosion products or mill scale to remove from the surface.

4. Abrasive blast cleaning procedures outlined by Steel Structures Painting Council for carbon steel may also be used for stainless steel. Only very hard silica sand or other abrasive media should be used for a fast cutting action and to obtain a sharp angular profile.

G. Gypsum Drywall:

1. Sand joint compound with fine grit, open-coated sandpaper to provide a smooth flat surface. Avoid heavy sanding of the adjacent wall board surfaces, which will raise the nap of the paper covering. Remove dust from the surface by wiping with clean rags or other means. If additional joint finishing is required to provide a smooth surface, the same joint compound of a ready-mixed spackling compound should be used. Putty, patching pencils, caulking or masking tape should not be applied to dry wall surfaces to be painted. Finish level 4 or 5 must be achieved prior to beginning to paint. Level shall be suitable for coating system to be applied.

2. Lightly scuff-sand tape joints after priming to remove raised paper nap. Take care not to sand through the prime coat and remove dust by wiping with clean rags.

H. Galvanized Steel, and Non-Ferrous Metal:

1. Galvanized steel and aluminum will only be coated when so specified.

2. Surfaces shall be clean and dry. Remove dust and dirt by blowing off the surface with high pressure air or wiping clean with dry rags. Oil, grease and protective mill coatings should be removed by solvent cleaning in accordance with SSPC-SP1.

3. All galvanized surfaces for non-immersion service should be cleaned with a minimum SSPC SP3 or brush blasted to remove any passivation layer and to provide a surface profile.

4. Other surface preparation as outlined in the coating manufacturer's latest written Application Instructions shall be observed more demanding exposures.

I. Previously-Painted Surfaces (except ferrous metal, non-immersion):

1. Careful examination of the old coating is necessary in order to determine the condition of the coating prior to recommending the degree of surface preparation that will be needed. The old coating should be shaved with a knife to ascertain its present adhesion to the substrate, as well as the flexibility of the film. If the old coating has a tendency to

powder or shatter easily under the knife, or disbonds freely from the substrate or underfilms, it would indicate total removal is necessary.

a. When up to 10 percent of the total area has failed, spot blasting back to at least one-inch into sound film, feathering of edges and spot priming is required.
b. When the coating system has deteriorated to approximately 25 percent of the total area, or if the coating is brittle, eroded or underfilm rusting is present, completely remove original coating system by sandblasting as specified.

2. Tank linings, immersion-service coatings, and some other types of high performance coatings require total removal before recoating. Consult manufacturer's recommendations for which of the other types of high performance coatings require total removal.

3. In instances where the film has been eroded due to weathering or worn thin due to abrasion or impingement with no rusting, the surface contaminants may be removed through water blasting (approximately 3,000 psi or more, over 4 gallons per minute) with emulsifying agents or cleaners, rinsed and dried. Roughening of the surface shall be used to improve the adhesion of subsequent coats. Recoat with the recommended finish coat(s).

J. PVC or Other Plastic Piping or Ductwork:

1. Remove any grease or oily residue on PVC.

2. Lightly sand off sheen and clean. Abrade surface.

3. If recommended by manufacturer, lightly abrade surface with medium grade sandpaper. Remove dust by wiping with clean rags.

4. Remove dust and sand by wiping with a dry cloth. Apply coating before any contamination.

K. Shop Bituminous Coated Pipe:

1. Hand tool clean in accordance with SSPC-SP 2.

2. Wipe or brush clean.

3. Recoat with compatible bituminous coating.

3.4 MATERIALS PREPARATION

A. General:

1. Mix and prepare painting materials in strict accordance with manufacturer's directions.

2. Do not mix coating materials produced by different manufacturers.

3. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in a clean condition, free of foreign materials and residue.

4. Stir all materials before application to produce a mixture of uniform density, and as required during application of materials. Do not stir any film which may form on surface into material. Remove film and, if necessary, strain material before using.

5. If material has thickened or must be diluted for application, buildup coating to same film thickness achieved with undiluted material. Do not use thinner to extend coverage of paint unless recommended by the manufacturer and listed on their product literature.

B. Tinting:

1. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat. Provide code number that identifies material tinted by manufacturer.

3.5 APPLICATION

A. General:

1. Strictly follow paint manufacturer's label instructions for proper application, spreading rate and drying time.

2. Apply paint by brush, roller, air spray, or airless spray in accordance with manufacturer's directions, and recommendations of Paint Application Specifications No.1 in SSPC Vol. 2, where applicable. Use brushes best suited for type of material being applied. Use rollers of carpet, velvet back, or high pile sheep’s wool as recommended by paint manufacturer for material and texture required. Do not use rollers having nap exceeding 3/8-inch.

   a. Apply by brush to newly welded seams.
   b. Apply prime coats by roller, brush, or spray.

3. Apply paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 and 95 degrees F, and will remain in this range during curing, unless otherwise permitted by paint manufacturer's printed instructions.

4. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces.

5. Painting may be continued during inclement weather only if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

6. Provide adequate illumination and ventilation in areas where painting operations are in progress.

7. Maintain number of coats and minimum paint film thickness per coat required regardless of application method. Do not apply succeeding coats until previous coat has completely dried or the minimum time recommended by manufacturer has elapsed, whichever is longer.

8. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, and until paint film is of uniform finish, color and appearance. This requirement is of particular importance regarding intense primary accent colors. Ensure surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.

9. Surfaces not exposed to view do not require color coding and in some cases do not require painting.

10. Paint interior surfaces of ducts (in accordance with materials), where visible through registers or grilles, with a flat, non-specular black paint as specified, before final installation of equipment.

11. Paint backs of access panels, and removable or hinged covers to match exposed surfaces.

12. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces, unless otherwise specified.

13. Do not apply paint over sealants and caulking compounds until integral solvents have been released from compound. Conform to sealant and caulking manufacturer's recommendations.

14. Paint existing structural steel to match new structural steel.

15. Spray painting of sound-absorbing concrete masonry units containing sound insulation material is prohibited. This requirement prevents insulation material from being sprayed, resulting in a consequent loss of sound attenuation effectiveness. Apply paint on sound-absorbing masonry by rolling or brushing.

16. Sprayed Finishes: Spray paint finish doors, frames and windows, where required. Brush or roller finishes will not be acceptable.

17. Install piping markers and safety signs only after painting and finish work is completed.

B. Minimum Coating Thickness: Apply each material at not less than the manufacturer's recommended spreading rate, and provide total dry film thickness as specified. In no case allow area coverage per gallon to exceed manufacturer's recommendations. Apply extra coat at no additional expense to obtain specified total dry film thickness.

C. Scheduling Painting:

1. Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

    a. Apply primers before rust bloom forms but in no case allow cleaned steel to be exposed for more than 24-hours.

2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of

adhesion of undercoat. In no case apply an additional coat until manufacturer's minimum recommended drying time between coats has elapsed.

D. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.

E. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling such as laps, irregularities in texture, skid marks, or other surface imperfections.

F. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

G. Brush Application:

1. Brush-out and work all blush coats onto surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections are not acceptable. Neatly draw all glass and color break lines.

2. Brush apply all primer or first coats, unless otherwise permitted to use mechanical applicators.

H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not in compliance with specified requirements as required by the Engineer.

I. Placing Into Service: Do not place painted items into service until paints and coatings are fully cured (dry-hard).

J. Safety Signs: Apply safety signs at locations directed by Engineer.

3.6 RE-PAINT SURFACE PREPARATION

A. Assume complete responsibility for quality of repaint work insofar as proper surface preparation will affect finished appearance. Quality of finishes is subject to Engineer's approval or rejection. Recoat work as a result of rejection will be at no expense to Owner.

B. Prepare previously painted surface where rust, powdering, scaling, peeling or flaking is present by wire brushing, scraping, sanding and blast cleaning to solid material. Sand solid edges smooth. Taper back edges to tightly adhered coating.

C. Prepare hard, glossy, repaint surfaces for paint adhesion by sandpapering, followed by surface washing and rinsing. When a de-glosser is used, washing and rinsing may be eliminated.

D. To avoid rust showing from nails' heads in repainted wood surfaces, countersink nails and fill holes, together with all other crevices, with wood filler similar to DAP 33 after priming coat has dried. Lightly sand wood filler to a smooth surface. Coat knots and sappy spots with shellac before painting.

E. Just prior to application of paint or coatings, re-paint surfaces must be dry, clean and free of loose dirt, dust and grit.

F. Patch test unknown old coatings for compatibility.

3.7 FIELD QUALITY CONTROL

A. Engineer reserves right to invoke following material testing procedure at any time, and any number of times during the period of field painting.

1. Engage the service of an independent testing laboratory to sample any paint being used. Samples of materials delivered to Project site will be taken, identified and sealed, and certified in presence of Contractor.

2. Have independent testing laboratory perform appropriate tests for any or all of following characteristics: abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance, quantitative materials analysis, and compatibility of coatings.

3. If test results show that material being used does not comply with specified requirements, a directive may be made, at no expense to Owner, to stop painting work and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two (2) coatings are non-compatible.

B. Testing Equipment:

1. Provide calibrated magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by ElektroPhysik U.S.A., Arlington Heights, IL, MikroTest Digital or other Engineer-approved manufacturer.

2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-l.

3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

C. Testing:

1. Thickness and Continuity Testing:

a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before coat has dried.
b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE RP0188.
c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE RP0188.

d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

D. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

E. Unsatisfactory Application:

1. If an item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.

3. Repair defects in accordance with written recommendations of coating manufacturer.

F. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.

2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.

3. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.8 PROTECTION

A. Protect work of other trades against damage caused by painting and finishing work. Correct damages by cleaning, removing paint splatter, repairing or replacing, and repainting, as acceptable to Engineer.

B. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided after completion of painting operations.

C. Protect painted surfaces from damage. Touch up and restore damaged or defaced painted surfaces as determined by Engineer.

3.9 CLEANING

A. The Contractor shall perform the work under this Section while keeping the premises free from accumulation of dust, debris and rubbish and shall remove all scaffolding, paint cloths, paint, and brushes from the building when completed.

B. Cleaning: All paint brushed, splattered, spilled or splashed on any surface not specified to be painted shall be removed.

C. The Contractor shall insure that all glass throughout that portion of the facility in which he worked is cleaned of dirt and paint before he leaves the job site. Further, the Contractor shall insure that all glass in this area is thoroughly washed and polished.

D. Upon completion of the project, the job site shall be left neat and clean.

END OF SECTION 098000