

TREATMENT TRAINS 5 AND 6 REHABILITATION PROJECT

Project Specifications

BV PROJECT NO. 406161

PREPARED FOR



Peace River Manasota

FEBRUARY 01, 2021

PEACE RIVER MANASOTA REGIONAL WATER SUPPLY AUTHORITY
TREATMENT TRAINS 5 AND 6 REHABILITATION PROJECT SPECIFICATIONS

JANUARY 2021

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Section 01015

PROJECT REQUIREMENTS

1. GENERAL DESCRIPTION OF WORK. The Work to be performed under these Contract Documents is generally described as follows:

The Peace River Facility is a fifty-one (51) million gallons per day (mgd) water treatment plant that consists of 4 treatment plants (8 separate treatment trains) that were constructed at different times over the past 40 years. Plant 3 (Trains 5 and 6), have been in service since 2009 and have accrued nearly 100,000 hours of runtime and treated an estimated 40 billion gallons of water.

This project includes restorative measures and improvements that affect the following unit processes in Plant 3 - Trains 5 and 6 and associated ancillary systems:

- Powder Activated Carbon (PAC) Contact Tanks
- Rapid Mix Chamber
- Solids Contact Units (SCU) No. 5 & 6
- Chlorine Contact Chamber
- Filters
- Transfer Pump Station

This project includes all ancillary and appurtenant work connected with these rehabilitation improvements, including emptying, cleaning, concrete restoration and protective coating application for six (6) multimedia filters, two (2) solid contact units and other ancillary concrete chambers and spaces, rehabilitation of the rake drive and rapid mixer drives in the solid contact units, complete rebuilding of the six (6) multi-media filters with all new filtration media and associated stainless steel underdrain repairs. The work also includes removal and replacement of (fifty-six) 56 filter control valves with actuators.

Overall, the improvements to be implemented at the facility include work in the following disciplines: civil/site, structural, process mechanical, electrical, and instrumentation and control.

2. WORK BY PUBLIC UTILITIES. Not Used.

3. WORK BY OWNER. Owner shall perform certain activities in connection with the Project with its own personnel as indicated in the Drawings and Specifications. In addition, Owner shall continue to conduct normal operational and maintenance activities on the Site. Contractor shall plan and execute work in coordination with Owners ongoing activities.

4. ITEMS FURNISHED BY OWNER. Not Used.

5. OFFSITE STORAGE. Offsite storage arrangements shall be approved by Owner for all materials and equipment not incorporated into the Work but included in Applications for Payment. Such offsite storage arrangements shall be presented in writing and shall afford adequate and satisfactory security and protection. Offsite storage facilities shall be accessible to Owner and Engineer.

6. SUBSTITUTES AND "OR-EQUAL" ITEMS. Provisions for evaluation of proposed "or-equal" items of materials or equipment are covered in Paragraph 7.04 of the General Conditions. Provisions for evaluation of proposed substitute items of materials or equipment are covered in Paragraph 7.05 of the General Conditions. Requests for review of equivalency will not be accepted by Engineer from anyone except Contractor, and such requests will not be considered until after the Effective Date of the Agreement.

7. PREPARATION FOR SHIPMENT. All materials shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces that are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

8. SALVAGE OF MATERIALS AND EQUIPMENT. Existing materials and equipment removed and not reused as a part of the Work shall become Contractor's property or as specified in the Demolition and Salvage section.

9. LAND FOR CONSTRUCTION PURPOSES. Contractor will be permitted to use available land belonging to Owner, on or near the Site, for construction purposes and for storage of materials and equipment.

The locations and extent of the areas so used shall be as indicated on the Drawings and specified herein. Contractor staging areas shall be coordinated with Owner at the pre-construction meeting prior to mobilization to the site.

Contractor shall immediately move stored materials or equipment if any occasion arises, as determined by Owner, requiring access to the storage area. Materials or equipment shall not be placed on the property of Owner until Owner has agreed to the location to be used for storage.

10. OPERATION OF EXISTING FACILITIES. The existing treatment plant facilities for Plant 3 will be offline for the work performed under the Contract. However, Plants 1, 2, and 4 will remain online and no interruption will be permitted that adversely affects the degree of service provided for the mentioned plants. Provided written permission is obtained from Owner in advance, portions of the existing facilities may be taken out of service for short periods corresponding with periods of minimum service demands.

Contractor shall provide temporary facilities and make temporary modifications as necessary to keep the existing facilities in operation during the construction period.

11. NOTICES TO OWNERS AND AUTHORITIES. Contractor shall, as provided in the General Conditions, notify owners of adjacent property and utilities when execution of the Work may affect them.

When it is necessary to temporarily deny access to adjacent property, or when any utility service connection must be interrupted, Contractor shall give notices sufficiently in advance to enable the affected persons to provide for their needs. Notices shall conform to any applicable local ordinance and, whether delivered orally or in writing, shall include appropriate information concerning the interruption and instructions on how to limit inconvenience caused thereby.

Utilities and other concerned agencies shall be notified at least twenty-four (24) hours prior to cutting or closing streets or other traffic areas or excavating near underground utilities or pole lines.

12. LINES AND GRADES. Not Used.

13. ALLOWANCES. Not Used.

14. CONNECTIONS TO EXISTING FACILITIES. Unless otherwise specified or indicated, Contractor shall make all necessary connections to existing facilities, including structures, drain lines, and utilities such as water, sewer, gas, telephone, and electric. In each case, Contractor shall receive permission from Owner or the owning utility prior to undertaking connections. Contractor shall protect facilities against deleterious substances and damage.

Connections to existing facilities which are in service shall be thoroughly planned in advance, and all required equipment, materials, and labor shall be on hand at the time of undertaking the connections. Work shall proceed continuously (around the clock) if necessary to complete connections in the minimum time. Operation of valves or other appurtenances on existing utilities, when required, shall be by or under the direct supervision of the owning utility.

15. UNFAVORABLE CONSTRUCTION CONDITIONS. During unfavorable weather, wet ground, or other unsuitable construction conditions, Contractor shall confine its operations to work that will not be affected adversely by such conditions. No portion of the Work shall be constructed under conditions which would affect adversely the quality or efficiency thereof, unless special means or precautions are taken by Contractor to perform the Work in a proper and satisfactory manner.

16. CUTTING AND PATCHING. As provided in General Conditions, Contractor shall perform all cutting and patching required for the Work and as may be necessary in connection with uncovering Work for inspection or for the correction of defective Work.

Contractor shall perform all cutting and patching required for and in connection with the Work, including but not limited to the following:

Removal of improperly timed Work.

Removal of samples of installed materials for testing.

Alteration of existing facilities.

Installation of new Work in existing facilities.

Contractor shall provide all shoring, bracing, supports, and protective devices necessary to safeguard all Work and existing facilities during cutting and patching operations. Contractor shall not undertake any cutting or demolition that may affect the structural stability of the Work or existing facilities without Engineer's written concurrence.

Materials shall be cut and removed to the extent indicated on the Drawings or as required to complete the Work. Materials shall be removed in a careful manner, with no damage to adjacent facilities or materials. ***Materials that are not salvable shall be removed from the site by Contractor.***

All Work and existing facilities affected by cutting operations shall be restored with new materials, or with salvaged materials acceptable to Engineer, to obtain

a finished installation with the strength, appearance, and functional capacity required. If necessary, entire surfaces shall be patched and refinished.

17. HAZARDOUS ENVIRONMENTAL CONDITIONS AT SITE. No Hazardous Environmental Conditions at the Site in areas that will be affected by the Work are known to the Owner.

18. CLEANING UP. Contractor shall keep the premises free at all times from accumulations of waste materials and rubbish.

Construction materials, such as concrete forms and scaffolding, shall be neatly stacked by Contractor when not in use. Contractor shall promptly remove splattered concrete, asphalt, oil, paint, corrosive liquids, and cleaning solutions from surfaces to prevent marring or other damage.

Volatile wastes shall be properly stored in covered metal containers and removed daily.

Wastes shall not be buried or burned on the Site or disposed of into storm drains, sanitary sewers, streams, or waterways. All wastes shall be removed from the Site and disposed of in a manner complying with local ordinances and antipollution laws.

Adequate cleanup will be a condition for recommendation of progress payment applications.

19. APPLICABLE CODES. References in the Contract Documents to local codes mean the following:

- Florida Building Code

Other standard codes that apply to the Work are designated in the Specifications.

20. PRECONSTRUCTION CONFERENCE. Prior to the commencement of Work at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by:

Contractor and its superintendent.

Principal Subcontractors.

Engineer.

Representatives of Owner.

Others as requested by Contractor, Owner, or Engineer.

Unless previously submitted to Engineer, Contractor shall bring to the conference a preliminary schedule for each of the following:

Progress Schedule.

Procurement schedule.

Schedule of Values for progress payment purposes.

Schedule of Shop Drawings and other submittals.

The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda will include:

Contractor's preliminary schedules.

Transmittal, review, and distribution of Contractor's submittals.

Processing Applications for Payment.

Maintaining record documents.

Critical Work sequencing.

Field decisions and Change Orders.

Use of premises, office and storage areas, security, housekeeping, and Owner's needs.

Major equipment deliveries and priorities.

Contractor's assignments for safety and first aid.

Engineer will preside at the conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.

21. PROGRESS MEETINGS. Contractor shall schedule and hold regular progress meetings at least monthly and at other times as requested by Engineer or required by progress of the Work. Contractor, Engineer, and all

Subcontractors active on the Site shall be represented at each meeting. Contractor may at its discretion request attendance by representatives of its Suppliers, manufacturers, and other Subcontractors.

Contractor shall preside at the meetings. Meeting minutes shall be prepared and distributed by Contractor. The purpose of the meetings will be to review the progress of the Work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.

22. SITE ADMINISTRATION. Contractor shall be responsible for all areas of the Site used by it, and by all Subcontractors in the performance of the Work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of property and existing facilities, except such controls as may be specifically reserved to Owner or others. Contractor shall have the right to exclude from the Site all persons who have no purpose related to the Work or its inspection and may require all persons on the Site (except Owner's employees) to observe the same regulations as Contractor requires of its employees.

22.01. Construction Work Hours. Construction work to be performed under this Contract shall be 8 hour days performed between the times of 7AM through 5 PM.

22.02. Site Access. Contractor and staff shall access the construction site through the use of gate 2 at the WTP. Contractor shall coordinate with the Authority for access terms and conditions at the pre-construction meeting.

End of Section

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Section 01025

MEASUREMENT AND PAYMENT

1. SCOPE. This section covers methods of measurement and payment for items of Work under this Contract.
2. GENERAL. The Total Bid Price shall cover all Work required by the Contract Documents. All costs in connection with the proper and successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction plant, equipment, and tools; and performing all necessary labor and supervision to fully complete the Work, shall be included in the lump sum and adjustment unit prices bid. All Work not specifically set forth as a pay item in the Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the prices bid.
3. ESTIMATED QUANTITIES. All estimated quantities stipulated in the Bid Form or other Contract Documents are approximate and are to be used only (a) as a basis for estimating the probable cost of the Work and (b) for the purpose of comparing the Bids submitted for the Work. The actual amounts of work done and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that it will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work actually performed and materials actually furnished and the estimated amounts therefor.
4. ADJUSTMENT UNIT PRICES. The Bid Form lists adjustment unit prices for certain items of the Work. The quantities indicated for the adjustment unit price items are estimated. The actual quantities to be paid shall only be for work that is specifically approved to be performed by Owner.

A description of each adjustment unit price item is included below:

BID ITEM 1 - Remove Defective Concrete & Surface Repairs – Overlay Thickness < 1/4".

The unit price for this item includes all material, labor and equipment costs for removing soft, deteriorated or defective concrete and for providing surface repairs to deteriorated concrete areas in water containing (process) structures in accordance with the details shown on the Drawings and in accordance with the Specifications. Prior to any of this work being performed, and after initial cleaning

of the interior (wet side) of the basins, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to removal and repair may not be measured for payment. It is important to note that the Contractor is not directed to apply a certain thickness of material; the intent is to restore a smooth and flat vertical/horizontal face suitable for subsequent protective coating application. It is the Contractor's responsibility to ascertain for themselves how deep the material application should be and to incorporate this, as appropriate, into their unit price for this bid item. There will be no negotiation of bid price or quantities based on depth/thickness of the restorative application used during work performance. The only negotiation during work performance will be the area coverage in square feet; the area coverage quantity provided in the Bid Form was the most accurate estimate available at the time of bidding. Contractor compensation will be based on actual work accomplished, which may be somewhat more or less.

BID ITEM 2 - Remove Defective Concrete & Surface Repairs – Overlay Thickness > 1/4" and < 3/4".

The unit price for this item includes all material, labor, and equipment costs for removing soft, deteriorated, or defective concrete and for providing surface repairs to deteriorated concrete areas in water containing (process) structures in accordance with the details shown on the Drawings and in accordance with the Specifications. Prior to any of this work being performed, and after initial cleaning of the interior (wet side) of the basins, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to removal and repair may not be measured for payment. It is important to note that the Contractor is not directed to apply a certain thickness of material; the intent is to restore a smooth and flat vertical/horizontal face suitable for subsequent protective coating application. It is the Contractor's responsibility to ascertain for themselves how deep the material application should be and to incorporate this, as appropriate, into their unit price for this bid item. There will be no negotiation of bid price or quantities based on depth/thickness of the restorative application used during work performance. The only negotiation during work performance will be the area coverage in square feet; the area coverage quantity provided in the Bid Form was the most accurate estimate available at the time of bidding. Contractor compensation will be based on actual work accomplished which may be somewhat more or less.

BID ITEM 3 - Remove Defective Concrete & Repair Concrete Spalls.

The unit price for this item includes all material, labor, and equipment costs for removing soft, deteriorated, or defective concrete and for providing concrete spall repairs that may include replacement of corroded steel and placement of cast concrete as needed to repair severely deteriorated concrete in water

containing (process) structures in accordance with the details shown on the Drawings and in accordance with the Specifications. Prior to any of this work being performed, and after initial cleaning of the interior (wet side) of the basins, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to removal and repair may not be measured for payment. The quantity estimate provided in the Bid Form is an allowance and the most accurate estimate available at the time of bidding. Only appropriate surface preparation will reveal how much of this type of work may be required. Contractor compensation will be based on actual work accomplished which may be somewhat more or less.

BID ITEM 4 - Epoxy Protective Coatings.

The unit price for this item includes cleaning, surface preparation, and application of epoxy protective coating to the interior (wet side) surfaces of the concrete process basins in accordance with Section 09940 System C5. All concrete surface repairs, spall repairs, and crack repairs shall be completed prior to surface preparation for the epoxy protective coating. The Contractor will be paid based upon the extent of the actual area coverage in square feet and the Bid Item unit price. The area coverage quantity provided in the Bid Form was the most accurate estimate available at the time of bidding. Contractor compensation will be based on actual work accomplished which may be somewhat more or less.

BID ITEM 5 – Pressure Cleaning with Scaffolding.

The unit price for this item includes all material, labor, and equipment costs for pressure cleaning surfaces in accordance with the details shown on the Drawings and in accordance with the Specifications. Prior to any of this work being performed, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to pressure cleaning may not be measured for payment. The only negotiation during work performance will be the area coverage in square feet; the area coverage quantity provided in the Bid Form was the most accurate estimate available at the time of bidding. Contractor compensation will be based on actual work accomplished which may be somewhat more or less.

BID ITEM 6 – Repair Seepage Cracks.

The unit price for this item shall include all material, labor, and equipment costs for replacing the sealant in existing seepage concrete cracks in treatment structures in accordance with the details shown on the Drawings and in accordance with the Specifications. This item includes removal of the existing joint caulking, acid washing of the concrete groove as needed to remove residuals and gummy or deteriorated sealant and in-fill of the groove with joint

sealant. Prior to any repairs, and after initial cleaning of the interior (wet side) of the basins, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 7 – Repair Structural Cracks (Epoxy Injection).

The unit price for this item shall include all material, labor, and equipment costs for providing structural concrete crack repairs by epoxy injection in treatment structures in accordance with the details shown on the Drawings and in accordance with the Specifications. Prior to any repairs, and after initial cleaning of the interior (wet side) of the basins, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 8 – Repair Control Joint Sealant Groove.

The unit price for this item shall include all material, labor, and equipment costs for restoring joint sealant grooves in the walls of treatment structures in accordance with the details shown on the Drawings and in accordance with the Specifications. As shown in the drawings, this item includes removal of the existing joint caulking and bond breaker tape the entire length of each joint. No partial payment of joint material is allowed. This item includes acid washing of the concrete groove as needed to remove residuals and gummy or deteriorated sealant, applying bond breaking backing tape, primer, and in-fill of the approximate 4-inch by 4-inch groove with SIKAFLEX 2CNS joint sealant. Prior to any repairs, and after initial cleaning of the interior (wet side) of the basins, the Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 9 – Grinding Filter Concrete Floor Surface (<1/2").

The unit price for this item shall include all material, labor, and equipment costs for grinding of concrete floor surfaces within the filter bays in accordance with the details shown on the Drawings and in accordance with the Specifications. Subsequent to any grinding, after removal of the backwash troughs, filter media, underdrain materials, air scour piping, and initial cleaning of the filter floors, Contractor and Engineer shall jointly inspect the concrete floor surfaces of the filters to determine if grinding is recommended and or required. The Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 10 – Grinding Filter Concrete Floor Surface (>1/2" and <1").

The unit price for this item shall include all material, labor, and equipment costs for grinding of concrete floor surfaces within the filter bays in accordance with the details shown on the Drawings and in accordance with the Specifications. Subsequent to any grinding, after removal of the backwash troughs, filter media, underdrain materials, air scour piping, and initial cleaning of the filter floors, Contractor and Engineer shall jointly inspect the concrete floor surfaces of the filters to determine if grinding is recommended and or required. The Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 11 – Levelling of Filter Concrete Floor with Self-Levelling Surface Repair Material.

The unit price for this bid item includes all material, labor, and equipment costs for leveling a filter cell floor. The Work includes surface preparation, forming, furnishing, and placing a bonding agent and flowable self-leveling cementitious material. The price shall include a thickness of up to 1/2" of placed material. This work is exclusive of the surface repair that would otherwise be performed as described in Bid Items 1 and 2 if the floor does not require leveling. Note that this price is also exclusive of the concrete grinding that may or may not be required as described in Bid Items 9 and 10. Surveying the filter floor and the development of the leveling and work plan is included in the Bid Item 13. The Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 12 – Replacement of Existing 1/2" Threaded Rod Anchors.

The unit price for this bid item includes all material, labor and equipment costs for the removal of the existing 1/2" threaded rod anchors by core drilling and the replacement of them with 5/8" diameter 316 stainless steel threaded rod epoxy adhesive anchors in the same locations, as needed. Surveying the filter floor and the development of the leveling and work plan is included in the Bid Item 13. The Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

BID ITEM 13 – All Other Work Required to Complete the Base Bid.

This bid item is lump sum. Contractor shall provide a schedule of values to facilitate measurement and payment based on the actual progress of the work after award of contract.

OWNERS ALLOWANCE.

This bid item is a contingency allowance that is for miscellaneous work items to be determined by the Owner. As examples, after the Award of Contract, the Owner may desire additional work such as additional restorative improvements to other water treatment plant structures or miscellaneous protective coatings of exposed piping, aluminum grating repairs, spray water hose replacements, etc. Compensation for any work completed under the Owner's allowance contingency will be as mutually agreed by formal Work Change Directive and/or Change Order to adjust the Base Bid amount. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

ADDITIVE ALTERNATE BID ITEM 1 – Epoxy Protective Coatings for Piping < 4" in Diameter.

This unit price shall include all material, labor, and equipment costs for painting small diameter piping as noted on the Drawings and as Specified. The Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

ADDITIVE ALTERNATE BID ITEM 2 – Epoxy Protective Coatings for Large Process Piping and Transfer Pumps.

This lump sum price shall include all material, labor, and equipment costs for painting large process piping and transfer pumps as well as other miscellaneous items such as painting of steps, hydrants, bollards, and a water backflow assembly as noted on the Drawings and as specified. The Contractor shall confirm with Owner and Engineer the extent of this work. Work not confirmed by the Owner or the Engineer in writing prior to repair may not be measured for payment.

ADDITIVE ALTERNATE BID ITEM 3 – Spare PAC Mixer Drives (one of each size).

This lump sum price shall include all material, labor, and equipment costs for the furnishing of two (2) spare PAC mixer drives (one (1) of each size) that are to be handed over to Owner and placed in storage at the Water Treatment Plant as Specified in Section 11520.

End of Section

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Section 01070

ABBREVIATIONS OF TERMS AND ORGANIZATIONS

1. LIST OF ABBREVIATIONS. Abbreviations for standards and organizations used in the Contract Documents are defined as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association now recognized as the ABMA
AFPA	American Forest & Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHRI	Air-Conditioning, Heating and Refrigeration Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
APA	Engineered Wood Association (formerly American Plywood Association)
API	American Petroleum Institute
AREMA	American Railway Engineers and Maintenance-of-Way Association
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineers
ASTM	ASTM International
AWG	American Wire Gauge
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association

AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CDA	Copper Development Association
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
Fed Spec	Federal Specification
FGMA	Flat Glass Marketing Association
FHWA	Federal Highway Administration
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IBC	International Building Code
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association
IRI	Industrial Risk Insurers
ISA	International Society of Automation

LEED	Leadership in Energy and Environmental Design
MHI	Materials Handling Institute
MIL	Military Specification
MMA	Monorail Manufacturers Association
MSS	Manufacturers Standardization Society of Valve and Fitting Industry
NAAMM	National Association of Architectural Metals Manufacturers
NACE	NACE International
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBS	See NIST
NCSPA	National Corrugated Steel Pipe Association
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEII	National Elevator Industry, Inc.
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology (formerly NBS)
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	NSF International (formerly National Sanitation Foundation)
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PS	Product Standard
RIS	Redwood Inspection Service
SAE	SAE International
SDI	Steel Door Institute
SFPA	Southern Forest Products Association

SI	Système International des Unités (International System of Units)
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSFI	Scaffolding, Shoring & Forming Institute, Inc
SSPC	SSPC: The Society for Protective Coatings
TABB	Testing, Adjusting, and Balancing Bureau
UL	Underwriters' Laboratories
USBR	U.S. Bureau of Reclamation
USGBC	U.S. Green Building Council
WEF	Water Environment Federation

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Section 01300

SUBMITTALS PROCEDURES

1. SHOP DRAWINGS AND ENGINEERING DATA.

1.01. General. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials that will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

All submittals, regardless of origin, shall be approved by Contractor and clearly identified with the name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Contractor. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.

Contractor shall be solely responsible for the completeness of each submittal. Contractor's stamp or affixed approval statement of a submittal, per Figure 1-01300, is a representation to Owner and Engineer that Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that Contractor has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.

All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal using

Figure 2-01300. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

The Contractor shall submit shop drawings in either hard copy or electronically. All submittals shall be made with the selected method, and the Contractor shall inform the Engineer by letter one (1) week after award of the Contract, which method has been selected. Submittals made by any method other than that selected by the Contractor, will be returned without review.

For electronic submittals, Drawings and the necessary data shall be submitted electronically to Engineer as specified below. Submittal documents shall be in black and white unless color is required for the review of the submittal. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

The opening view for each PDF document shall be as follows:

Initial View: Bookmarks and Page

Magnification: Fit In Window

The file shall open to the Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.

PDF document properties shall include the submittal number for the document title and the Contractor's name for the author.

Electronic submittal file sizes shall be limited to ten (10) MB. When multiple files are required for a submittal the least number of files possible shall be created.

The contractor shall post submittals and retrieve the Engineer's submittal review comments through the Engineer's project website accessible through the

Internet. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract.

Facsimiles (fax) will not be acceptable. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

1.02. Engineer's Review of Submittals. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Engineer's submittal review period shall be 21 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office. The time required to mail the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.

When the drawings and data are returned with review status "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the corrections shall be made as instructed by Engineer. The corrected drawings and data shall be resubmitted through the project website. Resubmittals by facsimile or e-mail will not be accepted. When the drawings and data are returned with review status "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer .

1.03. Resubmittal of Drawings and Data. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal.

When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal.

If more than one resubmittal is required because of failure of Contractor to provide all previously requested corrected data or additional information, Contractor shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

Resubmittals shall be made within thirty (30) days of the date of the letter returning the material to be modified or corrected, unless within fourteen (14) days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time. The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

1.04. Color Selection. Contractor shall submit samples of colors and finishes for all accepted products before Engineer will coordinate the selection of colors and finishes with Owner. Engineer will prepare a schedule of finishes that includes the colors and finishes selected for both manufactured products and for surfaces to be field painted or finished and will furnish this schedule to Contractor within 60 days after the date of acceptance of the last color or finish sample.

2. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare a project specific operation and maintenance manual for each type of equipment indicated in the individual equipment sections or the equipment schedule.

Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.

Operation and maintenance manuals shall include the following:

- a. Equipment function, normal operating characteristics, and limiting conditions.
- b. Assembly, installation, alignment, adjustment, and checking instructions.
- c. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.

- d. Lubrication and maintenance instructions.
- e. Guide to troubleshooting.
- f. Parts lists and predicted life of parts subject to wear.
- g. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
- h. Test data and performance curves, where applicable.

The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Contractor.

Three hard copies and one electronic copy of each manual shall be submitted to Engineer prior to the date of shipment of the equipment. When the O&M manuals are returned with the review status "RETURNED FOR CORRECTION", the corrections shall be made as instructed by the Engineer, and two copies of the corrected portion(s) and one complete corrected copy of the O&M manual returned to the Engineer. After review by Engineer, is complete one hard copy and one electronic copy of each operation and maintenance manual shall be prepared and delivered to Engineer not later than 30 days prior to placing the equipment in operation.

All material shall be marked with project identification, and inapplicable information shall be marked out or deleted.

Shipment of equipment will not be considered complete until all required manuals and data have been received.

2.01. Hard Copy Operation and Maintenance Manuals. Hard copies submitted for review shall be temporarily bound in heavy paper covers bearing suitable identification. All manuals and other data shall be printed on heavy, first quality 8-1/2 x 11 inch paper, with standard three-hole punching. Drawings and diagrams shall be reduced to 8-1/2 x 11 inches or 11 x 17 inches. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs. The final hard copy of each manual shall be prepared and delivered in substantial, permanent, three-ring or three-post binders with a table of contents and suitable index tabs.

2.02. Electronic Operation and Maintenance Manuals. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.

File size shall be limited to 10 MB. When multiple files are required the least number of files possible shall be created. File names shall be in the format OMXXXXX-YYYYZ-V.pdf, where XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, Z is the letter signifying a resubmittal, A, B, C, etc, and V is a number used only when more than one 10 MB file is required for an O&M manual.

2.03. Labeling. As a minimum, the following information shall be included on all final O&M manual materials, including CD-ROM disks, jewel cases, and hard copy manuals:

Equipment name and/or O&M title spelled out in complete words.
Project Name.
Authority Project/Contract Number.
Specification Section Number. Example: "Section 15500"
Manufacturer's name.
File Name and Date.

For example:

Backwash Pump Operation and Maintenance Manual
Somewhere Plant Expansion
Project/Contract No. _____
Specification Section 11110
Manufacturer
OM11110-001.pdf, 5/05/07

End of Section

SUBMITTAL No. _____

SECTION _____

Do not combine multiple sections together
unless required by specifications.

(Contractor's Letterhead)

SUBMITTAL IDENTIFICATION & CONTRACTOR'S APPROVAL STATEMENT

DATE: _____ **COPIES** _____ **DRAWING SHEET NO.** _____

Description submittal contents: _____

Location: _____

Manufacturer _____

Subcontractor or Supplier (Optional) _____

REMARKS: _____

CONTRACTOR'S APPROVAL

(_____ Construction Company) has reviewed and coordinated the submitted documentation and verifies that the equipment and material meet the requirements of the Work and the Contract Documents. We accept sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data contained in the submittal as required by the Contract Documents.

Deviations: ☐ None ☐ Yes (See attached Figure 2-01300 for written description)

Approved By: _____ Date: _____

This approval does not release subcontractor / vendor from the contractual responsibilities.

Black & Veatch
Project No. _____ Phase _____
Contract No. _____
Project Description: _____

FIGURE 1-01300

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Black & Veatch
Project No. _____ Phase _____
Contract No. _____
Project Description: _____

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Black & Veatch
Project No. _____ Phase _____
Contract No. _____
Project Description: _____

Section 01310

CONSTRUCTION PROGRESS SCHEDULE

1. GENERAL OVERVIEW. A Progress Schedule shall be used to control the Work and to provide a definitive basis for determining project progress. The Progress Schedule shall be prepared, maintained, and updated by the Contractor and historical dates agreed monthly with the Engineer. The Contractor shall submit a preliminary Progress Schedule and a Progress Schedule for acceptance by the Engineer. These schedules shall be the Contractor's working schedules and shall be used to plan, organize and execute the Work, record and report actual performance and progress, and show how the Contractor plans to complete all remaining Work as of the end of each progress report period.

The Progress Schedule shall comprise all the detailed construction-related activities using the critical path method (CPM). The Progress Schedule shall provide sufficient detail and clarity to reflect the intricacies and interdependencies of activities so the Contractor can plan, schedule, monitor, control and report on the progress of his work. In addition, it shall provide the Engineer and Owner a tool to monitor and follow the progress for all phases of the Work.

Contractor shall submit an updated construction progress schedule with each pay application as a condition of payment.

2. PRE-CONSTRUCTION SCHEDULING CONFERENCE. The Engineer will conduct a pre-construction scheduling conference with the Contractor to review requirements for the schedules including Schedule of Values, cost-loading and schedule configuration. The conference shall be conducted sufficiently early to allow the Contractor to submit the preliminary Progress Schedule within ten days of the Effective Date of the Agreement.

At this meeting, the Contractor shall explain in detail the procedure to be used to develop the schedule activity cost-loading or Schedule of Values and cash flow. This procedure is subject to the review and acceptance of the Engineer.

PRELIMINARY PROGRESS SCHEDULE. Following the pre-construction scheduling conference but within ten calendar days of the Effective Date of the Agreement, the Contractor shall submit a preliminary Progress Schedule for review by the Engineer. The preliminary Progress Schedule shall show detailed construction-related activities for the first forty-five (45) days of the Project. The remainder of the Contract activities shall be shown as summary bars within the Milestones of the Work. If the Engineer has comments on the preliminary Progress Schedule, Contractor shall make the necessary changes and resubmit

it within ten (10) calendar days. No progress payments will be made during the period specified above for the preliminary Progress Schedule until the preliminary Progress Schedule has been accepted by the Engineer.

The preliminary Progress Schedule shall:

- a. Illustrate a feasible schedule for completion of the Work within the time and Milestones specified.
- b. Provide an elementary example of the schedule in the format to be used for the Progress Schedule.
- c. Include the activity code structure as described in paragraph 19 of this specification.

3.01. Preliminary Progress Schedule Submittal Format: Contractor shall submit two compact disks of the preliminary Progress Schedule. Compact disks shall be read-write and enable the use of the schedule as an executable file as described herein. A brief narrative shall accompany the submittal, describing Contractor's scheduling approach to the project. The narrative shall include a description of the Contract Milestones, approach for construction activities during the period of the preliminary Progress Schedule, description of the general approach of the activities for the work beyond the preliminary Progress Schedule period, a description of the project's critical path, identification of critical long-lead submittals, and planned outages. The narrative shall also incorporate activity codes, calendars, weather days, Milestone constraints, and work breakdown structure in accordance with the requirements specified herein.

3. PROGRESS SCHEDULE. The Progress Schedule comprises all the construction-related activities for the Work and shall show the order in which the Contractor proposes to carry out the work. Contractor shall include Milestones, coordination necessitated by limited access and available work areas, and the availability and use of manpower, material, and equipment. Contractor shall use the Progress Schedule to plan, schedule and coordinate the Work including activities of subcontractors, equipment vendors, and suppliers.

The Progress Schedule shall be to the level of detail acceptable to the Engineer, and shall include the following:

- a. Organization and structural breakdown of the Project;
- b. Milestones and completion dates;
- c. Type of work to be performed and the labor trades involved;

- d. Purchase, manufacture and delivery activities for major materials and equipment;
- e. Preparation, submittal, and acceptance of shop drawings and material samples;
- f. Deliveries of owner-furnished equipment and/or materials;
- g. Acceptances required by regulatory agencies and/or other third parties;
- h. Assignment of responsibility for each activity;
- i. Access requirements to work areas;
- j. Identification of interfaces and dependencies with preceding, concurrent and follow-on Contractors;
- k. Tests, submittal of test reports and acceptance of test results;
- l. Planning for phased or total acceptance by Owner; including start up and commissioning;
- m. Identification of any manpower, material and equipment restrictions.
- n. Sequence of construction to maintain plant operations; and
- o. Planned outages.

The activities included in the Progress Schedule shall be defined in work days. Durations shall be based on the labor (crafts), equipment, and materials required to perform each activity on a normal workday basis. Activity durations shall be twenty (20) working days or less except in the case of non-construction activities such as procurement of materials, delivery of equipment, and concrete curing. All durations shall be the result of definitive manpower and resource planning by Contractor to perform the Work, in consideration of contractually defined on-site work conditions and Contractor's planned means and methods.

When the Progress Schedule is accepted by the Engineer, the Engineer will save a copy of the Progress Schedule as the baseline schedule, and will use it for analysis of Contractor's progress.

The Contractor shall update the Progress Schedule monthly.

4. ELECTRONIC PROGRESS SCHEDULE FORMAT AND REPORTING. The Progress Schedule shall be created using Primavera P6 scheduling software. Contractor shall use Engineer's file-naming format throughout the project.

- a. Electronic schedule files shall be saved with .XML or .XER file extensions.
- b. Primavera Project Manager settings for "Baseline Type" shall be used in the following manner:
 - i. Select <None> as the baseline type for the Preliminary Schedule Submittal.
 - ii. Once the Preliminary and Project Schedule are accepted, the baseline type shall be named <Initial Plan>.
 - iii. Each subsequent Project Schedule update shall set the baseline type to <Last Performance Update>.
- c. The data date for schedule calculation in the preliminary Progress Schedule and Progress Schedule shall be set as the date of the Notice to Proceed unless otherwise specified by the Engineer.

5. COST-LOADING. Except for manufacturer lead-time, each Progress Schedule activity that has an actual cost shall have a cost value assigned to it. Equipment or material delivery activities bearing cost shall be separate activities. Each activity's assigned cost shall consist of all costs associated with that activity including all project management, superintendence, overhead, and profit costs. The sum of all activity costs shall be equal to the current Contract value at all times, including approved change orders. The Contractor shall certify that the costs are not unbalanced and that the value assigned to each activity represents the Contractor's total cost to perform that activity.

If the Engineer or Owner determines cost data does not meet the requirements for a balanced bid breakdown, the Contractor shall submit documentation substantiating any cost allocation questioned. Cost allocations will be considered unbalanced if activity on the Progress Schedule has been assigned a disproportionate allocation of direct costs, overhead, and profit. If documentation of the cost data does not, in the opinion of the Engineer substantiate cost allocations, the Progress Schedule will be returned to the Contractor for action.

Unit Price items required to be paid on a unit cost basis as identified in the Bid Form and the Measurement and Payment section shall be incorporated into the

Progress Schedule and measured and updated as specified herein and as specified in the Measurement and Payment section.

The Contractor shall produce Cash Flow Projection reports and graphics from the Primavera P6 application. Cost-loaded data shall be the basis for monthly payment applications and shall be included with monthly updates of the Progress Schedule.

6. RESOURCE-LOADING. Not used.

7. COORDINATING PROGRESS SCHEDULE WITH OTHER CONTRACT SCHEDULES. Where work is to be performed under this Contract concurrently with or contingent upon work performed on the same facilities or area under other contracts, the Progress Schedule shall be coordinated with the schedules of the other contracts. Owner will provide the schedules of other contracts for preparation and updating of the Progress Schedule. Contractor shall revise the Progress Schedule as required by changes in schedules of other contracts.

In case of interference between the operations of different Contractors, the Owner will determine the work priority of each Contractor and the sequence of work necessary to expedite the completion of the entire project. In all such cases, the decision of Owner shall be accepted as final.

8. SUBMITTALS. The Progress Schedule and associated reports shall be submitted to the Engineer for acceptance within the period of the preliminary Progress Schedule specified herein. If the Progress Schedule is not submitted, no progress payments will be made after the due date until the Progress Schedule has been submitted.

Printouts and electronic layouts required as part of the Progress Schedule submittal and monthly updates are as follows:

- a. Summary Schedule: one page milestone and summary schedule, sorted by total float, early-start, early-finish;
- b. Detailed Project Schedule: organized by Work Breakdown Structure (WBS) or area of work; sorted by total float, early-start, early-finish;
- c. Critical Path Schedule: sorted based on the total float, early-start, early-finish;
- d. 60-Day Look Ahead Schedule: sorted by total float, early-start, early-finish;

- e. Activities in Progress: organized by WBS or area of work; sorted by total float, early-start, early-finish;
- f. Cash Flow Trending Report: presented in an S-Curve format based on original planned early start and late start forecasted expenditures. In addition, the historical actual data point(s) are to be graphed within the S-Curve graphic report;
- g. Monthly payment projections;
- h. Out-of-sequence Report: tabular report showing work performed out-of-sequence.

Contractor shall submit additional layouts if directed by Engineer.

The submittal shall include the following:

- a. Narrative report summarizing the contract milestones, critical path, project approach including phasing or use of crews, significant submittal and fabrication items, coordination or interface requirements, Owner-provided items, and list of subcontractors and vendors.
- b. Graphic reports including critical path report (longest path), summary schedule report, total float report by early-start early-finish, look-ahead report grouped by work breakdown structure or project phasing, and cash flow projection. Cash flow projections include estimated cumulative cost curves based on early and late start dates and projection of monthly payments over the life of the project

The schedule, critical path, and look-ahead schedules shall be submitted on E (34"x44") size paper or 36" wide plots;

The Progress Schedule file shall be submitted in an executable format, using Primavera Project Manager (P6) format on a read-write compact disk.

The narrative and graphic reports shall be provided on 8"x11" paper and E-size plots respectively.

Contractor shall submit four (4) copies of each deliverable.

9. MONTHLY SCHEDULE UPDATES. Monthly Progress Schedule updates shall be submitted for the duration of the Contract on a date agreed to by the Owner, Engineer, and Contractor. If monthly Progress Schedule updates are not submitted by the due date, progress payments will be withheld until the required information is submitted.

The updated schedule shall be reviewed each month in a meeting with Engineer to verify:

- a. Actual start dates,
- b. Actual completion dates,
- c. Activity percent completion,
- d. Revised logic (as-built and projected) and changes in activity durations, cost assigned,
- e. Cost influence of change orders, if any, and
- f. Revisions due to extension of time.

Prior to each meeting, Contractor shall prepare a complete and accurate report of current procurement and construction progress through the end of the update period, and a depiction of how Contractor plans to continue the Work to meet all contract completion dates. All network changes and status data agreed to during each update meeting shall be considered as accepted by both parties unless written notice of any exceptions is given within five calendar days after the meeting.

For major network changes that cannot be agreed to during an updating meeting, Contractor shall submit the proposed changes for Engineer's acceptance prior to inserting such changes into the network. Submittals may be in the form of marked-up networks, fragnets, or schedule abstracts, provided they are submitted with a letter of transmittal. A fragnet is defined as a sequence of new activities and/or activity revisions that are proposed to be added to the existing schedule to demonstrate how project events have an impact on the schedule.

10. DATA DATE. The data date is the re-settable date in P6 that serves as the end of a reporting period. The reporting period will be recorded on a monthly basis, e.g., January 1st through January 31st with the 31st as the data date. If required for coordination purposes by the Owner, the Engineer will provide specific data dates to be used by the Contractor.

11. REVIEW PROCESS. Engineer will review Contractor's preliminary Progress Schedule and full Progress Schedule submittals within fifteen (15) calendar days after receipt of all required information.

At the request of Owner or Engineer, Contractor shall participate in any meetings necessary to reach a mutual agreement and acceptance of the preliminary Progress Schedule, Progress Schedules, or Cash Flow Projections.

If any of the required submittals are returned to Contractor for corrections or revisions, they shall be resubmitted within ten calendar days after the return mailing date. Resubmittals shall include all information and media included in the first submittal. Review and response by Engineer will be given within ten (10) calendar days after receipt of each resubmittal.

Schedules shall show contract completion of the Work on the Contract completion date and with zero or positive total float even if the Contractor plans to finish early. In no event shall acceptance of the schedule be a basis for a claim for delay against Owner or Engineer by Contractor for an early finish. A Progress Schedule containing activities with negative float or that extend beyond the Contract completion date will not be acceptable.

Acceptance of the Progress Schedule by Engineer does not relieve Contractor of responsibility for accomplishing the Work by the Contract completion date. Omissions and errors in the accepted Progress Schedule shall not relieve the Contractor of obligations under the Contract. Acceptance by Engineer in no way makes Engineer or Owner an insurer of the Schedule's success or liable for time or cost overruns. Engineer and Owner hereby disclaim any obligation or liability by reason of acceptance of the Progress Schedule by the Engineer.

12. RESPONSIBILITY FOR SCHEDULE COMPLIANCE. Whenever it becomes apparent from the current Progress Schedule that the critical path is delayed and the contract completion date will not be met, Contractor shall mitigate the delay by taking some or all of the following actions at no additional cost to Owner.

- a. Increase construction manpower in such quantities and crafts as will bring the project back on schedule within the completion dates and milestones.
- b. Increase the number of working hours per shift, shifts per day, working days per week, and the amount of construction equipment, or any combination of the foregoing, to substantially eliminate the backlog of work.

- c. Re-schedule activities to achieve maximum practical concurrence of activities and to comply with the schedule date(s).

Within ten (10) calendar days of the Engineer's request, Contractor shall submit a recovery schedule and written statement of the steps intended to remove or arrest the delay to the critical path in the schedule. If the Contractor fails to submit the required information or should fail to take measures acceptable to the Engineer, the Engineer with Owner concurrence may direct Contractor to increase man-power, equipment and scheduled work hours to remove or arrest the delay to the critical path and the Contractor shall promptly provide such level of effort at no additional cost to Owner.

In the event Contractor fails to follow the updated or revised recovery schedule, Owner may elect to withhold progress payments until Contractor complies with the revised schedule.

Should Contractor's efforts not remove or arrest the delay to the critical path of the accepted schedule, then Owner shall be entitled to supplement Contractor's work-force and equipment to remove and arrest any delay, and shall be entitled to deduct all costs and expenses associated therewith from payments due to the Contractor. If insufficient Contract funds remain, Owner may recover such funds from Contractor and its Surety.

13. CHANGE ORDERS, DELAYS, AND EXTENSIONS OF TIME. When change orders or delays are experienced by Contractor and Contractor requests an extension of time, Contractor shall submit a written time impact analysis to the Engineer illustrating the influence of each change or delay to the current Contract Schedule completion date. Each time impact analysis shall include a fragnet incorporating the change order or delay into the Progress Schedule to demonstrate how Contractor was delayed.

Each time impact analysis shall demonstrate the estimated time impact based on the events of the change or the delay; the date the change was given to Contractor or the delay incurred, the status of construction at that point in time, and the event time computation of all activities affected by the change or delay. The event times used in the analysis shall be those included in the latest update of the Progress Schedule or as adjusted for the events of delay.

Three (3) copies of the time impact analysis and an electronic copy on compact disk shall be submitted within seven calendar days of delay occurrence or direction to proceed with a change is given to Contractor. No time extensions will be considered if the time impact analysis is not submitted within the specified time.

The Engineer will review Contractor's time impact analysis. Contractor shall furnish such justification and supporting evidence as the Engineer deems necessary to determine whether Contractor is entitled to an extension of time. Engineer's review of each time impact analysis will be made within five (5) working days of receipt of the time impact analysis and additional information as required by the Engineer, unless subsequent meetings and negotiations are necessary.

The Contract completion time will be adjusted only for causes specified in paragraph 15. Time extensions will be granted only to the extent that equitable time adjustments for the activity or activities affected exceed the total or remaining float along the critical path at the time of actual delay. Delays in activities which are not on the critical path and do not affect Contract completion dates, will not be considered for an extension of time.

14. CAUSES FOR EXTENSIONS OF TIME. Additional positive total float in the Progress Schedule generated by efficiencies of Owner or Contractor is a shared commodity to be reasonably used by either party, and belongs exclusively to the Project. The Contractor is not entitled to any additional compensation for completion of the project prior to expiration of the Contract Times.

15.01. Owner-Initiated Changes. Owner initiated changes to the Contract work that absorb float time will not be considered for an extension of time. Owner-initiated changes that affect the critical path of the Progress Schedule shall be grounds for extending or shortening completion dates. Use of float time for Contractor initiated changes will require Owner's concurrence. Contractor's changes, however, shall give way to Owner-initiated changes competing for the same float time.

15.02. Outside Contractor's Control. Events outside of the Contractor's control that affect the critical path of the Progress Schedule will be considered for an extension or reduction of the Contract Times.

15.03. Regional Water Supply Continuity. Due to the critical need for the Peace River Water Treatment Plant to supply water to the Regional System, the Owner may delay the Facility Shutdown Date, as provided for in Section 23, up to sixty (60) calendar days to ensure that regional supplies are available to meet Customer's demands. Any delays initiated by Owner under this provision shall be remunerated on a calendar day for calendar day basis to the Substantial Completion and Final Completion dates. There shall be no additional charges or costs claimed by the Contractor on the Project for such action by the Owner.

Weather Delays. In evaluating a claim for delay due to weather, Engineer will obtain weather data during the period of delay claim from a reputable source and

determine Contractor's entitlement to an extension of the Contract time as a result of weather delays. Extension of contract time will be the only adjustment to the contract due to approved weather related claim for delay; any weather related extension of Contract time shall be non-compensable and no increase in the contract price will be allowed for delay due to weather.

An application for a weather related contract time extension shall be submitted to the Engineer, and shall be supported by the relevant weather data to be confirmed by Engineer.

15. AS-BUILT SCHEDULE. As a condition precedent to release of final payment, the last update to the Progress Schedule submitted shall be identified by the Contractor as the "As-Built Schedule". The "As-Built Schedule" shall reflect the exact manner in which the project was actually constructed (including actual start and completion dates, activities, sequences, and logic) and shall be signed and certified by the Contractor's project manager.

16. SCHEDULING SOFTWARE APPLICATION. Scheduling software shall be Primavera Project Manager (P6) without exception.

17. SCHEDULE SOFTWARE SETTINGS AND RESTRICTIONS: Contractor shall consult with Engineer for acceptable Primavera Project Manager software settings and restrictions. The following shall apply unless otherwise directed by the Engineer.

- a. Schedule Options:
 - i. Shall be defined only to "Use expected finish dates";
 - ii. Scheduling progressed activities to be set to "Use only retained logic", not progress override option;
 - iii. Critical Path activities defined as Total Float less than or equal to zero;
 - iv. Calculating start-to-start lag from "early start" dates; and computing total float as "finish float = late finish – early finish"; and
 - v. Calendar to be set for scheduling relationship lag as "Predecessor Activity Calendar."
- b. Activity progress shall be shown using Remaining Duration. Date format shall be DDMMYY.
- c. Default activity type shall be set to "Independent Task".

- d. Date/time activity constraint(s), other than those required by the Contract, will not be allowed unless accepted by Engineer. Contractor shall identify proposed constraints and explain the constraint purpose in the Narrative Report.
- e. Lags shall not be used in the creation of an activity that will perform the same function, e.g., concrete cure time. Lag durations contained in the project schedule shall not have a negative value. Contractor shall identify any lag proposed and explain the purpose of the lag in the Narrative Report.
- f. Actual Start and Finish dates shall not be automatically updated by default mechanism that may be included in the CPM scheduling software system. Actual Start and Actual Finish dates on the CPM schedule shall be updated by actual work progression.

18. ACTIVITY CODES. The Primavera (P6) activity codes and work breakdown structure (WBS) to be confirmed or revised by the Engineer are listed below. Confirmation or revision of the activity codes and WBS will be provided to the Contractor within three workdays of the Effective Date of the Agreement. Use of the Engineer prescribed activity codes and WBS is mandatory.

“Project Codes” as defined by Primavera P6 is reserved for the Owner. Only “Activity Codes” at Project Level will be permitted for Contractor use.

<u>Activity Code</u>	<u>Code Value</u>	<u>Description</u>
Phase	0005	Construction Phase
Construction Phase	A	Milestones
	BC	Administrative
	D	Submittals
	E	Construction Activities
		Closeout Phase
Submittals	SUB	Submittals
	R&A	Review & Approve
	F&D	Fabricate & Deliver

Other Codes to be prescribed by Engineer or requested by Contractor for project specific criteria.

19. ACTIVITY RELATIONSHIPS. Relationships between activities shall be identified with the following information:

- a. Predecessor and successor activity ID.
- b. Relationship types:
 - i. FS - Finish to start
 - ii. SS - Start to start
 - iii. FF - Finish to finish
 - iv. SF - Start to finish – This relationship is not allowed, unless authorized by Engineer.

20. PROJECT CALENDARS. Project Calendars shall use workdays and calendar days as the planning unit for the schedule. Use of Global Calendars is reserved for Owner. Each calendar shall be set to start on Mondays with holidays in accordance with the Contract Documents. The following calendars shall be used for each activity except as otherwise accepted by Engineer:

- a. 5-Day x 8 Hour Workweek (with holidays) shall be used for 5-day 40-hour workweek activities: Monday through Friday. All holidays and non-work days shall be assigned to this calendar. This calendar shall be used for all normal work activities, submittals, and fabricate and delivery activities. This calendar shall be the default calendar for the project unless otherwise specified.
- b. 5-Day x 10-Hour Workweek (with holidays) shall be used for 5-day 50-hour workweek activities: Monday through Friday. All holidays and non-work days shall be assigned to this calendar.
- c. 6-Day x 10-Hour Workweek (with holidays) shall be used for 6-day 60-hour workweek activities. Monday through Saturday. All holiday and non-work days shall be assigned to this calendar.
- d. 7-Day Calendar (no holidays) shall be used for 7-day workweek activities. No non-work days shall be entered into this calendar.
- e. Additional Calendars may be assigned depending on need. However, Contractor shall consult with the Engineer before other calendars are entered and/or used in the Project schedule.

The work day to calendar day correlation shall be based on a single shift and 5-day work week with adequate allowance for holidays, adverse weather and all other special requirements of the Work. Contractor may, at his option, propose alternate baseline calendars to allow a second shift and/or a single shift on Saturdays subject to the concurrence and acceptance of Owner. Under no circumstances will a schedule be accepted which allows regularly scheduled work on Sundays.

The holidays observed by the Owner are as follows:

New Years Day
Martin Luther King Day
Memorial Day
July 4th
Labor Day
Veterans Day
Thanksgiving Day
Friday Following Thanksgiving
Christmas Eve
Christmas Day

21. FLOAT. Contractor shall not use float suppression techniques, including preferential sequencing (arranging critical path through activities more susceptible to Owner caused delay); lag logic restraints; zero total or free float constraints; extended activity times; or imposing constraint dates other than as required by the Contract. Float suppression will be cause for rejection of the preliminary Progress Schedule or full Progress Schedule and its updates.

22. MANDATORY MILESTONES. The Contract duration shall be equal to the time period between the Notice to Proceed and the completion Milestone. The following milestones are mandatory.

- a. Project Award
- b. Notice to Proceed
- c. Facility Shutdown Date – No Sooner than May 15, 2021
- d. Substantial Completion as established in the Bid Form
- e. Final Completion as established in the Bid Form

The following additional milestones are to be considered and incorporated into the Progress Schedule in accordance with the Contract terms, if applicable.

- a. Permit constraints
- b. Partial Facility shut down or outage milestone requirements
- c. Applicable phasing milestones
- d. Other milestones deemed appropriate by the Engineer

End of Section

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Section 01320

CONSTRUCTION PROGRESS DOCUMENTATION

1. GENERAL. Not used.

2. SCHEDULE OF VALUES. After review of the preliminary schedule at the preconstruction conference, and before submission of the first Application for Payment, Contractor shall prepare and submit to Engineer a Schedule of Values covering each lump sum item. The Schedule of Values, showing the value of each kind of work, shall be acceptable to Engineer before any Application for Payment is prepared.

The sum of the items listed in the Schedule of Values shall equal the Contract Price. Such items as Bond premium, temporary construction facilities, and plant may be listed separately in the Schedule of Values, provided the amounts can be substantiated. Overhead and profit shall not be listed as separate items.

The Schedule of Values shall have sufficient detail such that partial completion of separable items of work can easily be calculated. The Schedule of Values shall have separate lines for manufacturer's field services, O&M manuals, and performance testing for each item of equipment requiring such services.

An unbalanced Schedule of Values providing for overpayment of Contractor on items of Work which would be performed first will not be accepted. The Schedule of Values shall be revised and resubmitted until acceptable to Engineer. Final acceptance by Engineer shall indicate only consent to the Schedule of Values as a basis for preparation of applications for progress payments, and shall not constitute an agreement as to the value of each indicated item.

3. SCHEDULE OF PAYMENTS. Within thirty (30) days after award of contract, Contractor shall furnish to Engineer a schedule of estimated monthly payments. The schedule shall be revised and resubmitted each time an Application for Payment varies more than ten percent (10%) from the estimated payment schedule.

4. SURVEY DATA. All field books, notes, and other data developed by Contractor in performing surveys required as part of the Work shall be available to Engineer for examination throughout the construction period. All such data shall be submitted to Engineer with the other documentation required for final acceptance of the Work.

5. LAYOUT DATA. Contractor shall keep neat and legible notes of measurements and calculations made in connection with the layout of the Work. Copies of such data shall be furnished to the Resident Project Representative for use in checking Contractor's layout as provided in the project requirements section. All such data considered of value to Owner will be transmitted to Owner by Engineer with other records upon completion of the Work.

6. SCHEDULE OF SHOP DRAWINGS. Within two (2) weeks after award of contract, Contractor shall submit a preliminary Schedule of Shop Drawings listing the shop drawing submittals required per the contract documents and which are otherwise intended for submittal. Engineer will review and comment on the preliminary Schedule of Shop Drawings, and the Contractor shall revise it and resubmit.

End of Section

Section 01380

CONSTRUCTION PHOTOGRAPHS

1. CONSTRUCTION PHOTOGRAPHS BY CONTRACTOR. Contractor shall be responsible for the production of construction photographs as provided herein. Engineer shall designate the subject of each photograph.

For plant projects, twenty-five (25) photographs of the entire site or pertinent features thereof, shall be taken before the commencement of Work and promptly submitted to Engineer. The same views shall be re-photographed upon completion of all construction activities and submitted with Contractor's application for final payment. Twenty-five (25) additional photographs shall be made each month throughout the progress of the Work at such times as requested by Engineer, and submitted with Contractor's application for progress payment.

All photographs shall be color digital, produced by a competent professional photographer. Contractor shall submit the photographs electronically and two (2) copies of 4 by 5 inch prints. Digital images shall be compiled on CD and provided with a descriptive index of the images. Prints shall be mounted on linen with flap for binding or enclosed in clear plastic binders, and marked with the name and number of the Contract, name of Contractor, description and location of view, and date photographed.

Engineer will transmit the digital files and one copy of the prints to Owner.

2. CONSTRUCTION VIDEO BY CONTRACTOR. Contractor shall be responsible for the production of a construction video before the commencement of Work. The subject of the video shall include the entire area of the project. Video will be used at the completion of the project to determine prior condition of facilities.

End of Section

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Section 01400

QUALITY CONTROL

1. TESTING SERVICES. Testing services shall be provided in accordance with Paragraph 13.03 of the General Conditions. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to Engineer and/or Authority Having Jurisdiction excluding testing as specified to be conducted directly by Contractor. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

Testing services provided by Owner are for the sole benefit of Owner and/or as required by the governing building code; however, test results shall be available to Contractor. Testing necessary to satisfy Contractor's internal quality control procedures shall be the sole responsibility of Contractor.

1.01. Testing Services Provided by Contractor. Unless otherwise specified, Contractor shall provide all testing services in connection with the following:

Any Work or part thereof specifically to be inspected, tested, or approved by an employee or representative of an Authority Having Jurisdiction.

Contractor shall assume full responsibility for arranging and obtaining such inspections, tests or approvals. Contractor shall pay all costs associated for these activities and shall provide the required certificates of inspection or approval.

Any inspections, tests or approvals required for Owner or Engineer acceptance of materials or equipment to be incorporated in the Work. This includes any items required for acceptance of materials, concrete mix designs or equipment submitted for approval prior to Contractor's purchase for incorporation in the Work.

Testing, adjusting and balancing of mechanical, electrical and other equipment and systems as specified to be incorporated into the Work. This includes services required by manufacturers of equipment or other products such as concrete repair products, pipe, coatings, linings and roof membranes furnished under the Contract Documents.

Tightness testing of containment structures and pressure or leakage testing of piping as specified.

Any Work (or part thereof) required by the Contract Documents to be approved by Owner, Engineer or other designated individual or entity.

Contractor shall assume full responsibility for arranging and obtaining such approvals, pay all costs in connection therewith and submit to Engineer the required certificates of approval.

Excluding those conducted directly by an Authority Having Jurisdiction or expressly specified to be conducted directly by Contractor, inspections and tests shall be performed by independent inspectors, approved agencies, or other qualified individuals or entities acceptable to Owner and Engineer.

1.02. Testing Services and Special Inspections Provided by Owner. Not Used.

1.03. Transmittal of Test Reports. Written reports of tests and engineering data furnished by Contractor for Engineer's review of materials and equipment proposed to be used in the Work shall be submitted as specified for Shop Drawings.

Two copies of each test report will be transmitted to the Resident Project Representative, one copy to the Special Inspector, one copy to Engineer, and one copy to Contractor, within three (3) days after each test is completed or as directed by the Statement of Special Inspections as applicable.

2. OFFSITE INSPECTION. Inspection of materials or equipment during the production, manufacturing, or fabricating process, or before shipment, will be performed by Engineer or an independent testing firm or Approved Agency acceptable to Engineer and Authority Having Jurisdiction as specified in the materials and equipment sections.

Except as otherwise specified in other sections, Contractor shall give appropriate written notice to Engineer not less than ten (10) days before offsite inspection services are required, and shall provide for the producer, manufacturer, or fabricator to furnish safe access and proper facilities and to cooperate with inspecting personnel in the performance of their duties.

The inspection organization will submit a written report to Engineer, with a copy to Contractor, at least once each week or as directed by the Statement of Special Inspections as applicable.

3. MANUFACTURER'S FIELD SERVICES. Manufacturer's field services shall be as specified herein except as specifically specified in the respective equipment sections.

3.01. Services Furnished Under This Contract. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated in the respective equipment section or in the equipment schedule section shall visit the Site of the Work and inspect, check,

adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

Each manufacturer's representative shall furnish to Owner, through Engineer , a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

All costs for these services shall be included in the Contract Price.

End of Section

Section 01500

TEMPORARY FACILITIES

1. OFFICE AT SITE OF WORK. Not Used.

2. WATER. Water required for and in connection with the Work to be performed will be furnished by Owner, to the extent available, in the vicinity of the Site without charge to Contractor, provided:

- a. Contractor shall procure such water in the location and in the manner designated by Engineer.
- b. Contractor at its own expense shall make authorized connections and provide means for delivering the water to the Site.
- c. Contractor shall provide adequately against waste and needless use of water.
- d. The availability of water shall be limited to the quantity and source locations available through existing facilities.

3. POWER. Power for heating, lighting, and operation of Contractor's plant and equipment in connection with the Work to be done under this Contract shall be provided by Owner, to the extent available, without charge to Contractor, subject to the following conditions:

- a. The existing heating system will remain in operation and may be utilized by Contractor to the extent available.
- b. Existing lighting systems may be utilized by Contractor to the extent available. Any necessary additional or temporary lighting systems shall be provided by Contractor at no additional cost to Owner.
- c. Power will be available at existing power panels at the locations indicated on the drawings.
- d. Power will be available at 120 volts, 60 Hz, single phase and 480 volts, 60 Hz, 3 phase.
- e. Contractor at its own expense shall make authorized connections to the existing power sources and shall extend temporary service lines to

the required areas. Temporary wiring shall conform to Article 305 of the NEC.

- f. Contractor shall at all times provide adequately against waste and needless use of power. Electrical power shall be used only in such quantities as will not interfere with Owner's requirements, and care shall be taken not to overload the existing facilities. Contractor shall provide any additional or temporary electrical power or power of other voltages it may require for prosecution of the Work.

These provisions shall not be construed as a guarantee by Owner of the uninterrupted continuation of power, and interruptions beyond the control of Owner shall not be reason for claims for additional costs nor for extensions of time. Contractor shall provide, at no additional cost to Owner, any necessary power required for prosecution of the Work during such interruptions.

4. VOICE AND DATA SERVICES. Not Used.

5. SANITARY FACILITIES. Contractor shall furnish temporary sanitary facilities at the Site, as provided herein, for the needs of all construction workers and others performing work or furnishing services on the Project.

Sanitary facilities shall be of reasonable capacity, properly maintained throughout the construction period, and obscured from public view to the greatest practical extent. If toilets of the chemically treated type are used, at least one (1) toilet will be furnished for each twenty (20) persons. Contractor shall enforce the use of such sanitary facilities by all personnel at the Site.

6. MAINTENANCE OF TRAFFIC. Not Used.

7. BARRICADES AND LIGHTS. Not Used.

8. FENCES. All existing fences affected by the Work shall be maintained by Contractor until completion of the Work. Fences which interfere with construction operations shall not be relocated or dismantled until written permission is obtained from the owner of the fence, and the period the fence may be left relocated or dismantled has been agreed upon. Where fences must be maintained across the construction easement, adequate gates shall be installed. Gates shall be kept closed and locked at all times when not in use.

On completion of the Work across any tract of land, Contractor shall restore all fences to their original or to a better condition and to their original locations.

9. DAMAGE TO EXISTING PROPERTY. Contractor will be held responsible for any damage to existing structures, Work, materials, or equipment because of his operations and shall repair or replace any damaged structures, Work, materials, or equipment to the satisfaction of, and at no additional cost to, Owner.

Contractor shall protect all existing structures and property from damage and shall provide bracing, shoring, or other work necessary for such protection.

Contractor shall be responsible for all damage to streets, roads, curbs, sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, or other public or private property, which may be caused by transporting equipment, materials, or workers to or from the Work. Contractor shall make satisfactory and acceptable arrangements with the agency having jurisdiction over the damaged property concerning its repair or replacement.

10. TREE AND PLANT PROTECTION. All trees and other vegetation which must be removed to perform the Work shall be removed and disposed of by Contractor; however, no trees or cultured plants shall be unnecessarily removed unless their removal is indicated on the Drawings. All trees and plants not removed shall be protected against injury from construction operations.

Trees considered by Engineer to have any significant effect on construction operations are indicated on the Drawings and those which are to be preserved are so indicated.

Contractor shall take extra measures to protect trees designated to be preserved, such as erecting barricades, trimming to prevent damage from construction equipment, and installing pipe and other Work by means of hand excavation or tunneling methods. Such trees shall not be endangered by stockpiling excavated material or storing equipment against their trunks.

When injuring or removal of trees designated to be preserved cannot be avoided, or when removal and replacement is indicated on the Drawings, each tree injured beyond repair or removed shall be replaced with a similar tree of the nearest size possible.

All trimming, repair, and replacement of trees and plants shall be performed by qualified nurserymen or horticulturists.

11. ACCESS ROADS. Contractor shall establish and maintain temporary access roads to various parts of the Site as required to complete the Project. Such roads shall be available for the use of all others performing work or furnishing services in connection with the Project.

12. PARKING. Contractor shall provide and maintain suitable parking areas for the use of all workers and others performing work or furnishing services in connection with the Project, as required to avoid any need for parking personal vehicles where they may interfere with public traffic, Owner's operations, or construction activities.

13. DUST CONTROL. Contractor shall take reasonable measures to prevent unnecessary dust. Earth surfaces subject to dusting shall be kept moist with water or by application of a chemical dust suppressant. When practicable, dusty materials in piles or in transit shall be covered to prevent blowing dust.

Buildings or operating facilities which may be affected adversely by dust shall be adequately protected from dust. Existing or new machinery, motors, instrument panels, or similar equipment shall be protected by suitable dust screens. Proper ventilation shall be included with dust screens.

14. TEMPORARY DRAINAGE PROVISIONS. Contractor shall provide for the drainage of storm water and such water as may be applied or discharged on the Site in performance of the Work. Drainage facilities shall be adequate to prevent damage to the Work, the Site, and adjacent property.

Existing drainage channels and conduits shall be cleaned, enlarged, or supplemented as necessary to carry all increased runoff attributable to Contractor's operations. Dikes shall be constructed as necessary to divert increased runoff from entering adjacent property (except in natural channels), to protect Owner's facilities and the Work, and to direct water to drainage channels or conduits. Ponding shall be provided as necessary to prevent downstream flooding.

15. EROSION CONTROL. Contractor shall prevent erosion of soil on the Site and adjacent property resulting from its construction activities. Effective measures shall be initiated prior to the commencement of clearing, grading, excavation, or other operation that will disturb the natural protection.

Work shall be scheduled to expose areas subject to erosion for the shortest possible time, and natural vegetation shall be preserved to the greatest extent practicable. Temporary storage and construction buildings shall be located, and construction traffic routed, to minimize erosion. Temporary fast-growing vegetation or other suitable ground cover shall be provided as necessary to control runoff.

16. POLLUTION CONTROL. Contractor shall prevent the pollution of drains and watercourses by sanitary wastes, sediment, debris, and other substances resulting from construction activities. No sanitary wastes shall be permitted to

enter any drain or watercourse other than sanitary sewers. No sediment, debris, or other substance shall be permitted to enter sanitary sewers, and reasonable measures shall be taken to prevent such materials from entering any drain or watercourse.

End of Section

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Section 01610

GENERAL EQUIPMENT STIPULATIONS

1. SCOPE. When an equipment specification section in this Contract references this section, the equipment shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.
2. COORDINATION. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or Specifications.
3. MANUFACTURER'S EXPERIENCE. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past five (5) years.
4. WORKMANSHIP AND MATERIALS. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.

Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick. When dissimilar metal components are used, consideration shall be given to prevention of galvanic corrosion.

5. STRUCTURAL DESIGN REQUIREMENTS. All equipment, including non-structural components and non-building structures as defined in ASCE 7, and their anchorage, shall be designed and detailed in accordance with the Florida

Building Code (FBC) 2020, ASCE 7-10 "Minimum Design Loads for Buildings and Other Structures", AISC 360 "Specification for Structural Steel Buildings".

6. LUBRICATION. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.

Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Lubricants for equipment where the lubricants may come in contact with water before or during a potable water treatment process or with potable water, shall be food grade lubricants. This includes lubricants for equipment not normally in contact with water, but where accidental leakage of the lubricants may contaminate the water.

Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

7. ELEVATION. The elevation of the site shall be as indicated on the drawings. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at the specified elevation.

8. ELECTRIC MOTORS. Unless otherwise specified, motors furnished with equipment shall meet the requirements specified in Common Motor Requirements for Process Equipment section or specified in specific equipment sections.

9. DRIVE UNITS. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for twenty-four (24) hour continuous service.

9.01. Gearmotors. The use of gearmotors sharing an integral housing or cutgears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.

9.02. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.

Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower [kilowatts] of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L₁₀ bearing life shall be 200,000 hours.

The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L₁₀ 200,000 hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

9.03. Adjustable Speed Drives. Each mechanical adjustable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor. A spare belt shall be provided with each adjustable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

9.04. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor.

10. SAFETY GUARDS. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage thick or thicker galvanized, aluminum-clad sheet steel, or stainless sheet steel or from 1/2 inch mesh galvanized expanded metal, or pultrusion molded UV resistant materials. Each safety guard shall be reinforced or shaped to provide suitable strength to prevent vibration and deflection and shall comply with OSHA. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

11. ANCHOR BOLTS. Equipment suppliers shall design and detail suitable anchor bolts for each item of equipment. Anchor bolts shall be designed for all operating conditions of the equipment, including wind and seismic loadings when applicable.

Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete or masonry grout is placed.

Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches [38 mm] of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

12. EQUIPMENT BASES. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least six (6) inches high. Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the Grouting section.

13. SPECIAL TOOLS AND ACCESSORIES. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment

requiring special devices for lifting or handling shall be furnished complete with those devices.

14. SHOP PAINTING. All iron and steel surfaces of the equipment shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an epoxy or polyurethane enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of a universal primer.

Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

15. PREPARATION FOR SHIPMENT. Equipment shall be prepared for shipment as specified in the Product Delivery Requirements section.

16. STORAGE. Handling and storage of equipment shall be as specified in the Product Storage and Handling Requirements section.

17. INSTALLATION AND OPERATION. Installation and operation shall be as specified in respective equipment sections.

18. OBSERVATION OF PERFORMANCE TESTS. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests.

19. PROGRAMMING SOFTWARE. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-based operating system. A copy of the manufacturer's original operating logic program shall be provided for use in maintaining and troubleshooting the equipment. Where multiple pieces of equipment, from the same or different

vendors, use the same programming software, only one (1) copy of the software need be provided.

End of Section

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Section 01612

PRODUCT DELIVERY REQUIREMENTS

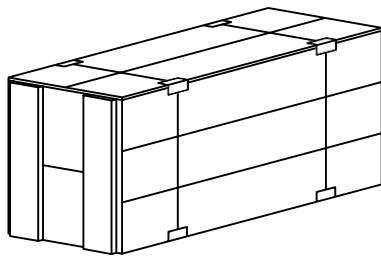
1. SCOPE. This section covers packaging and shipping of materials and equipment.
2. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces that are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

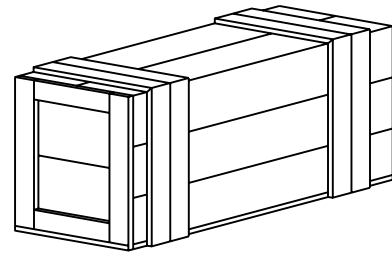
Grease and lubricating oil shall be applied to all bearings and similar items.
3. SHIPPING. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

End of Section

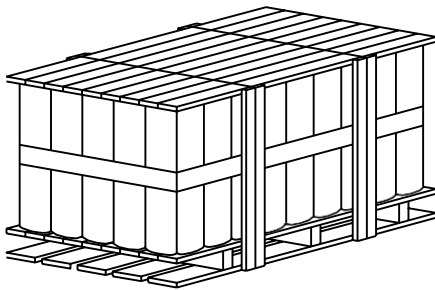
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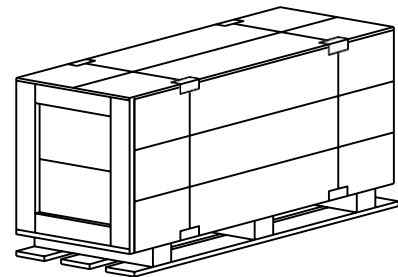
STYLE 4



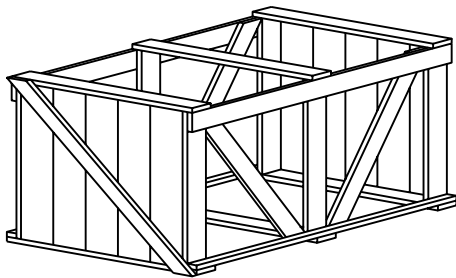
STYLE 2
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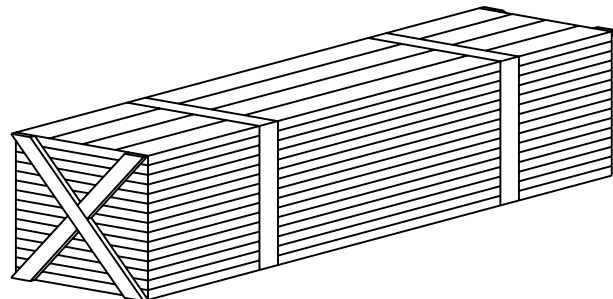
STYLE X



STYLE 2
(PALLETIZED)



OPEN CRATE



STRAPPING 1 3/8" (35 mm)
SPACED ON 24" (600 mm) CTRS.
WITH CORNER PLATES.

EXPORT SHIPMENT PACKING INSTRUCTIONS

BLACK & VEATCH

PRODUCT DELIVERY
REQUIREMENTS

FIG 1-01612

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50 mm COLOR BAND

MARKING INSTRUCTIONS

FIG 2-01612

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Section 01614

PRODUCT STORAGE AND HANDLING REQUIREMENTS

1. SCOPE. This section covers delivery, storage, and handling of materials and equipment.

2. DELIVERY. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified. These requirements also apply to any subsuppliers making direct shipments to the Site.

Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished before and after receipt at the port of entry. Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.

All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.

Delivery of portions of the equipment in several individual shipments shall be subject to review of Engineer before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy accumulation, and to facilitate eventual installation.

3. STORAGE. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.

Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60°F. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.

Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.

When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of Engineer, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.

Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.

4. HANDLING. Stored items shall be laid out to facilitate their retrieval for use in the Work. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.

During handling, carbon steel constructed material including chains, straps, and forks on lifting equipment shall not directly contact any equipment or material constructed of stainless steel. It shall be the Contractor's responsibility to correct any carbon steel contamination of stainless steel.

End of Section

Section 01615

EQUIPMENT AND VALVE IDENTIFICATION

PART 1 – GENERAL

1-1. SCOPE. This section covers the furnishing and installation of nameplates and tags for identification of equipment, valves, panels, and instruments.

1-2. GENERAL. Except as otherwise specified in equipment, valve, and instrumentation sections, nameplates and tags shall be as specified herein. Nameplates or tags shall be provided for all equipment, valves, operator interfaces, control and electrical panels, cabinets, instruments, and instrument racks that have been named and/or tagged on the Drawings.

1-3. SUBMITTALS. Drawings and data shall be submitted in accordance with the requirements of the Submittals Procedures section for each type of tag provided including materials, colors, sizes, letter sizes, and installation instructions.

PART 2 - PRODUCTS

2-1. EQUIPMENT NUMBER PLATES. All equipment tagged on the drawings, except for submerged equipment shall be provided with number plates bearing the equipment tag number identified on the Drawings. Number plates shall be bevelled, 1/8th inch thick laminated black phenolic plastic engraving stock with white core. Lettering on number plates shall be capitalized block letters $\frac{3}{4}$ inch high. Number plate height shall be twice the letter height. Number plate length shall be as needed, with suitable margins all around. Lettering shall be placed in one row where practicable; however, where necessary due to excessive length, lettering shall be placed on more than one row and centered.

Number plates shall be attached with stainless steel panhead screws, rivets, or drive screws.

When a number plate cannot be installed due to the physical size, space, or mounting surface geometry of the equipment, the Contractor shall provide a twelve (12) gauge stainless steel tag with engraved or imprinted equipment tag number. Lettering on tags shall be $\frac{1}{4}$ inch high. Tags shall be rectangular with smooth edges and shall be fastened to the equipment with stainless steel mechanical fasteners or with a stainless steel chain.

2-2. EQUIPMENT INFORMATION PLATES. Equipment shall be provided with engraved or stamped equipment information plates securely affixed with mechanical fasteners to the equipment in an accessible and visible location. Equipment information plates shall be in addition to the number plates specified. Equipment information plates shall indicate the manufacturer's name, address, product name, catalog number, serial number, capacity, operating and power characteristics, labels of tested compliances, and any other pertinent design data. Equipment information plates listing the distributing agent only will not be acceptable.

2-3. VALVE AND GATE TAGS.

2-3.01. Temporary Tags. Each valve and gate with an identifying number indicated on the Drawings or listed in the valve or gate schedule, shall be tagged or marked in the factory with the identifying number.

2-3.02. Permanent Tags. All valves and gates, except buried or submerged valves, that have been assigned a number on the Drawings or in the valve or gate schedule, shall be provided with a permanent number plate. Tags shall be permanently attached to valves and gates with stainless steel mechanical fasteners or with stainless steel chains. Numerals shall be $\frac{3}{4}$ inch high and shall be black baked enamel on an anodized aluminum plate.

All buried valves shall be tagged with a brass plate cast into a 6-inch by 6 inch concrete pad at grade next to the valve box. The valve number shall be engraved in the brass plate with lettering and numerals at least one (1) inch high.

2-4. PANEL NAMEPLATES. Nameplates shall be provided on the face of each panel and cabinet. Panel identification nameplates shall be mounted at the top of the panel shall include the panel descriptive name and tag number as indicated on the Drawings, in two or three lines of text. Lettering shall be $\frac{3}{4}$ inch high.

Nameplates for devices mounted on or in the panel shall be inscribed with the text as indicated on the Drawings. Where nameplate information is not indicated on the Drawings, inscriptions shall be in accordance with information in the supplier's submittal drawings as guided by information in the relevant specification section. Panel device nameplates shall have engraved letters $\frac{3}{16}$ inch high.

Nameplate material and size shall be as specified above for equipment number plates. Nameplates shall be secured to the panel with stainless steel panhead screws.

2-5. INSTRUMENT TAGS.

2-5.01. Temporary Tags. Where instruments are not provided with permanent tags furnished from the factory, instruments shall be tagged or marked in the factory with the instrument tag number indicated on the Drawings.

2-5.02. Permanent Tags. Instruments shall be tagged with the instrument tag number indicated on the Drawings. Tags shall be twelve (12) gauge stainless steel with engraved or imprinted symbols. Lettering on tags shall be ¼ inch high. Tags shall be rectangular with smooth edges, and shall be fastened to the instrument with stainless steel mechanical fasteners or with a stainless steel chain.

PART 3 – EXECUTION

Not used.

End of Section

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Section 01739

EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers general installation requirements of new equipment units that have been purchased by Contractor as part of this Work. Equipment specific installation requirements are covered in the equipment sections.

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Any equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment has been purchased are available.

Any existing equipment which is removed and salvaged for reinstallation shall be handled as indicated in the Demolition and Salvage section.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least thirty (30) days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished by others under each procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

Flanged connections to equipment shall include 316SS bolts, nuts, hardware, and gaskets compatible to the equipment service conditions.

PART 2 - PRODUCTS

2-1. MATERIALS. Materials shall be as follows:

Grout	As specified in the Grouting section.
Anti-Seize thread lubricant for SS bolts	As specified in the Anchorage in Concrete and Masonry section.

PART 3 - EXECUTION

3-1. INSTALLATION. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results.

Each equipment unit shall be leveled, aligned, and shimmed into position. Installation procedures shall be as recommended by the equipment manufacturer and as required herein. Shimming between machined surfaces will not be permitted.

Anti-seize thread lubricant shall be liberally applied to the threaded portion of all stainless steel bolts during assembly. For equipment installed in drinking water facilities, the anti-seize lubricant shall meet requirements of NSF-61.

When specified in the equipment sections, the equipment manufacturer will provide installation supervision and installation checks. For installation supervision, the manufacturer's field representative will observe, instruct, guide, and direct Contractor's erection or installation procedures as specified in the equipment specifications. For installation checks, the manufacturer's field representative will inspect the equipment installation immediately following installation by Contractor, and observe the tests. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

All equipment shall be protected after installation, prior to final acceptance by Owner. Protection provisions shall be as recommended by the manufacturer, and shall include provisions to prevent rust, mechanical damage, and foreign objects entering the equipment.

3-2. STARTUP AND TESTING. Field tests shall be as indicated in the specific equipment sections. Startup and tests required shall occur in the order listed in the following paragraphs. Tests shall not begin until any installation supervision

and installation checks by the equipment manufacturer have been completed, except where noted below.

3-2.01. Preliminary Field Tests. Preliminary field tests shall be conducted on all equipment by Contractor. When an installation check is specified in the equipment sections, the equipment manufacturer's representative will participate in these tests to the extent described in the equipment sections.

3-2.02. Field System Operation Tests. Field system operation tests shall be conducted on all equipment by Contractor. When an installation check is specified in the equipment sections, the equipment manufacturer's service personnel will participate in these tests to the extent described in the equipment sections.

3-2.03. Field Demonstration Tests. Field demonstration tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.04. Field Performance Tests & Distribution Tests. Field performance tests or distribution tests will be conducted by the equipment manufacturer on equipment as indicated and as specified in the equipment sections.

3-2.05. Field Baseline Performance Tests. Field baseline performance tests shall be conducted by Contractor on the equipment indicated in the equipment sections, and the tests shall be performed as indicated. When indicated in the equipment sections, the equipment manufacturer will participate in these tests. This test shall not be considered an acceptance test, but rather a test to determine initial performance curves and efficiency just prior to the equipment entering service.

End of Section

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Section 02050

DEMOLITION

PART 1 - GENERAL

1-1. SCOPE. This section covers the demolition of existing sitework and the salvage of existing equipment as indicated on the Drawings or as specified herein.

1-2. GENERAL. Contractor shall be responsible for all work under this section. Contractor shall provide thirty (30) days written notice prior to beginning demolition activities.

All structures and facilities of the existing Peace River Water Treatment Plant that are not to be removed must remain in continuous operation during the work. Demolition and salvage work shall create minimum interference with Owner's operations and minimum inconvenience to Owner. Contractor shall provide protection and safety of all roadways, sidewalks, and all accessible areas during demolition activities.

Blasting will not be permitted.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. DEMOLITION. Removal of equipment or facilities shall include removal of all accessories, piping, wiring, supports, associated electrical starters and devices, baseplates and frames, and all other appurtenances, unless otherwise directed. Existing materials and equipment removed, and not indicated to be reused as a part of the Work, shall become Contractor's property unless otherwise specified, and shall be removed from the Site and properly disposed of or recycled in accordance with state laws.

Contractor shall conduct demolition activities in a manner that prevents damage to existing facilities which are indicated to remain and shall provide all necessary protection for existing facilities. Any remaining facilities damaged during demolition shall be repaired by Contractor to a condition equal to or better than the original condition.

When demolition is complete, all debris shall be removed from the Site and the Site graded to the lines and grades indicated on the Drawings.

3-1.01. Structure Demolition. Not used.

3-1.02. Piping and Equipment Demolition.

The following piping and equipment shall be removed and shall become the property of Contractor. All such items shall be promptly removed from the jobsite.

- SCU 5 and 6 rapid mixer drives.
- Valves with Actuators

3-1.03. Sitework Demolition. Sitework demolition shall include the following:

- Removal of Plant 3 Filter Media from 6 filter cells

3-2. SALVAGE.

3-2.01. Items To Be Salvaged by Owner. Not Used.

3-2.02. Items To Be Salvaged by Contractor. Removed and salvaged equipment or facilities shall include removal and salvage of all accessories, piping, wiring, supports, associated electrical starters and devices, baseplates and frames, and all other appurtenances, unless otherwise directed.

The following items shall remain Owner's property and shall be delivered to Owner by Contractor in good condition at the delivery points indicated:

<u>Item</u>	<u>Location</u>	<u>Delivery Point</u>
24" Filter Effluent Valve	Filter Cell 35	Water Treatment Plant
6" Air Scour Valve	Filter Cell 33	Water Treatment Plant

If the Owner, in between the time of this writing and the execution of the Work, needs to replace any of the other fifty-four (54) existing valves currently scheduled to be removed and become the Contractor's property, the Owner reserves the right to maintain ownership of such recently replaced valves.

Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified herein or indicated to be salvaged and to remain the property of Owner. Contractor shall store and protect salvaged items specified or

indicated to be reused in the work. Any items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by Contractor in kind or with new items.

Salvaged items shall be stored at the Peace River Water Treatment Plant. Contractor shall coordinate with Owner staff on the specific storage and delivery location within the facility once salvaged items are removed.

End of Section

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Section 02675

CLEANING AND DISINFECTION OF WATER PIPELINES

PART 1 - GENERAL

1-1. SCOPE. This section covers cleaning of potable and non-potable water pipelines and disinfection of all potable water pipelines installed under this Contract.

1-2. GENERAL.

1-2.01. Coordination. Contractor shall coordinate cleaning and disinfection work with adjacent work as necessary to preclude work interferences or duplication of effort and to expedite the overall progress of the work.

Contractor shall provide all necessary piping, piping connections, temporary valves, backflow preventers, flowmeters, sampling taps, pumps, disinfectant, neutralization agents, chlorine residual test apparatus, and all other items of equipment or facilities necessary to complete the cleaning and disinfection work.

Water for cleaning and disinfection work will be provided as stipulated in the Temporary Facilities section.

In all cases where it is necessary to interrupt service, permission of Owner shall be obtained at least one week before the service will be interrupted. In all cases where it is necessary to interrupt service to water customers, permission of the Owner shall be obtained and each customer affected shall be notified of the proposed service interruption and its possible duration in accordance with the Project Requirements section.

Unless otherwise specified, final cleaning and disinfection work shall not be performed until after hydrostatic testing of the pipelines and any resulting repair work completed.

Contractor shall conduct all flushing, disinfection, and disposal / discharge of water in accordance with applicable permits / authorizations.

Contractor shall notify Owner prior to the work to allow their representatives to be present during cleaning and/or disinfection of the pipelines.

1-2.02. Related Work. Other sections directly related to work covered in this section are:

13755 - Cleaning and Disinfection of Structures

1-2.03. Governing Standard. All disinfection work shall conform to the requirements of ANSI/AWWA C651, and the requirements of Florida Department of Environmental Protection, except as modified herein. If any state or local requirements conflict with the provisions of this section, the state and local requirements shall govern.

Contractor shall notify federal, state, and local regulatory agencies to determine if any special procedures or permits are required for disposal of neutralized or diluted chlorinated water from the final flushing of pipelines and to identify acceptable locations for disposal of the flushing water. All requirements and costs associated with notification and obtaining any discharge permits shall be the responsibility of the Contractor.

1-2.04. Experience. The disinfection work shall be performed by a subcontractor specialized in such work, or with the permission of Engineer, Contractor may provide the necessary equipment and do the work with his own personnel. In either case, all work shall be done under the direct supervision of a competent and experienced specialist in such work.

Personnel performing the disinfection shall demonstrate a minimum of 5 years experience in the chlorination and dechlorination of similar pipelines.

1-2.05. Special Cleaning and Disinfection Requirements. Not used.

1-3. SUBMITTALS.

1-3.01. Cleaning and Disinfection Plan. Unless otherwise specified, Contractor shall submit a detailed cleaning and disinfection plan to Engineer fourteen (14) days prior to starting any cleaning and disinfection work. The plan shall cover the method and procedure proposed, necessary coordination, qualification of personnel performing the disinfection work, sequence of operations, the limits of the pipelines to be cleaned and disinfected, the positions of all valves, location of temporary bulkheads, materials and quantities of each to be used, equipment to be used, manner of filling and flushing the pipelines, chlorine injection points, sample points, bacteriological testing location and schedule, potable water source, method of metering the water if required, neutralization and disposal of wasted water, and all other methods and procedures to be followed in performing the cleaning and disinfection work.

1-3.02. Testing. Bacteriological testing shall be performed by an independent testing laboratory furnished by Contractor. Contractor shall submit the qualifications of the proposed independent testing laboratory for Owner approval

prior to performing the specified bacteriological tests. Upon completion of each test, three copies of the test results shall be submitted to Engineer.

Contractor shall provide all items of equipment, piping, and other facilities necessary to assist with the collection of the samples as required. Locations for bacteriological sampling shall be as shown in the Drawings, in accordance with the governing standards, and as otherwise acceptable to the Owner.

The chlorine residual tests shall be performed by Contractor. The test logbook shall be made available to Owner or Engineer upon request and shall be submitted to Engineer upon completion of all chlorine residual testing.

1-4. QUALITY ASSURANCE.

1-4.01. Chlorine Residual Tests. Contractor shall provide the necessary apparatus for making the chlorine residual tests by the drop dilution method in Appendix A of ANSI/AWWA C651. Test results shall be recorded in a logbook that includes for each test: the location, date, time, test results, and test kit manufacturer.

1-4.02. Bacteriological Tests. Sampling and testing of water in the pipelines shall be performed after final flushing in accordance with Section 5 of ANSI/AWWA C651. Two consecutive sets of acceptable samples, taken at least twenty-four (24) hours apart, shall be collected and standard heterotrophic plate counts measured for each sample.

1-4.03. Redisinfection. Should the bacteriological tests indicate the presence of coliform organisms at any sampling point, the pipelines shall be reflushed, resampled and retested in accordance with Section 5 of ANSI/AWWA C651. If check samples show the presence of coliform organisms, then the pipelines shall be rechlorinated until acceptable results are obtained.

PART 2 - PRODUCTS

2-1. MATERIALS. All materials furnished by Contractor shall conform to the requirements of ANSI/AWWA C651 and shall be clean and free of debris which could infer questionable test results.

2-1.01. Liquid Chlorine. Liquid chlorine shall conform to AWWA B301.

2-1.02. Calcium Hypochlorite (Dry). Calcium hypochlorite shall conform to AWWA B300.

2-1.03. Sodium Hypochlorite (Solution). Sodium hypochlorite shall conform to AWWA B300.

2-1.04. Chlorine Residual Test Kit. Chlorine residual concentration shall be measured using an appropriate range, drop count titration kit or an orthotolidine indicator comparator with wide range color discs. The color disc range shall be selected to match chlorine concentration limits. Test kits shall be maintained in good working order and available for immediate test of residuals at point of sampling. Test kits manufactured by Hach Chemical or Orbeco-Hellige are acceptable.

PART 3 - EXECUTION

3-1. APPLICATION.

3-1.01. Cleaning. Pipelines, including all associated valves and fittings, shall be cleaned to the satisfaction of Owner and Engineer.

All new piping shall be cleaned by flushing with water at a minimum velocity of 2.5 feet per second until the piping is free of dirt, debris, and other foreign materials and until turbidity measurements indicate readings at or below 1.0 NTU. Cleaning shall precede disinfection. Flushing shall be accomplished through the installed valves or fittings, or through corporation cocks furnished and installed for that purpose.

If a flushing velocity of 2.5 fps cannot be reasonably attained, other methods may be proposed to ENGINEER. CONTRACTOR must receive approval from ENGINEER prior to implementing an alternative cleaning protocol.

Flushing shall be accomplished through the installed valves or fittings, blow-offs or through temporary flushing connections installed for that purpose and in accordance with any details indicated on the Drawings.

Booster pumps shall be used if needed to obtain the necessary volume or velocity of water. Pumping equipment installed under this Contract shall not be used for flushing, nor shall the flushing water be passed through them or other installed equipment; temporary bypass piping at each pump or installed equipment shall be provided as needed.

3-1.02 Pipelines to be Disinfected. The following pipelines (plant piping) shall be disinfected as specified herein:

- a. Filter feed piping
- b. Filter influent piping

- c. Filter to waste lines
- d. Filter backwash lines
- e. Line from filters to transfer pump station

3-1.03 Disinfection Procedure. The pipelines shall be disinfected by the continuous feed method. Potable water shall be used in conjunction with the chlorination agent.

For the continuous feed method, the chlorination agent shall be injected into the line at the supply end of each new pipeline or valved section thereof.

Admission of disinfectant solution into or the flushing thereof through existing, in-service piping shall be held to the minimum possible, and then only after adequate measures have been taken to prevent any such solution of chlorinated water from entering other piping systems.

During disinfection, all valves and hydrants shall be operated to ensure that all appurtenances are disinfected. Valves shall be operated such that the chlorine solution in the pipeline being chlorinated will not flow back into the supply line. Check valves shall be used if needed.

Existing pipelines which may become contaminated during work requiring connections to the new pipeline, involving either tapping or cutting into operations, shall be flushed and disinfected in accordance with Section 4 of ANSI/AWWA C651.

3-1.04. Final Flushing. Upon completion of chlorination, but before sampling and bacteriological testing, all heavily chlorinated water shall be removed from the lines by flushing with potable water until the chlorine residual in the lines is not higher than that generally prevailing in the adjacent existing system or as acceptable to the Owner.

Final flushing shall be accomplished as specified for cleaning of pipelines.

3-1.05. Disposal of Chlorinated Wastewater. All chlorinated wastewater to be discharged shall be neutralized by chemical treatment and disposed in accordance with Section 4 and Appendix C of ANSI/AWWA C651 and the requirements of the governing agency specified herein. Schedule, rates of flow, and locations of discharge of disinfection and flushing water shall be in accordance with the contractor submitted and Engineer/Owner approved Cleaning and Disinfection Plan.

End of Section

Section 03600

GROUTING

PART 1 - GENERAL

1-1. SCOPE. This section covers procurement and installation of grout. Unless otherwise specified, only nonshrink grout shall be furnished.

Epoxy grouting and adhesive anchoring of anchor bolts, threaded rod anchors, and reinforcing bars is covered in the Anchorage in Concrete and Masonry section. Grouting of masonry is covered in the Masonry section.

1-2. SUBMITTALS. A letter of certification indicating the types of grout to be supplied and the intended use of each type shall be submitted in accordance with the Submittals Procedures section.

1-3. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage of any kind. Materials shall be protected from moisture.

PART 2 - PRODUCTS

2-1. MATERIALS.

Nonshrink Grout	Precision cementitious grout with demonstrated non-shrinking properties, minimum 28 day compressive strength of 9000 psi; L&M "Crystex", BASF "Masterflow 928", Sika "SikaGrout 328", Euclid "Hi-Flow Grout", Dayton Superior "Sure-Grip High Performance Grout", or SpecChem "SC Precision Grout".
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Water	Clean and free from deleterious substances.
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2-2. CEMENTITIOUS GROUT. Cementitious grout shall be furnished factory premixed so that only water is added at the jobsite.

2-3. EPOXY GROUT. Epoxy grout shall be used in lieu of cementitious grout when required by the equipment manufacturer for performance or warranty requirements. Epoxy grout shall be a three component system consisting of a Part A (resin), Part B (hardener) and Part C (aggregate). All three (3) components shall be products of the same manufacturer and be compatible.

Epoxy grout products and installation procedures shall be submitted to Engineer for approval.

PART 3 - EXECUTION

3-1. CEMENTITIOUS GROUT INSTALLATION.

3-1.01. Preparation. The concrete foundation to receive cementitious grout shall be saturated with water for at least twelve (12) hours preceding grouting unless additional time is required by the grout manufacturer.

3-1.02. Mixing. Grout shall be mixed in a mechanical mixer. No more water shall be used than is necessary to produce a flowable grout, nor shall water content exceed the amount recommended by the manufacturer.

3-1.03. Temperature Restrictions. Grout shall be placed in accordance with the manufacturer's published temperature restrictions. Ambient temperature and grout temperature shall be a minimum of forty (40) degrees F and rising at time of placement. Grout shall not be placed on frost covered surfaces. Grout shall be protected from freezing until it has reached a minimum strength of 4,000 psi. Grout shall not be placed when the ambient or grout temperature exceeds ninety (90) degrees F.

3-1.04. Placement. Unless otherwise specified or indicated on the Drawings, grout under baseplates shall be 1-1/2 inches [38 mm] thick. Grout shall be placed in strict accordance with the directions of the manufacturer so that all spaces and cavities below the baseplates are completely filled without voids. Forms shall be provided where structural components of baseplates will not confine the grout.

3-1.05. Edge Finishing. In all locations where the edge of the grout will be exposed to view, the grout shall be finished smooth after it has reached its initial set. Except where shown to be finished on a slope, the edges of grout shall be cut off flush at the baseplate.

3-1.06. Curing. Grout shall be protected against rapid loss of moisture by covering with wet cloths or polyethylene sheets. After edge finishing is completed, the grout shall be wet cured for at least three (3) days and then an acceptable membrane curing compound shall be applied.

3-2. EPOXY GROUT INSTALLATION. Epoxy grout shall be installed in accordance with ACI 351.5.

End of Section

Section 03920

CONCRETE SURFACE REPAIR

PART 1 - GENERAL

1-1. **SCOPE.** This section covers the repair of existing concrete surfaces as indicated on the drawings, as specified, or as required to complete the Work. This specification covers the furnishing of all labor, equipment and materials required to repair, rehabilitate or reconstruct spalled, deteriorated, or structurally damaged concrete surfaces. Depth of repairs shall be adequate to restore concrete surface profiles. Unless otherwise noted, restoring concrete members to original dimensions is not required for this project.

The Work covered by this section includes, but is not limited to, the interior (wet side) surfaces at the following locations in Plant 3:

- PAC Contact Tanks⁽¹⁾
 - Solids Contact Unit (SCU) Influent Channel⁽²⁾
 - Rapid Mix Chamber⁽³⁾
 - SCU No. 5 and SCU No. 6⁽²⁾
 - Chlorine Contact Chamber⁽⁴⁾
 - Filter Cells and Associated Influent Channels⁽²⁾
 - Transfer Pump Station⁽³⁾
1. Interior (wet side) concrete surfaces shall be cleaned by pressure washing/water blasting and the wall surfaces in Tank 3 shall be repaired. An inspection shall be performed following cleaning to verify surface restoration is not required in Tanks 1 and 2. If found to be necessary, surface restoration shall be performed in areas as directed by the Owner/Engineer.
 2. Generally, the concrete repair work to be performed in this location is the restoration of the surface profile of the interior (wet side) surfaces.
 3. Interior (wet side) concrete surfaces shall be cleaned by pressure washing/water blasting. An inspection shall be performed following cleaning to verify surface restoration is not required. If found to be necessary, surface restoration shall be performed in areas as directed by the Owner/Engineer.
 4. Concrete repairs shall be performed in the Chlorine Contact Chamber to address locations where rust spots are visible. In general, the protective coating on the wetted surfaces in this process basin is in good condition. An inspection shall be performed following cleaning to identify the repair

work that is required. Repairs shall be made in locations documented and approved by the Owner/Engineer.

1-2. SUBMITTALS. Specifications and data covering physical properties, the mixtures, application procedures, and curing procedures of the materials proposed shall be submitted in accordance with the Submittals Procedures section. Submittals shall include the approvals required from the material manufacturer.

1-3. QUALITY ASSURANCE.

1-3.01. Manufacturer's Field Services. The material manufacturer shall provide engineering field services to review the project and the selected material application prior to any preparation; to approve the applicator, the material used, and the procedure to be used; to observe and approve surface preparation; and to observe application and curing procedures. The field representative of the material manufacturer shall submit, in writing through Contractor, approvals of proposed materials, surface preparation, applicator, and application procedures. The field representative shall instruct the applicator, as needed, to assure that handling, mixing, placing, finishing, and curing of materials are in accordance with specifications and manufacturer's requirements. The field representative shall be an employee of the material manufacturer.

1-3.02. Applicator. The repair contractor shall have experience and proficiency specific to the repair type and shall be acceptable to Engineer and the material supplier. The applicator shall submit, through Contractor, a satisfactory experience record including references for previous application of the specified materials to concrete structures of similar design and complexity.

1-3.03. Pre-construction Meeting. At least thirty (30) days prior to planned performance of the Work, Contractor shall conduct a meeting to review the detailed requirements for the Work. Site conditions, surface preparation, proposed equipment, procedures, material mixing, placing and finishing procedures, and curing methods shall be discussed and approved by Engineer and by the manufacturer's field representative. Contractor shall require the attendance of all involved parties, including but not limited to Contractor's superintendent, repair contractor if applicable, manufacturer's field representative and proposed equipment supplier representative. Minutes of the meeting shall be recorded, typed and printed by Contractor and distributed to all parties, including Engineer, within 5 days after the meeting.

1-3.04. Site Conditions. Job conditions shall be maintained at standards that allow material placement within temperature and cleanliness requirements. Unusual conditions or unexpected additional deterioration uncovered during the

course of Work by Contractor shall be brought to Engineer's attention for analysis and disposition. These conditions include but are not limited to poor quality base concrete, severely corroded reinforcing steel, random cracks, deep oil penetration and any other condition which would prevent completion of the Work in accordance with manufacturer's recommendations and this specification.

1-4. PRE-BID INSPECTION. Contractor shall visit the site prior to bid submittal to witness and verify the extent of the required repairs. Final bid shall include a lump sum for the Work with a unit price adjustment for each repair type. Unit prices shall be utilized to adjust the final project cost upon completion and acceptance of the Work based on actual quantities more than or less than the bid form estimated quantities.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Concrete repair products shall be manufactured by the Euclid Chemical Company, BASF Corporation, Sika Corporation, or equal as specified herein. Equivalent products of other manufacturers regularly producing high quality concrete repair materials, providing engineering field services, and meeting the specified quality assurance requirements may be furnished subject to acceptance by Engineer.

2-2. MATERIALS. Unless otherwise specified or authorized, materials shall conform to the requirements specified herein. Types of materials or concrete repair not specified herein shall be as specified in other sections, as indicated on the drawings or, in the absence of any definite requirement, as recommended by the manufacturer's field representative and acceptable to Engineer.

Products shall not exceed VOC limits established by the federal, state, or local regulatory agency having jurisdiction over the project site.

Floor Surface Repairs, Thickness of 1/6 Inch or Less	One or two-component, polymer modified, cementitious material containing a corrosion inhibitor.
Compressive Strength	6000 psi at 28 days, using 2 inch cubes, per ASTM C109.
Products	BASF "MasterEmaco N 300 CI", Euclid "Thin-Top Supreme", or Sika "SikaTop 121 Plus".
Bonding Agent	Repair mortar scrub coat, per manufacturer's

	instructions.
Floor Surface Repairs, Thickness Between 1/6 Inch and 1 Inch	One or two-component, polymer modified, cementitious material containing a corrosion inhibitor.
Compressive Strength	7000 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	1100 psi at 28 days, per ASTM C348.
Bond Strength	2000 psi at 28 days, per ASTM C882.
Products	BASF "MasterEmaco T 310 CI", Euclid "VersaSpeed LS100", or Sika "SikaTop 122 Plus".
Bonding Agent	Repair mortar scrub coat, per manufacturer's instructions.
Floor Surface Repairs, Thickness Greater Than 1 Inch	One-component, polymer modified, cementitious material containing a corrosion inhibitor.
Compressive Strength	6750 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	1100 psi at 28 days, per ASTM C348.
Bond Strength	2400 psi at 28 days, per ASTM C882.
Products	BASF "MasterEmaco N 425", Euclid "VersaSpeed LS100", or Sika "SikaTop 122 Plus".
Bonding Agent	Repair mortar scrub coat, per manufacturer's instructions.
Vertical and Overhead Surface Repairs, Trowel Applied	One or two-component, polymer modified, cementitious material containing a corrosion inhibitor.

Compressive Strength	5500 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	600 psi at 28 days, per ASTM C348.
Bond Strength	1800 psi at 28 days, per ASTM C882.
Products	BASF "MasterEmaco N 400", Euclid "Eucorepair V100", or Sika "SikaTop 123 Plus".
Bonding Agent	Repair mortar scrub coat, per manufacturer's instructions.
Vertical Repairs, Form and Pour, Thickness 6 Inches or Less	One-component, cementitious material containing a corrosion inhibitor. Shrinkage compensated or polymer modified.
Compressive Strength	6500 psi at 28 days, using 2 inch cubes, per ASTM C109.
Flexural Strength	770 psi at 28 days, per ASTM C348.
Bond Strength	2500 psi at 28 days, per ASTM C882.
Rapid Chloride Permeability	Maximum 650 cuolombs at 28 days, per ASTM C1202.
Products	BASF "MasterEmaco S 466CI", Euclid "Eucorepair SCC Fast", or Sika "Sikacrete 211 SCC Plus".
Bonding Agent	Extended open time type; three component, epoxy modified, with corrosion inhibitor, minimum bond strength of 2000 psi at 7 days per ASTM C882. BASF "MasterEmaco P 124", Euclid "Duralprep A.C.", or Sika "Armatec 110 EpoCem".
Vertical Repairs, Thickness Greater Than 6 Inches	Cast-in-place concrete, per the concrete specification.

Bonding Agent	Slurry of one part Portland cement and one part fine aggregate, mixed with water and latex bonding agent to form a thick slurry. Latex product shall conform to ASTM C1059, Type II, Euclid "Flex-Con" or Sika "SikaLatex R".
Water	Clean and free from deleterious substances.
Reinforcement Anti-Corrosion Coating	Extended open time type; three component, epoxy modified, with corrosion inhibitor, minimum bond strength of 2000 psi at 7 days per ASTM C882. BASF "MasterEmaco P 124", Euclid "Duralprep A.C.", or Sika "Armatec 110 EpoCem".

Penetrating Sealer

Silane-based sealer with minimum 40% active ingredient. Minimum water repellency of 85% per ASTM C642. BASF "MasterProtect H 400", Euclid "Baracade Silane 40", or Sika "Sikagard 740 W".

2-2.01. Coarse Aggregate Extension of Cementitious Mortar. In areas where depth of repair exceeds manufacturer's recommended limits for neat repair mortar, repair mortar may be extended with washed, graded, rounded, high-density, low-absorption coarse aggregate meeting ASTM C33. Aggregate shall be in size and volumes recommended by the product manufacturer. Aggregate extension shall not be permitted unless approved by Engineer.

PART 3 – EXECUTION

3-1. GENERAL. Unless otherwise specified, all materials shall be prepared and applied in strict accordance with the manufacturer's printed installation instructions.

3-2. INSPECTION. Prior to the placement of repair material, the surface to be repaired shall be inspected by the material manufacturer's field representative to assure the surface conditions are correct for the type of repair and the material is being used as specified.

3-3. PREPARATION.

3-3.01. Cleaning. The surface of existing concrete shall be clean and the pores free of any dirt or material that will be detrimental to the bond of the repair material. All oil, dirt, debris, paint, and unsound concrete shall be removed. Cleaning shall include complete removal of all dust, dirt, and residue by high pressure washing.

3-3.02. Surface Preparation. All prepared surfaces shall conform to the requirements of the material manufacturer. All edges shall be square cut to avoid feather edges. As required, surfaces shall be prepared mechanically using a scabbler, bushhammer, chipping hammer, shotblast, scarifier or hydrodemolition equipment which will give the specified surface profile. Means and methods selected, subject to acceptance by Engineer, shall minimize surface micro-cracking (i.e. "bruising") and impact on areas surrounding the Work area.

Remove all loose and unsound concrete per International Concrete Repair Institute (ICRI) Guideline 310.1R "Guide for Surface Preparation." Repair areas

shall be sawcut around the perimeter in a square or rectangular shape. For thin repairs of 1/6 inch or less, the saw cut depth shall not exceed 1/6 inch deep. For thicker repairs, the saw cut depth shall be a minimum of one-half inch but shall be limited to prevent the saw from damaging embedded reinforcement. Saw cuts shall be made perpendicular to the concrete surface and all concrete removal boundaries shall be straight.

Contractor shall provide a surface profile which is suitable for bonding, as defined in repair manufacturer's printed installation instructions. In the absence of other instructions, the surface shall be roughened to 1/4 inch amplitude. If delamination, cracking, or unsound material exists beyond minimum removal depth, then removal shall continue until all unsound, delaminated, or cracked concrete has been removed from the repair area.

3-3.03. Cracks. Cracks shall be located and repaired, if required, in accordance with the Concrete Crack Repair specification. All cracks located within or adjacent to Work covered under this specification shall be repaired prior to performance of the Work covered under this specification.

3-3.04. Inspection and Replacement of Reinforcement. If reinforcement is exposed so that more than half the circumference of the bar is visible, the remaining concrete shall be removed to provide 1 inch of clear space all around the bar.

Reinforcement that has lost more than twenty percent (20%) of its original cross-sectional area shall be repaired by adding new reinforcement. The new reinforcement shall be spliced or connected to the existing reinforcement on both ends of the damaged portion of the original bar. Splices shall be Class B, and mechanical connectors shall be ACI 318 Type 2.

Contractor shall clean all exposed reinforcing steel to a bright finish prior to installation of repair materials.

Repaired reinforcement shall be inspected by Engineer or Owner's representative prior to placement of concrete repair materials.

3-4. APPLICATION. Concrete repair work shall be performed in accordance with the following requirements.

3-4.01. Bonding and Priming. Bonding agent shall be applied per manufacturer's recommendations. The manufacturer's coverage rate shall be followed. For rough surfaces, scrub bonding agent into the surface with a stiff broom.

Apply all prepackaged bonding agent materials within recommended ambient

and substrate temperatures published in the manufacturer's printed installation instructions. Materials shall not be applied over frozen or liquid filled surfaces.

Upon completion of all concrete and reinforcing steel demolition, surface preparation, and cleaning operations, apply specified bonding agent to substrate. Provide complete and thorough coverage of surface assuring that bonding agent has been fully worked into profile of surface.

For repair mortar scrub coat bonding agents, the concrete surface shall be saturated with water one hour prior to placement of the scrub coat to provide a saturated substrate. Just prior to application of the scrub coat, water shall be removed by compressed air blasting. Compressed air shall be maintained free of oil and contaminants by filtration as needed. The mortar scrub coat shall be wet and not yet stiffened when repair material is applied.

For extended open time bonding agents, mix bonding agent and apply two uniform coats at manufacturer's published recommended coverage rates to properly prepared surfaces. Allow adequate time between coats per manufacturer's recommendations. The repair material shall be applied within the allowable open time of the bonding agent.

3-4.02. Treatment of Reinforcement and Other Metal Embedments. All existing and new reinforcement shall be secured and properly positioned by tying to other secured bars or supplemental anchoring pins as needed.

All exposed reinforcement and other metal embedments within the repair area shall be treated with two coats of anti-corrosion coating.

3-4.03. Forming. Forms shall be water-tight and constructed with sufficient rigidity to withstand head pressure and prevent excessive deflection during material placement. For pumped applications without open top forms, provide a port connection or birdmouth of sufficient size to allow pumping into the form. After forms are removed, all birdmouths and other protrusions resulting from the placement method shall be carefully removed and the surface smoothed.

Tolerances for formed work shall be as stipulated in ACI 117 for cast-in-place concrete, unless otherwise indicated. Formed surfaces shall meet Class C requirements for both abrupt and gradual irregularities.

3-4.04. Shoring and Support. When removal and repair of deteriorated concrete may cause temporary weakness, excessive deflections, structural instability, or other unacceptable damage, shoring or other suitable supports shall be provided until completion of the repair work is complete and the material has reached its design compressive strength.

3-4.05. Cold Weather Conditions. Repair materials shall not be applied without protection in temperatures below 45 degrees F, nor when the temperature is expected to fall below forty-five (45) degrees F during the curing period, unless more stringent requirements are provided by the material manufacturer's printed installation instructions.

3-5. FINISHING. All surfaces shall be finished to match the surrounding concrete.

3-6. CURING. Immediately following placement and finishing procedures, cure cementitious repair mortars for a minimum of **seven (7) days**. Curing procedures shall be in accordance with ACI 308.1 and the manufacturer's printed installation instructions. The more stringent requirements shall control.

When ambient temperatures below forty-five (45) degrees F are expected during the curing period, the repair material shall be maintained at fifty (50) degrees F for the full period. Sudden cooling shall not be permitted. Gradual temperature drop shall be maintained at not more than twenty (20) degrees F in any twenty-four (24) hour period. Carbon dioxide or exhaust gases from combustion heaters shall not be allowed within enclosures or allowed to contact the repair material. Repair materials shall not be exposed to freezing temperatures until at least twenty-four (24) hours after the end of the curing period.

Unless specified otherwise, one or more of the following methods shall be used:

3-6.01. Water Curing. Keep concrete surfaces continuously wet with water during the curing period. The method used shall limit water runoff and any runoff shall be directed and controlled. The difference in temperature between the water used for curing and the concrete surface shall not exceed twenty (20) degrees F.

3-6.02. Wet Coverings Curing. Cover the surfaces with moisture retaining curing blankets, burlap, cotton mats, or other suitable moisture retaining materials. The coverings shall not stain or otherwise discolor the repair material or the surrounding surfaces, and shall keep the repair products fully saturated during the curing period. Lap all coverings at least eight (8) inches at joints.

3-6.03. Membrane Curing. Membrane curing compounds shall only be used if the repair material manufacturer's printed installation instructions recommend a compound be used instead of water or wet coverings.

3-7. SEALING. Provide a penetrating sealer over the concrete repair product when recommended by the repair product manufacturer, or when no other sealer is specified on the drawings or other specifications. The penetrating sealer shall be applied in accordance with the manufacturer's instructions.

3-8. FIELD QUALITY CONTROL.

3-8.01. Material Storage and Handling. The material shall be delivered in original, unopened containers. Containers shall be labeled with the manufacturer's name, product name, and lot number. Materials shall be stored at the job site under dry conditions and at temperatures between fifty (50) degrees F and ninety (90) degrees F unless more stringent limitations are required by the manufacturer.

3-8.02. Protection. Repair areas shall be protected from other trades and weather for a minimum of 10 days after material is placed.

3-8.03. Cleaning. Work areas are to be cleaned each day in accordance with the Project Requirements section. Upon completion of the final cleanup, Contractor shall restore all areas affected by repair procedures to their original condition, leaving no trace of material piles or other wasted materials.

End of Section

Section 03930

CONCRETE CRACK REPAIR

PART 1 - GENERAL

1-1. SCOPE. This section covers the repair of concrete cracks and joints.

Both inch-pound (English) and SI (metric) units of measurement are specified herein; the values expressed in inch-pound units shall govern.

Prior to beginning the repair work Contractor shall field verify and provide clear bright colored marking to the cracks to be repaired. Crack repair work shall not begin until marking is complete and has been approved by Engineer.

1-2. SUBMITTALS. Specifications and data covering physical properties, mixtures, application procedures, and curing procedures of the materials proposed shall be submitted in accordance with the Submittals Procedures section. Submittals shall include the approvals from the material manufacturer.

1-3. QUALITY ASSURANCE.

1-3.01. Manufacturer's Field Services. The material manufacturer shall provide engineering field services to review the Work and the material application prior to any preparation; to approve the applicator, the material used, and the procedure to be used; to observe surface preparation; to approve surface preparation; and to observe application. The field representative of the material manufacturer shall submit, in writing through Contractor, approvals of proposed material, application procedures, applicator, and surface preparation. The field representative shall be an employee of the material manufacturer.

1-3.02. Applicator. The applicator shall submit through Contractor a satisfactory experience record including references from previous application of the specified materials to structures of similar design and complexity.

1-3.03. Pre-Construction Meeting. At least thirty (30) days prior to concrete crack repairs, Contractor shall conduct a meeting to review the detailed requirements for rehabilitation work. Site conditions, surface preparation, proposed equipment, procedures, material mixing, placing procedures, and curing methods shall be discussed and approved by Engineer and by the manufacturer's field representative. Contractor shall require the attendance of all involved parties, including but not limited to Contractor's superintendent, repair contractor,

manufacturer's field representative and proposed equipment supplier representative. Minutes of the meeting shall be recorded, typed and printed by Contractor and distributed to all parties within five (5) days after the meeting.

1-3.04. Quality Assurance Certification. Material manufacturers shall be ISO 9001/9002 registered or shall provide proof of documented quality assurance. The documented quality assurance system shall be obtained through an independent auditing registrar.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS. Unless otherwise specified or authorized, repairs shall conform to the requirements specified herein. Types of repairs not specified herein shall be as specified in other sections, as indicated on the Drawings, or, in the absence of any definite requirement, as recommended by the manufacturer's representative and subject to acceptance by Engineer. The following types of repairs shall be performed as required.

2-1.01. Epoxy Resin. Unless indicated otherwise on the drawings, epoxy resin shall be used to seal construction joints and cracks. Epoxy resin shall be pressure-injected for vertical and overhead applications. Epoxy resin may be applied by gravity feed in lieu of pressure injection for cracks in floors, using a very low-viscosity material.

2-1.02. Foam Resin. Foam resin shall be used to seal expansion joints. Otherwise, foam resin shall only be used to seal crack and joints when indicated on the drawings or when permitted by Engineer in lieu of epoxy resin. Foam resin shall be pressure-injected.

2-2. ACCEPTABLE PRODUCTS. Repair products/materials shall be as specified herein. Equivalent products of other manufacturers regularly producing high quality concrete crack repair products/materials, providing engineering field services, and meeting the specified quality assurance requirements may be furnished subject to review and acceptance by Engineer.

2-3. MATERIALS. Materials shall be approved by the manufacturer for the type of application, including temperature and moisture conditions encountered.

Products used in structures containing potable water shall be certified for NSF/ANSI 61.

Epoxy Resin	ASTM C881, Type I or Type IV, moisture tolerant or moisture insensitive.
Crack Sealant	As recommended by the manufacturer of the epoxy resin product.
Foam Resin	Hydrophilic polyurethane foam; Prime Resins "Prime-Flex 900 XLV", DeNeef "Sealfoam PUR", Euclid "Dural Aqua-Fil", or Avanti "AV-333 Injectaflex".
Foam Resin Accelerator	As recommended by foam resin manufacturer.
Water	Clean and free from deleterious substances.

PART 3 - EXECUTION

3-1. INSPECTION. Prior to the placement of the repair materials, the crack to be repaired shall be inspected by the material manufacturer to assure that preparation and conditions are correct for the type of repair and the product/material being used as specified herein.

3-2. PREPARATION. All cracks and surfaces around the cracks shall be free of objectionable substances and shall conform to the requirements of the material manufacturer. Concrete and shotcrete to be repaired shall be cleaned by methods acceptable to the material manufacturer so that the cracks are free of dirt, oil, grease, laitance, and other foreign matter. All loose and deteriorated existing concrete and shotcrete shall be removed down to sound materials. All concrete and shotcrete surfaces shall be checked for delamination to ensure that all surfaces are sound. All edges shall be square cut to avoid feather edges.

Any other preparation recommended by the material manufacturer shall be brought to Engineer's attention and may be incorporated into the work if acceptable to Engineer.

Concrete and shotcrete surfaces in the area of a crack to be repaired shall be cleaned by wire brushing, blasting, or other acceptable methods.

Wall surfaces shall be sandblasted clean to expose crack networks and construction joints. If there is active water seepage in the repair area, the

seepage shall be stopped as recommended by the injection material manufacturer and as acceptable to Engineer. Injection ports shall be installed, when recommended by the injection material manufacturer.

3-2.01. Injected Epoxy Resin. Preparation for injected epoxy resin shall include sealing the surface at the crack, on both sides when possible, with crack sealant as recommended by the material manufacturer and as acceptable to Engineer for the pressure injection work. Injection ports for epoxy resin shall penetrate through the crack sealant into the cracks at spacings recommended by the material manufacturer.

3-2.02. Injected Foam Resin. Preparation for injected foam resin shall include drilling offset injection holes at an angle that will intersect the crack, joint, or crack network at approximately one-half the thickness of the concrete or shotcrete up to a thickness of thirty-six (36) inches [900 mm]. Spacing of injection ports shall be determined as recommended by the injection material manufacturer and as acceptable to Engineer. When the injection material manufacturer certifies, in writing, that spacing of injection ports and installation procedures are acceptable, the injection ports may be installed directly into the crack, subject to review by Engineer.

3-3. APPLICATION. Concrete and shotcrete repair work shall be performed in accordance with the following requirements.

3-3.01. Crack Sealant. Crack sealant shall be trowel-applied to a minimum dried thickness of 1/8 inch [3 mm], or thicker if directed by manufacturer's literature. The concrete surface where the sealant is applied shall be smooth, uniform, and free from irregularities. Crack sealant shall be removed after the injection of resin is completed, except for portions of wall faces that will be at least 12 inches below the finished grade.

3-3.02. Pressure-Injected Resin. The injected areas shall be prepared as specified and as recommended by the manufacturer.

After the joints and cracks are prepared and before the injection of the resin, the joints shall be flushed with water. The water flush shall be terminated when the turbidity of the expelled water is equal to that of the flush water. Unless otherwise acceptable to resin manufacturer and Engineer, cracks shall be dry prior to injecting resin.

The pumping equipment used for the pressure injection of resin shall have pressure metering. Written procedures for use and quality control of the injection equipment shall be furnished to Engineer for review and acceptance. The pump

shall be electric. The material and process used for the pressure injection of the resin shall have been in use a minimum of five (5) years.

The joints and crack networks shall have a minimum of 90 percent penetration of resin into the joint or crack network. Core samples may be taken at Engineer's discretion.

3-3.02.01. Epoxy Resin. Epoxy resin shall be injected into the structure in accordance with the material manufacturer's recommendations and as acceptable to Engineer. Epoxy resin shall be injected until the resin appears at the next injection port.

3-3.02.02. Foam Resin. Foam resin shall be premixed and injected into the structure in accordance with the material manufacturer's recommendations and as acceptable to Engineer. Foam resin shall be injected into the structure until the resin appears at the next injection port.

Surfaces of cracks and joints may need to be sealed with crack sealant.

3-3.03. Gravity Fed Resin. A bead of the epoxy resin shall be placed over the entire surface of the crack. Enough resin shall be applied so that there is a visible heaping above the floor surface. The applicator shall periodically inspect the resin to verify that it has penetrated the crack and flattened against the floor surface. After the resin has flattened, another bead shall be applied, and the process repeated until the crack cannot receive additional resin.

3-3.04. Cold Weather. When ambient temperatures below 40°F [4°C] are expected during the curing period, the repair materials shall be maintained at a temperature of at least 50°F [10°C] for 14 days or 75°F [24°C] for 7 days after placement. Sudden cooling of the repair materials shall not be permitted.

3-4. PROTECTION. Post-placement curing and protection shall be as specified herein and in accordance with the manufacturer's recommendations.

3-5. CLEANING. Work areas shall be cleaned each day in accordance with the Project Requirements section. Upon completion of the final cleanup, Contractor shall restore all areas affected by the repair procedures to their original condition, leaving no trace of material piles or other wasted materials.

End of Section

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Section 05550

ANCHORAGE IN CONCRETE AND MASONRY

PART 1 - GENERAL

1-1. SCOPE. This section covers the design and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts and anchor rods, adhesive anchors for both threaded rods and reinforcing bars, expansion anchors, and undercut anchors.

1-2. GENERAL.

1-2.01. Anchors Designed by Engineer. Cast-in-place and post-installed anchors that are fully detailed on the Drawings have been designed by Engineer and may not be changed to a different type without written approval of Engineer.

1-2.02. Anchors Designed by Contractor's Suppliers. Contractor's material suppliers shall be responsible for design of anchors for railings, ladders, equipment, pre-engineered structures, and other manufactured items, as indicated in the Drawings and Specifications. Anchors shall be designed for all operating conditions, including wind and seismic loadings when indicated in the Meteorological and Seismic Design Criteria section. Cast-in-place anchors shall be used unless post-installed types are indicated on the Drawings or accepted by Engineer.

Adhesive anchors used in vibrating applications, such as for pumps, shall only be used if the anchor manufacturer submits documentation indicating that the product is suitable for the anticipated service conditions.

1-2.03. Materials. Unless otherwise indicated, anchors of structural steel members connected to concrete shall have a diameter of at least 3/4 inch, and structural members connected to masonry shall have a diameter of at least 5/8 inch. Anchors for ladders and equipment shall have a diameter of at least 1/2 inch. Anchors for pedestrian railing systems shall have a diameter of at least 3/8 inch.

Unless otherwise indicated on the Drawings, anchors used in the following locations and applications shall be of the indicated materials.

Cast-In-Place Anchor Bolts and Anchor Rods

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Galvanized steel.
Other exterior locations	Galvanized steel.
Interior locations not subject to corrosion	Carbon steel.

Adhesive, Expansion, and Undercut Anchors

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Stainless steel.
Other exterior locations	Stainless steel.
Interior locations not subject to corrosion	Carbon steel.

Adhesive, expansion, and undercut anchors may be used instead of cast-in-place anchors only where specifically indicated or permitted on the Drawings or with the specific acceptance by Engineer.

1-3. SUBMITTALS. Data, catalog cuts, and manufacturer's research reports (from independent organizations such as ICC-ES or IAPMO UES) indicating the manufacturer and types of adhesive anchors, expansion anchors, and undercut anchors to be supplied shall be submitted in accordance with the Submittals Procedures section.

If Contractor requests use of products other than those indicated herein, calculations may be required as part of the submittal package. Calculations shall be prepared by a professional engineer licensed in the state of the project, using methods and procedures required by the building code. Contractor shall demonstrate that the proposed substitute anchors are equivalent in all necessary criteria, including strength, spacing and edge distance limitations, embedment depth limitations, temperature limitations, and any other criteria required by Engineer.

1-4. DELIVERY, STORAGE, AND HANDLING. Materials shall be handled, transported, and delivered in a manner which will prevent damage or corrosion. Damaged materials shall be promptly replaced. Materials shall be shipped and stored in original manufacturer's packaging.

PART 2 - PRODUCTS

2-1. MATERIALS. Unless otherwise indicated on the drawings, materials shall be as indicated below.

Cast-In-Place Anchor Bolts and Anchor Rods

Carbon steel	ASTM F1554, Grade 36 with compatible nuts.
Galvanized steel	ASTM F1554, Grade 36 with compatible nuts; hot-dip galvanized, ASTM F2329.
Stainless steel	Bolts, ASTM F593, Alloy Group 2 (minimum yield strength of 45 ksi); nuts, ASTM F594, Alloy Group 1 or 2.
Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.

Expansion Anchors in Concrete	Products shall be single component anchors tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete, and for resisting seismic forces. Hilti "Kwik-Bolt TZ", Simpson "Strong-Bolt 2", or DeWalt "Power-Stud+SD2" (carbon steel), "Power-Stud+SD4" (304 stainless steel), and "Power-Stud+SD6" (316 stainless steel).
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Expansion Anchors in Grouted Concrete Masonry Units	Products shall be single component anchors tested in accordance with ICC AC01, and shall have a manufacturer's research report in compliance with the applicable building code. Hilti "Kwik-Bolt TZ Masonry Anchors", Simpson "Wedge-All", or DeWalt "Power-Stud+ SD1".
Undercut Anchors in Concrete	Products shall be tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. Hilti "HDA Undercut Anchor" (carbon steel) and "HDA-R Undercut Anchor" (stainless steel), or DeWalt "Atomic+ Undercut Anchor" (A36 carbon steel).
Adhesive Anchors in Concrete	Products shall be tested in accordance with ICC AC308, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete, and for resisting seismic forces.
Threaded Rods and Nuts (Carbon Steel)	ASTM A307 or ASTM F1554 Grade 36.
Threaded Rods and Nuts (Stainless Steel)	ASTM F593, CW.
Reinforcing Bars	ASTM A615, Grade 60, deformed.
Reinforcing Bars, weldable	ASTM A706, Grade 60, deformed.
Adhesive	Hilti "HIT-HY 200", or DeWalt "Pure 110+".

Adhesive Anchors in Grouted
Concrete Masonry Units

Products shall be tested in accordance with ICC AC58, and shall have a manufacturer's research report in compliance with the applicable building code.

Threaded Rods and Nuts
(Carbon Steel)

ASTM A307 or ASTM F1554 Grade 36.

Threaded Rods and Nuts
(Stainless Steel)

ASTM F593 CW (Hilti or Powers systems), or ASTM A193 Grades B6, B8, or B8M (for Simpson system).

Adhesive

Hilti "HIT-HY 270", DeWalt "AC100+ Gold", or Simpson "SET XP".

Adhesive Anchors in Hollow
Concrete Masonry Units

Products shall be tested in accordance with ICC AC58, and shall have a manufacturer's research report in compliance with the applicable building code.

Threaded Rods and Nuts
(Carbon Steel)

ASTM A307 or ASTM F1554 Grade 36.

Threaded Rods and Nuts
(Stainless Steel)

ASTM F593 CW (Hilti or Powers systems), or ASTM A193 Grades B6, B8, or B8M (for Simpson system).

Adhesive

Hilti "HIT-HY 270", DeWalt "AC100+ Gold", or Simpson "SET XP".

Screen Tubes

As recommended by the manufacturer.

Adhesive Anchors in
Unreinforced Brick Masonry

Products shall be tested in accordance with ICC AC60, and shall have a manufacturer's research report in compliance with the applicable building code.

Threaded Rods and Nuts

ASTM A307.

Adhesive

Hilti "HIT-HY 270", DeWalt "AC100+ Gold", or Simpson "SET".

Screen Tubes

As recommended by the manufacturer.

2-2. ANCHORS.

2-2.01. Cast-in-Place Anchor Bolts and Anchor Rods. Cast-in-place anchor bolts and anchor rods shall have forged heads or embedded nuts and washers. Anchors shall be delivered in time to permit setting prior to the placing of structural concrete or masonry grout. Anchor sleeves shall not be used unless acceptable to Engineer. Unless installed in sleeves, anchor bolts and anchor rods shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts and anchor rods indicated on the Drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts and anchor rods without locknuts.

2-2.02. Adhesive, Expansion, and Undercut Anchors. When adhesive, expansion, or undercut anchors are indicated on the Drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the Drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer.

Unless otherwise noted, single nuts and washers shall be provided with adhesive anchors, expansion anchors, and undercut anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.

Adhesive anchors in hollow CMU masonry and unreinforced brick masonry shall utilize screen tubes as recommended by the manufacturer.

PART 3 - EXECUTION

3-1. GENERAL. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before tightening of the nuts.

3-1.01. Compliance With Manufacturer's Instructions. Post-installed anchors shall be installed in accordance with the manufacturer's printed installation instructions and all applicable requirements of the manufacturer's research report for the specific anchor system. If conflicts are found between the Drawings, the manufacturer's printed installation instructions, and the manufacturer's research report installation requirements, Contractor shall notify Engineer for resolution.

3-1.02. Special Inspection. Special inspection requirements for cast-in-place and post-installed anchors shall be as indicated in the Code-Required Special Inspections and Procedures section. Anchorage work shall be performed in a manner that allows the inspections to take place without adversely impacting the schedule.

3-2. CAST-IN-PLACE ANCHOR BOLTS AND ANCHOR RODS. Cast-in-place anchor bolts and anchor rods shall be carefully positioned with templates and secured in the forms prior to placing concrete, or in masonry bond beams prior to placing grout. Contractor shall verify that anchorage devices are positioned in accordance with the Drawings and with applicable equipment or structure submittal drawings.

Threads, bolts, and nuts spattered with concrete or masonry grout during placement shall be cleaned prior to final installation of the bolts and nuts.

Sleeves shall be filled with non-shrink grout.

3-3. ADHESIVE ANCHORS. Adhesive shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.

Anchors or bars shall be installed in holes hammer drilled into hardened concrete or masonry. Drill shall be set to rotation-only mode when drilling into hollow CMU or into brick. Diameter of holes shall be 1/16 inch larger than the outside diameter of the rod or bar unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared by removing all dust and debris using procedures recommended by the adhesive manufacturer.

Adhesive anchors and holes shall be clean, dry, and free of grease and other foreign matter at the time of installation. The adhesive shall be placed and the rods or bars shall be set in accordance with the recommendations of the manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids.

3-3.01. Concrete Installation. Unless indicated otherwise on the Drawings, reinforcing bars shall be embedded to a depth of 15 bar diameters, and threaded rods shall be embedded to a depth that will develop the yield strength of the rod.

Adhesive anchors in concrete shall be installed under the following conditions.

Minimum Age of Concrete Prior to Anchor Installation	21 days.
Concrete Temperature Range	Maximum short-term temperature 162 F, maximum long-term temperature 110 F.
Moisture Condition	Dry concrete.
Type of Lightweight Concrete	N/A
Hole Drilling and Preparation	Hammer drill only.

Installation of adhesive anchors into concrete that are either horizontal or upwardly inclined shall be performed only by personnel certified by the ACI/CRSI Adhesive Anchor Installation Certification Program.

3-3.02. Masonry Installation. Anchors shall be installed to meet all criteria in the manufacturer's installation instructions and ICC-ES reports, including but not limited to minimum compressive strength at time of installation, minimum edge distances, minimum clearances from mortar joints, minimum anchor spacing, and use of screen tubes.

3-4. EXPANSION AND UNDERCUT ANCHORS. Expansion and undercut anchors shall be installed using all procedures and accessory devices recommended by the anchor manufacturer.

End of Section

Section 07900

JOINT SEALANTS

PART 1 - GENERAL

1-1. SCOPE. This section covers caulking and sealing. Fire rated caulking is covered in the Fireproofing section.

1-2. GENERAL. The terms "caulking" and "sealing", as used on the Drawings and in these Specifications, are synonymous. Both terms indicate the materials specified herein. Oil-base caulking shall not be used on this Project.

1-3. APPROVALS. All caulking shall meet the requirements of the standards specified herein. All caulking and sealing to be used in contact with potable water shall meet the requirements of ANSI/NSF Standard 61.

1-4. SUBMITTALS. Specifications and data covering the materials proposed for use, together with samples or color cards showing the manufacturer's full line of sealant colors, shall be submitted in accordance with the Submittals Procedures section.

PART 2 - PRODUCTS

2-1. MATERIALS.

Thiokol Sealants (polysulfides)

Fed Spec TT-S-00227E, Class A or
ASTM 920 Type M; polysulfide rubber,
two component.

Nonsag

Submerged Service,
Non potable water

Pecora "Synthacalk GC-2+".

Nonsubmerged Service Service	Pecora "Synthacalk GC-2+"; Polymeric Systems "PSI-350".
Self-Leveling, nonsubmerged	A. C. Horn "Hornflex Traffic Grade"; Polymeric Systems "PSI-350".
Urethane Sealants (Polyurethanes)	Fed Spec TT-S-00227E, Class A, Type 2 and ASTM C920, Type M, Grade NS, two component.
Nonsag	
Submerged Service	
Potable Water	Polymeric Systems "RC-270"; Sika "Sikaflex-2cNS".
Nonpotable Water	Polymeric Systems "RC-270".
Nonsubmerged Service Service	Bostik "Chem-Calk 500"; Tremco "Vulkem 227"; Pecora "Dynatrol II"; Tremco "DYmeric 240"; Sika "Sikaflex-2cNS".
Self-Leveling, Nonsubmerged Service	Bostik "Chem-Calk 550"; Tremco "Vulkem 245"; Pecora "Urexpan NR-200"; Polymeric Systems "RC-2SL"; Tremco "THC-900".
Acrylic Sealant	Fed Spec TT-S-230; ASTM C834. Bostik "Chem-Calk 600"; Pecora "AC20"; Tremco "Mono 555".
Silicone Sealant	Silicone rubber, neutral color; Dow Corning "Mildew-Resistant silicone 786"; General Electric "Silicone Sanitary 1702 Sealant".
Primer	As recommended by the sealant manufacturer.
Backup Material	Polyethylene or polyurethane foam as recommended by the sealant manufacturer; Dow "Ethafoam SB" or Plateau "Denver Foam".

Bondbreaker Tape

Adhesive-backed polyethylene tape as recommended by the sealant manufacturer.

2-2. COLORS. Colors of sealants shall be as selected by Engineer from the manufacturer's standard line of colors. Different colors may be required for different locations.

2-3. LOCATIONS TO BE CAULKED.

2-3.01. With Thiokol or Urethane Sealant (Nonsag) - Submerged Service.

All joints requiring caulking in submerged locations.

Surface of basin weir plates in contact with supporting structure.

2-3.02. With Thiokol or Urethane Sealant (Nonsag) - Nonsubmerged Service.

Entire perimeter of frames for exterior metal doors.

Entire perimeter of metal louvers.

Entire perimeter of metal dampers and metal shutters.

Entire perimeter of aluminum windows.

Control joints in masonry walls.

Perimeter of aluminum entrances and assemblies, except exterior side of exterior sills.

Joints on the underside of prestressed, precast roof members where exposed to view.

Around service sinks.

Joints between masonry and cast-in-place concrete, where indicated on the Drawings.

Other locations where caulking is indicated on the Drawings, specified in other sections, or required for weatherproofing.

2-3.03. With Thiokol or Urethane Sealant (Self-Leveling).

Horizontal joints in walks or drives.

Horizontal joints in traffic-bearing decks and slabs.

Annular space around handrail posts set in sleeves.

2-3.04. With Acrylic Sealant.

Watertight joints in sheet metal work.

2-3.05. With Silicone Sealant. Not used.

PART 3 - EXECUTION

3-1. JOINT PREPARATION. All surfaces to receive sealant shall be clean, dry, and free from dust, grease, oil, or wax. Concrete surfaces which have been contaminated by form oil, paint, or other foreign matter which would impair the bond of the sealant to the substrate shall be cleaned by sandblasting. All surfaces shall be wiped with a clean cloth saturated with xylol or other suitable solvent, and shall be primed before the sealant is applied.

Unless otherwise recommended by the sealant manufacturer and permitted by the Engineer, the depth of sealant in a joint shall be equal to the width of the joint, but not more than 1/2 inch. Backup material shall be provided as necessary to control the depth of sealant and shall be of suitable size so that, when compressed 25 to 50 percent, the space will be filled. Backup material shall be rolled or pressed into place in accordance with the manufacturer's installation instructions, avoiding puncturing and lengthwise stretching. If depth of the joint does not permit use of backup material, bondbreaker tape shall be placed at the bottom of the joint to prevent three-sided adhesion.

3-2. SEALING. Sealing work shall be done before any field painting work is started. The air temperature and the temperature of the sealed surfaces shall be above 50°F when sealing work is performed.

Upon completion of the sealing work, each sealed joint shall have a smooth, even, tooled finish, flush with the edges of the sealing recess, and all adjacent surfaces shall be clean. Sealant shall not lap onto adjacent surfaces. Any sealant so applied as to prevent the painting of adjacent surfaces to a clean line, or with an excess of material outside the joint and feathered onto surfaces, shall be removed and the joint resealed.

End of Section

Section 08305

FLOOR ACCESS DOORS AND HATCHES

PART 1 - GENERAL

1-1. SCOPE. This section covers the replacement and refurbishment of floor access doors and hatch hardware for Plant 3 chlorine contact chamber and transfer pump station.

Fabricated items which are indicated on the Drawings but not mentioned specifically herein shall be fabricated in accordance with the applicable requirements of this section.

Contractor shall replace hatch hardware including latches, hinges, compression springs enclosed in telescopic tubes, and hold-open arms for locations indicated on the drawings.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Equipment shall be furnished complete with all components and accessories required for proper operation, and any additional materials or construction required by the manufacturer's design.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete assembly and installation drawings, together with detailed specifications, capacities, and data covering material used, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

1-5. WARRANTY. Provide manufacturer's standard warranty. Materials shall be free of defects in material and workmanship from the date of purchase. Should a part fail to function in normal use within the manufacturer's standard warranty period, manufacturer shall furnish a new part at no charge.

PART 2 - PRODUCTS

2-1. GENERAL. All members and parts shall be free of warps, local deformations, and unauthorized bends. Holes and other provisions for field connections shall be accurately located and shop checked so that proper fit will result when the units are assembled in the field. All field connection materials shall be furnished.

2-2. ACCEPTABLE MANUFACTURERS. Access door and hatches hardware shall be as manufactured by Halliday Products, Bilco Company, Dur-Red Products, or USF Fabrication Inc. For refurbishment of existing hatches, hardware shall be obtained from the original manufacturer.

2-3. DESIGN REQUIREMENTS. The operators shall provide for smooth, easy and controlled door operation throughout the entire arc of opening and closing. Operation shall not be affected by temperature.

2-4. HARDWARE. Hardware shall be Type 316 stainless steel throughout and provided as described below.

PART 3 - EXECUTION

3-1. INSTALLATION. Materials replaced or refurbished shall be erected and installed in conformity with the dimensions and arrangements of the existing hatches and as recommended by the manufacturer. Test units for proper function and adjust until proper operation is achieved. Product finishes damaged during erection shall be repaired as recommended by the manufacturer.

End of Section

Section 09940

PROTECTIVE COATINGS

PART 1 - GENERAL

1-1. SCOPE. This section covers field applied protective coatings, including surface preparation, protection of surfaces, inspection, and other appurtenant work for equipment and surfaces designated to be coated with heavy-duty maintenance coatings. Regardless of the number of coats previously applied, at least two field coats in addition to any shop coats or field prime coats shall be applied to all surfaces unless otherwise specified.

1-2. GENERAL. Cleaning, surface preparation, coating application, and thickness shall be as specified herein and shall meet or exceed the coating manufacturer's recommendations. When the manufacturer's minimum recommendations exceed the specified requirements, Contractor shall comply with the manufacturer's minimum recommendations. When equivalent products are acceptable to Engineer, Contractor shall comply with this Specification and the coating manufacturer's recommendations.

1-2.01. Governing Standards. All cleaning, surface preparation, coating application, thickness, testing, and coating materials (where available) shall be in accordance with the referenced standards of the following AWWA, ANSI, NACE, SSPC, NSF, and ASTM.

1-2.02. Delivery and Storage. All coating products shall be received and stored in accordance with the coating manufacturer's recommendations.

1-2.03. Coatings, Painting, and Linings Covered in Other Sections. Not used.

1-3. SUBMITTALS. Contractor shall submit color cards for all coatings proposed for use, together with complete descriptive specifications, manufacturer's product data sheet and the completed Coating System Data Sheets, to Engineer for review and color selection. Each product data sheet shall include application temperature limits including recoat time requirements for the ambient conditions at the site, including temperatures up to 130°F. Requests for review submitted directly to Engineer by coating suppliers will not be considered.

When the proposed products will be in contact with treated or raw water in potable water treatment facilities, Contractor shall submit certifications that the proposed systems are in compliance with ANSI/NSF 61.

Contractor shall submit a Coating System Data Sheet for each separately identified surface in the Metal Surfaces Coating Schedule, Concrete and Masonry Surfaces Coating Schedule, and the Miscellaneous Surfaces Coating Schedule that will be used in the Project, using the appropriate Coating System Data Sheet forms (Figures 1-09940 and 2-09940) at the end of this section. Each field coating system shall be acceptable to the coating material manufacturer.

Coating System Data Sheets shall be assigned a unique number with a prefix letter based on the following:

Prefix	Surfaces	Fig.09940
A	Iron and steel (coated entirely in field)	1
A	Iron and steel (shop primed)	2
C	Concrete and concrete block	1
E	Equipment - submerged	1
E	Equipment – nonsubmerged	2
F	Nonferrous metal	1
G	Galvanized	1
H	High temperature	1
P	PVC and FRP	1

Each coating system that will be applied entirely in the field shall be assigned only a prefix letter and no suffix letter. Fig.1-09940 shall be submitted for each surface coated entirely in the field.

Each shop-applied coating system that includes one or more field applied coats shall be assigned both a prefix letter and suffix letter “F”. Fig.2-09940 shall be submitted for each surface having a shop applied coating and one or more field applied finish coats.

A separate Coating System Data Sheet shall be developed and submitted for each surface scheduled to be coated or variation or change in a coating system. The number identifying the surface and coating system shall be of the form A1₁ or A1₂-F. The subscript number shall be assigned by the Contractor so that each surface and coating system combination is uniquely identified. For example:

A1₁-F may be assigned to “Epoxy – one coat to metal curbs for skylights and power roof ventilators that have been shop primed.”

A2₁ may be assigned to “Epoxy – two coats to non-galvanized structural and miscellaneous steel exposed to view inside buildings.”

C2₁ may be assigned to “Epoxy – two coats to all concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.”

C2₂ may be assigned to “Epoxy – two coats to walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment as indicated on the Drawings.”

For the epoxy and for aliphatic polyurethane, a total of not more than 15 custom colors (excluding deeptone or high-level colors) may be required. The manufacturer's standard colors will be acceptable for all other coatings.

1-4. QUALITY ASSURANCE.

1-4.01. Coating System Data Sheet Certifications. The coating applicator and coating manufacturer shall review and approve in writing the coating manufacturer's written recommendations for the coating system and the intended service. Any variations from the Specifications or the coating manufacturers published recommendations shall be submitted in writing and approved by the coating manufacturer.

1-4.02. Special Interior Coating Systems. Not used.

PART 2 - PRODUCTS

2-1. ACCEPTABLE MANUFACTURERS.

2-1.01. Alternative Manufacturers. In addition to the coatings listed herein, equivalent products of other manufacturers that distribute globally will also be acceptable.

2-1.02. Equivalent Coatings. Whenever a coating is specified by the name of a proprietary product or of a particular manufacturer or vendor, it shall be understood as establishing the desired type and quality of coating. Other manufacturers' coatings will be accepted, provided that sufficient information is submitted to enable Engineer to determine that the proposed coatings are equivalent to those named. Information on proposed coatings shall be submitted for review in accordance with the Submittals Procedures section. Requests for

review of equivalency will be accepted only from Contractor, and will be considered only after the contract has been awarded.

2-2. MATERIALS. All coatings shall be delivered to the job in original, unopened containers, with labels intact. Coatings shall be stored indoors and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the coating formulation shall be added to the coating for any purpose.

All coatings shall conform to the air quality regulations applicable at the location of use. Coating materials that cannot be guaranteed by the manufacturer to conform, whether or not specified by product designation, shall not be used.

With the exception of heat resistant coatings, the coatings specified have been selected on the basis of the manufacturer's statement that the VOC content of the product is 2.8 lbs per gallon or less; however, it shall be the Contractor's responsibility to use only coating materials that are in compliance with the requirements of all regulatory agencies. Local regulations may require some coatings to have a lower VOC content than specified herein. The coatings specified may meet the VOC limits in the unthinned (as shipped) condition, but may exceed the limits if thinned according to the manufacturer's recommendations. In such case, the coatings shall not be thinned beyond the 2.8 lbs per gallon limit, and if the product cannot be thinned to suit the application method or temperature limits, another manufacturer's coating shall be used, subject to acceptance by Engineer.

Contractor shall be responsible for ensuring the compatibility of field coatings with each other or with any previously applied coatings. Coatings used in successive field coats shall be produced by the same manufacturer. The first field coat over shop coated or previously coated surfaces shall cause no wrinkling, lifting, or other damage to underlying coats.

All coatings used on surfaces that will be in contact with potable or treated water shall be certified as being in compliance with ANSI/NSF 61. Coatings that cannot be so certified, whether or not specified by manufacturer and by product designation, shall not be used.

2-2.01 Primers.

Universal Primer (tie coat)

PPG Amercoat "Amercoat 385 Epoxy", Carboline "Rustbond", ICI Devoe "Devran 224HS", Tnemec "Series 27 F.C. Typoxy", or

Sherwin-Williams "Dura Plate 235".

Zinc Primer

PPG Amercoat "Dimetate 9 Series", Carboline "Carbo Zinc II Series", ICI Devoe "Catha-Coat 304V", or Sherwin-Williams "Zinc Clad II Series".

2-2.02. Fillers and Surfacers.

Epoxy Concrete Block Filler

PPG Amercoat "Amerlock 400BF Epoxy Block Filler", Carboline "Sanitile 600", ICI Devoe "Truglaze 4015", Tnemec "Series 54-562", or Sherwin-Williams "Kem Cati-Coat HS".

Epoxy Concrete Filler and Surfacers

Tnemec "Series 218 MortarClad", PPG Amercoat "NuKlad 114A", Carboline "Carboguard 510", or Sherwin-Williams "Steel Seam FT910".

2-2.03. Intermediate and Finish Coatings.

Epoxy (NSF certified systems)

Ferrous Metal Surfaces and Concrete Surfaces in Contact with Treated or Raw Water in Potable Water Facilities

PPG Amercoat "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", ICI Devoe "Bar-Rust 233H" Tnemec "Series N140 Pota-Pox Plus", or Sherwin-Williams "Dura Plate 235 NSF"; immersion service.

Epoxy

Concrete Floors

PPG Amercoat "Amerlock 400", Carboline "Carboguard 890", ICI Devoe "Devran 224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Armorseal 1000HS"; nonskid.

Ferrous Metal Surfaces and Masonry or Concrete Surfaces Other Than Floors	PPG Amercoat "Amercoat 385 Epoxy", Carboline "Carboguard 890", ICI Devoe Devran "224HS", Tnemec "Series N69 Hi-Build Epoxoline II", or Sherwin-Williams "Dura Plate 235".
Flake-Filled Epoxy	Carboline "Plasite 4500/4500S", Sherwin-Williams "Sher-Glass FF".
Aliphatic Polyurethane	PPG Amercoat "Amercoat 450H", Carboline "Carbothane 134HG", ICI Devoe "Devthane 379H" Tnemec "Series 1074 Endura-Shield II", or Sherwin- Williams "Acrolon 218HS".
Coal Tar Epoxy	High-build coal tar epoxy; PPG Amercoat "Amercoat 78HB Coal Tar Epoxy", Carboline "Bitumastic 300 M", Tnemec "46H-413 Hi-Build Tneme-Tar", or Sherwin- Williams "Hi-Mil Sher-Tar Epoxy".
Medium Consistency Coal Tar	Carboline "Bitumastic 50" or Tnemec "46-465 H.B. Tnemecol".
Vinyl Ester	Tnemec "Series 120 Vinester" Carboline "Plasite 4110" or Sherwin-Williams "Magnalux 304FF".
Heat-Resistant	Suitable for temperatures up to 400°F; PPG Amercoat "Amerlock 400", Carboline "Thermaline 450", Tnemec "43-36 Chrome Aluminum", or Sherwin-Williams "Silver-Brite Aluminum".
High Heat-Resistant	Suitable for temperatures up to 1000°F; PPG Amercoat "Amercoat 878", Carboline "Thermaline 4700 VOC", or Sherwin-Williams "Silver- Brite Hi-Heat Silicone Aluminum".

PART 3 - EXECUTION

3-1. SURFACE PREPARATION. All surfaces to be coated shall be clean and dry and shall meet the recommendations of the coating manufacturer for surface preparation. Freshly coated surfaces shall be protected from dust and other contaminants. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started. The gloss on previously coated surfaces shall be dulled if necessary for proper adhesion of topcoats.

Surfaces shall be free of cracks, pits, projections, or other imperfections that would interfere with the formation of a smooth, unbroken coating film, except for concrete block construction where a rough surface is an inherent characteristic.

When applying touchup coating or repairing previously coated surfaces, the surfaces to be coated shall be cleaned as recommended by the coating manufacturer, and the edges of the repaired area shall be feathered by sanding or wire brushing to produce a smooth transition that will not be noticeable after the coating is applied. All coatings made brittle or otherwise damaged by heat of welding shall be completely removed.

3-1.01. Galvanized Surfaces. Galvanized surfaces shall be prepared for coating according to the instructions of the manufacturer of the epoxy. Any chemical treatment of galvanized surfaces shall be followed by thorough rinsing with clean water.

3-1.02. Ferrous Metal Surfaces. Ungalvanized ferrous metal surfaces shall be prepared for coating by using one or more of the following cleaning procedures specified here-in: solvents (SSPC-SP1); abrasive blasting (SSPC-SP5, -SP10, -SP6, or -SP7) power tools (SSPC-SP3 or -SP11); or hand tools (SSPC-SP2). Oil and grease shall be completely removed in accordance with SSPC-SP1 before beginning any other cleaning method. Surfaces of welds shall be scraped and ground as necessary to remove all slag and weld spatter. Tools which produce excessive roughness shall not be used.

All components of equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components that will be inaccessible after installation shall have the surfaces prepared and coated before installation. Motors, drive trains, and bearings shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

All cut or sheared edges shall be ground smooth to a 1/8 inch [3 mm] minimum radius for all material 1/4 inch thickness and larger. For material thickness less

than 1/4 inch all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of the 1/16 inch will not be required.

All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard SP0178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as required by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory adhesion of paint.

The cleaning methods and surface profiles specified herein are minimums, and if the requirements printed in the coating manufacturer's data sheets exceed the limits specified, the value printed on the data sheets shall become the minimum requirement.

3-1.02.01. Ferrous Metal Surfaces – Non-immersion Service. Ferrous metal surfaces, including fabricated equipment, in non-immersion service shall be cleaned to the degree recommended by the coating manufacturer for surfaces to be coated with coal tar epoxy, epoxy, and heat-resistant coatings, except galvanized surfaces. Surface preparation of ferrous metal surfaces in non-immersion service shall consist of abrasive blast cleaning to SSPC-SP6, and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 2.0 mils.

3-1.02.02. Ferrous Metal Surfaces - Immersion Service. Surface preparation of ferrous metal surfaces in immersion service shall consist of abrasive blast cleaning to at least SSPC-SP10 and the first application of coating shall be performed on the same day. If more surface area is prepared than can be coated in one day, the uncoated area shall be blast cleaned again to the satisfaction of Engineer. Surface profile shall be as recommended by coating manufacturer, but not less than 3.5 mils.

3-1.03. Concrete Surfaces. All concrete surfaces shall be free of objectionable substances and shall meet the coating manufacturer's recommendations for surface preparation. Concrete surfaces shall be prepared in accordance with SSPC-SP13/NACE 6. Any other surface preparation recommended by the coating material manufacturer shall be brought to Engineer's attention and may be incorporated into the work if acceptable to Engineer.

All concrete surfaces shall be dry when coated and free from dirt, dust, sand, mud, oil, grease, and other objectionable substances. Oil and grease shall be completely removed by use of solvents or detergents before mechanical cleaning is started.

New concrete shall have cured for at least four (4) weeks before coating is applied as recommended by the material manufacturer. Concrete surfaces shall be tested for capillary moisture in accordance with ASTM D4263. There shall be no capillary moisture when coatings are applied on concrete.

All surfaces to be coated shall be cleaned in accordance with ASTM D4258 and abraded in accordance with ASTM D4259. Surface profile shall be at least 25 percent of the dry film thickness specified for the coating system. Prior to application of the coating, the surfaces shall be thoroughly washed or cleaned by air blasting to remove all dust and residue. Spalled areas, voids, and cracks shall be repaired in accordance with the Concrete section and as acceptable to the Engineer. Fins and other surface projections shall be removed to provide a flush surface before application of coating.

Except where epoxy is applied as damp-proofing, the concrete surfaces, including those with bug holes less than one (1) inch in any dimension, shall be prepared as recommended by the manufacturer, using an epoxy concrete filler and surfacer. Where coating with a vinyl ester the concrete filler and surfacer shall be as recommended by the manufacturer to be compatible with vinyl ester.

3-1.04. Concrete Block Surfaces. Voids and openings in concrete block surfaces shall be pointed. All exposed exterior surfaces and surfaces to be coated with epoxy, including the joints, shall be filled so that a continuous unbroken coating film is obtained.

3-1.05. Copper Tubing. All flux residue shall be removed from joints in copper tubing. Immediately before coating is started, tubing shall be wiped with a clean rag soaked in xylol.

3-1.06. Plastic Surfaces. All wax and oil shall be removed from plastic surfaces that are to be coated, including PVC and FRP, by wiping with a solvent compatible with the specified coating.

3-1.07. Hardware. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to coating if there is no evidence of dirt, corrosion, or foreign material.

3-1.08. Aluminum. When a coating system is required, remove all oil or deleterious substance with neutral detergent or emulsion cleaner or blast lightly with fine abrasive.

3-1.09. Stainless Steel. When a coating system is required, surface preparation shall conform to the coating manufacturer's recommendations.

3-2. MIXING AND THINNING. Coating shall be thoroughly mixed each time any is withdrawn from the container. Coating containers shall be kept tightly closed except while coating is being withdrawn.

Coating shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied coating be reduced, by addition of coating thinner or otherwise, below the thickness recommended by the coating manufacturer. Thinning shall be done in compliance with all applicable air quality regulations.

3-3. APPLICATION. Coating shall be applied in a neat manner that will produce an even film of uniform and proper thickness, with finished surfaces free of runs, sags, ridges, laps, and brush marks. Each coat shall be thoroughly dry and hard before the next coat is applied. Each coat shall be a different color, if available. In no case shall coating be applied at a rate of coverage greater than the maximum rate recommended by the coating manufacturer.

Coating failures will not be accepted and shall be entirely removed down to the substrate and the surface recoated. Failures include but are not limited to sags, checking, cracking, teardrops, fat edges, fisheyes, or delamination.

Spray painting shall not be permitted.

3-3.01. Priming. Edges, corners, crevices, welds, and bolts shall be given a brush coat (stripe coat) of primer before application of the primer coat. The stripe coat shall be applied by a brush and worked in both directions. Special attention shall be given to filling all crevices with coating. When using zinc primers the stripe coat shall follow the initial prime coat.

Abraded and otherwise damaged portions of shop-applied coating shall be cleaned and recoated as recommended by the manufacturer of the finish coating. Welded seams and other uncoated surfaces, heads and nuts of field-installed bolts, and surfaces where coating has been damaged by heat shall be given a brush coat of the specified primer. Before the specified spot or touchup coating of metal surfaces, edges, corners, crevices, welds, and bolts in the area of the

spot or touchup coating shall be given a brush coat of primer. This patch, spot, or touchup coating shall be completed, and the paint film shall be dry and hard, before additional coating is applied.

3-3.02. Epoxy. When used, epoxy shall be applied in accordance with the coating manufacturer's recommendations, including temperature limitations and protection from sunlight until top-coated.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

When applying high build epoxy coatings with a roller or brush and where a dry film thickness of at least 4-6 mils per coat is required, two or more coats shall be applied to achieve the recommended dry film thickness equal to a spray applied coating.

3-3.03. Coal Tar Epoxy. When used, the application of coal tar epoxy, including time limits for recoating, shall conform to the recommendations of the coating manufacturer.

When concrete is to be coated, coatings shall not be applied to concrete surfaces in direct sunlight or when the temperature of the concrete is rising. Preferably the coating shall be applied when the temperature of the concrete is dropping.

3-3.04. Vinyl Ester. When used, the application of vinyl ester coating system, including time limits for recoating and temperature requirements of the materials, shall conform to the recommendations of the coating manufacturer.

3-3.05. Film Thickness. The total coating film thickness including intermediate coats and finish coat, shall be not less than the following:

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Medium consistency coal tar	20 mils.
Coal tar epoxy (two coats)	20 mils.
Epoxy	
Floors (two coats)	10 mils.
Surfaces with first coat of epoxy and final coat of aliphatic polyurethane	7 mils (5 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Surfaces with first and second coat of epoxy and final coat of aliphatic polyurethane	12 mils (10 mils DFT for epoxy plus 2 mils DFT for aliphatic polyurethane).
Other surfaces (two coats)	10 mils.

<u>Type of Coating</u>	<u>Minimum Dry Film Thickness</u>
Immersion service (three coats)	15 mils.
Flake-filled epoxy (two coats)	30 mils.
Vinyl ester	30 mils.
Zinc, epoxy, polyurethane	
Surfaces with first coat of zinc, intermediate coat of epoxy, and final coat of aliphatic polyurethane	10 mils, 3 mils zinc, 5 mils epoxy, plus 2 mils for aliphatic polyurethane.
Heat-resistant (silicone)	3 mils.
High heat-resistant (silicone)	3 mils.
Other (one coat)	5 mils.
Other (two coats)	10 mils.

3-3.06. Weather Conditions. Coatings shall not be applied, except under shelter, during wet, damp, or foggy weather, or when windblown dust, dirt, debris, or insects will collect on freshly applied coating.

Coatings shall not be applied at temperatures lower than the minimum temperature recommended by the coating manufacturer, or to metal surfaces such as tanks or pipe containing cold water, regardless of the air temperature, when metal conditions are likely to cause condensation. When necessary for proper application, a temporary enclosure shall be erected and kept heated until the coating has fully cured.

Coatings shall not be applied at temperatures higher than the maximum temperature recommended by the coating manufacturer. Where coatings are applied during periods of elevated ambient temperatures, Contractor and the coatings manufacturer shall be jointly responsible to ensure that proper application is performed including adherence to all re-coat window requirements. Precautions shall be taken to reduce the temperature of the surface application, especially for metal, at elevated temperatures above 100°F including shading application area from direct sunlight, applying coating in the evening or at night, and ventilating the area to reduce the humidity and temperature,

Vinyl ester coating materials, when required, shall be maintained during transportation, storage, mixing, and application at the temperature required by the coating manufacturer, 35°F to 90°F.

3-4. REPAIRING FACTORY FINISHED SURFACES. Factory finished surfaces damaged prior to acceptance by Owner shall be spot primed and recoated with materials equivalent to the original coatings. If, in the opinion of Engineer, spot repair of the damaged area is not satisfactory, the entire surface or item shall be recoated.

3-5. PROTECTION OF SURFACES. Throughout the work Contractor shall use drop cloths, masking tape, and other suitable measures to protect adjacent surfaces. Contractor shall be responsible for correcting and repairing any damage resulting from its or its subcontractors' operations. Coatings spilled or spattered on adjacent surfaces which are not being coated at the time shall be immediately removed. Exposed concrete or masonry not specified to be coated which is damaged by coatings shall be either removed and rebuilt or, where authorized by Owner, coated with two coats of masonry coating.

3-6. FIELD QUALITY CONTROL. The following inspection and testing shall be performed: surface profile, visual inspection, and wet and dry film thickness testing. All inspection and testing shall be witnessed by Engineer.

3-6.01. Surface Profile Testing. The surface profile for ferrous metal surfaces shall be measured for compliance with the specified minimum profile. The surface profile for concrete shall comply with SSPC 13/NACE 6 Table 1 for severe service.

3-6.02. Visual Inspection. The surface of the protective coatings shall be visually inspected.

3-6.03. Film Thickness. Coating film thickness shall be verified by measuring the film thickness of each coat as it is applied and the dry film thickness of the entire system. Wet film thickness shall be measured with a gauge that will measure the wet film thickness within an accuracy of ± 0.5 mil. Dry film thickness shall be measured in accordance with SSPC-PA 2.

3-6.04. Spark Testing. Not required.

3-6.05. Adhesion Testing. Not required.

3-7. FIELD PRIMING SCHEDULE. In general, steel and cast iron surfaces of equipment are specified to be shop primed. Any such surfaces which have not been shop primed shall be field primed. Damaged or failed shop coatings which have been determined unsuitable by Engineer shall be removed and the surfaces shall be field coated, including prime coat (if any). Galvanized, aluminum, stainless steel, and insulated surfaces shall be field primed. Primers used for field priming, unless otherwise required for repair of shop primers, shall be:

<u>Surface To Be Primed</u>	<u>Material</u>
Equipment, surfaces to be coated with	
Aliphatic polyurethane	Universal primer.

<u>Surface To Be Primed</u>	<u>Material</u>
Epoxy	Same as finish coats.
Coal tar coating	Same as finish coats.
Vinyl ester	Same as finish coats.
Steel and cast iron, surfaces to be coated with	
Epoxy	Same as finish coats or inorganic zinc.
Coal tar coating	Same as finish coats.
Aluminum	Epoxy.
Galvanized	Epoxy.
Copper	Epoxy.
Stainless steel	Epoxy.
Plastic surfaces, including PVC and FRP	Same as finish coats.
Insulated piping	As recommended by manufacturer of finish coats.
Concrete, surfaces to be coated with epoxy	
For damp-proofing	Epoxy.
For all other surfaces	Epoxy concrete filler and surfacer.
Concrete block exposed in exterior locations	Epoxy concrete block filler.
Concrete block to be coated with epoxy	Epoxy concrete block filler.

Unless otherwise recommended by the coating manufacturer or specified herein, priming will not be required on concrete, or concrete block, nor on metal surfaces specified to be coated with coal tar epoxy, and heat-resistant coatings. Concrete surfaces to be coated with epoxy shall be filled with epoxy concrete filler and surfacer so that a continuous film is obtained, except where concrete is damp-proofed with epoxy.

3-8. FINISH COATING SYSTEMS. The following schedule lists coatings systems and coating surface designations. See Article 1-3 for a definition of the surface designations.

No.	Finish Coating Systems	Coating Surface Designation						
		A	C	E	F	G	H	P
1.	Epoxy – One coat	x			x	x		
2.	Epoxy – Two coats	x	x	x	x	x		x
3.	Epoxy / NSF – Two coats		x	x				
4.	Epoxy – Three coats	x	x	x				
5.	Epoxy / NSF – Three coats	x	x	x				
6.	Epoxy – First coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		x
7.	Epoxy – First and second coat Aliphatic polyurethane – Finish coat	x	x	x	x	x		
8.	Universal primer – First coat Aliphatic polyurethane – Finish coat	x		x				
9.	Medium consistency coal tar – Two coats	x	x	x				
10.	Coal tar epoxy – Two coats	x	x	x				
11.	Vinyl ester – Two coats	x	x	x				
12.	Heat resistant – Two coats						x	
13.	High heat resistant – Two coats						x	
14.	Zinc primer – First coat Epoxy – Intermediate coat Aliphatic polyurethane – Final coat	x		x				
15.	Flake-filled epoxy	x		x				

3-8.01. Surfaces Not To Be Coated. Unless otherwise specified, the following surfaces shall be left uncoated:

Exposed aluminum, except ductwork.

Polished or finished stainless steel. Unfinished stainless steel, except flashings and counter flashings, shall be coated.

Nickel or chromium.

Galvanized surfaces, except piping, conduit, ductwork, and other items specifically noted.

Rubber and plastics, except as specified.

Exterior concrete.
FRP wastewater troughs.
Surfaces specified to be factory finished.

3-8.02. Shop Finishing. Items to be shop finished include the following. Shop finishing shall be in accordance with the coating manufacturer's recommendations.

- a. All slide gates.
- b. All conveyors.
- c. Other surfaces where blast cleaning cannot be or is not recommended to be performed in the field.
- d. Other items as otherwise specified.

3-8.03. Field Coating. Items to be field coated include the following. Field coating shall be in accordance with the field priming schedule, the coating schedule, and the manufacturer's recommendations.

- a. Exterior surface of the sludge hopper.
- b. Surfaces not indicated to be shop finished and surfaces where blast cleaning can be performed in the field.
- c. All interior ferrous metal surfaces except stainless steel on the digester cover.
- d. Other items as otherwise specified.

3-9. METAL SURFACES COATING SCHEDULE.

<u>Surface To Be Coated</u>	<u>Finish Coating System</u>
Non-galvanized structural and miscellaneous steel exposed to view or to the elements in exterior locations.	A6A7 A14
Non-galvanized structural and miscellaneous steel exposed to view inside buildings.	A2
Unless otherwise specified, pumps, motors, speed reducers, and other machines and equipment exposed to view.	E8
Metal curbs for skylights and power roof ventilators.	A1

<u>Surface To Be Coated</u>	<u>Finish Coating System</u>
Heating and air conditioning units, convector covers, electrical equipment cabinets, and similar items and equipment (unless factory finished) exposed to view.	E8
Cast Iron and steel piping inside buildings, including piping to be insulated, valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A2
Cast Iron and steel piping in immersion service including inside buildings, including valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A5
Cast Iron and steel piping above grade exposed to the elements and to view outdoors, including piping to be insulated, valves, fittings, flanges, bolts, supports, and accessories, and galvanized surfaces after proper priming.	A7
Circular sludge collecting equipment platform, walkway, walkway beams, and other iron or steel parts and accessories above the walkway except motors and speed reducers.	E7
Basin launders, troughs, weir plates, and accessories.	A5
All metal surfaces, unless otherwise specified, which will be submerged or buried, all or in part, including valves, and scum baffles, and cast iron slide gates, but excluding piping laid in the ground.	E5
Miscellaneous castings, including manhole rings and covers, and manhole steps. (One coat, if not shop coated.)	E3
All metal harness anchorage for buried piping.	A10

<u>Surface To Be Coated</u>	<u>Finish Coating System</u>
Supports and miscellaneous metal for equipment handling corrosive chemicals.	Outdoor – A7 Indoor – A2
Aluminum in contact with concrete.	F1
Aluminum materials exposed to the elements outdoors.	F6F7

3-10. CONCRETE AND MASONRY SURFACES COATING SCHEDULE.

<u>Surface To Be Coated</u>	<u>Finish Coating System</u>
All concrete and concrete block in corrosive area (Except floors and surfaces scheduled to receive other coatings) which are exposed to view.	Indoor –C2 Outdoor –C7
Filter wash water troughs.	C5
Interior surfaces of sludge drawoff boxes.	C10
Where indicated on the Drawings, walls, floors, and curbed areas, adjacent to corrosive chemical storage and feed equipment.	C2
All walls in contact with treated or potable water where the opposite face is above grade or which form is a part of an interior room or a dry pit.	C5
Interior walls of filter boxes, full height above underdrains and including edges of walkways.	C5

3-11. MISCELLANEOUS SURFACES COATING SCHEDULE.

Plastic Surfaces, including PVC and FRP.	Outdoor – P6 Indoor – P2
Piping Insulation	Outdoor – P6 Indoor – P2

3-12. PIPING IDENTIFICATION SCHEDULE. Exposed piping and piping in accessible chases shall be identified with lettering or tags designating the service of each piping system, marked with flow directional arrows, and color coded.

Piping scheduled to be color coded shall be completely coated with the indicated colors, except surfaces specified to remain uncoated shall include sufficiently long segments of the specified color to accommodate the lettering and arrows. All other piping shall be coated to match adjacent surfaces, unless otherwise directed by Engineer.

3-12.01. Location. Lettering and flow direction arrows shall be provided on pipe near the equipment served, adjacent to valves, on both sides of wall and floor penetrations, at each branch or tee, and at least every fifty (50) feet in straight runs of pipe. If, in the opinion of Engineer, this requirement will result in an excessive number of labels or arrows, the number required shall be reduced as directed.

3-12.02. Metal Tags. Where the outside diameter of pipe or pipe covering is 5/8 inch or smaller, aluminum or stainless steel tags shall be provided instead of lettering. Tags shall be stamped as specified and shall be fastened to the pipe with suitable chains. Pipe identified with tags shall be color coded as specified.

3-12.03. Lettering. Lettering shall be painted or stenciled on piping or shall be applied as snap-on markers. Snap-on markers shall be plastic sleeves, Brady "Bradysnap-On B-915", Seton "Setmark", or equal. Letter size shall be as follows:

<u>Outside Diameter of Pipe or Covering</u>	<u>Minimum Height of Letters</u>
5/8 inch and smaller	Metal tags -1/4 inch
3/4 to 4 inches	3/4 inch
5 inches and larger	2 inches

3-12.04. Color Coding and Lettering. All piping for the following services shall be color coded. Bands shall be 6 inches wide spaced along the pipe at 5 foot intervals. For services not listed, the color coding and lettering shall be as directed by the Engineer.

Piping Identification		
Service	Color of Pipe	Color of Letters
Alum (solution)	Orange	Black
Ammonia	White	Black

Piping Identification		
Service	Color of Pipe	Color of Letters
Carbon	Black	White
Chlorine (solution)	Yellow	Black
Drain	Dark gray	White
Filtrate	Dark gray with red bands	White
Fire Protection Water	Red	White
Instrument Air	Light green with dark green bands	Black
Nonpotable Water (downstream of backflow preventer)	Purple	Black ²
Potable Water (hot or cold)	Dark blue	White ⁴
Raw Water	Olive green	White
Sample	Light gray with green bands	Black
Service Water	Dark blue with red bands	White
Settled Water	Aqua	Black
Sludge	Dark brown	White
Sodium Hydroxide (caustic)	Yellow with green bands	Black

Notes:

1. Lettering shall read, "CAUTION: NONPOTABLE WATER, DO NOT DRINK."
2. Lettering shall be on a yellow background and shall read, "CAUTION: NONPOTABLE WATER, DO NOT DRINK." Each outlet on the nonpotable water line shall be similarly labeled.
3. Lettering shall read, "CAUTION: RECLAIMED WATER, DO NOT DRINK."
4. Lettering shall be on a light green background.

Electrical conduit shall be coated to match adjacent ceiling or wall surfaces as directed by Engineer. Vent lines shall be coated to match surfaces they adjoin.

In addition, special coating of the following items will be required:

<u>Item</u>	<u>Color</u>
Valve handwheels and levers	Red
Hoist hooks and blocks	Yellow and black stripes

Numerals at least 2 inches [50 mm] high shall be painted on or adjacent to all accessible valves, pumps, flowmeters, and other items of equipment which are identified on the Drawings or in the Specifications by number.

End of Section

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SURFACE DESCRIPTION	SYSTEM NO. -

SURFACE PREPARATION DESCRIPTION
<input type="checkbox"/> Solvent SSPC-SP1 <input type="checkbox"/> Ferrous Metal Nonimmersion SSPC-SP6 <input type="checkbox"/> Ferrous Metal Immersion <input type="checkbox"/> SSPC-SP10 <input type="checkbox"/> SSPC-SP-5 <input type="checkbox"/> Other

COATING	DFT mils [μm]	MANUFACTURER AND PRODUCT
First Coat (Primer)		
Second Coat		
Third Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 1-09940

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SHOP PRIMED SURFACE DESCRIPTION	SYSTEM NO. -	-F

SURFACE PREPARATION DESCRIPTION
<input type="checkbox"/> Solvent SSPC-SP1 <input type="checkbox"/> Other:

COATING	DFT mils [μm]	MANUFACTURER AND PRODUCT
Shop (Primer)		(Identify Product/Type)
Touchup		
Intermediate Coat		
Finish Coat		
Total System		Not less than minimum thickness specified.

Notes: (Attached if needed.)

Project:		
Coatings Manufacturer:		Initials _____
Painting Applicator:		Initials _____
BLACK & VEATCH	COATING SYSTEM DATA SHEET	Fig 2-09940

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Section 11420

SOLIDS CONTACT CLARIFIER EQUIPMENT

PART 1 - GENERAL

1-1. SCOPE. This section covers the replacement of the circular solids contact recirculation mixers and refurbishment of the collector drive equipment as specified herein.

Basin designation.	Solids Contact Unit (SCU) No. 5 & 6
Number of basins.	2
Number of SCU Mixers.	2
Number of SCU Collector Drives	2

The solids contact units are of the center drive type, supported on a stationary influent column, with a center mixing zone. Basin influent flow enters the center mixing zone from the side and is mixed with chemicals and with previously formed precipitates (residuals) to promote the chemical reaction. Flow from the mixing zone is recirculated within the center column with an interior recirculation propeller and then enters the outer settling zone for clarification. Basin effluent flow from the settling zone is removed with radial launders. Scrapers move the settled residuals to a receiving pit(s) for removal.

Each unit shall be as specified herein and shall be designed for installation on existing solids contact clarifying equipment as manufactured by Proquip and Chemineer. Copies of the existing basin equipment shop drawings are available as indicated in the Instructions to Bidders. Specific work to be completed within the solids contact units 5 and 6 of Plant 3 includes the following items:

- Replacement of two recirculation mixer drives complete with propeller, 4 inch diameter tubular drive shaft, main gear box, right-angle primary reducer and 5 HP electric motor.
- Rehabilitation of two collector drives in place.

1-1.01. PRELIMINARY INSPECTION. Contractor shall be responsible for communicating with and scheduling a preliminary inspection with the drive manufacturer. One week notice shall be provided to the Authority prior to scheduling this SCU equipment inspection. Contractor shall support a lot of two preliminary inspection trips for factory field service for inspection of the two SCU's; one trip per each SCU shall be scheduled. Each trip will consist of one

day on site for inspection. A written summary of manufacturer's opinion of equipment condition and any recommended repair/rehabilitation actions will be made available after completion of each trip.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Equipment shall be furnished complete with all mechanical and electrical components and accessories required for proper operation, including complete drive units and controls; and any additional materials or construction required by the manufacturer's design.

For equipment furnished under this section, all material in contact with the liquid shall be NSF certified. Field painting of the equipment shall be as specified herein and in the Protective Coating section.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Seismic Design Requirements. Not Used.

1-2.03. Power Supply. Power supply to the equipment shall be 480 volts, 60 Hz, 3 phase and will remain unchanged.

1-2.04. Equipment Identification. Equipment shall be tagged as specified in the Equipment and Valve Identification section.

1-2.05. Piping and Valves. The threads for oil fill and drain piping and fittings shall be NPT standard.

1-3. SUBMITTALS. Complete assembly and installation drawings, together with detailed specifications and data covering material used, power drive assemblies, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. Drawings shall indicate all dimensions and structural member sizes, and shall be certified by an officer of the company manufacturing the equipment that the design is in compliance with all local laws and codes for the location where the equipment will be installed.

Data and specifications for each unit shall include, but shall not be limited to, the following:

Residual Collecting Equipment

- Torque rating.
- Arm tip speed.
- Shop painting.
- Structural drawings, including anchor bolt details sealed by a Professional Engineer licensed in the State of the project.
- Electrical control equipment.
- Type, specifications, AGMA rating, details, input and output speeds, exact gear ratios, and service factor (24 hour continuous service) of gear reducers.
- Description of overload device.
- Wiring diagram and electrical schematic.
- Bearing type, size, hardness, and manufacturer.
- Gear box type, size, manufacturer, torque ratings, input Hp, duty classification, shaft diameter, coupling information, service factors, and mounting bracket information.
- Certification of the AGMA driving rating calculations by a registered professional engineer.
- Certification of the bearing life calculations by a registered professional engineer.
- Certification of installation and service compatibility of gear reducer by gear reducer manufacturer.

Mixing Equipment

- Detention time at normal water level and specified design rate.
- Mixer pumping capacity.
- Maximum tip speed at the periphery of mixer blades.
- Shop painting.
- Structural drawings.
- Size, manufacturer, and type of electric motor.
- Electrical control equipment.
- Type, specifications, details, and service factor (24 hour continuous service) of variable speed drives.
- Type, specifications, details, input and output speeds, exact gear ratios, and service factor (24 hour continuous service) of gear reducers.
- Wiring diagram and electrical schematic.
- Certification of the AGMA driving rating calculations by a registered professional engineer.
- Certification of the bearing life calculations by a registered professional engineer.

Motors

- As specified in the Common Motor Requirements for Process Equipment section.

1-3.02. Operation and Maintenance Manuals. Adequate operation and maintenance manuals shall be supplied as required in the Submittals Procedures section. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

1-4. SPARE PARTS AND ACCESSORIES. Not used.

PART 2 – PRODUCTS

2-1. SERVICE CONDITIONS. The solids contact unit's service conditions will not change based on the Work to be completed.

2-2. STRUCTURAL DESIGN. Anchor bolts shall be cast-in-place type and shall be designed and detailed in accordance with all applicable provisions of ACI 318.

2-3. PERFORMANCE AND DESIGN REQUIREMENTS. Solid contact clarifying equipment shall be suitable for installation as required by the existing equipment. The basin equipment shall be designed to accomplish chemical mixing in the presence of previously formed precipitate, clarification by sedimentation, and collection and removal of excess residuals.

2-3.01. Basin Dimensions and Features. The equipment shall be designed to operate in basins having the following dimensions and features. The Contractor shall field verify all dimensions prior to ordering equipment.

Basin designation	SCU 5 & 6
Basin configuration	Circular
Basin Inside diameter	85 ft
Total sidewall depth	19 ft
Water depth at center pier	20 ft
Diameter of influent pipe	30 In
Diameter of center column	8 ft

2-3.02. Design Requirements. The design parameters are to remain unchanged for this work. The rehabilitation and replacement equipment shall match existing equipment parameters.

The rated torque of all components of the collector drive unit shall equal or exceed the torque equivalent to the nameplate horsepower [kW] of the drive motors.

The torque shall be measured from the centerline of the equipment. All parts of each mechanism shall be designed to withstand the maximum stalled torque of the motor without damage to any component except the motor. Loading to develop the torque shall be considered as uniform loads applied simultaneously at panel points on both arms.

2-3.03. Noise Level. All motor-driven components shall be designed and constructed so that the maximum noise level measured at 3 feet [1 m] from the installed drives and motors does not exceed 80 dBA.

2-4. ACCEPTABLE MANUFACTURERS. Solids contact basin equipment shall be center column supported supplied by Ovivo/Eimco Water Technologies, General Filter, WesTech, ProQuip, Chemineer or equivalent.

2-5. BOLTS AND NUTS. The bolts and nuts shall be suitable for field assembly, and be provided for each item of equipment.

All field assembly bolts and anchor bolts, nuts, and washers in submerged locations shall be stainless steel. Field assembly bolts and anchor bolts, nuts, and washers in other locations shall be stainless steel.

A flat washer shall be installed under the head and nut of each assembly.

Anchor Bolts and Nuts and Assembly Bolts and Nuts.

Stainless Steel	Bolts ASTM F593, Alloy Group 1 or 2; Nuts ASTM F594, Alloy Group 1 or 2. Bolts ASTM F593, Alloy Group 2; Nuts ASTM F594, Alloy Group 2.
Flat Washers	ANSI B18.22.1; of the same material as the bolts and nuts.
Thread Lubricant	John Crane "Thred Gard Nickel", Permatex "Nickel Anti-Seize Lubricant", or Jet-Lube "Nikal".

Anti-seize thread lubricant shall be applied to the threads of all stainless steel bolts before assembly.

2-6. CONSTRUCTION.

2-6.01. Fabrication. The materials of construction for all non-immersed components not otherwise specified, shall be 316L stainless steel. All submerged components, and all components, except carbon steel plate to seal holes in collector ring launder, located within 6 inches above the maximum water surface elevation, shall be constructed of 316L stainless steel.

Welded joints shall be sealed watertight with continuous welds. Fillets and corners must be accessible for grinding. Bolts that are provided at connections to facilitate field weld joints shall be removed and the holes, and any other temporary bolt holes, shall be plug welded and ground smooth before painting. Faying surfaces of bolted joints shall be shop painted.

2-6.02. Edge Grinding. All cut or sheared edges shall be ground smooth to a 1/8 inch [3 mm] minimum radius for all material 1/4 inch [6 mm] thickness and larger. For material thickness less than 1/4 inch [6 mm] all cut or sheared edges shall be ground smooth to a radius equal to 1/2 the material thickness. Grinding of rolled edges on standard shapes with a minimum radius of 1/16 inch [1.5 mm] will not be required.

2-6.03. Surface Preparation. All ferrous metal surfaces shall have all welds ground smooth and free of all defects in accordance with NACE Standard RPO178, Appendix C, Designation C and sharp edges ground smooth, if not previously prepared in the shop. Instead of blending of the weld with the base metal as specified by the NACE standard, it will be acceptable to furnish a welded joint that has a smooth transition of the weld to the base metal. All welds shall be ground smooth to ensure satisfactory paint adhesion.

2-6.04. Shop Coating. Iron and steel surfaces of the equipment that will be in immersion service shall be cleaned to SSPC-SP10 and primed with manufacturer's standard shop coating which will be removed prior to field coating. All other iron and steel surfaces of the equipment shall be cleaned to SSPC-SP10 and prepared as recommended by the coating manufacturer for the intended service, and then shop coated with one or more coats of a universal epoxy primer. Stainless steel surfaces shall not be shop coated. The General Equipment Stipulations include further shop coating requirements.

Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting.

Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed and finished with universal epoxy type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.

Machined, polished, and nonferrous surfaces which are not to be coated shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

The shop coatings shall be certified as being in compliance with ANSI/NSF 61. A coating that cannot be so certified, whether or not specified by the manufacturer and by product designation, shall not be used.

2-6.05. Stainless Steel. All stainless steel shall be pickled in accordance with ASTM A380 at the mill before being shipped. Pickling shall produce a modest etch and shall remove all embedded iron and heat tint. After fabrication, pickled surfaces shall be subjected to a 24 hour water test for a ferroxyl test to detect the presence of residual embedded iron. All pickled surfaces contaminated or damaged during fabrication including welded areas shall be repickled or passivated in accordance with ASTM A380 as needed to remove all traces of iron contamination and heat tint. All stainless steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination from iron or carbon steel objects or surfaces.

2-6.06 Field Painting. Iron and metal surfaces of the equipment that will be in immersion service shall have the shop coating removed prior to field painting and the surfaces field painted as specified in Protective Coatings section. The center drive equipment, electric motors, speed reducers, and other drive components shall be completely protected during blasting operations. Also, equipment components that are shop primed and top coating in the field shall be painted as specified in the Protective Coating section.

Preparation and painting of the stainless steel components, if required, shall be as specified in the Protective Coatings section.

The field coatings shall be certified as being in compliance with ANSI/NSF 61. A coating that cannot be so certified, whether or not specified by the manufacturer and by product designation, shall not be used.

2-6.07. Drive Unit Gear Reducers. Drive unit gear reducers for both the residuals collecting equipment and the mixers shall be selected, designed, and rated in accordance with the appropriate AGMA standards and the criteria specified herein. Where AGMA standards and the criteria specified herein are in conflict, the values that will result in the most conservative design for long life and

minimum maintenance shall be selected. Drive units shall be of weatherproof design. The drive unit motor shall be in accordance with the Common Motor Requirements for Process Equipment section.

The nominal input horsepower [kW] rating of each gear or speed reducer shall be at least equal to the nameplate horsepower [kW] of the drive motor. Drive units shall be designed for 24 hours continuous service.

2-6.07.01. Gearmotors. The use of gearmotors sharing an integral housing, or that cut gears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.

2-6.07.02. Gear Reducers. Each gear reducer shall be a totally enclosed self contained unit and shall be oil or grease lubricated, with anti-friction bearings throughout and shall be AGMA rated.

Spur, helical, herringbone, and bevel-type gear reducers shall be rated as specified in AGMA 6010-F97 or the current standard, with minimum service factor of 2.0 based on the motor nameplate horsepower of the drive motor. Worm gear reducers shall be rated as specified in AGMA 6034-B92 or the current standard, with a service factor of at least 1.75 based on the nameplate horsepower [kW] of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class II. Each gear reducer shall be designed and manufactured in compliance with applicable AGMA standards, except the ABMA L₁₀ bearing life shall be 200,000 hours.

An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

2-6.08. Lubrication. Gear reducer gears and motor bearings shall be oil or grease lubricated. Gears and lubricated bearings shall run in oil or shall be provided with a positive means of continuous lubrication. Seals shall be provided around shafts to prevent leakage of oil. Splash lubrication is not acceptable. Due to the potential low speed gear rotation when an adjustable speed drive is

provided, Particular attention shall be given to providing a positive means of lubrication.

Roller chain shall be self-lubricating type with oil-impregnated, sintered steel bushings or O-ring type with lubricant factory installed in the pin-bushing contact areas and sealed in place by means of elastomeric O-rings on each pin between the roller link plate and pin link plate.

Lubrication systems shall be so designed that they are protected against contamination and the lubricants cannot contaminate the water being treated. Each lubrication system shall be provided with an external, visual method of checking lubricant level, without removing parts or fittings. A dipstick or sight glass arranged to permit visual inspection of the lubricant level shall be provided on each unit.

Lubrication shall be accomplished by means of convenient and readily accessible oil fill and drain plugs or grease fittings that do not require the removal of parts or dismantling of equipment. Oil drain and fill openings shall be easily accessible from the operating platform, convenient for collection of oil in 18 inch (450 mm) high containers from the platform, without removing the unit or equipment platform from its normal installed position. Alternatively, systems that allow oil to be easily drained and filled from the equipment platform which utilize a portable pump to remove the oil to containers on the equipment platform may be used if acceptable to Engineer.

2-6.09. Equipment Bases. The existing equipment bases shall be reused.

2-7. CENTER SUPPORT. The existing center support shall be reused.

2-8. BRIDGE SUPPORT. The existing bridge support shall be reused

2-9. INFLUENT PIPE. Not used.

2-10. COLLECTOR DRIVE COMPONENTS. The collector drive precision bearings shall be capable of being replaced without disconnecting the drive cages from the gear housings or removing the access bridges or platforms.

The collector drive gears shall be an oil lubricated internal cut spur gear which shall be of AISI 1045 forged steel, hardened to 280 to 320 BHN, having a 99,000 psi yield strength. The main gear shall have internal teeth with a diametrical pitch and length to produce up to 43,000 ft. lbs. continuous operating torque as calculated by AGMA 218.01. The gear teeth shall be stressed to no more than the allowable bending stress at the continuous rated output torque. Life factors should be based on 1 million load cycles.

The following items shall be supplied and installed by the Contractor.

- Clarifier 35" Clarifier Drive Equipment, for both SCU 5 & 6.
- The 35" bearing spur gear unit to be removed and replaced with new. The bearing shall be capable of being replaced without disconnecting the drive cage from the drive housing or removing the access bridge or platform.
- The drive pinion gear is to be replaced with new.
- The drive pinion gear lower support bearing is to be replaced with new.
- The neoprene dust seal spanning the circumference of the 35" drive is to be replaced with new.
- The oil drain valve is to be replaced with new.
- The clarifier drive reduction gearmotor assembly is to be replaced in its entirety with new, including both primary and secondary reducers and electric motor. The units shall be rehabilitated and replaced with same-model replacements by same Manufacturer as existing, with all component ratings and efficiencies equal to or exceeding existing.
- The torque sensing unit is to be replaced complete with limit switches, junction box and torque indicator assembly. The limit switches shall be factory pre-calibrated and set as per OEM specifications for both over torque pending alarm and shut down functions.

2-10.01. Residual Collection Turntable Assembly. The main bearing shall be a strip liner bearing or four-point contact bearing as specified herein. Main bearings shall have an ABMA L₁₀ life rating of at least 200,000 hours and shall be designed to carry all vertical loads and torque loads plus an additional allowance of 25 percent of the weight of the rotating equipment. A ring gear shall be provided on the turntable. Ring gears shall be cast integrally with the turntable or bolted in place. Where specified herein, a balanced dual pinion drive shall be provided for the ring gear.

The turntable and ring gear shall be cast iron, ductile iron, or steel. Ring gears shall be rated according to AGMA Standard 2001-C95 or the current standard for operation at the required continuous torque rating for a minimum life of 200,000 hours.

2-10.01.01. Strip Liner Bearing Ball Races. Strip liner turntables shall rotate on alloy steel balls. Ball races for each main bearing shall be hardened to at least Rockwell C60 or provided with renewable hard steel liner strips. The balls shall run in an oil bath and shall be protected by a felt or synthetic flexible seal and dust shield. A cast iron, ductile iron, or steel ring gear shall be provided on each turntable. Ring gears shall be cast integrally with the turntable or bolted in place.

2-10.01.02. Four-point Contact Lock Race Bearings. Turntables with four-point contact lock race bearings shall rotate on chrome steel ABMA Grade 48 balls. The ball race shall be four-point contact, precision ground raceway, induction hardened to at least Rockwell 55. The balls shall run in an oil bath and shall be protected by a felt or synthetic flexible seal and dust shield. A ring gear heat treated to at least Rockwell 30 shall be provided on each turntable and shall be bolted in place.

2-10.01.03. Center Mechanism Drive Unit. The drive unit shall be constant speed and shall be anchored to the turntable base. Each drive unit shall consist of a worm gear reduction unit connected by a roller chain, V-belt drive, or directly connected to a speed reducer and drive motor. Drive units having a pinion mounted directly on the motor shaft will not be acceptable. Gearing shall be designed for a minimum life of 200,000 hours, and bearings shall have an ABMA L₁₀ rating of at least 200,000 hours, excluding the motor.

The residual collection drive unit motor shall be in accordance with the Common Motor Requirements for Process Equipment section, except that sealed bearings may be provided if they have an ABMA L₁₀ rating of at least 100,000 hours.

2-10.02. Overload Mechanism. The drive of the rotating scraper assemblies shall be equipped with an indicating torque overload mechanism with a NEMA Type 4X cast iron, stainless steel housing or baked epoxy-coated cast aluminum housing, and two independently adjustable, electrically isolated contacts. The overload mechanism shall be factory adjusted. The "Alarm" contact shall open to operate specified alarm devices when the load reaches approximately 100 percent of the rated torque of the drive unit. The "Stop" contact shall close to unlatch a relay to stop the motor at approximately 120 percent of the minimum rated torque. The overload mechanism shall be adjusted and set at the factory. The torque indication and alarm contact shall be mechanically or electrically actuated. The torque overload contact shall be mechanically actuated.

A shear pin or alternative acceptable to Engineer shall be provided as an additional overall protection to prevent 150 percent of the rated torque from being applied to the drive mechanism. A third independently adjustable, electrically operated contact shall not be provided as a substitute for a shear pin.

2-11. MIXING EQUIPMENT. Contractor is to replace two existing ProQuip Q-Series mixers, model number 50GX25 for SCU 5 & 6, with updated equivalent. Mixing equipment shall be installed within the existing mixing column, within the constraints of the center drive unit. Replacement mixing equipment shall meet or exceed the existing equipment parameters.

2-11.01. Mixers. The mixing equipment in the mixing zone shall be capable of maintaining a 3 percent by weight solids concentration over the specified flow rate range when treating water having the chemical characteristics indicated in the Service Conditions paragraph. The specified solids concentration is the minimum concentration that will be acceptable, and compliance shall be determined by testing, if requested by Engineer.

Vertical shafting for the impeller assemblies shall be of ample size and design for the service intended and shall be supported and steadied so that the unit will operate without shaft whip or vibration. Shafting may be of the solid type, fabricated from solid section cold-rolled steel, or of the torque tube type fabricated from extra strong steel pipe. The rotating speed shall not exceed 40 percent of the critical speed of the shaft. Submerged steady bearings will not be acceptable. Impeller assemblies and rigid type couplings, including accessories for attachment of these items, shall be fabricated from carbon steel or stainless steel.

The mixer drive unit motor shall be in accordance with Common Motor Requirements for Process Equipment section.

2-11.02. Mixer Drive Units. Mixer drive units shall be a right angle type and conform to requirements for the collector drive. Drive units shall be designed for the specific requirements of the mixers and shall be suitable for 24 hour a day operation under moderate shock conditions. The speed of mixing equipment shall be infinitely variable over the specified range.

The main mixer gear reducer shall be designed for a life of 200,000 hours and a minimum overall service factor of 1.5 based on the continuous load plus any transient loads other than starting loads.

The mechanical rating of the gear reducers shall be based on a minimum service factor of 1.0 based on the nameplate horsepower of the drive motor or 1.5 based on the maximum driven load of the mixer, whichever is greater.

The propeller water-horsepower requirements, gear losses, and an ample allowance for buildup on the impeller shall not exceed 87 percent of the horsepower [kW] rating of the drive motor.

Each right angle gear reduction unit shall be driven by a horizontal motor and shall be equipped with spiral bevel and/or helical gears and rolling element, antifriction bearings. The mixer shaft shall be rigidly coupled to the reducer output shaft or shall be an integral extension of gear reduction unit shafting. Each gear reduction unit shall be provided with radial and thrust bearings as necessary to carry the entire shaft load, impeller load, and hydraulic thrust, and

to maintain the shaft steady under all normal conditions. Underwater bearings will not be permitted.

2-12. ACCESS WALKWAY. Not used.

2-13. SAMPLE PIPING. Not used.

2-14. EFFLUENT LAUNDER SYSTEM. Not Used.

2-15. CONTROL EQUIPMENT. Not Used.

PART 3 - EXECUTION

3-1. INSTALLATION. The existing solids contact mixer drive unit, and miscellaneous equipment shall be removed and disposed of by the Contractor. The collector drive mechanism shall be refurbished as specified herein and as recommended by the manufacturer. Contractor shall make all modifications to the existing equipment as required by the drive equipment and mixer manufacturer for installation of the equipment. Contractor shall be responsible for supporting existing bridge, launders, center cone, and all other existing equipment to be reused during rehabilitation of the clarifier collector drive and recirculation mixer. Contractor shall also be responsible for any modifications to the existing equipment to allow for proper installation of the new equipment.

Installation shall be in accordance with the Equipment Installation section and as specified herein.

All stainless steel bolts shall be tightened with a torque wrench. Torque values for all stainless steel bolts shall be in accordance with the manufacturer's recommendations. The recommended values shall prevent undershearing and/or seizing of stainless steel bolts.

The clarifier 35" drive unit lubricant shall be drained.

While the clarifier drive unit is disassembled, the inside of the gear housing shall be thoroughly cleaned by the Contractor as per the drive Manufacturer's recommendations. The housing and all accessible drive components shall be inspected by the Manufacturer's field representative for excessive wear, damage, cracks, leakage, or abnormal conditions. Any items found shall be documented and reported to the Engineer by the Contractor.

The oil drain valves shall be replaced. The oil drain piping and site glasses shall be thoroughly cleaned and re-used if their condition warrants. Any damaged or broken items shall be replaced with identical new items.

Once all work has been accomplished to the clarifier drive unit, the Contractor shall provide and fill the drive gear housing to the proper level with lubricant as recommended by the Manufacturer. Any oil spilled during filling shall be cleaned immediately afterward. Any oil leakage from the drive drain piping arrangement shall be unacceptable and shall be repaired by the contractor for final acceptance.

While the basin is dewatered, the submerged, wetted and structural components of the clarifier collector mechanisms shall be thoroughly inspected by the Manufacturer's field representative for any damage, excessive wear or abnormal conditions. The Contractor shall document and report any items found to the Engineer.

To ensure that each sludge collecting mechanism is functioning properly, it shall be run at least 4 hours before flow is admitted to the basin. There shall be no binding, jerky or unusual motion or vibration exhibited during this run-in period. Motor amperage and drive torque shall be checked at least hourly for any unusual or higher than normal readings. The drive drain arrangement shall be inspected for oil leakage. If the unit should fail under any of these conditions, the test shall be halted, and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be replaced at no additional cost to the Owner, and the test rerun until passed.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Supervision. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation. Such services shall be included in the contract price.

Manufacturers' installation supervisor shall observe, instruct, guide, and direct the installing contractor's erection or installation procedures. The equipment manufacturer shall be provided with written notification 10 days prior to the need for such services.

3-2.02 Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3-2.03. Field Load Test. Contractor shall perform a load test on the sludge collection equipment in accordance with the recommendation of the equipment manufacturer. The mechanism shall be loaded until there is sufficient torque created on the drive to trip the alarm unit at 100 percent of the rated torque and continue loading until the "Stop" contact is activated at 120 percent of the rated torque of the drive unit. The equipment manufacturer shall provide Contractor with detailed instructions on where and how to connect the loads to the arms and shall have a service representative present during the test.

3-2.04. Equipment Testing. The mechanism shall be operated in a dry tank for a minimum of 3 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky or unusual motion or vibration exhibited during this run-in period. Motor amperage and drive torque shall be checked at least hourly for any unusual or higher than normal readings. The drive drain arrangement shall be inspected for oil leakage. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be replaced at no additional cost to the Owner, and the test rerun until passed.

3-3. EXTENDED WARRANTY. The Contractor and equipment manufacturer shall warrant the equipment and coatings of the solids contact clarifying equipment to be free from defects in workmanship, design, and materials for a 2 year period. Defects shall include failures in painting systems both above and below the water surface. If any parts of the equipment should fail or become defective during the warranty period, they shall be replaced or restored to their original condition to the satisfaction of the Owner and the equipment restored to service at no expense to the Owner. The warranty period shall commence on the date of Substantial Completion for the equipment.

Contractor and equipment manufacturer shall provide the extended warranty to the Owner prior to declaration of the equipment installation as Substantial Complete. The warranty shall include an 18 month inspection of the equipment as specified herein. The warranty shall be conditional in that the Owner shall operate the equipment and perform normal maintenance as recommended by the equipment manufacturer.

End of Section

Section 11520

VERTICAL MIXERS

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing of vertical, shaft-driven mixers as specified herein:

Mixer Designation.	SCU 5 & 6 PAC Contact Mixers
Number of Mixers.	Two
Mixer tag numbers.	15-M-3A 15-M-3C

Contractor to furnish two mixer drives for PAC contact, to be stored as spares, which are not to be installed. Contractor shall coordinate with the Authority once drives are delivered to the WTP for guidance on the storage location.

1-2. GENERAL. Equipment furnished under this section shall be fabricated and assembled in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Each unit shall be furnished complete with all anchors and supports, all mechanical equipment required for proper operation, including a complete drive unit, and all additional material or construction required by the manufacturer's design.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Seismic Design Requirements. Not Used.

1-2.03. Power Supply. Unless otherwise indicated, power supply to the equipment shall be 480 volts, 60 Hz, 3 phase

1-2.04. Identification. Vertical mixers shall be identified in accordance with the Equipment and Valve Identification section.

1-3. SUBMITTALS.

1-3.01. Drawings and Data. Complete fabrication and assembly drawings, together with detailed specifications and data covering materials, power drive assemblies, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the Submittals Procedures section. The data and specifications for each unit shall include, but shall not be limited to, the following:

Mixers

- Name of manufacturer.
- Type and model.
- Tag number.
- Mixer location.
- Rotative speed.
- Number, size, and type of impeller(s).
- Impeller shaft size, material, and number of sections.
- Net weight of mixer unit.
- Dynamic forces of mixer.
- Maximum horsepower requirements.
- Ratio of rotative speed to critical speed of shaft.
- Electrical wiring diagrams.
- Electrical control equipment.

Support Platform

- Dimensional drawings of support platform and structural members.
- Details for connections between the platform and the existing concrete walls.
- Provide details on the coating system
- Details for connecting the mixer to the platform.

Motors

- As required by the Common Motor Requirements for Process Equipment section.

Gear reducers

- Type, specifications, details, input and output speeds, exact gear ratios, and service factor (24 hour continuous service).
- Manufacturer's certification.

1-3.02. Operation and Maintenance Data and Manuals. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section. The operation and maintenance manuals shall be in addition to any instruction or parts lists packed with or attached to the equipment when delivered.

1-4. SPARE PARTS. Not used.

PART 2 – PRODUCTS

2-1. SERVICE CONDITIONS. Raw water flows into three powdered activated carbon (PAC) contact chambers where a PAC slurry is injected. Three existing vertical mixers are located on the top of each respective PAC contact basin which aid in creating a homogenous mixture of PAC and raw water to aid in the initial filtration of raw water. Two of the three mixer drives shall be furnished only, as spares, and not installed.

The mixing units shall be suitable for the following service conditions:

Mixer Tag Numbers	15-M-3A	15-M-3C
Basin or process	PAC Contact Chamber #1 (Raw Water Influent)	PAC Contact Chamber #3 (To SCU Influent Channel)
Type of environmental exposure.	Outdoor	Outdoor
Liquid characteristics		
Liquid type	Raw Water	Raw Water
Chemicals introduced to the mixing zones	Powder Activated Carbon	Powder Activated Carbon
Water depth	17.57	17.57 ft
Freeboard	2.60	2.60 ft
Total Flow rate (Per Cell)		
Average	13.50	13.50 mgd
Basin Parameters		
Length	19.33	35.03 ft
Width	24.00	24.00 ft
Volume	60,970	110,490 gal
Detention Time (Per Cell)	389.9	706.6 sec

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. The impeller water-horsepower requirements, gear losses, and an allowance for buildup on the impeller for each mixer shall be included in determination of the brake horsepower requirements.

Mixer Tag Numbers	15-M-3A	15-M-3C
Motor size	15	20 hp
Motor speed	1,750	1,750 rpm
Maximum impeller speed	65.1	65.1 rpm
Impeller diameter	62	68 in
Minimum Direct Pumping Rate	40,176	53,005 gpm
Mixer speed requirements	Variable Speed	Variable Speed

2-3. ACCEPTABLE MANUFACTURERS. Mixing equipment shall be as manufactured by Anco, Philadelphia Mixing Solutions, Lightnin, Chemineer, Invent Environmental Technologies, or Hayward Gordon, or equal.

2-4. MATERIALS. Each mixer shall be constructed of the following materials.

Assembly Bolts and Nuts

Stainless Steel	Bolts ASTM F593, Alloy Group 1 or 2; Nuts ASTM F594, Alloy Group 1 or 2.
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Flat Washers	ANSI B18.22.1; of the same material as the bolts and nuts.
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Shafts – torque tube	316 stainless steel
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Impeller Assembly (body)	316 stainless steel insert nuts
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Couplings	AISI Type 316 stainless
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2-4.01. Bolts and Nuts. Field assembly bolts and nuts and anchor bolts in accordance with the Anchorage in Masonry and Concrete section shall be provided for each item of equipment.

All field assembly bolts, nuts, and washers in submerged, or exposed, locations shall be stainless steel. Field assembly bolts, nuts, and washers in other locations shall be hot-dip galvanized.

Anti-seize thread lubricant shall be applied to the threads of all stainless steel bolts.

2-5. CONSTRUCTION.

2-5.01. Drive Units. Drive units shall be designed for the specific requirements of mixer service and shall be suitable for 24 hour a day operation under moderate shock conditions. Each drive unit shall consist of an electric motor and a gear reducer. The use of gears mounted directly to the motor shaft will be allowed when approved by Engineer. Proposed motor and gear drive shall be submitted to Engineer for approval. Lifting lugs or support points shall be provided on each motor and gear reducer. One set of lifting lugs or support points shall be designed and located to permit lifting the complete mixer and drive unit. Motors shall be readily separated from gear reducers. The gear reducer output shaft shall be constructed and supported such that shaft deflections caused by operating loads do not affect alignment of the anti-friction bearings, or cause gear misalignment.

All gear reducer and motor bearings shall be oil or grease lubricated, rolling element, antifriction type. Thrust bearings shall be provided to carry all shafting and impeller loads, plus an allowance of at least 25 percent of the weight of the shaft and impeller. No bearings shall be located below the bottom of the supporting platform.

The nominal input horsepower rating of each gear or speed reducer shall be at greater than or equal to the nameplate horsepower of the drive motor.

2-5.01.01. Gear Reducers. Each gear reducer shall be a totally enclosed unit, and shall be rated as specified in AGMA 6013-A06. Gear reducers shall be double or triple reduction type with helical or spiral bevel gearing, and shall have a gear quality of 10 or higher. Worm gearing will not be acceptable. The helical or spiral bevel reducers shall have an AGMA service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft mounted and flange mounted gear reducers shall be rated AGMA Class II. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable AGMA standards. The output shaft shall be enclosed in a drywell which provides positive leakproof sealing. The mixer shaft shall be rigidly coupled to the output shaft.

Gear reducers shall be specifically designed for mixer service. The gear reducers shall be selected, designed, and rated in accordance with the appropriate AGMA standards. The gearing shall be designed with a life factor at least equivalent to 10 million cycles, and an overall service factor of 2.5, based on the sum of the continuous loads plus any transient loads other than starting

loads. Bearings shall have an ABMA L₁₀ Life Rating of at least 100,000 hours, except output shaft bearings, which shall have an L₁₀ rating of at least 200,000 hours. The mixer manufacturer shall submit evidence of having furnished equipment similar in size, torque, and shaft overhang, which has performed successfully for a period of at least 5 years.

Gear reducers shall include a doweled cast iron, fabricated steel case and cover to ensure alignment of components under load.

The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F.

Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. Oil lubricated units shall include a dipstick or sight glass, and ventilators and drain plugs.

Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual greasing of bearings will not be acceptable.

Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.

2-5.02. Mixer Supports. Each mixer shall be designed so that the motor and gear reducer can be removed from its box as a complete unit after the impeller is removed from the shaft.

2-5.03. Impellers and Shafts. Mixer impellers shall be axial flow.

Axial flow impellers shall be of the HE turbine type. The impeller shall be an open type without balancing rings or discs.

Impeller design, arrangement, and operating speed shall provide efficient and proper mixing of the basin contents at any rate of flow through the mixing basin up to the peak rate of flow specified herein. Submerged or bottom steady bearings will not be acceptable.

The location of the impellers above the bottom of the mixing chamber or tank

shall be as recommended by the manufacturer and shall be acceptable to Engineer. The shaft shall be of sufficient length and keyed to allow vertical adjustment of the impeller.

Vertical shafting for the impeller assembly shall be of ample size and design for the service intended and shall be supported and steadied so that the unit will operate without shaft whip or vibration. The mixer rotative speed shall be not more than 40 percent of the critical speed of the shaft (including impellers and appurtenances).

Stainless steel shafts shall be solid type or sheathed stainless steel shafts. Rigid type couplings shall also be fabricated from stainless steel.

Each impeller shaft (exclusive of shafting in the gear reducer) shall be constructed preferably in one section, but in no case more than two sections, as determined by the manufacturer. If furnished in two sections, the shaft shall be connected with a suitable rigid coupling.

Each impeller shaft shall connect to the gear reducer output shaft with a suitable rigid coupling. The gear reducer output shaft and the top half of the coupling need not be of stainless steel.

2-5.04. Edge Grinding. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius as necessary to ensure satisfactory paint adherence.

2-5.05. Surface Preparation. All welds shall be thoroughly cleaned and ground smooth in preparation for coating. All ferrous metal surfaces, except motors, speed reducers, and stainless steel, shall be solvent cleaned in accordance with SSPC-SP1 before shop primer is applied.

2-5.06. Mixer Support Bridges. Not Used.

2-5.07. Electric Motors. The motors shall be designed as specified in the Common Motor Requirements for Process Equipment section.

2-5.08. Adjustable Frequency Drives. Adjustable frequency drives (AFD's) are as specified by equipment manufacturer for this intended service.

Each AFD shall be coordinated with the requirements of the driven load. The Contractor shall be responsible for furnishing the drive and for matching motor and drive, and for coordinating the collection of data and the design effort

required to limit harmonics to the levels specified. Any additional information required by the AFD supplier to provide a complete functioning system shall be the responsibility of the Contractor.

PART 3 - EXECUTION

3-1. INSTALLATION. Not Used.

3-2. FIELD QUALITY CONTROL.

3-2.01. Installation Check. Not Used.

3-2.02. Installation Supervision. Not Used.

3-2.03. Field System Operation Tests. Not Used.

3-3. PERFORMANCE TEST. Not Used.

3-4. TEST REPORTS. Not Used.

3-5. MODIFICATIONS. Not Used.

3-6. TRAINING. Not used.

3-6.01. Operations Training. Not used.

3-6.02. Maintenance Training. Not used.

3-6.03. Maintenance Assistance. Not used.

End of Section

Section 13220

FILTER UNDERDRAINS AND MEDIA

PART 1 - GENERAL

1-1. SCOPE. This section covers the replacement of the existing filter media, and the removal and re-installation of underdrains for the 6 filter cells in Train 5 and 6 filters. The new media shall be furnished and installed as specified herein.

1-2. GENERAL. Each filter cell shall be rebuilt as indicated on the Drawings, as specified, and as required to provide a properly operating filter installation acceptable to the Engineer.

1-2.01. Coordination. Installation of the underdrains and media shall be coordinated with the installation of related items of filter equipment and materials covered in other sections including piping, valves and structural improvements. Filter underdrains shall not be re-installed until concrete repairs and concrete coating inside the filter cells have been completed.

1-2.02. Manufacturer's Experience. The media supplier shall have furnished media of the types specified which have been in successful operation for not less than 5 years.

1-2.03. Installation Supervision. The installation of filter media shall be under the direct supervision and control of a competent and experienced field representative employed by the media supplier and acceptable to the Engineer.

The qualifications and experience record of these field representatives shall be submitted to the Engineer for review along with the initial drawing submittals.

1-3. SUBMITTALS. Complete descriptive data for filter underdrain and filter media materials shall be submitted for review prior to shipment, in accordance with the Submittals Procedures section. Information shall include, but shall not be limited to, the following:

Filter Media Materials

Name of supplier.

Specific gravity.

Sieve analyses for fine sand and anthracite.

Effective size and uniformity coefficient for fine sand and anthracite.

Mohs' hardness for anthracite.

Acid solubility for anthracite.

Caustic solubility for anthracite.

Loss on ignition for filter sands.
Qualifications and experience record of the field representative.

1-4. DELIVERY, STORAGE, AND HANDLING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section and as specified herein.

Filter underdrain components shall be handled carefully to prevent damage and shall be stored on platforms clear of the ground. Only sound, undamaged units shall be used in the Work. Any items damaged before final completion of the Work shall be removed and replaced with undamaged units by and at the expense of the Contractor.

Containers for shipping filter media shall be new and unused.

PART 2 - PRODUCTS

2-1. UNDERDRAINS.

2-1.01. Removal and Re-installation. The existing underdrain system shall be removed and re-installed as specified and as indicated on the Drawings

2-1.02. Performance Requirements. The entire floor area of each filter is equipped with an underdrain. The filter underdrain system is a folded perforated plate type with an air scour distribution tube between each plate section. The filter underdrain system is designed to uniformly collect filtered water and uniformly distribute backwash water under the following conditions:

Downflow of filtered water at 2.04 gpm/ft².

Low rate upflow of backwash water at 17 gpm/ft².

High rate upflow of backwash water at 25 gpm/ft².

There shall be no mounding, lateral displacement or other disturbances to the filter bed caused by non-uniform flows. The average maldistribution of water flow during backwash across the filter shall not exceed $\pm 10\%$ of the average flow per unit of filter surface area at all specified flow conditions.

2-1.03. Air Distribution Manifold. The air scour piping shall be removed and re-installed as required for the replacement of the media and the removal and re-installation of the underdrains as indicated on the Drawings.

2-1.04. Plates, Anchorage, and Grout. All new metal components provided shall be 316 stainless steel. Grout shall be in accordance with the Grout section.

2-1.05. Stainless Steel. Stainless steel components shall be cleaned and passivated in accordance with ASTM A380. Passivation shall remove embedded iron and heat tint. After fabrication, passivated surfaces shall be subjected to a 24 hour water wetting and drying test to detect the presence of residual iron. Passivated surfaces where iron is detected or that have been damaged during fabrication shall be repassivated. Stainless steel surfaces shall be protected during fabrication, shipping, handling, and installation to prevent contamination from iron or carbon steel objects or surfaces.

2-2. FILTER GRAVEL AND MEDIA. Filter gravel and media materials shall comply with AWWA B100, except as modified herein. Gradation sizes shall be based on square hole sieves conforming to ASTM E11.

Filter Gravel

Specific Gravity	2.60 minimum
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Filter Sand

Loss on Ignition	ASTM C25; 4 percent maximum.
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Anthracite

Specific Gravity	1.5 minimum.
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Acid Solubility	5 percent maximum.
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Hardness, Mohs' Scale	2.7 or greater.
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Caustic Solubility	2 percent maximum in 1 percent sodium hydroxide solution at 190°F .
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2.2.01. Media Suppliers. All filter media shall be supplied by one supplier who shall assume responsibility for the quality and compatibility of the media. Media shall be supplied by Leopold, Roberts, Severn Trent Services, Carbon Enterprises Incorporated (CEI), or Unifilt.

2-2.02. Filter Gravel. Total gravel depth shall be 12 inches and shall be graded using one of the following sets of limits:

<u>Layer Above Filter Bottom</u>	<u>Depth of Layer, inches</u>	<u>Retained on Sieve Size</u>	<u>Passing Sieve Size, inches</u>
1st	9	1/2"	3/4"
2nd	2.5	1/4"	1/2"
3rd	2.5	1/8"	1/4"
4th	2.5	No. 16	No. 8]

2-2.03. Filter Sand. Filter sand shall be furnished in a single size and installed in one layer 12 inches thick.

Fine sand shall have the following characteristics:

Effective Size	0.40 to 0.50 mm.
Uniformity Coefficient	1.50 maximum.
Passing No. 16 Sieve	98 percent minimum.
Passing No. 50 Sieve	2 percent maximum.

2-2.04. Anthracite. Anthracite filter media shall be furnished in a single size range and installed in a single layer 24 inches thick directly over the fine sand. Anthracite shall have the following characteristics:

Effective Size	0.90 to 0.99 mm
Uniformity Coefficient	1.50 maximum.
Passing No. 8 Sieve	98 percent minimum.
Passing No. 25 Sieve	2 percent maximum

Anthracite shall be of deep pit mine origin and shall not contain dredged or bank material. Anthracite shall be free of extraneous material.

PART 3 - EXECUTION

3-1. INSTALLATION.

3-1.01. Filter Underdrains. The underdrain system shall be removed and re-installed so that a uniform backwash is obtained over the entire surface of the filter. Underdrains shall be securely anchored to withstand forces under all operating conditions. Installations shall be in accordance with the recommendations of the underdrain manufacturer, Ovivo USA, LLC (formerly Enviroquip), and as specified herein.

Prior to removal of the underdrain units, each component shall be labeled with a permanent marker or other means to identify its location relative to the other components thus allowing each underdrain plate and air scour tube to be re-installed in exactly the same position as it was prior to removal. This is critical since the existing anchors are to be re-used and the bolt hole pattern for each tube will vary slightly.

Contractor shall thoroughly clean the filter cell and piping connected to the underdrain system. Backwash water pipe shall be flushed with water, and all dirt and debris within the filter cell shall be removed prior to re-installation of the

underdrain system.

Underdrain units shall be re-installed on the leveled base of the filter cells. The base of the filters shall be leveled as noted on the Drawings and as specified. The filter floors shall be level to within a tolerance of plus or minus 1/8".

For each filter, Contractor shall survey the floor to determine the extent to which the floor is unlevel. The survey data shall be submitted to the Owner prior to proceeding with the Work. A plan shall be developed by the Contractor, in coordination with the Owner, outlining the proposed approach to leveling each filter floor and re-installing the underdrains and air scour piping in alignment with the wall fitting. The plan shall also identify the equipment, materials, resources, and procedures to be used. The plan shall include consideration of grinding high spots, the use of cementitious leveling material, the replacement of anchors where needed to extend the projection above the finished floor, and any modifications to the air scour header and supports that may be needed.

The leveling plan shall be submitted to the Owner for review and approval. Contractor shall coordinate the proposed work with the Owner to determine the most cost effective approach.

After the underdrain sections are set in place, the perimeter edges at the walls shall be grouted to seal gaps and finished smooth. Care shall be taken to prevent grout from extruding into any flow passages or ports. Any extruded grout shall be removed. Cleanliness of the underdrain shall be maintained throughout installation and placement of media.

3-1.02. Air Distribution Manifold and Tubes. All o-ring gaskets in air piping connections shall be replaced with the same material and type as the existing gaskets.

3-1.03. Filter Media and Gravel. Filter media and gravel placement shall comply with AWWA B100, except as modified herein. Media which becomes dirty or contaminated shall be removed and replaced with clean media.

The bottom layer shall be carefully placed to avoid damage to the filter underdrain system. Each layer shall be completed before starting the layer above. For materials less than 1/2 inch in size, workers shall not stand or walk directly on the media, but on boards which will sustain their weight without displacing the media.

Each layer of filter material shall be deposited to a uniform thickness, with the top surface screeded or otherwise brought to a true level plane. Care shall be taken in depositing each layer not to disturb the level surface of the layer beneath. The correct thickness of each layer shall be determined by screeding each layer to a

continuous level line on the side of the filter cell. The layer shall then be leveled, with the water surface maintained at the appropriate elevation mark.

Placement of filter material shall be performed so as to avoid staining or damaging surfaces of the filter walls. Surfaces that are stained or damaged shall be repaired to the satisfaction of the Engineer.

After placing the gravel layers and before placing any sand or anthracite, backwash the gravel two times.

Backwash the filter by opening the backwash trough waste valve and then slowly opening the backwash water supply valve. Apply initial water at no more than 2 gpm/sq ft of filter area, and then gradually increase the water rate over a period of three minutes to 15 gpm/sq ft. Continue until backwash water clears, but not less than 5 minutes. Upon completion, slowly close the backwash valve.

Drain the filter and inspect the top layer of gravel (1/8" x #16). If fine sand or silt is present, remove it from the filter by skimming the top 1/8" to 1/4" with a sharp flat trowel and discard the skimmings. If the top elevation of the gravel has settled below the target level, add additional gravel to the proper elevation and screed. Additional backwash of this layer is not required.

Place sand in the filter to an excess of 1/2" above the top elevation of the finished sand layer. Use water to level and screed as with the gravel layers.

Backwash the sand three times as described above for the gravel layers. Drain the filter and inspect the sand layer. Settling and compaction may occur.

If settling and compaction exceeds 1/4", before skimming place additional sand for an excess of 1/2" above the top elevation of the finished layer of sand and backwash twice.

If settling and compaction is less than 1/4", skim the excess sand above the top elevation and discard.

Place anthracite in the filter to an excess of 1" above the finished media elevation. Slowly add water to the filter until the anthracite is submerged and let the filter stand for a minimum of one hour. Stir or spray any floating anthracite to make it sink.

Backwash the sand three times as described above. Drain the filter and verify that at least 1/2" of anthracite is available above the finished elevation for skimming the fine particles. If necessary, add more anthracite and backwash once more.

Skim the surface to remove all fine particles and to bring the top surface to the finished filter media elevation. Sample the surface of the media to determine that no particles that will pass a #50 sieve remain in the filter.

3-1.03.01. Field Control Tests. Field control tests for filter media materials will be performed in accordance with the procedures and requirements of AWWA B100, by an independent testing laboratory at the expense of the Contractor. Media not passing field control testing shall be replaced.

- a. Filter Gravel. At least one sieve analysis will be made representing each carload or truckload of each size of gravel. Additional analyses will be made whenever deemed necessary by the Engineer.
- b. Fine Sand. At least one sieve analysis will be made representing each carload or truckload. In addition, a sample for determination of the portion passing a No. 50 sieve will be taken from each 100 cubic feet of sand placed in a filter. A composite sample will be prepared for each filter and at least three sieve analyses will be made on the composite sample. The average of the sieve analyses will be used to determine the amount of fine material to be removed from the filter by scraping.
- c. Anthracite. At least one sieve analysis will be made for each carload or truckload.

3-2. FILTER DISTRIBUTION TESTING. Contractor shall conduct testing and furnish all materials, instrumentation, and personnel, for testing as specified herein. All testing and rectification work for systems failing testing shall be at the Contractor's expense.

Contractor shall verify that all equipment is properly installed and that the filter, backwash system is complete prior to performing any tests. A manufacturer's representative shall inspect the underdrain systems prior to testing and supervise all testing.

Contractor shall provide Engineer two week's notice of testing.

Contractor shall correct deficiencies revealed during testing, and shall retest as required to demonstrate deficiencies have been rectified.

All test set-ups, procedures, and instrumentation shall provide data accuracy of ± 2 percent.

Contractor shall submit 3 copies of complete test reports for all tests, describing the units tested; the type of test; test set-ups, procedures, and instrumentation;

and test flow rates, pressures, levels, and all other data and results as required to demonstrate that all items tested meet specified requirements.

Flow rates for testing shall be as specified in the Performance and Design Requirements paragraph.

3-2.01. Visual Distribution Tests. The filter underdrain system in each filter shall be given a visual distribution test to verify flow uniformity. This test shall be performed before filter media and the gravel bed are placed.

For the water distribution test, filter cells shall be flooded with clean water to the top of the underdrain. After all residual air is released, the water flow rate shall be slowly increased to the specified low rate water flow and sustained for approximately 2 minutes while visual observations are made. The test shall be repeated for the high rate water flow.

During each test, the water surface shall present a uniformly turbulent appearance, without dead spots or boils. Tests shall be repeated if, in the Engineer's judgment, additional testing is needed to make observations.

3-2.02. Metered Distribution Tests. A metered distribution test shall be performed on a filter underdrain system selected by the Engineer, prior to placement of gravel and/or media in any filter. A metered distribution test shall also be performed on a filter where the Contractor is unable to rectify deficiencies demonstrated by the visual distribution testing. Testing shall be performed in accordance with the underdrain manufacturer's metered distribution testing protocol.

The Contractor shall install piezometer tubes at 6 points on the underdrain for water distribution testing. The locations shall be as directed by the filter underdrain manufacturer's field representative.

The high rate water only test shall be performed in a manner similar to that described in the Visual Distribution Tests paragraph above. Water flow rates shall be held constant at the specified rates for a minimum of 4 minutes while the piezometer tube readings are recorded. Each test shall be repeated 3 times and the results of the tests shall be averaged.

Holes in the underdrain for connection of test instruments shall be plugged with pipe plugs.

Average maldistribution of water shall be in accordance with the tolerances specified herein and calculated as follows using the highest (H) and lowest (L) average readings recorded at the test points.

$$\text{Average maldistribution} = (1 - (L/H)^{1/2}) \times 0.5 \times 100\%$$

The Contractor shall perform metered testing on two other filters of the Engineer's selection if the underdrain system first tested failed to perform within the specified tolerances during the initial test run. Subsequent metered testing of all filters will be required if either of the additional two filters fail testing.

3-2.03. Final Distribution Tests. At least two filters shall be tested for acceptable flow uniformity following placement and washing and skimming of the filter material. The filter cells to be tested shall be selected by the Engineer.

Final distribution tests shall consist of a backwash cycle as follows:

Start with initial water surface ± 6 inches above the top of the media.

Water backwash at specified flow rates for approximately 3 minutes or until the water level is just below the bottom of the troughs.

Low rate water backwash at the specified flow rate for 3 minutes.

High rate water backwash at the specified flow rate for 10 minutes followed by a gradual reduction of flow to zero over a 2 minute period.

All flows and durations shall be adjusted during the test if directed by the Engineer.

At the conclusion of the final distribution test, the water level shall be lowered to the top of the filter media. The top of the media shall be inspected, and shall have no areas deviating more than ± 2 inches from the average level plane.

If either filter that is tested fails to pass the test, all filter cells shall be tested.

3-3. DISINFECTION. Disinfect the filter as required by FDEP regulations and as specified in Section 13755.

End of Section

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Section 13500

INSTRUMENTATION AND CONTROL SYSTEM

PART 1 – GENERAL

1-1. SCOPE. This section covers the modification of an instrumentation and control system designated as the Plant Control System.

The system shall be furnished as specified, complete with all software, human machine interface (HMI) hardware, input/output hardware, instrumentation, and all devices, accessories, appurtenances, testing, and training necessary for proper operation.

The supplier shall provide a new PLC panel (CP-3) with CP-3 PLC I/O to be wired and connected to the PLC I/O signals terminated in existing PLC panel (CP-3) with the existing panel CP-3 remaining as a field signal marshalling, filter 32/33 local control and termination panel for the new CP-3. The removal of existing PLC CPU & I/O in Panel CP-3, conversion of the existing GE PLC program to the new GE PLC Rx3i platform, and modifications to the existing Plant Control System are to be performed in conjunction with replacement of filter valves, provided separately, connected to existing field wiring and conduit between valve and the valve control panels, 30-CP-2, 30-CP-3, 30-CP-4 and 30-CP-5. The new filter valves will require new flexible conduit from the existing valve rigid conduit to the new valves.

The new PLC panel will continue to provide remote monitoring and control of filters 30, 31, 32, 33, 34, 35 and 36 as well as allowing the local control of the filter valves via the existing local filter control panel switches and existing filter panel relays. System supplier shall make modifications to the existing wiring of CP-3 to provide new PLC CP-3 output switched power to the filter valve solenoids and other existing PLC I/O supplied from CP-3.

Each new filter valve will require only one solenoid valve whereas existing filter valves utilize two solenoids, one for open and one for close position control. The existing valve control panels shall be modified to disconnect the default state solenoid wiring to the valves, as the new valves are to be provided with a 4-way solenoid valve that when deenergized returns valve to the default deenergized position. The disconnected default state solenoid wiring shall remain as spares.

Power for the new PLC CP-3 panel components such as UPS, PLC, network switch and Operator Interface Terminal (OIT) will be provided from the existing CP-3 control panel 120-volt circuits. Existing CP-3 Panel UPS shall be

maintained and a new UPS provided and mounted in the new CP-3B panel. CP-3B will be equipped with the Phoenix Contact SFN 8TX Ethernet switch and shall be connected to CP-3's Ethernet switch via CAT5E cable.

The existing GE 90-30 program in the CP-3 PLC will be converted and modified as necessary to be used in programming the new RX3i PLC in CP-3B by the Owner. The Owner will also provide any modifications to the Plant Control System human machine interface (HMI) necessary to account for addressing changes in the HMI due to hardware changes in the PLC.

Existing filter control panel drawings will be provided to the PLC panel supplier for use in integrating the new CP-3 panel to existing CP-3.

1-1.02. Associated Sections. This section also includes the equipment and services specified in the following sections.

Section 13530	PROGRAMMABLE LOGIC CONTROLLERS
Section 13550	SOFTWARE CONTROL BLOCK DESCRIPTIONS
Section 13561	PANEL MOUNTED INSTRUMENTS
Section 13570	PANELS, CONSOLES, AND APPURENANCES

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. The Drawings indicate locations and arrangements of equipment and may include installation details and block and one-line diagrams showing connections and interfaces with other equipment. The input/output (I/O) lists are attached as an appendix to the Programmable Logic Controllers section.

Principal components of the instrumentation systems shall be as indicated on the P&ID drawings..

1-2.03. Codes, Permits and Agency Approvals. All work performed and all materials used shall be in accordance with the National Electrical Code, and with

applicable local regulations and ordinances. Where mandated by codes, panels, assemblies, materials, and equipment shall be listed by Underwriters' Laboratories. Contractor shall, as part of their work, arrange for and obtain all necessary permits, inspections, and approvals by the authorities having local jurisdiction of such work. This shall include any third-party inspections and testing of panels and equipment.

1-2.04. Supplier's Qualifications. Equipment and software furnished under this section and under other related sections listed in the Scope paragraph above shall be designed, coordinated, and supplied by a single manufacturer or supplier, hereinafter referred to as the System Supplier. The System Supplier shall be regularly engaged in the business of supplying computer-based monitoring, control, and data acquisition systems. The Contractor shall utilize the services of the System Supplier to coordinate all control system related items, to check-out and calibrate instruments, and to perform all testing, training, and startup activities specified to be provided.

The System Supplier shall have the following minimum qualifications:

- The supplier shall maintain a design office staffed with qualified technical design personnel experienced with GE RX3i PLCs.
- The supplier shall maintain competent and experienced service personnel to service the hardware and software furnished for this project.
- The supplier shall have as a minimum 5 years of experience in the design, coordination and supply of computer-based monitoring, control, and data acquisition systems.
- The supplier shall be one of the following system integrators:
 1. Automated Integration
 2. CEC Controls Company, Inc
 3. J.H. Ham Engineering, Inc.
 4. Locher Environmental Technology, LLC.
 5. Revere Control Systems, Inc.

1-2.05. Coordination. Systems supplied under this section shall be designed and coordinated by System Supplier for proper operation with related equipment and materials furnished by other suppliers under other sections of these specifications, under other contracts, and, where applicable, with related existing equipment. All equipment shall be designed and installed in full conformity with the Drawings, specifications, engineering data, instructions, and recommendations of the manufacturer, and the manufacturer of the related equipment.

1-2.06. Related Equipment and Materials. Related equipment and materials may include, but will not be limited to, instrumentation, motor controllers, valve actuators, chemical feeders, analytical measuring devices, conduit, cable, and piping as described in other sections or furnished under other contracts.

1-2.07. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with System Supplier's equipment drawings and shall be as close as practical to the tag numbers used on the Drawings and device schedules. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.

1-3. GENERAL REQUIREMENTS. The drawings and specifications indicate the extent and general arrangement of the systems. If any departures from the Drawings or Specifications are deemed necessary by System Supplier, details of such departures and the reasons shall be submitted to Engineer for review with or before the first stage submittal. No departures shall be made without prior written acceptance.

The specifications describe the minimum requirements for hardware and software. Where System Supplier's standard configuration includes additional items of equipment or software features not specifically described herein, such equipment or features shall be furnished as a part of the system and shall be warranted as specified herein.

1-3.01. Governing Standards. Equipment furnished under this section shall be designed, constructed, and tested in accordance with IEEE 519, ANSI C37.90, FCC Part 15 - Class A, and NEMA ICS-1-109.60.

1-3.02. Dimensional Restrictions. Layout dimensions will vary between manufacturers and the layout area indicated on the Drawings is based on typical values. The System Supplier shall review the Drawings, the manufacturer's layout drawings and installation requirements, and make any modifications requisite for proper installation subject to acceptance by Engineer. At least three feet of clear access space shall be provided in front of all instrumentation and control system components.

1-3.03. Workmanship and Materials. System Supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.

All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except for testing.

1-3.04. Corrosive Fluids. All parts which are exposed to corrosive conditions shall be made from corrosion resistant materials. System Supplier shall submit certification that the instrument manufacturer approves the selection of materials of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.

1-3.05. Appurtenances. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation devices shall be furnished as needed for proper performance of the equipment.

1-3.06. Programming Devices. Not used.

1-4. SUBMITTALS. Complete dimensional, assembly, and installation drawings, wiring and schematic diagrams; and details, specifications, and data covering the materials used and the parts, devices and accessories forming a part of the system furnished, shall be submitted in accordance with the submittals section. Submittal data shall be grouped and submitted in three separate stages. The submittal for each stage shall be substantially complete. Individual drawings and data sheets submitted at random intervals will not be accepted for review. Equipment tag numbers or identifications used on the Drawings shall be referenced where applicable. Review of drawings submitted prior to the final determination of related equipment shall not relieve System Supplier from supplying systems in full compliance with the specific requirements of the related equipment.

1-4.01. First Stage Submittal. The first stage submittal shall include the following items.

- a. A detailed list of any exceptions, functional differences, or discrepancies between the system proposed by System Supplier and this specification.
- b. Product catalog cut sheets on all hardware and software items, clearly marked to show the model number, optional features, and intended service of each device.
- c. A brief, concise description of the proposed system, including major hardware and software components and personnel training.

- d. A block diagram or schematic drawing showing the principal items of equipment furnished, including model numbers, and their interrelationships.
- e. Drawings showing floor and wall space or desktop area requirements for all equipment items, including allowances for door swings and maintenance access.
- f. Environmental and power requirements, including heat release information for each equipment item.
- g. Standard field termination drawings for all process input/output equipment, showing typical terminations for each type of point available in the system.
- h. A copy of the proposed software licenses for all software associated with the system.
- i. Outline for training classes.
- j. Additional Requirements identified in other Division 13 sections.

1-4.02. Second Stage Submittal. Before any equipment is released for shipment to the site and before factory testing is scheduled, the following data shall be submitted.

At System Supplier's option, the first and second stage submittals may be combined.

- a. Detailed functional descriptions of all software modules specified and furnished as part of System Supplier's standard system. The descriptions shall be identified with the applicable specification paragraph.
- b. Complete panel fabrication drawings and details of panel wiring, piping, and painting. Panel and subpanel drawings shall be to scale and shall include overall dimensions, metal thickness, door swing, mounting details, weight, and front of panel arrangement to show general appearance, with spacing and mounting height of instruments and control devices.
- c. Wiring and installation drawings for all interconnecting wiring between components of the system and between related equipment and the equipment furnished under this section. Wiring diagrams shall show complete circuits and indicate all connections. If panel terminal designations, inter-device connections, device features and options, or other features are modified during the fabrication or factory testing, revised drawings shall be submitted before shipment of the equipment

to the site.

- d. Fiber termination diagrams to show all fiber terminations at fiber patch panels and final termination at equipment. Fiber termination diagrams shall show individual fiber type (single or multimode), fiber core/cladding dimensions, fiber colors, circuit identifications, and type of terminator.
- e. Input/output listings showing point names, numbers, and addresses. Input/output identification numbers from the contract documents shall be cross-referenced in this submittal.
- f. Proposed lesson plans or outlines for all training courses specified herein, including schedule, instructors' qualifications and experience, and recommended prerequisites.
- g. Standard system engineering and user manuals describing the use of the system and application programming techniques for creating reports, graphics, database, historical records, and adding new process I/O nodes to the system.
- h. Additional Requirements identified in other Division 13 sections.

1-4.03. Third Stage Submittal. Complete system documentation, in the form of Operation and Maintenance Manuals, shall be submitted before the commencement of field acceptance testing. Operation and Maintenance Manuals shall include complete instruction books for each item of equipment and software furnished. Where instruction booklets cover more than one specific model or range of device, product data sheets shall be included which indicate the device model number and other special features. A complete set of "as-built" wiring, fabrication, and interconnection drawings shall be included with the manuals. If field-wiring modifications are made after these drawings are submitted, the affected drawings shall be revised and resubmitted. Additional requirements are identified in other Division 13 specification sections.

1-5. PREPARATION FOR SHIPMENT. All electronic equipment and instruments shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements, shall be kept dry at all times, and shall not be exposed to adverse ambient conditions.

Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces that are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Each shipment shall include an appropriate shipping list that indicates the contents of the package, including the specific instrument tags. The shipping list shall be accessible without exposing the instruments to the atmosphere. The shipping list shall also contain any cautionary notes regarding storage of the instruments, including requirements to protect the instrument from static discharge, desensitizing chemicals (solvents, paints, etc.), or ambient atmospheric conditions.

Individual instruments shall be appropriately tagged or labeled to positively identify the device. All identification shall be visible without the need to unpack the instrument from its protective packaging.

Instrument shipment and storage requirements shall be coordinated with Engineer or Owner prior to shipment. System Supplier shall provide adequate storage and be ready to accept the shipment before shipping any equipment to the site. Additional shipping and storage requirements shall be as detailed in the individual instrument specifications.

Components which are shipped loose due to transportation limitations shall be assembled and disassembled by the manufacturer prior to shipment to assure that all components fit together and are adequately supported.

1-6. DELIVERY, STORAGE, AND SHIPPING. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

1-7. SPARE PARTS. Spare parts and consumable items are specified in other sections.

1-7.01. Packaging. All spare parts shall be delivered to Owner before final acceptance of the system. Packaging of spare parts shall provide protection against dust and moisture and shall be suitable for storage. Circuit boards and other electronic parts shall be enclosed in anti-static material. All packages shall be clearly marked with the manufacturer's name, part number or other identification, date of manufacture, and approximate shelf life.

1-7.02. Replacement. System Supplier may utilize spare parts and supplies during system installation, de-bugging, startup, or training, but shall restore all such materials and supplies to the specified quantities before final acceptance of the systems.

PART 2 - PRODUCTS

2-1. GENERAL REQUIREMENTS. All equipment furnished under each section referenced in SCOPE is a part of this section and shall be selected by System Supplier for its superior quality and intended performance. Equipment and materials used shall be subject to review.

2-1.01. Standard Products. The systems furnished shall be standard products. Where two or more units of the same type of equipment are supplied, they shall be the products of the same manufacturer; however, all components of the systems furnished hereunder need not be the products of one manufacturer unless specified herein.

To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. The design of the systems furnished hereunder shall utilize concepts, techniques and features that provide maximum reliability and ease of maintenance and repair. The systems shall include board-level devices such as light emitting diodes or other indicators to facilitate quick diagnosis and repair. Diagnostic software shall be furnished to facilitate system-level troubleshooting.

2-2.01. Factory Assembly. Equipment shall be shipped completely factory assembled, except where its physical size, arrangement, configuration, or shipping and handling limitations make the shipment of completely assembled units impracticable.

2-3. POWER SUPPLY AND INSTRUMENT SIGNAL. Power supply to all control system equipment will be 120 volts, 60 Hz, single phase. System Supplier shall be responsible for distribution of power among enclosures, consoles, peripherals, and other components of the system from the power supply receptacles and junction boxes indicated on the Drawings. Power distribution hardware shall include cables and branch circuit overcurrent protection installed in accordance with the electrical section.

Unless otherwise indicated, power supply to the instrumentation will be unregulated 120 volts ac. All transmitted electronic analog instrument signals shall be 4-20 mA dc and shall be linear with the measured variable.

2-3.01. Facility Distribution System. Equipment not indicated to be powered from an uninterruptible power source shall be suitable for being supplied from the facility distribution system and shall be capable of withstanding voltage variations

of ± 10 percent and harmonics up to the limits of IEEE 519 without affecting operation. System Supplier shall provide voltage conditioning or filtering equipment if necessary to meet the requirements specified.

2-3.02. Power Supplies. Power supplies for voltages other than those listed above shall be an integral part of the equipment furnished. Internal power supplies shall be regulated, current limiting, and self-protected.

2-3.03. Surge Withstand. All equipment shall meet all surge withstand capability tests as defined in ANSI C37.90 without damage to the equipment.

2-3.04. Uninterruptible Power Supply. An uninterruptible power supply (UPS) shall be furnished hereunder to power the equipment indicated on the Drawings and is specified in Section 13570. System Supplier shall be responsible for coordinating the size of the UPS unit with the equipment furnished hereunder, and shall advise Engineer if a unit of higher capacity is necessary.

2-4. SERVICE CONDITIONS AND ENVIRONMENTAL REQUIREMENTS. The equipment provided for the instrumentation and control system shall be suitable for the service conditions specified in the attached equipment sections.

All equipment shall be designed and selected to operate without degradation in performance throughout the environmental extremes specified. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.

2-4.01. Ambient Temperature and Elevation. All system equipment located in air conditioned rooms shall be suitable for operation in ambient temperatures from 10°C to 35°C and a relative humidity of 10 to 80 percent, noncondensing. All equipment located in non air conditioned indoor areas shall be suitable for an ambient temperature range of 0°C to 50°C and a relative humidity of 10 to 95 percent, noncondensing. All equipment located outdoors shall be suitable for operation in an ambient temperature range -20°C to 60°C and a relative humidity of 5 to 100 percent. Heaters and air conditioning/cooling equipment shall be provided where essential to maintain equipment within its manufacturer-recommended operating ranges.

All equipment and instruments shall be designed to operate at the site elevation of 22 ft.

2-4.02. Deleterious Effects. All system equipment will be installed in areas without anti-static floor construction and without any provisions for control of particulates or corrosive gases other than ordinary office-type HVAC filtering.

System Supplier shall furnish any additional air cleaning equipment, anti-static chair pads, or other protective measures necessary for proper operation of the system.

All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

2-4.03. Noise Level. The equivalent "A" weighted sound level for any system equipment located in the control room, except printers, shall not exceed 35 dBA. The sound level for printers shall not exceed 65 dBA. Sound reduction enclosures shall be provided where necessary to comply with these limits.

2-4.04. Lightning Protection. In addition to other environmental protection specified herein, the entire system shall be provided with lightning protection. Lightning protection measures shall include the following.

2-4.04.01. Grounding. All major components of the system shall have a low resistance ground connection. Grounding system provisions indicated on the Drawings shall be modified as recommended by System Supplier.

2-4.04.02. Surge Suppressors. Surge and lightning suppressors shall be non-faulting, non-interrupting, and shall protect against line-to-line and line-to-ground surges. Devices shall be solid-state metal oxide varistor (MOV) or silicon junction type, with a response time of less than 50 nanoseconds. Surge protective devices shall be applied for the following:

- a. All 120 VAC power connections to PLCs, instruments and control room equipment. Surge arresters shall be Transtector "ACP-100-HW Series", Power Integrity Corporation "ZTA Series", Phoenix Contact "Mains PlugTrab", or MCG Surge Protection "400 Series".
- b. All analog signal circuits shall be protected at the control system end of the circuit. The instrument end of the circuit is existing. Surge protection devices shall not impede or interfere with the use of smart transmitter calibration/communication. Protection devices located near the transmitter shall be Telematic "TP48." Protection devices in control panels shall be Transtector "PDS Series or FSP Series", Telematic "SD Series", Phoenix Contact "PipeTrab Series", or Citel "BP1-24."
- c. All metallic pair (twisted and untwisted) conductor local area network and data highway termination points, where any part of the data highway cable is routed outside of the building envelope. Single-port protective devices shall be Phoenix Contact "PlugTrab Series", Transtector "FSP" Series", or Telematic "NP Series."

- d. All serial, PLC data highway, and remote I/O network termination points where any part of the circuit is routed outside of the building envelope. Surge protection devices shall be Transtector "DRDC Series" (RS-232); Transtector "FSP Series" (RS-422), Phoenix Contact "PlugTrab Series" or Citel "E280 Series".

2-5. SOFTWARE DOCUMENTATION. System Supplier shall furnish complete documentation on all software supplied with the systems specified herein. Operating systems, compilers, assemblers, and utility and diagnostic programs that are standard commercial products of third parties need not be included in the optical media backup. Software documentation shall consist of the following principal items.

- a. One backup set of any integrated circuit or solid-state memory-based plug-in firmware used.
- b. Two complete back-up copies of system and application software in executable format on optical media compatible with the system furnished.
- c. Three sets of user reference manuals for all standard system and application software.
- d. One set of user reference manuals for all operating system software.
- e. Three sets of printed as-built reference documentation for any special software provided specifically for this contract.
- f. For each licensed software product, all documentation provided by the product manufacturer shall be provided. This includes all reference manuals and any other documents that were provided by the manufacturer. One set of this documentation shall be supplied for each and every piece of equipment provided. Multiple pieces of similar equipment or software require multiple copies of this documentation.

2-6. SOFTWARE LICENSE. All software programs supplied as a standard part of System Supplier's products for this project shall be licensed to Owner for use on the system specified herein. Such license shall not restrict Owner from using the software on the system provided hereunder or its replacement. Owner shall have the right to make copies of the software for use on the system provided. Specific requirements of System Supplier's software license are subject to review and approval by Owner and Engineer.

2-7. INSTALLATION TEST EQUIPMENT. All necessary testing equipment for calibration and checking of system components shall be provided by System Supplier. System Supplier shall also furnish calibration and maintenance records

for all testing and calibration equipment used on the site if requested by Engineer.

2-8. PROGRAMMING DEVICES. Not used.

PART 3 – EXECUTION

3-1. INSTALLATION REQUIREMENTS. The installation of equipment furnished hereunder shall be by the Contractor or their assigned subcontractors.

3-1.01. Field Wiring. Field wiring materials and installation shall be in accordance with the electrical section.

3-1.02. Sunshades Sunshades shall be provided for CP-3B similar to the sunshades on CP-3. Modifications to the existing sunshades on CP-3 may be necessary for routing conduit between the two panels.

3-1.03. Salvage of Existing Equipment. Existing equipment and materials removed or replaced under this contract shall be delivered to Owner at a location designated by Owner, or shall be properly disposed of at Owner's discretion. Care shall be taken to avoid damage to equipment delivered to Owner.

Any mounting brackets, enclosures, stilling wells, piping, conduits, wiring, or openings that remain after removal of equipment and support hardware shall be removed or repaired in a manner acceptable to Owner and Engineer. Transmitters or switches containing mercury shall be removed and disposed of by personnel trained in the handling of hazardous materials and using approved procedures.

3-2. SYSTEM SOFTWARE CONFIGURATION. System software shall be configured by the Owner. System Supplier configuration services shall consist of factory testing the panel, setting up the PLC panel in the field, verifying communications and performing the IO checkout from the field devices to the new CP-3 PLC. The System Supplier shall fully configure the system using data provided herein or supplied by the Engineer and/or the Owner after award of the contract.

3-2.01. Control System Database. The control system database will be modified and configured by the Owner.

3-2.02. Graphic Screen Displays. Existing Plant 3 Filter display screens will be modified by the Owner as necessary for CP-3 to accommodate I/O points for each filter.

3-2.03. Report Formats. Not used.

3-2.04. Configuration Standards and Conventions. Not used.

3-2.05. Configuration Review Meetings. Not used.

3-2.06. Software Functional Requirements. Not used.

3-3. SYSTEMS CHECK. System Supplier shall provide the services of a field manager to assist the installation contractor during installation, and to calibrate, test, and advise others of the procedures for installation, adjustment, and operation.

3-3.01. Field Manager. System Supplier shall appoint a field services manager who shall be responsible for the coordination of all system check-out and startup activities, and who shall be immediately available to Engineer and Owner by phone or on site for the duration of this project.

3-3.02. Field Inspection at Delivery. The field services manager shall inspect major equipment items within five working days of delivery, to assure that the equipment was not damaged during shipment and shall supervise or assist with unpacking, initial placement, and initial wiring of the system.

3-3.03. Field Calibration of Instruments. Not used.

3-3.04. Training for Installation Personnel. Not used.

3-3.05. Field Inspection Prior to Start Up. After installation and wiring connections are complete, the field supervisor, with additional System Supplier's personnel shall verify that each external connection to the system is correctly wired and field process components and devices are functioning as intended. A minimum of 5 working days shall be included for this task, but System Supplier shall be responsible for completing the following scope of work.

3-3.05.01. Analog Signals. Analog input signals shall be simulated at the transmitting source and verified to be received at the proper register address in the PLC. Analog outputs shall be generated at the PLC, and verified to be received with the correct polarity, at the respective receiving device.

3-3.05.02. Discrete Signals. Discrete input and output signals shall be simulated and verified that they are received at the respective receiving device, and at the proper voltage.

3-3.05.03. Devices by Other Suppliers. If interrelated devices furnished by other suppliers, under other contracts, or by Owner, such as valve actuators, motor controls, chemical feeders, and instruments, do not perform properly at the time of system checkout, the field supervisor shall use suitable test equipment to introduce simulated signals to and/or measure signals from these devices to locate the sources of trouble or malfunction.

3-3.05.04. System Check Out Report. The System Supplier shall submit a written report on the results of such tests to Engineer. Additional documentation shall be furnished as requested by Engineer to establish responsibility for corrective measures. System Supplier shall verify, in writing, to Engineer or Owner that System Supplier has successfully completed the external connection check before beginning system startup or field acceptance testing.

3-3.06. Start Up Assistance. Not used.

3-4. TESTING. The system shall be acceptance tested at the factory and on site.

System Supplier shall prepare a testing procedure to be approved by Owner and Engineer that shall demonstrate that the system conforms to the specifications. The testing procedure shall be submitted at least 30 days in advance of testing. The testing shall be conducted by System Supplier and witnessed by Owner and/or Engineer.

System Supplier shall notify Engineer and Owner in writing at least 14 days before the proposed testing date. If the factory acceptance test is concluded unsuccessfully, the test shall be repeated. System Supplier shall reimburse Owner and Engineer for all expenses incurred in connection with attending repeated factory or site testing necessitated by system failure or inadequate preparation.

3-4.01. Factory Acceptance Testing. After system assembly and debugging at System Supplier's facility, the system shall be tested before the system is shipped to the site. The factory test shall be conducted on the PLC panel provided as part of this project.

All basic functions shall be demonstrated by the System Supplier, including I/O processing and communications.

Alarm handling HMI display functions, alarm logging, as well as the specific functions listed herein will be demonstrated on site by the Owner.

The test procedure shall also include at a least four-hour period for discretionary tests to be conducted by Engineer or Owner.

3-4.01.01. Hardware Test. Processors, processor modules, and peripheral devices associated with the system shall be assembled together as they will be installed in the field and shall be tested. The test shall demonstrate proper operation of each hardware device and communications among devices, and shall include verification of selected analog and discrete inputs and outputs.

3-4.01.02. Software Test. Software testing will be performed on site by the Owner.

3-4.02. Site Acceptance Testing. After installation and checkout by System Supplier's personnel, the system shall be subjected to an acceptance test.

Site acceptance testing will be scheduled and performed by the Owner.

3-4.02.01. Failure of Redundant Equipment. Not used.

3-4.02.02. Completion of Test. Successful completion of the site acceptance test, including the operational demonstration, is prerequisite to Substantial Completion as specified in the Supplementary Conditions.

3-5. TRAINING. Not used.

End of Section

INSTRUMENT NAME & SERVICE:		
BRAND & MODEL NO.:		
TAG OR LOOP NO.:		
INPUT/OUTPUT RANGE:		
INPUT	ACTUAL OUTPUT	DESIRED OUTPUT
PROPORTIONAL BAND:		
RESET:		
POSITION OF SWITCHES, JUMPERS, ETC.		
COMMENTS:		
DATE OF CALIBRATION: CALIBRATED BY:		
Black & Veatch	INSTRUMENT CALIBRATION REPORT	Figure 1-13500

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Section 13530

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 – GENERAL

1-1. SCOPE. This section covers programmable logic controllers (PLCs), including associated input/output hardware to control process equipment and serve as the interface to field devices.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all equipment furnished under this section. Additional PLC software requirements are indicated in Software Control Block Descriptions section.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Drawings. Supplementing this section, the Drawings indicate the number and types of PLCs, locations of PLCs, and provide diagrams and schematics regarding connection and interaction with other equipment. All hardware, including power supplies, special cables, and other appurtenant equipment, shall be provided to meet the functional requirements described herein and indicated on the Drawings.

1-2.03. I/O List. An input/output (I/O) field device signal listing is included as an appendix attached to this section.

1-3. SUBMITTALS. Submittals shall be as specified in the Instrumentation and Control System section.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as specified in the Instrumentation and Control System Section.

1-5. SPARE PARTS. Spare parts shall be furnished as follows:

<u>Spare Part</u>	<u>Quantity</u>
Processor modules	1 of each type used
Power supply modules	1 of each type used
I/O modules	1 of each type used
Communications modules	1 of each type used

PART 2 - PRODUCTS

2-1. GENERAL. All equipment furnished under this section shall be expressly selected by System Supplier for its superior quality for the intended purpose and shall comply with the following requirements.

2-1.01. Interchangeability. All programmable logic controller systems shall be products of the same manufacturer and of the same series or product line. Processors, local and remote input/output hardware, communications modules, and specialty modules such as coprocessors and ASCII modules shall be interchangeable among all I/O panels and systems. PLC modules and hardware by other manufacturers will be acceptable only if the PLC manufacturer does not offer suitable modules and hardware for the same functions.

2-1.02. Initial, Spare, and Future Memory (RAM). System Supplier shall provide adequate memory for the amount of I/O, control algorithms, and communications in the initial system.

Each programmable logic controller shall include provisions for future expansion and shall have 100 percent spare memory capacity and 100 percent spare data capacity installed. The spare memory capacity shall be documented by submitting to Engineer, during factory testing, a statement indicating the amounts of memory of all types being utilized and the total amount available in each system. The statement shall include an estimate of the total program and data memory necessary, including spare memory, based on the I/O hardware for the system, and previous programming experience.

2-1.03. Spare I/O. Each PLC input/output enclosure shall be provided with spares as reflected in the existing CP3 drawings. Contractor shall obtain the existing CP3 drawings from the Owner. Spare I/O shall be installed, wired, and interfaced properly to the terminal strip. The spare I/O shall be in addition to any I/O installed and reserved for future process signals as may be indicated on the I/O list. In addition, each PLC input/output enclosure shall be capable of accommodating 20 percent of additional input/output capacity of each type as originally assembled, without the need for additional expansion racks,

communication adapters, cables, or PLC power supplies.

2-1.04. Expandability. Each new PLC processor and associated I/O shall have a future expandability of at least 50 percent of the provided system.

2-1.05. Acceptable Manufacturers. The new PLCs shall be GE Intelligent Platform RX3i Process Automation Controllers (PAC3), model IC695CPE305, without exception.

2-1.06. Signal Power Supplies. Regulated dc power supplies shall be provided in each PLC enclosure for analog inputs, digital outputs, digital inputs, as required. Power supplies shall be suitable for an input voltage variation of ± 10 percent, and the supply output shall be fused or protected against short-circuiting. Output voltage regulation shall be as required by the instrumentation equipment supplied under another section.

The loop power supply shall be separate from the power supply circuit for the processor and racks.

The power source for all digital inputs from field devices shall be separately fused for each digital input module. Unless otherwise noted, all field devices will be provided with dry contacts that close to provide an input to the PLC.

2-1.07. Appurtenances. The PLC processor and I/O hardware shall be provided as complete systems. The PLCs shall include all necessary hardware and software for a complete working system. All special rack or panel mounted power supplies, special interconnecting and programming cables, special grounding hardware, or isolation devices shall be furnished for proper operation of the equipment. Signal converters, signal boosters, amplifiers, special power supplies, special cable, special grounding, and current repeaters, surge suppression devices, and isolation devices shall be furnished and installed for proper operation of the equipment.

2-1.08. Service Conditions. PLCs will be installed outdoors where the ambient temperature range is 32-100 °F. PLCs installed outdoors shall be furnished with sun shades and be powder coated white.

2-2. LARGE PLC PROCESSOR. The programmable logic controller processor shall be an industrial-type rack-mounted unit that utilizes battery-backed CMOS type or nonvolatile type memory. Battery backed memory shall include integral batteries with sufficient capacity for at least 6 months' memory retention without power to the processing unit. Standby and shelf life of the batteries shall be at least 5 years.

The system shall include an Erasable Programmable Read Only Memory (EPROM) card for storage of the user program. The processor shall automatically download the user program from the EPROM upon startup after a power loss. The EPROM shall be programmable by the PLC or PLC software, without the use of external PROM programmable equipment.

2-2.01. Diagnostics. The processor shall utilize self-monitoring diagnostic techniques and shall contain easily visible LED diagnostic indicators for "run" and "halt" conditions as well as memory and input/output error conditions. Diagnostic codes shall also be available through the programming device to facilitate troubleshooting.

2-2.02. Programming Port. The processor shall include a programming port that is available for programming and monitoring on-line after the system is fully functional, and after all communications, human machine interface (HMI), and network connections have been made. Removal or disruption of network communications, remote I/O communications, and HMIs to allow for on-line programming and monitoring will not be acceptable. A key switch shall be provided on the processor for selection of the operating mode and as a security measure.

2-2.03. Communications. The processor shall be programmed to operate autonomously, regardless of communications status with other units. Each programmable controller shall be furnished complete with communication modules for local and remote input/output hardware communications, communications with other programmable controllers, and communication with host computers as shown on the block diagram..

2-2.04. Environment. The processor shall be suitable for operation in the environments specified in another section.

2-2.05. Programming. The processor shall be programmable using the IEC 1131 All programming in any of the listed programming languages shall be documented from the tags to the logic with detailed descriptions explaining the process that is being controlled.

1131 international programming standards and ladder logic programming. IEC 1131 programming shall include the following:

Functional Block Diagram

Sequential Function Chart.

Instruction List.

Structured Text.

Ladder Diagram.

Ladder logic programming shall include a minimum of the following capabilities:

Contacts, coils, branching.

Data comparisons.

On-delay and off-delay timers.

Counters with comparators.

Floating point Math and Logical instructions.

PID loop control.

Jumps and Subroutine functions.

Master control relay.

Transitional or one-shot outputs.

Standard and user-defined data tables for digital and analog value storage.

Remote I/O capability.

Fault-mode subroutine.

2-2.06. Programming Capabilities. The processor shall include the following capabilities for programming, debugging of programs, and troubleshooting.

Off-line programming.

On-line programming.

On-line status of coils and registers.

Input/output forcing.

2-2.07. Hardware Configuration. Processors shall be configured for standard rack mounting. Each programmable logic controller processor shall include integral communications ports for the programming device, remote input/output, HMI device, or remote communications interfaces.

2-2.08. Input/Output Hardware. Input/output hardware shall be arranged as indicated on the Drawings. Programmable logic controller systems shall support the following types of input/output modules.

120 volt ac digital input and output.

4-20 mA dc analog input.

All digital input/output hardware shall include isolation against surges of at least 1500 volts. All output hardware connected to inductive loads shall be supplied with surge suppression devices and recommended by the PLC manufacturer to prevent damage to output hardware.

2-2.08.01. Wiring Terminals. All input/output modules shall utilize easily removable plug-in or hinged field wiring terminals to allow removal of modules without disconnecting individual wires.

2-2.08.02. I/O Circuit Power Supply. Outputs for motor driven equipment will typically be powered from the driven equipment. Digital outputs for miscellaneous equipment shall be powered either from the controlled equipment or the PLC enclosure as indicated on the Drawings or as coordinated with the controlled equipment supplier. Outputs that control process equipment specified under other sections or provided under other contracts shall operate interposing relays in the PLC cabinet.

2-2.08.03. Digital Input Modules. Digital input modules shall sense voltages between 100 and 130 volts ac and shall have LED indicators for each point to display the status of the field contact. Each input module shall be suitable for being connected to a separate voltage source and return. Return voltage may be common to the entire input module. Digital input modules shall have 16 inputs. Module shall be the IC694MDL240 with 16 channels.

2-2.08.04. Digital Output Modules. Digital output modules shall control voltages from 100 and 130volts ac and shall be rated at least 1 ampere. Outputs shall be individually fused and shall have LED indicators to display output status. Outputs shall withstand a surge of at least 80 amperes for one cycle and shall have an off-state leakage current not to exceed 2.0 mA. Digital output modules shall have 16 outputs. Module shall be the IC694MDL340 with 16 channels.

2-2.08.05. Relay Digital Output Modules. Not used.

2-2.08.06. Analog Input Modules. Analog input modules shall accept linear 4-20 mA dc signals from field transmitters. Analog to digital conversion accuracy shall be at least 12-bit (0-4095 count) resolution. Analog input modules shall have multiple inputs. Module shall be the IC694AL221 with 8 channels.

2-2.08.07. Analog Output Modules. Not used.

2-2.08.08. Panel Terminations. All PLC input/output signals for field connections shall be terminated through panel enclosure terminal strips. Direct connection of field wiring to the I/O module terminals is not acceptable.

2-2.08.09. Interposing Relays. Interposing relays shall be incorporated on all I/O circuits as shown on the PLC input/output listing.

2-4. COMMUNICATIONS. Each programmable controller system shall be furnished complete with communication hardware modules for local input/output hardware, remote input/output hardware, other programmable controllers, or for host computers.

Communication hardware shall be compatible with the cable, data highway, fiber optic, or radio communication media. Ethernet components and cable are specified in other specification sections.

2-4.01. Addressability. Each programmable logic controller shall be individually addressable so that only the selected controller responds when queried. IP addressing shall be used. Designation of a controller's network address may be either a software or hardware function.

2-4.02. Communications Hardware. System Supplier shall provide all necessary communications hardware to continue communications previously established. A separate Ethernet module shall be provided for communications and be mounted in the last slot of the main rack. System Supplier shall not rely on the Ethernet port of the CPU. Module shall be the IC695ETM001.

2-4.02.01. PLC to PLC Communications Hardware. Not used.

2-4.02.02. PLC to Remote Communications Hardware. Not used.

2-4.02.03. PLC to Host Communications Hardware. Not used.

2-4.03. Communications Media. System Supplier shall provide all necessary cabling for the PLC communications network and PLC remote I/O communications network. Communications cables shall meet the requirements of the manufacturers of the PLCs and communications modules. PLC communications media shall be as specified under the Network Systems section.

2-5. MEDIA CONVERTERS. Not Used.

2-6. TELEPHONE NETWORKS. Not used.

2-7. SERIAL NETWORKS. Not Used.

2-8. PROGRAMMING DEVICE HARDWARE. The programming device shall be a System Supplier owned portable notebook computer.

2-9. PROGRAMMING SOFTWARE. System Supplier shall utilize one licensed copy of PLC programming software.

2-9.01. Standard Product. The programming software shall be personal computer based and the Professional Machine Edition product of the GE Intelligent Platform. The System Supplier shall ensure that all programming is accomplished with version compatibility with the Owner's existing PLCs and licensed PLC software.

2-9.02. PLC Simulation. The programming software shall include a PLC simulation feature that allows the program logic of a single PLC to be tested and debugged entirely in the programming device without the PLC.

2-9.03. Programming Software Features. The programming software shall allow off-line development of all PLC-related programming, including user annotation of the program, and creation and printing of application programs and I/O cross-reference lists. Special programming tasks originally provided by System Supplier shall also be included.

On-line features shall include IEC-1311 standards program modification, ladder-logic modification, program language modification, monitoring of real-time ladder-logic execution, monitoring of program execution, monitoring and manipulation of timer and counter preset and present values, monitoring and forcing of physical I/O, and monitoring and manipulation of analog (register) and bit (binary) data table values. PLC and I/O hardware diagnostic and status information shall be accessible using the software in on-line mode.

2-10. SYSTEM ENCLOSURES. Programmable logic controllers and input/output hardware shall be housed in shop-assembled panels as indicated on the Drawings and as described in the Panels, Consoles, and Appurtenances section.

2-11. OPERATOR INTERFACE TERMINALS. Not Used.

PART 3 - EXECUTION

3-1. INSTALLATION REQUIREMENTS. PLCs installation requirements are specified in Instrumentation and Control System section except as described herein.

Field check, testing, and training shall be as specified in the Instrumentation and Control System section.

3-2. CONFIGURATION.

3-2.01. PLC Programming and Configuration. Configuration services are specified in the Instrumentation and Control System section.

3-2.02. Communications Configuration. The communications shall be fully configured and installed by System Supplier, and shall be operational before application software configuration by others. Communications shall be configured as shown on the Drawings.

End of Section

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Input/Output List - Legend/Description Sheet

Item. This is an arbitrary sequential number which is for reference only.

Panel ID. This is the panel identification for the I/O cabinet, PLC cabinet, or controller where the I/O signal terminates.

Type: This is the type of I/O signal, as follows:

AI = Analog Input

AO = Analog Output

DI = Discrete Input

DO = Discrete Output

PI = Pulse Input (totalizer or accumulator type input)

Service Description. This is the description or the function (i.e. Filter No. 1 Loss-of-Head).

Field Device. This is the tag number or equipment identifier associated with the I/O point.

Analog Data (Signal Type). This will typically be 4-20mA, but could also be 1-5Vdc, serial, HART, FLD-BUS, or similar to indicate the signal type of the associated input or output.

Analog Data (Calibrated Range). This will be the scaled value of the input in engineering units.

Analog Data (Power). This will typically be '2-wire' for devices which are loop powered from the PLC enclosure, or '4-wire' for devices which are powered from external power supplies, unless noted otherwise.

Discrete Data (Signal Type). This will be 120VAC, 24VDC, or similar to indicate the signal type of the associated input or output.

Discrete Data (Closed State). This will indicate the state of the input or output when it is considered to be closed or energized (normal, alarm, running, failed, etc.).

Discrete Data (Power Source). This will indicate the location of the power source for the wetting voltage on the contacts, as follows:

Field = External field power source. (May require interposing relays or isolated I/O module type.)

Local = Power originates from within the PLC or I/O enclosure.

Discrete Data (Interp Relay). This will be either 'Yes' or 'No' to indicate whether the input or output requires an interposing relay. Relays are typically required to isolate external voltage sources. See specifications for additional details.

Comments/Notes. This column may include a cross reference to another specification section where applicable, or to a note which provides additional information. Notes are appended to the end of the I/O listing.

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DI	FILTER CELL 30 INFLUENT VALVE NO.1 30-FCV-30A OPEN	30-FCV-30A-OP	30-CP-3	0	2	1			N/A	N/A	PLC PANEL	OPEN	NO	379	225	
	DI	FILTER CELL 30 INFLUENT VALVE NO.1 30-FCV-30A CLOSED	30-FCV-30A-CL	30-CP-3	0	2	2			N/A	N/A	PLC PANEL	CLOSED	NO	378	225	
	DI	FILTER CELL 30 INFLUENT VALVE NO.2 30-FCV-30B OPEN	30-FCV-30B-OP	30-CP-3	0	2	3			N/A	N/A	PLC PANEL	OPEN	NO	381	225	
	DI	FILTER CELL 30 INFLUENT VALVE NO.2 30-FCV-30B CLOSED	30-FCV-30B-CL	30-CP-3	0	2	4			N/A	N/A	PLC PANEL	CLOSED	NO	380	225	
	DI	FILTER CELL 30 BACKWASH VALVE NO.1 30-FCV-30C OPEN	30-FCV-30C-OP	30-CP-3	0	2	5			N/A	N/A	PLC PANEL	OPEN	NO	383	225	
	DI	FILTER CELL 30 BACKWASH VALVE NO.1 30-FCV-30C CLOSED	30-FCV-30C-CL	30-CP-3	0	2	6			N/A	N/A	PLC PANEL	CLOSED	NO	382	225	
	DI	FILTER CELL 30 BACKWASH VALVE NO.2 30-FCV-30C OPEN	30-FCV-30D-OP	30-CP-3	0	2	7			N/A	N/A	PLC PANEL	OPEN	NO	385	225	
	DI	FILTER CELL 30 BACKWASH VALVE NO.2 30-FCV-30D CLOSED	30-FCV-30D-CL	30-CP-3	0	2	8			N/A	N/A	PLC PANEL	CLOSED	NO	384	225	
	DI	FILTER CELL 30 FTW OPEN	30-FCV-30J-OP	30-CP-3	0	2	9			N/A	N/A	PLC PANEL	OPEN	NO	387	225	
	DI	FILTER CELL 30 FTW CLOSED	30-FCV-30J-CL	30-CP-3	0	2	10			N/A	N/A	PLC PANEL	CLOSED	NO	386	225	
	DI	FILTER CELL 30 EFFLUENT VALVE NO.1 30-FCV-30F OPEN	30-FCV-30F-OP	30-CP-3	0	2	11			N/A	N/A	PLC PANEL	OPEN	NO	389	225	
	DI	FILTER CELL 30 EFFLUENT VALVE NO.1 30-FCV-30F CLOSED	30-FCV-30F-CL	30-CP-3	0	2	12			N/A	N/A	PLC PANEL	CLOSED	NO	388	225	

Black Veatch

Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DI	FILTER CELL 30 EFFLUENT VALVE NO.2 30-FCV-30G OPEN	30-FCV-30G-OP	30-CP-3	0	2	13			N/A	N/A	PLC PANEL	OPEN	NO	391	225	
	DI	FILTER CELL 30 EFFLUENT VALVE NO.2 30-FCV-30G CLOSED	30-FCV-30G-CL	30-CP-3	0	2	14			N/A	N/A	PLC PANEL	CLOSED	NO	390	225	
	DI	FILTER CELL 30 AIR SCOUR OPEN	30-FCV-30E-OP	30-CP-3	0	2	15			N/A	N/A	PLC PANEL	OPEN	NO	393	225	
	DI	FILTER CELL 30 AIR SCOUR CLOSED	30-FCV-30E-CL	30-CP-3	0	2	16			N/A	N/A	PLC PANEL	CLOSED	NO	392	225	
	DI	FILTER CELL 31 INFLUENT VALVE NO.1 30-FCV-31A OPEN	30-FCV-31A-OP	30-CP-3	0	3	1			N/A	N/A	PLC PANEL	OPEN	NO	395	225	
	DI	FILTER CELL 31 INFLUENT VALVE NO.1 30-FCV-31A CLOSED	30-FCV-31A-CL	30-CP-3	0	3	2			N/A	N/A	PLC PANEL	CLOSED	NO	394	225	
	DI	FILTER CELL 31 INFLUENT VALVE NO.2 30-FCV-31B OPEN	30-FCV-31B-OP	30-CP-3	0	3	3			N/A	N/A	PLC PANEL	OPEN	NO	397	225	
	DI	FILTER CELL 31 INFLUENT VALVE NO.2 30-FCV-31B CLOSED	30-FCV-31B-CL	30-CP-3	0	3	4			N/A	N/A	PLC PANEL	CLOSED	NO	396	225	
	DI	FILTER CELL 31 BACKWASH VALVE NO.1 30-FCV-31C OPEN	30-FCV-31C-OP	30-CP-3	0	3	5			N/A	N/A	PLC PANEL	OPEN	NO	399	225	
	DI	FILTER CELL 31 BACKWASH VALVE NO.1 30-FCV-31C CLOSED	30-FCV-31C-CL	30-CP-3	0	3	6			N/A	N/A	PLC PANEL	CLOSED	NO	398	225	
	DI	FILTER CELL 31 BACKWASH VALVE NO.2 30-FCV-31D OPEN	30-FCV-31D-OP	30-CP-3	0	3	7			N/A	N/A	PLC PANEL	OPEN	NO	401	225	
	DI	FILTER CELL 31 BACKWASH VALVE NO.2 30-FCV-31D CLOSED	30-FCV-31D-CL	30-CP-3	0	3	8			N/A	N/A	PLC PANEL	CLOSED	NO	400	225	
	DI	FILTER CELL 31 FTW OPEN	30-FCV-31J-OP	30-CP-3	0	3	9			N/A	N/A	PLC PANEL	OPEN	NO	403	225	
	DI	FILTER CELL 31 FTW CLOSED	30-FCV-31J-CL	30-CP-3	0	3	10			N/A	N/A	PLC PANEL	CLOSED	NO	402	225	
	DI	FILTER CELL 31 EFFLUENT VALVE NO.1 30-FCV-31F OPEN	30-FCV-31F-OP	30-CP-3	0	3	11			N/A	N/A	PLC PANEL	OPEN	NO	405	225	
	DI	FILTER CELL 31 EFFLUENT VALVE NO.1 30-FCV-31F CLOSED	30-FCV-31F-CL	30-CP-3	0	3	12			N/A	N/A	PLC PANEL	CLOSED	NO	404	225	
	DI	FILTER CELL 31 EFFLUENT VALVE NO.2 30-FCV-31G OPEN	30-FCV-31G-OP	30-CP-3	0	3	13			N/A	N/A	PLC PANEL	OPEN	NO	407	225	
	DI	FILTER CELL 31 EFFLUENT VALVE NO.2 30-FCV-31G CLOSED	30-FCV-31G-CL	30-CP-3	0	3	14			N/A	N/A	PLC PANEL	CLOSED	NO	406	225	
	DI	FILTER CELL 31 AIR SCOUR OPEN	30-FCV-31E-OP	30-CP-3	0	3	15			N/A	N/A	PLC PANEL	OPEN	NO	409	225	
	DI	FILTER CELL 31 AIR SCOUR CLOSED	30-FCV-31E-CL	30-CP-3	0	3	16			N/A	N/A	PLC PANEL	CLOSED	NO	408	225	
	DI	FILTER CELL 30 AUTOSTART BACKWASH	30-CP-2	30-CP-3	0	4	1			N/A	N/A	PLC PANEL	AUTOSTART	NO	410	225	
	DI	FILTER CELL 31 AUTOSTART BACKWASH	30-CP-2	30-CP-3	0	4	2			N/A	N/A	PLC PANEL	AUTOSTART	NO	412	225	
	DI	FILTER CELL 30 AUTOMODE BACKWASH	30-CP-2	30-CP-3	0	4	3			N/A	N/A	PLC PANEL	AUTOMODE	NO	414	225	
	DI	FILTER CELL 31 AUTOMODE BACKWASH	30-CP-2	30-CP-3	0	4	4			N/A	N/A	PLC PANEL	AUTOMODE	NO	416	225	
	DI	FILTER CELL 30&31 AIRSCOUR BLOWER START	30-CP-2	30-CP-3	0	4	5			N/A	N/A	PLC PANEL	START	NO	418	225	
	DI	FILTER CELL 30 AIRSCOUR DONE	30-CP-2	30-CP-3	0	4	6			N/A	N/A	PLC PANEL	DONE	NO	420	225	
	DI	FILTER CELL 31 AIRSCOUR DONE	30-CP-2	30-CP-3	0	4	7			N/A	N/A	PLC PANEL	DONE	NO	422	225	
	DI	FILTER CELL 30 BACKWASH DONE	30-CP-2	30-CP-3	0	4	8			N/A	N/A	PLC PANEL	DONE	NO	424	225	
	DI	FILTER CELL 31 BACKWASH DONE	30-CP-2	30-CP-3	0	4	9			N/A	N/A	PLC PANEL	DONE	NO	426	225	
	DI	FILTER CELL 34 INFLUENT VALVE NO.1 30-FCV-34A OPEN	30-FCV-34A-OP	30-CP-3	0	5	1			N/A	N/A	PLC PANEL	OPEN	NO	434	227	

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DI	FILTER CELL 34 INFLUENT VALVE NO.1 30-FCV-34A CLOSED	30-FCV-34A-CL	30-CP-3	0	5	2			N/A	N/A	PLC PANEL	CLOSED	NO	436	227	
	DI	FILTER CELL 34 INFLUENT VALVE NO.2 30-FCV-34B OPEN	30-FCV-34B-OP	30-CP-3	0	5	3			N/A	N/A	PLC PANEL	OPEN	NO	438	227	
	DI	FILTER CELL 34 INFLUENT VALVE NO.2 30-FCV-34B CLOSED	30-FCV-34B-CL	30-CP-3	0	5	4			N/A	N/A	PLC PANEL	CLOSED	NO	440	227	
	DI	FILTER CELL 34 BACKWASH VALVE NO.1 30-FCV-34C OPEN	30-FCV-34C-OP	30-CP-3	0	5	5			N/A	N/A	PLC PANEL	OPEN	NO	442	227	
	DI	FILTER CELL 34 BACKWASH VALVE NO.1 30-FCV-34C CLOSED	30-FCV-34C-CL	30-CP-3	0	5	6			N/A	N/A	PLC PANEL	CLOSED	NO	444	227	
	DI	FILTER CELL 34 BACKWASH VALVE NO.2 30-FCV-34D OPEN	30-FCV-34D-OP	30-CP-3	0	5	7			N/A	N/A	PLC PANEL	OPEN	NO	446	227	
	DI	FILTER CELL 34 BACKWASH VALVE NO.2 30-FCV-34D CLOSED	30-FCV-34D-CL	30-CP-3	0	5	8			N/A	N/A	PLC PANEL	CLOSED	NO	448	227	
	DI	FILTER CELL 34 FTW OPEN	30-FCV-34J-OP	30-CP-3	0	5	9			N/A	N/A	PLC PANEL	OPEN	NO	450	227	
	DI	FILTER CELL 34 FTW CLOSED	30-FCV-34J-CL	30-CP-3	0	5	10			N/A	N/A	PLC PANEL	CLOSED	NO	452	227	
	DI	FILTER CELL 34 EFFLUENT VALVE NO.1 30-FCV-34F OPEN	30-FCV-34F-OP	30-CP-3	0	5	11			N/A	N/A	PLC PANEL	OPEN	NO	454	227	
	DI	FILTER CELL 34 EFFLUENT VALVE NO.1 30-FCV-34F CLOSED	30-FCV-34F-CL	30-CP-3	0	5	12			N/A	N/A	PLC PANEL	CLOSED	NO	456	227	
	DI	FILTER CELL 34 EFFLUENT VALVE NO.2 30-FCV-34G OPEN	30-FCV-34G-OP	30-CP-3	0	5	13			N/A	N/A	PLC PANEL	OPEN	NO	458	227	
	DI	FILTER CELL 34 EFFLUENT VALVE NO.2 30-FCV-34G CLOSED	30-FCV-34G-CL	30-CP-3	0	5	14			N/A	N/A	PLC PANEL	CLOSED	NO	460	227	
	DI	FILTER CELL 34 AIR SCOUR OPEN	30-FCV-34E-OP	30-CP-3	0	5	15			N/A	N/A	PLC PANEL	OPEN	NO	462	227	
	DI	FILTER CELL 34 AIR SCOUR CLOSED	30-FCV-34E-CL	30-CP-3	0	5	16			N/A	N/A	PLC PANEL	CLOSED	NO	464	227	
	DI	FILTER CELL 35 INFLUENT VALVE NO.1 30-FCV-35A OPEN	30-FCV-35A-OP	30-CP-3	0	6	1			N/A	N/A	PLC PANEL	OPEN	NO	465	227	
	DI	FILTER CELL 35 INFLUENT VALVE NO.1 30-FCV-35A CLOSED	30-FCV-35A-CL	30-CP-3	0	6	2			N/A	N/A	PLC PANEL	CLOSED	NO	466	227	
	DI	FILTER CELL 35 INFLUENT VALVE NO.2 30-FCV-35B OPEN	30-FCV-35B-OP	30-CP-3	0	6	3			N/A	N/A	PLC PANEL	OPEN	NO	467	227	
	DI	FILTER CELL 35 INFLUENT VALVE NO.2 30-FCV-35B CLOSED	30-FCV-35B-CL	30-CP-3	0	6	4			N/A	N/A	PLC PANEL	CLOSED	NO	468	227	
	DI	FILTER CELL 35 BACKWASH VALVE NO.1 30-FCV-35C OPEN	30-FCV-35C-OP	30-CP-3	0	6	5			N/A	N/A	PLC PANEL	OPEN	NO	469	227	
	DI	FILTER CELL 35 BACKWASH VALVE NO.1 30-FCV-35C CLOSED	30-FCV-35C-CL	30-CP-3	0	6	6			N/A	N/A	PLC PANEL	CLOSED	NO	470	227	
	DI	FILTER CELL 35 BACKWASH VALVE NO.2 30-FCV-35D OPEN	30-FCV-35D-OP	30-CP-3	0	6	7			N/A	N/A	PLC PANEL	OPEN	NO	471	227	
	DI	FILTER CELL 35 BACKWASH VALVE NO.2 30-FCV-35D CLOSED	30-FCV-35D-CL	30-CP-3	0	6	8			N/A	N/A	PLC PANEL	CLOSED	NO	472	227	
	DI	FILTER CELL 35 FTW OPEN	30-FCV-35J-OP	30-CP-3	0	6	9			N/A	N/A	PLC PANEL	OPEN	NO	473	227	
	DI	FILTER CELL 35 FTW CLOSED	30-FCV-35J-CL	30-CP-3	0	6	10			N/A	N/A	PLC PANEL	CLOSED	NO	474	227	
	DI	FILTER CELL 35 EFFLUENT VALVE NO.1 30-FCV-35F OPEN	30-FCV-35F-OP	30-CP-3	0	6	11			N/A	N/A	PLC PANEL	OPEN	NO	475	227	
	DI	FILTER CELL 35 EFFLUENT VALVE NO.1 30-FCV-35F CLOSED	30-FCV-35F-CL	30-CP-3	0	6	12			N/A	N/A	PLC PANEL	CLOSED	NO	476	227	
	DI	FILTER CELL 35 EFFLUENT VALVE NO.2 30-FCV-35G OPEN	30-FCV-35G-OP	30-CP-3	0	6	13			N/A	N/A	PLC PANEL	OPEN	NO	477	227	
	DI	FILTER CELL 35 EFFLUENT VALVE NO.2 30-FCV-35G CLOSED	30-FCV-35G-CL	30-CP-3	0	6	14		13530	N/A	N/A	PLC PANEL	CLOSED	NO	478	227	

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DI	FILTER CELL 35 AIR SCOUR OPEN	30-FCV-35E-OP	30-CP-3	0	6	15			N/A	N/A	PLC PANEL	OPEN	NO	479	227	
	DI	FILTER CELL 35 AIR SCOUR CLOSED	30-FCV-35E-CL	30-CP-3	0	6	16			N/A	N/A	PLC PANEL	CLOSED	NO	480	227	
	DI	FILTER CELL 34 AUTOSTART BACKWASH	30-CP-4	30-CP-3	0	7	1			N/A	N/A	PLC PANEL	AUTOSTART	NO	481	227	
	DI	FILTER CELL 35 AUTOSTART BACKWASH	30-CP-4	30-CP-3	0	7	2			N/A	N/A	PLC PANEL	AUTOSTART	NO	482	227	
	DI	FILTER CELL 34 AUTOMODE BACKWASH	30-CP-4	30-CP-3	0	7	3			N/A	N/A	PLC PANEL	AUTOMODE	NO	483	227	
	DI	FILTER CELL 35 AUTOMODE BACKWASH	30-CP-4	30-CP-3	0	7	4			N/A	N/A	PLC PANEL	AUTOMODE	NO	484	227	
	DI	FILTER CELL 34&35 AIRSCOUR BLOWER START	30-CP-4	30-CP-3	0	7	5			N/A	N/A	PLC PANEL	START	NO	485	227	
	DI	FILTER CELL 34 AIRSCOUR DONE	30-CP-4	30-CP-3	0	7	6			N/A	N/A	PLC PANEL	DONE	NO	486	227	
	DI	FILTER CELL 35 AIRSCOUR DONE	30-CP-4	30-CP-3	0	7	7			N/A	N/A	PLC PANEL	DONE	NO	487	227	
	DI	FILTER CELL 34 BACKWASH DONE	30-CP-4	30-CP-3	0	7	8			N/A	N/A	PLC PANEL	DONE	NO	488	227	
	DI	FILTER CELL 35 BACKWASH DONE	30-CP-4	30-CP-3	0	7	9			N/A	N/A	PLC PANEL	DONE	NO	489	227	
	DI	FILTER CELL 36 INFLUENT VALVE NO.1 30-FCV-36A OPEN	30-FCV-36A-OP	30-CP-3	0	8	1			N/A	N/A	PLC PANEL	OPEN	NO	497	229	
	DI	FILTER CELL 36 INFLUENT VALVE NO.1 30-FCV-36A CLOSED	30-FCV-36A-CL	30-CP-3	0	8	2			N/A	N/A	PLC PANEL	CLOSED	NO	498	229	
	DI	FILTER CELL 36 INFLUENT VALVE NO.2 30-FCV-36B OPEN	30-FCV-36B-OP	30-CP-3	0	8	3			N/A	N/A	PLC PANEL	OPEN	NO	499	229	
	DI	FILTER CELL 36 INFLUENT VALVE NO.2 30-FCV-36B CLOSED	30-FCV-36B-CL	30-CP-3	0	8	4			N/A	N/A	PLC PANEL	CLOSED	NO	500	229	
	DI	FILTER CELL 36 BACKWASH VALVE NO.1 30-FCV-36C OPEN	30-FCV-36C-OP	30-CP-3	0	8	5			N/A	N/A	PLC PANEL	OPEN	NO	501	229	
	DI	FILTER CELL 36 BACKWASH VALVE NO.1 30-FCV-36C CLOSED	30-FCV-36C-CL	30-CP-3	0	8	6			N/A	N/A	PLC PANEL	CLOSED	NO	502	229	
	DI	FILTER CELL 36 BACKWASH VALVE NO.2 30-FCV-36D OPEN	30-FCV-36D-OP	30-CP-3	0	8	7			N/A	N/A	PLC PANEL	OPEN	NO	503	229	
	DI	FILTER CELL 36 BACKWASH VALVE NO.2 30-FCV-36D CLOSED	30-FCV-36D-CL	30-CP-3	0	8	8			N/A	N/A	PLC PANEL	CLOSED	NO	504	229	
	DI	FILTER CELL 36 FTW OPEN	30-FCV-36J-OP	30-CP-3	0	8	9			N/A	N/A	PLC PANEL	OPEN	NO	505	229	
	DI	FILTER CELL 36 FTW CLOSED	30-FCV-36J-CL	30-CP-3	0	8	10			N/A	N/A	PLC PANEL	CLOSED	NO	506	229	
	DI	FILTER CELL 36 EFFLUENT VALVE NO.1 30-FCV-36F OPEN	30-FCV-36F-OP	30-CP-3	0	8	11			N/A	N/A	PLC PANEL	OPEN	NO	507	229	
	DI	FILTER CELL 36 EFFLUENT VALVE NO.1 30-FCV-36F CLOSED	30-FCV-36F-CL	30-CP-3	0	8	12			N/A	N/A	PLC PANEL	CLOSED	NO	508	229	
	DI	FILTER CELL 36 EFFLUENT VALVE NO.2 30-FCV-36G OPEN	30-FCV-36G-OP	30-CP-3	0	8	13			N/A	N/A	PLC PANEL	OPEN	NO	509	229	
	DI	FILTER CELL 36 EFFLUENT VALVE NO.2 30-FCV-36G CLOSED	30-FCV-36G-CL	30-CP-3	0	8	14			N/A	N/A	PLC PANEL	CLOSED	NO	510	229	
	DI	FILTER CELL 36 AIR SCOUR OPEN	30-FCV-36E-OP	30-CP-3	0	8	15			N/A	N/A	PLC PANEL	OPEN	NO	511	229	
	DI	FILTER CELL 36 AIR SCOUR CLOSED	30-FCV-36E-CL	30-CP-3	0	8	16			N/A	N/A	PLC PANEL	CLOSED	NO	512	229	
	DI	FILTER CELL 32 INFLUENT VALVE NO.1 30-FCV-32A OPEN	30-FCV-32A-OP	30-CP-3	0	10	1			N/A	N/A	PLC PANEL	OPEN	NO	253	223	duplicate terminal number
	DI	FILTER CELL 32 AUTOSTART BACKWASH	30-CP-5	30-CP-3	0	10	1			N/A	N/A	PLC PANEL	AUTOSTART	NO	513	229	
	DI	FILTER CELL 32 INFLUENT VALVE NO.1 30-FCV-32A CLOSED	30-FCV-32A-CL	30-CP-3	0	10	2			N/A	N/A	PLC PANEL	CLOSED	NO	253	223	duplicate terminal number

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DI	FILTER CELL 36 AUTOMODE BACKWASH	30-CP-5	30-CP-3	0	10	2			N/A	N/A	PLC PANEL	AUTOMODE	NO	514	229	
	DI	FILTER CELL 32 INFLUENT VALVE NO.2 30-FCV-32B OPEN	30-FCV-32B-OP	30-CP-3	0	10	3			N/A	N/A	PLC PANEL	OPEN	NO	254	223	
	DI	FILTER CELL 36&35 AIRSCOUR BLOWER START	30-CP-5	30-CP-3	0	10	3			N/A	N/A	PLC PANEL	START	NO	515	229	
	DI	FILTER CELL 32 INFLUENT VALVE NO.2 30-FCV-32B CLOSED	30-FCV-32B-CL	30-CP-3	0	10	4			N/A	N/A	PLC PANEL	CLOSED	NO	255	223	
	DI	FILTER CELL 36 AIRSCOUR DONE	30-CP-5	30-CP-3	0	10	4			N/A	N/A	PLC PANEL	DONE	NO	516	229	
	DI	FILTER CELL 32 BACKWASH VALVE NO.1 30-FCV-32C OPEN	30-FCV-32C-OP	30-CP-3	0	10	5			N/A	N/A	PLC PANEL	OPEN	NO	256	223	
	DI	FILTER CELL 36 BACKWASH DONE	30-CP-5	30-CP-3	0	10	5			N/A	N/A	PLC PANEL	DONE	NO	517	229	
	DI	FILTER CELL 32 BACKWASH VALVE NO.1 30-FCV-32C CLOSED	30-FCV-32C-CL	30-CP-3	0	10	6			N/A	N/A	PLC PANEL	CLOSED	NO	257	223	
	DI	FILTER CELL 32 BACKWASH VALVE NO.2 30-FCV-32D OPEN	30-FCV-32D-OP	30-CP-3	0	10	7			N/A	N/A	PLC PANEL	OPEN	NO	258	223	
	DI	FILTER CELL 32 BACKWASH VALVE NO.2 30-FCV-32D CLOSED	30-FCV-32D-CL	30-CP-3	0	10	8			N/A	N/A	PLC PANEL	CLOSED	NO	259	223	
	DI	FILTER CELL 32 FTW OPEN	30-FCV-32J-OP	30-CP-3	0	10	9			N/A	N/A	PLC PANEL	OPEN	NO	260	223	
	DI	FILTER CELL 32 FTW CLOSED	30-FCV-32J-CL	30-CP-3	0	10	10			N/A	N/A	PLC PANEL	CLOSED	NO	261	223	
	DI	FILTER CELL 32 EFFLUENT VALVE NO.1 30-FCV-32F OPEN	30-FCV-32F-OP	30-CP-3	0	10	11			N/A	N/A	PLC PANEL	OPEN	NO	262	223	
	DI	FILTER CELL 32 EFFLUENT VALVE NO.1 30-FCV-32F CLOSED	30-FCV-32F-CL	30-CP-3	0	10	12			N/A	N/A	PLC PANEL	CLOSED	NO	263	223	
	DI	FILTER CELL 32 EFFLUENT VALVE NO.2 30-FCV-32G OPEN	30-FCV-32G-OP	30-CP-3	0	10	13			N/A	N/A	PLC PANEL	OPEN	NO	264	223	
	DI	FILTER CELL 32 EFFLUENT VALVE NO.2 30-FCV-32G CLOSED	30-FCV-32G-CL	30-CP-3	0	10	14			N/A	N/A	PLC PANEL	CLOSED	NO	265	223	
	DI	FILTER CELL 32 AIR SCOUR OPEN	30-FCV-32E-OP	30-CP-3	0	10	15			N/A	N/A	PLC PANEL	OPEN	NO	266	223	
	DI	FILTER CELL 32 AIR SCOUR CLOSED	30-FCV-32E-CL	30-CP-3	0	10	16			N/A	N/A	PLC PANEL	CLOSED	NO	267	223	
	DI	FILTER CELL 33 INFLUENT VALVE NO.1 30-FCV-33A OPEN	30-FCV-33A-OP	30-CP-3	1	1	1			N/A	N/A	PLC PANEL	OPEN	NO	268	223	
	DI	FILTER CELL 33 INFLUENT VALVE NO.1 30-FCV-33A CLOSED	30-FCV-33A-CL	30-CP-3	1	1	2			N/A	N/A	PLC PANEL	CLOSED	NO	269	223	
	DI	FILTER CELL 33 INFLUENT VALVE NO.2 30-FCV-33B OPEN	30-FCV-33B-OP	30-CP-3	1	1	3			N/A	N/A	PLC PANEL	OPEN	NO	270	223	
	DI	FILTER CELL 33 INFLUENT VALVE NO.2 30-FCV-33B CLOSED	30-FCV-33B-CL	30-CP-3	1	1	4			N/A	N/A	PLC PANEL	CLOSED	NO	271	223	
	DI	FILTER CELL 33 BACKWASH VALVE NO.1 30-FCV-33C OPEN	30-FCV-33C-OP	30-CP-3	1	1	5			N/A	N/A	PLC PANEL	OPEN	NO	272	223	
	DI	FILTER CELL 33 BACKWASH VALVE NO.1 30-FCV-33C CLOSED	30-FCV-33C-CL	30-CP-3	1	1	6			N/A	N/A	PLC PANEL	CLOSED	NO	273	223	
	DI	FILTER CELL 33 BACKWASH VALVE NO.2 30-FCV-33D OPEN	30-FCV-33D-OP	30-CP-3	1	1	7			N/A	N/A	PLC PANEL	OPEN	NO	274	223	
	DI	FILTER CELL 33 BACKWASH VALVE NO.2 30-FCV-33D CLOSED	30-FCV-33D-CL	30-CP-3	1	1	8			N/A	N/A	PLC PANEL	CLOSED	NO	275	223	
	DI	FILTER CELL 33 FTW OPEN	30-FCV-33J-OP	30-CP-3	1	1	9			N/A	N/A	PLC PANEL	OPEN	NO	276	223	
	DI	FILTER CELL 33 FTW CLOSED	30-FCV-33J-CL	30-CP-3	1	1	10			N/A	N/A	PLC PANEL	CLOSED	NO	277	223	
	DI	FILTER CELL 33 EFFLUENT VALVE NO.1 30-FCV-33F OPEN	30-FCV-33F-OP	30-CP-3	1	1	11			N/A	N/A	PLC PANEL	OPEN	NO	278	223	
	DI	FILTER CELL 33 EFFLUENT VALVE NO.1 30-FCV-33F CLOSED	30-FCV-33F-CL	30-CP-3	1	1	12		13530	N/A	N/A	PLC PANEL	CLOSED	NO	279	223	

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point	Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DI	FILTER CELL 33 EFFLUENT VALVE NO.2 30-FCV-33G OPEN	30-FCV-33G-OP	30-CP-3	1	1	13		N/A	N/A	PLC PANEL	OPEN	NO	280	223	
	DI	FILTER CELL 33 EFFLUENT VALVE NO.2 30-FCV-33G CLOSED	30-FCV-33G-CL	30-CP-3	1	1	14		N/A	N/A	PLC PANEL	CLOSED	NO	281	223	
	DI	FILTER CELL 33 AIR SCOUR OPEN	30-FCV-33E-OP	30-CP-3	1	1	15		N/A	N/A	PLC PANEL	OPEN	NO	282	223	
	DI	FILTER CELL 33 AIR SCOUR CLOSED	30-FCV-33E-CL	30-CP-3	1	1	16		N/A	N/A	PLC PANEL	CLOSED	NO	283	223	
	DI	FILTER CELL 32 AUTOSTART BACKWASH	PB604	30-CP-3	1	2	1		N/A	N/A	PLC PANEL	AUTOSTART	NO	310	223	
	DI	FILTER CELL 33 AUTOSTART BACKWASH	PB605	30-CP-3	1	2	2		N/A	N/A	PLC PANEL	AUTOSTART	NO	311	223	
	DI	FILTER CELL 32 AUTOMODE BACKWASH	SS202	30-CP-3	1	2	3		N/A	N/A	PLC PANEL	AUTOMODE	NO	310	223	
	DI	FILTER CELL 33 AUTOMODE BACKWASH	SS242	30-CP-3	1	2	4		N/A	N/A	PLC PANEL	AUTOMODE	NO	311	223	
	DI	FILTER CELL 32&33 AIRSCOUR BLOWER START	PB611	30-CP-3	1	2	5		N/A	N/A	PLC PANEL	START	NO	314	223	
	DI	FILTER CELL 32 AIRSCOUR DONE	TR556	30-CP-3	1	2	6		N/A	N/A	PLC PANEL	DONE	NO	315	223	
	DI	FILTER CELL 33 AIRSCOUR DONE	TR569	30-CP-3	1	2	7		N/A	N/A	PLC PANEL	DONE	NO	316	223	
	DI	FILTER CELL 32 BACKWASH DONE	TR561	30-CP-3	1	2	8		N/A	N/A	PLC PANEL	DONE	NO	317	223	
	DI	FILTER CELL 33 BACKWASH DONE	TR574	30-CP-3	1	2	9		N/A	N/A	PLC PANEL	DONE	NO	318	223	
	DI	FILTER CELL 32&33 MANUAL BLOWER STOP	PB629	30-CP-3	1	2	14		N/A	N/A	PLC PANEL	STOP	NO	323	223	
	DI	BLOWER RUN	30-BL-37	30-CP-3	1	2	15		N/A	N/A	PLC PANEL	RUNNING	NO	324	223	
	DI	BLOWER RUN	30-BL-36	30-CP-3	1	2	16		N/A	N/A	PLC PANEL	RUNNING	NO	326	223	
	AI	FILTER CELL 30 TURBIDITY INDICATION	AI-30-30A	30-CP-3	1	9	1	4-20 mA		4-WIRE	N/A	N/A	NO	707/708		
	AI	FILTER CELL 31 TURBIDITY INDICATION	AI-30-31A	30-CP-3	1	9	2	4-20 mA		4-WIRE	N/A	N/A	NO	709/710		
	AI	FILTER CELL 32 TURBIDITY INDICATION	AI-30-32A	30-CP-3	1	9	3	4-20 mA		4-WIRE	N/A	N/A	NO	711/712		
	AI	FILTER CELL 33 TURBIDITY INDICATION	AI-30-33A	30-CP-3	1	9	4	4-20 mA		4-WIRE	N/A	N/A	NO	713/714		
	AI	FILTER CELL 34 TURBIDITY INDICATION	AI-30-34A	30-CP-3	1	9	5	4-20 mA		4-WIRE	N/A	N/A	NO	715/716		
	AI	FILTER CELL 35 TURBIDITY INDICATION	AI-30-35A	30-CP-3	1	9	6	4-20 mA		4-WIRE	N/A	N/A	NO	717/718		
	AI	FILTER CELL 36 TURBIDITY INDICATION	AI-30-36A	30-CP-3	1	9	7	4-20 mA		4-WIRE	N/A	N/A	NO	719/720		
	AI	FILTER CELL 30 LEVEL INDICATION	AI-30-30C	30-CP-3	1	10	1	4-20 mA		4-WIRE	N/A	N/A	NO	723/724		
	AI	FILTER CELL 31 LEVEL INDICATION	AI-30-31C	30-CP-3	1	10	2	4-20 mA		4-WIRE	N/A	N/A	NO	725/726		
	AI	FILTER CELL 32 LEVEL INDICATION	AI-30-32C	30-CP-3	1	10	3	4-20 mA		4-WIRE	N/A	N/A	NO	727/728		
	AI	FILTER CELL 33 LEVEL INDICATION	AI-30-33C	30-CP-3	1	10	4	4-20 mA		4-WIRE	N/A	N/A	NO	729/730		
	AI	FILTER CELL 34 LEVEL INDICATION	AI-30-34C	30-CP-3	1	10	5	4-20 mA		4-WIRE	N/A	N/A	NO	731/732		
	AI	FILTER CELL 35 LEVEL INDICATION	AI-30-35C	30-CP-3	1	10	6	4-20 mA		4-WIRE	N/A	N/A	NO	733/734		
	AI	FILTER CELL 36 LEVEL INDICATION	AI-30-36C	30-CP-3	1	10	7	4-20 mA		4-WIRE	N/A	N/A	NO	735/736		

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DO	FILTER CELL 30 INLET VALVE NO 1	30-FCV-30A	30-CP-3	1	3	1			N/A	N/A	FIELD	CLOSE	YES	615	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 INLET VALVE NO 2	30-FCV-30B	30-CP-3	1	3	2			N/A	N/A	FIELD	CLOSE	YES	616	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 BACKWASH VALVE NO 1	30-FCV-30C	30-CP-3	1	3	3			N/A	N/A	FIELD	OPEN	YES	617	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 BACKWASH VALVE NO 2	30-FCV-30D	30-CP-3	1	3	4			N/A	N/A	FIELD	OPEN	YES	618	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 AIR-SCOUR VALVE	30-FCV-30E	30-CP-3	1	3	5			N/A	N/A	FIELD	OPEN	YES	619	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 FILTER TO WASTE VALVE	30-FCV-30J	30-CP-3	1	3	6			N/A	N/A	FIELD	OPEN	YES	620	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 EFFLUENT VALVE NO 1	30-FCV-30F	30-CP-3	1	3	7			N/A	N/A	FIELD	CLOSE	YES	621	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 30 EFFLUENT VALVE NO 2	30-FCV-30G	30-CP-3	1	3	8			N/A	N/A	FIELD	CLOSE	YES	622	614	614 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 INLET VALVE NO 1	30-FCV-31A	30-CP-3	1	3	9			N/A	N/A	FIELD	CLOSE	YES	624	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 INLET VALVE NO 2	30-FCV-31B	30-CP-3	1	3	10			N/A	N/A	FIELD	CLOSE	YES	625	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 BACKWASH VALVE NO 1	30-FCV-31C	30-CP-3	1	3	11			N/A	N/A	FIELD	OPEN	YES	626	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 BACKWASH VALVE NO 2	30-FCV-31D	30-CP-3	1	3	12			N/A	N/A	FIELD	OPEN	YES	627	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 AIR-SCOUR VALVE	30-FCV-31E	30-CP-3	1	3	13			N/A	N/A	FIELD	OPEN	YES	628	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 FILTER TO WASTE VALVE	30-FCV-31J	30-CP-3	1	3	14			N/A	N/A	FIELD	OPEN	YES	629	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 EFFLUENT VALVE NO 1	30-FCV-31F	30-CP-3	1	3	15			N/A	N/A	FIELD	CLOSE	YES	630	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 31 EFFLUENT VALVE NO 2	30-FCV-31G	30-CP-3	1	3	16			N/A	N/A	FIELD	CLOSE	YES	631	614	623 CONTROL POWER FROM 30-CP2
	DO	FILTER CELL 34 INLET VALVE NO 1	30-FCV-34A	30-CP-3	1	4	1			N/A	N/A	FIELD	CLOSE	YES	633	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 INLET VALVE NO 2	30-FCV-34B	30-CP-3	1	4	2			N/A	N/A	FIELD	CLOSE	YES	634	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 BACKWASH VALVE NO 1	30-FCV-34C	30-CP-3	1	4	3			N/A	N/A	FIELD	OPEN	YES	635	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 BACKWASH VALVE NO 2	30-FCV-34D	30-CP-3	1	4	4			N/A	N/A	FIELD	OPEN	YES	636	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 AIR-SCOUR VALVE	30-FCV-34E	30-CP-3	1	4	5			N/A	N/A	FIELD	OPEN	YES	637	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 FILTER TO WASTE VALVE	30-FCV-34J	30-CP-3	1	4	6			N/A	N/A	FIELD	OPEN	YES	638	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 EFFLUENT VALVE NO 1	30-FCV-34F	30-CP-3	1	4	7			N/A	N/A	FIELD	CLOSE	YES	639	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 34 EFFLUENT VALVE NO 2	30-FCV-34G	30-CP-3	1	4	8			N/A	N/A	FIELD	CLOSE	YES	640	632	632 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 INLET VALVE NO 1	30-FCV-35A	30-CP-3	1	4	9			N/A	N/A	FIELD	CLOSE	YES	642	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 INLET VALVE NO 2	30-FCV-35B	30-CP-3	1	4	10			N/A	N/A	FIELD	CLOSE	YES	643	632	641 CONTROL POWER FROM 30-CP4

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DO	FILTER CELL 35 BACKWASH VALVE NO 1	30-FCV-35C	30-CP-3	1	4	11			N/A	N/A	FIELD	OPEN	YES	644	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 BACKWASH VALVE NO 2	30-FCV-35D	30-CP-3	1	4	12			N/A	N/A	FIELD	OPEN	YES	645	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 AIR-SCOUR VALVE	30-FCV-35E	30-CP-3	1	4	13			N/A	N/A	FIELD	OPEN	YES	646	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 FILTER TO WASTE VALVE	30-FCV-35J	30-CP-3	1	4	14			N/A	N/A	FIELD	OPEN	YES	647	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 EFFLUENT VALVE NO 1	30-FCV-35F	30-CP-3	1	4	15			N/A	N/A	FIELD	CLOSE	YES	648	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 35 EFFLUENT VALVE NO 2	30-FCV-35G	30-CP-3	1	4	16			N/A	N/A	FIELD	CLOSE	YES	649	632	641 CONTROL POWER FROM 30-CP4
	DO	FILTER CELL 36 INLET VALVE NO 1	30-FCV-36A	30-CP-3	1	5	1			N/A	N/A	FIELD	CLOSE	YES	651	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 INLET VALVE NO 2	30-FCV-36B	30-CP-3	1	5	2			N/A	N/A	FIELD	CLOSE	YES	652	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 BACKWASH VALVE NO 1	30-FCV-36C	30-CP-3	1	5	3			N/A	N/A	FIELD	OPEN	YES	653	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 BACKWASH VALVE NO 2	30-FCV-36D	30-CP-3	1	5	4			N/A	N/A	FIELD	OPEN	YES	654	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 AIR-SCOUR VALVE	30-FCV-36E	30-CP-3	1	5	5			N/A	N/A	FIELD	OPEN	YES	655	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 FILTER TO WASTE VALVE	30-FCV-36J	30-CP-3	1	5	6			N/A	N/A	FIELD	OPEN	YES	656	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 EFFLUENT VALVE NO 1	30-FCV-36F	30-CP-3	1	5	7			N/A	N/A	FIELD	CLOSE	YES	657	632	650 CONTROL POWER FROM 30-CP5
	DO	FILTER CELL 36 EFFLUENT VALVE NO 2	30-FCV-36G	30-CP-3	1	5	8			N/A	N/A	FIELD	CLOSE	YES	658	632	650 CONTROL POWER FROM 30-CP5
	DO	BLOWER START/STOP CONTROL			1	5	9			N/A	N/A	FIELD	START	YES	979	980	
	DO	FILTER CELL 33 INLET VALVE NO 1	30-FCV-33A	30-CP-3	1	6	1			N/A	N/A	FIELD	CLOSE	YES	245	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-11
	DO	FILTER CELL 33 INLET VALVE NO 2	30-FCV-33B	30-CP-3	1	6	2			N/A	N/A	FIELD	CLOSE	YES	246	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-12
	DO	FILTER CELL 33 BACKWASH VALVE NO 1	30-FCV-33C	30-CP-3	1	6	3			N/A	N/A	FIELD	OPEN	YES	247	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-13
	DO	FILTER CELL 33 BACKWASH VALVE NO 2	30-FCV-33D	30-CP-3	1	6	4			N/A	N/A	FIELD	OPEN	YES	248	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-14

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ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DO	FILTER CELL 33 AIR-SCOUR VALVE	30-FCV-33E	30-CP-3	1	6	5			N/A	N/A	FIELD	OPEN	YES	249	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-15
	DO	FILTER CELL 33 FILTER TO WASTE VALVE	30-FCV-33J	30-CP-3	1	6	6			N/A	N/A	FIELD	OPEN	YES	250	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-16
	DO	FILTER CELL 33 EFFLUENT VALVE NO 1	30-FCV-33F	30-CP-3	1	6	7			N/A	N/A	FIELD	CLOSE	YES	251	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-17
	DO	FILTER CELL 33 EFFLUENT VALVE NO 2	30-FCV-33G	30-CP-3	1	6	8			N/A	N/A	FIELD	CLOSE	YES	252	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-18
	DO	FILTER CELL 32 INLET VALVE NO 1	30-FCV-32A	30-CP-3	1	6	9			N/A	N/A	FIELD	CLOSE	YES	234	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-3
	DO	FILTER CELL 32 INLET VALVE NO 2	30-FCV-32B	30-CP-3	1	6	10			N/A	N/A	FIELD	CLOSE	YES	236	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-4
	DO	FILTER CELL 32 BACKWASH VALVE NO 1	30-FCV-32C	30-CP-3	1	6	11			N/A	N/A	FIELD	OPEN	YES	237	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-5
	DO	FILTER CELL 32 BACKWASH VALVE NO 2	30-FCV-32D	30-CP-3	1	6	12			N/A	N/A	FIELD	OPEN	YES	238	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-6
	DO	FILTER CELL 32 AIR-SCOUR VALVE	30-FCV-32E	30-CP-3	1	6	13			N/A	N/A	FIELD	OPEN	YES	239	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-7
	DO	FILTER CELL 32 FILTER TO WASTE VALVE	30-FCV-32J	30-CP-3	1	6	14			N/A	N/A	FIELD	OPEN	YES	240	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-8
	DO	FILTER CELL 32 EFFLUENT VALVE NO 1	30-FCV-32F	30-CP-3	1	6	15			N/A	N/A	FIELD	CLOSE	YES	241	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-9
	DO	FILTER CELL 32 EFFLUENT VALVE NO 2	30-FCV-32G	30-CP-3	1	6	16		13530	N/A	N/A	FIELD	CLOSE	YES	242	235 SOURCE	POWER FOR NEW PLC RELAY DRY CONTACTS TO ENERGIZE EXISTING RELAYS LOCATED IN CP-10

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Input/Output List

ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
	DO	CELL 30 ENABLE AIR SCOUR TIMER		30-CP-2	1	7	1			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES	594	595	
	DO	CELL 30 ENABLE BACKWASH TIMER		30-CP-2	1	7	2			N/A	N/A	FIELD	ENABLE BACKWASH	YES	604	605	
	DO	CELL 31 ENABLE AIR SCOUR TIMER		30-CP-2	1	7	3			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES	596	597	
	DO	CELL 31 ENABLE BACKWASH TIMER		30-CP-2	1	7	4			N/A	N/A	FIELD	ENABLE BACKWASH	YES	606	607	
	DO	CELL 32 ENABLE AIR SCOUR TIMER		30-CP-3	1	7	5			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES			
	DO	CELL 32 ENABLE BACKWASH TIMER		30-CP-3	1	7	6			N/A	N/A	FIELD	ENABLE BACKWASH	YES			
	DO	CELL 33 ENABLE AIR SCOUR TIMER		30-CP-3	1	7	7			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES			
	DO	CELL 33 ENABLE BACKWASH TIMER		30-CP-3	1	7	8			N/A	N/A	FIELD	ENABLE BACKWASH	YES			
	DO	CELL 34 ENABLE AIR SCOUR TIMER		30-CP-2	1	7	9			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES	598	599	
	DO	CELL 34 ENABLE BACKWASH TIMER		30-CP-2	1	7	10			N/A	N/A	FIELD	ENABLE BACKWASH	YES	608	609	
	DO	CELL 35 ENABLE AIR SCOUR TIMER		30-CP-2	1	7	11			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES	600	601	
	DO	CELL 35 ENABLE BACKWASH TIMER		30-CP-2	1	7	12			N/A	N/A	FIELD	ENABLE BACKWASH	YES	610	611	
	DO	CELL 36 ENABLE AIR SCOUR TIMER		30-CP-2	1	7	13			N/A	N/A	FIELD	ENABLE AIR SCOUR	YES	602	603	
	DO	CELL 36 ENABLE BACKWASH TIMER		30-CP-2	1	7	14			N/A	N/A	FIELD	ENABLE BACKWASH	YES	612	613	
	DO	FILTER 30 LEVEL HIGH	LSH-30-30C		1	8	1			N/A	N/A	FIELD	HIGH LEVEL	YES	67	68	
	DO	FILTER 31 LEVEL HIGH	LSH-30-31C		1	8	2			N/A	N/A	FIELD	HIGH LEVEL	YES	70	71	
	DO	FILTER 32 LEVEL HIGH	LSH-30-32C		1	8	3			N/A	N/A	FIELD	HIGH LEVEL	YES	292	293	
	DO	FILTER 33 LEVEL HIGH	LSH-30-33C		1	8	4			N/A	N/A	FIELD	HIGH LEVEL	YES	295	296	
	DO	FILTER 34 LEVEL HIGH	LSH-30-34C		1	8	5			N/A	N/A	FIELD	HIGH LEVEL	YES	845	846	
	DO	FILTER 35 LEVEL HIGH	LSH-30-35C		1	8	6			N/A	N/A	FIELD	HIGH LEVEL	YES	848	849	
	DO	FILTER 36 LEVEL HIGH	LSH-30-36C		1	8	7			N/A	N/A	FIELD	HIGH LEVEL	YES	1029	1030	
	DO	FILTER 30 pH LOW	ASL-30-30A		1	8	8			N/A	N/A	FIELD	LOW pH	YES	67	69	
	DO	FILTER 31 pH LOW	ASL-30-31A		1	8	9			N/A	N/A	FIELD	LOW pH	YES	70	75	
	DO	FILTER 32 pH LOW	ASL-30-32A		1	8	10			N/A	N/A	FIELD	LOW pH	YES	292	294	
	DO	FILTER 33 pH LOW	ASL-30-33A		1	8	11			N/A	N/A	FIELD	LOW pH	YES	295	297	
	DO	FILTER 34 pH LOW	ASL-30-34A		1	8	12			N/A	N/A	FIELD	LOW pH	YES	845	847	
	DO	FILTER 35 pH LOW	ASL-30-35A		1	8	13			N/A	N/A	FIELD	LOW pH	YES	848	850	
	DO	FILTER 36 pH LOW	ASL-30-36A		1	8	14			N/A	N/A	FIELD	LOW pH	YES	1029	1031	

13530A

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ITEM	IO Type	Description	Field Device	PLC	Original Rack	Slot	Point		Analog Signal Type	Analog Range	Analog Power Type	Digital Power Source	Digital Close State	Digital Interp Relay	OLD CP3 FIELD TERMINAL	OLD CP3 SOURCE TERMINAL	Remarks
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Section 13561

PANEL MOUNTED INSTRUMENTS

PART 1 - GENERAL.

1-1. SCOPE. The Panel Mounted Instruments section covers the furnishing of all panel mounted instruments and accessories required for the Instrumentation and Control System as specified herein or as indicated on the Drawings.

Equipment and services provided under this section shall be subject to the Instrumentation and Control System section. This section shall be used and referenced only in conjunction with the Instrumentation and Control System section. Supplementing the Instrumentation and Control System section, instrument data, special requirements, and options are indicated on the Drawings or the Instrument Device Schedule.

When multiple instruments of a particular type are specified, and each requires different features, the required features are described on the Drawings or the Instrument Device Schedule.

1-2. DESIGN CRITERIA. The instruments shall be installed to measure, monitor, or display the specified process at the ranges and service conditions indicated on the Drawings or as indicated in the Instrument Device Schedule. The instruments shall be installed at the locations indicated on the Drawings or the Instrument Device Schedule.

Where possible, each instrument shall be factory calibrated to the calibration ranges indicated on the Drawings or in the Instrument Device Schedule. Transmitters or similar measurement instruments shall be calibrated using National Institute of Standards and Technology (NIST) approved bench calibration procedures, when such procedures exist for the instrument type. For "smart" devices, calibration data shall be stored digitally in each device, including the instrument tag designation indicated on the Drawings and/or Instrument Device Schedule.

1-3. SUBMITTALS. Submittals shall be as specified in the Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. GENERAL. The following paragraphs describe minimum device stipulations. The Drawings or Instrument Device Schedule shall be used to determine any additional instrument options, requirements, or service conditions.

2-1.01 Programming Device. Not used.

2-1.02 Configuration Software/Serial Interface. Not used.

2-2. PANEL FRONT MOUNTED DEVICES.

2-2.01. Totalizers. Not used.

2-2.02 Digital Panel Indicators. Not used.

2-2.03. Electronic Bar Graph Indicators. Not used.

2-2.04. Edgewise Panel Indicators. Not used.

2-2.05. Manual Loading Stations. Not used.

2-2.06. Ratio Stations. Not used.

2-2.07. 1/4 DIN Single-Loop Control Stations. Not used.

2-2.08. 1/4 DIN Manual/Auto Backup Stations. Not used.

2-2.09. Large Case Recorders. Not used.

2-2.10. Strip Chart Recorders. Not used.

2-2.11. Panel-Mounted Pressure Gauges. Not used.

2-2.12 Digital and Panel Clocks. Not used.

2-2.13. Switches, Lights, and Push Buttons.

2-2.13.01. Selector Switches. Not used.

2-2.13.02. Indicating Lights. Not used.

2-2.13.03. Push Buttons. Not used.

2-2.13.04. Potentiometers. Not used.

2-2.14. Alarm Horns. Not used.

2-3. PANEL INTERIOR MOUNTED DEVICES.

2-3.01. Integrators. Not used.

2-3.02. Power Supplies. Regulated dc power supplies for instrument loops shall be designed and arranged so that loss of one supply does not affect more than one instrument loop or system. Power supplies shall be suitable for an input voltage variation of ± 10 percent, and the supply output shall be fused or shortcircuit protected. Output voltage regulation shall be by the instrumentation equipment supplied. Multiloop or multisystem power supplies will be acceptable if backup power supply units are provided which will automatically supply the load upon failure of the primary supply. The backup supply systems shall be designed so either the primary or the backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation. Multiloop power supply connections shall be individually fused so a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Fuses shall be clearly labeled and shall be located for easy access. Multiloop supply systems shall be oversized for an additional 10 percent future load. Failure of a multiloop supply shall be indicated on the respective instrument panel or enclosure.

Power supplies shall be Allen Bradley, Phoenix Contact, PULS, or equal.

Filter control systems may be designed so one power supply feeds all instrument loops common to one individual filter.

2-3.03. Relays. Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be UL recognized and shall have not less than double-pole, double-throw contacts. Control circuit relays shall have silver cadmium oxide contacts rated 10 amperes at 120 V ac. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low-level signals. Relays used for computer input, alarm input, or indicating light service shall have contacts rated at least 3 amperes. Time delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of ± 2 percent of setting. Latching and special purpose relays shall be for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that illuminates to indicate an energized condition. Relays shall be IDEC "Series RR"; Potter & Brumfield "Series KRP, CB"; or Struthers-Dunn "Series 219, 246".

- 2-3.04. Intrinsically Safe Relays. Not used.
- 2-3.05. Electronic Signal Booster/Isolators. Not used.
- 2-3.06. Electronic Signal Selectors. Not used.
- 2-3.07. Electronic Signal Summers. Not used.
- 2-3.08. Fixed Deadband Signal Monitors. Not used.
- 2-3.09. Adjustable Deadband Signal Monitors. Not used.
- 2-3.10. Strip Heaters. Not used.
- 2-3.11. Intrinsically Safe Barriers. Not used.

PART 3 – EXECUTION

3-1 FIELD SERVICES. Manufacturer's field services shall be provided for installation, field calibration, startup, and training as specified in the Instrumentation and Control System section. Instruments shall not be shipped to the Work Site until two weeks prior to the scheduled installation. System Supplier shall be responsible for coordinating the installation schedule with the Installation Contractor. Each shipment shall contain a listing of protective measures required to maintain sensor operation, including a listing of any common construction or cleaning chemicals that may affect instrument operation.

End of Section

Section 13570

PANELS, CONSOLES, AND APPURTENANCES

PART 1 - GENERAL

1-1. SCOPE. The Panels, Consoles and Appurtenances section covers the furnishing of panels, consoles, and appurtenances as indicated on the Drawings and listed in the attached Equipment Schedules 13570-S01 and 13570-S02.

This section also describes requirements for panels furnished under other sections whose respective specification refers to this section. Panels furnished under other sections are not listed in the attached Equipment Schedules.

1-1.01. Control System. The Instrumentation and Control System section shall apply to all equipment furnished under the Panels, Consoles and Appurtenances section.

1-2. GENERAL. Equipment furnished and installed under this section shall be fabricated and assembled in full conformity with the Drawings, specifications, equipment schedules, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment and materials provided under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.02. Seismic Design Requirements. Not Used.

1-2.03. Drawings. General dimensions and arrangements are indicated on the Drawings and on the attached equipment schedules. System Supplier shall be responsible for coordinating the console and enclosure sizes and arrangements to accommodate the equipment provided.

1-3. SUBMITTALS. Submittals shall be made as specified in the Instrumentation and Control System section.

1-4. DELIVERY, STORAGE, AND SHIPPING. Delivery, storage and shipping shall be as per The Instrumentation and Control System section.

PART 2 - PRODUCTS

2-1. PANEL DESIGN AND FABRICATION FEATURES. All panels furnished shall conform to the stipulations of NEMA ICS-6-1993. Unless indicated otherwise on the Drawings, the following paragraphs describe general fabrication specifications for the PLC cabinets, instrument panels, consoles, enclosures, and subpanels.

2-1.01. Piping. Pneumatic tubing shall be 1/4-inch [6 mm] OD, soft annealed copper with compression fittings. Tubing and fittings shall be as specified in the Miscellaneous Piping section.

2-1.01.01. Fittings. Compression type bulkhead fittings shall be provided near the bottom or the top of the panel for all field connections. Compression nuts and sleeves shall be provided for the field connections. Indicators, recorders, controllers, and other pneumatic devices shall be provided with plugged test connections and shutoff valves for isolation.

2-1.01.02. Valves. All devices shall have separate air supply shutoff valves. Valves and compression fittings shall be as manufactured by Nupro, Parker Hannifin, Swagelock, Tylok, or Whitey.

2-1.02. Power Entrance. The power entrance to each panel shall be provided with a surge protection device. Refer to the Instrumentation and Controls section for surge suppression requirements.

2-1.03. Power Wiring. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring shall be minimum 14 AWG. Wiring for ac power distribution, dc power distribution, intrinsically safe, and control circuits shall have different colors and shall agree with the color-coding legend on System Supplier's panel wiring diagrams. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture resistant and flame retardant covering rated for not less than 90°C.

2-1.04. Instrument and Control Wiring. All internal panel wiring shall be type MTW stranded copper wiring rated not less than 600 volts. Electronic analog circuits shall be twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Intrinsically safe circuits shall be physically separated from other circuits in accordance with applicable codes. Wires within the panel shall conform to the minimum size as shown in the table below.

Type	Min. Wire Size	Color
------	----------------	-------

AC Control	16 AWG	Red
DC Control	16 AWG	Blue
Analog Circuits	18 AWG Twisted Pair	Black-White

All wiring shall be grouped or cabled and firmly supported inside the panel. Each individual wire in power, control, and instrumentation circuits shall be provided with identification markers at each point of termination. The wire markers shall be positioned to be readily visible for inspection and the identification numbers shall match the identification on the supplier's panel wiring drawings. Wiring shall be bundled in groups and bound with nylon cable ties or routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel, with removable covers, and with space equal to at least 40 percent of the depth of the duct remaining available for future use after completion of installation and field wiring. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

2-1.05. Terminal Blocks. Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.

2-1.06. Backup Power. Power supply to the panels shall be from electrical sources shown on the Drawings, which may be backed by redundant utility feeds, engine generators, or externally mounted uninterruptible power supplies (UPSs) specified in other sections.

Where indicated in the attached equipment schedules, on the Drawings or in the referring equipment specifications, free-standing vertical panels and wall cabinets shall each be provided with an interior-mounted UPS to provide backup power to critical loads upon loss of power supply to the panel. UPS-backed power shall be provided to the programmable logic controller CPU, instrument loops, I/O modules (operating and wetting voltages), all network communications devices, and any other load essential to preventing loss of control system function. Backup power for panel interior lights, heaters, and convenience receptacles is not required. UPSs for free-standing vertical panels and wall cabinets shall meet the requirements specified below.

2-1.06.01. UPS for Free-Standing Vertical Panels and Wall Cabinets. Each UPS shall accept incoming 120 volts ac, 60Hz, single-phase utility power, apply surge protection, and supply power to the connected loads. The UPS shall be a double-conversion (“on-line”) type to provide a breakless transfer to backup power. In the event of incoming power failure, the UPS shall provide 120 volts ac, 60 Hz, single-phase power to its connected loads by inverting power stored within integral storage batteries. The UPS shall be contained inside the enclosure and supported by a dedicated shelf attached to the backplane or sidewall. The shelf shall be between 12 and 18 inches from the bottom of the enclosure and shall not be directly above any electronic or electromechanical devices.

The UPS shall have at least two integral NEMA 5-15R receptacles for connection of battery-backed loads. Upon restoration of incoming power, the UPS shall recharge the batteries and return its connected loads to the incoming power source. The factory-installed line cord and plug shall not be altered. The UPS output shall be connected by plug and line cord to terminal blocks as necessary to distribute power to loads not having a power cord and plug; all other loads shall be connected directly to the UPS’s integral receptacles or to permanently installed receptacles fed from the UPS output.

The UPS shall maintain a temperature-compensated, float charge voltage on the batteries when utility power is available. Overcurrent protection when utility power is available shall be from a circuit breaker internal to the UPS. The UPS shall be intrinsically current-limiting when the unit is on battery.

The UPS shall meet the following requirements.

Capacity, minimum	1000 VA / 700 watts
Filtering and surge Protection (on utility power)	Meets IEEE/ANSI C62.41 Category B (IEEE 587)
Voltage, output (on battery)	120 volts ± 3 percent
Voltage, output (on-line)	Nominal ± 3 percent
Frequency and waveform, output (on battery)	60 \pm 0.3 Hz, true sine-wave
Efficiency, minimum (on-line)	90 percent

Operating environment	0 to 40°C; 0 to 95 percent relative humidity, non-condensing
Backup time, minimum at half of rated load	10 minutes
Recharge time, maximum to 90 percent of full charge	12 hours

The UPS shall have spare capacity of at least 30 percent based on actual connected loads. The System Supplier shall advise the Engineer if the UPS capacity needs to be higher than specified above to meet this requirement.

The UPS shall have a visual status indicator for low (or faulty) battery and incoming ac power failure. The UPS shall emit an audible signal when the UPS is operating on battery power. A relay shall be installed within the panel and its coil connected across the UPS input power as a means of providing a contact for remote indication of a power failure condition.

Batteries shall be sealed maintenance-free, gelled electrolyte lead-acid, or valve-regulated, maintenance-free, lead-acid. Flooded-electrolyte type batteries will not be acceptable.

The UPS shall be APC "Smart-UPS", Emerson/Liebert "GXT1000MT", Toshiba "1000 Series", or equal.

2-1.06.02. Rack-Mounted Uninterruptible Power Supply (UPS). Not used.

2-1.07. Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with the Instrument Device Schedule and with the supplier's equipment drawings. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered labels or tape labels will not be permitted.

2-1.08. Nameplates. Nameplates shall be provided on the face of the panel or on the individual device. Panel nameplates shall have legends and approximate dimensions as indicated on the Drawings and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch [5 mm] high extending through the whit face into the black layer. Nameplates shall be secured firmly to the panel. Panel face nameplates do not replace the

requirement for device identification tags as specified under the Device Tag Numbering System paragraph.

2-1.09. Indicating Light Color Designations. Indicating lights are specified in the Panel Mounted Instruments section. Indicating lights shall be colored as shown in the following table unless indicated otherwise on the Drawings, in other specification sections, or in the instrument device schedule.

Color	Meaning
Red	Associated equipment or device is “running,” “open,” or is in an “unsafe” state or position
Green	Associated equipment or device is “stopped,” “closed,” or is in a “safe” state or position
Yellow or Amber	Associated equipment or device has “failed” or a process alarm condition is present or imminent.
White	All other conditions not defined above.

2-1.10. Painting. Interior and exterior surfaces of all indoor located carbon-steel panels shall be thoroughly cleaned and painted with rust inhibitive (universal) primer. The panel interior shall be painted white with the manufacturer's standard coating. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be painted with one or more finish coats of the manufacturer's standard coating. Finish coats shall have a dry film thickness of at least 4 mils [100 mm]. Color shall be white. All outdoor located enclosures shall be 316 stainless steel construction with exterior panel and sun-shield surfaces powder-coated white color. One quart [1 liter] of touch-up paint shall be furnished with the panels.

2-1.11. Panel-Mounted Instruments. Instruments, power supplies, pilot devices, and appurtenances mounted within or on the face of the panel shall meet the requirements specified in Section 13561, Panel Mounted Instruments, for those items unless noted otherwise herein, on the Drawings or, if applicable, within the referring equipment specification section.

2-1.12. Factory Test. Panels shall be factory tested electrically and pneumatically by the panel fabricator before shipment.

2-2. FREESTANDING VERTICAL PANELS. The following paragraphs specify the freestanding vertical panels:

2-2.01. Construction. Panel construction shall be an indoor, dusttight, completely enclosed cubicle formed from steel structural members and steel

plates. The base shall be formed of steel channels, with flanges extending upwards. The base shall be provided with 1/2 inch [12.5 mm] diameter holes at 12 inch [300 mm] centers so that the base can be bolted to the concrete equipment base. Welds, seams, and edges on all exposed surfaces shall be ground smooth. Suitable lifting facilities shall be provided for handling and shipment. Enclosures located in outdoor / wet locations shall be constructed of 316 stainless steel. Outdoor located enclosures and associated sunshields shall have exterior surfaces powder-coated white.

2-2.02. Structure. Panel structure shall be suitably braced and of sufficient strength to support all equipment mounted on or within, to withstand handling and shipment, to remain in proper alignment, and to be rigid and freestanding. Top, sides, and back shall be fabricated from USS 10 gage [3.42 mm thick] or heavier carbon steel sheets, with stationary back suitable for back to wall installation, or designed for rear access with hinged back doors. Doors shall not be greater than 24 inches [600 mm] wide or spaced not greater than 36 inches [900 mm] center to center. Rear access doors shall be fabricated from USS 14 gage [1.9 mm thick] or heavier carbon steel.

2-2.03. Panel Front. The front shall be a hinged door, or doors, with mounted instruments and control devices, fabricated from USS 10 gage [3.42 mm thick] carbon steel sheet and suitably braced and supported to maintain alignment. Panels with hinged fronts shall be of sufficient width to permit door opening without interference with rear projection of flush mounted instruments.

2-2.04. Doors. Doors shall be essentially full height, having turned back edges and additional bracing to ensure rigidity and prevent sagging. Doors shall be mounted with strong, continuous, piano type hinges. Positive latches, acting from a common door handle, shall hold doors securely compressed at top, side, and bottom against rubber gaskets.

2-2.05. Mounted Instruments. The front shall be stationary, with mounted instruments and control devices, fabricated from 3/16 inch [5 mm] carbon steel plate. Panel fronts shall be suitably reinforced between mounting cutouts and drilling to support instruments and devices without deformation and shall be free from waves and other imperfections, Panel fronts shall be recessed at the base. Adjoining panel sections shall be accurately shop fitted to assure satisfactory assembly in the field.

2-2.05.01. Instrument Arrangement. Panel instruments and control devices shall be arranged in a logical configuration for the plant operators. The centerline of recorders shall be within 3 feet [900 mm] and 5'-9" [1.75 m] above the base of the panel for convenient reading and chart replacement. Control switches shall be within 6 feet [1.83 m] and 2'-6" [760 mm] above the base of the panel.

Indicators may be located within 2'-6" [760 mm] and 6'-6" [1.98 m] above the base of the panels. Annunciators and clocks may be mounted near the top of the panels.

2-2.06. Conduit Entrance. The bottom shall be open, and components shall be arranged for external wiring conduit and piping to enter from below.

2-2.07. Size and Arrangement. Panel dimensions and general instrument arrangement shall be as indicated on the Drawings or in the attached equipment schedules.

2-2.08. Interior Lighting. Illumination of panel interiors shall be provided by ceiling mounted lamp fixtures spaced at approximately 2'-6" [760 mm] and near the door. Fixtures shall be nominal 40-watt fluorescent tube type, with a common "On-Off" switch near each end door. Duplex-grounded receptacles shall be provided for service and maintenance tools at spacing not greater than 5 feet [1.52 m] throughout the length of a panel. The lighting and receptacle circuit shall be fused separately from the instrumentation systems.

2-3. FILTER CONSOLES. Not used.

2-4. WALL-MOUNTED CABINETS. Cabinets, which contain the system components indicated on the Drawings, shall be suitable for wall mounting and shall meet the NEMA enclosure rating as indicated on the Drawings or, if applicable, in the attached equipment schedules or the referring equipment specification section. The enclosures shall be fabricated from USS 14 gage [1.9 mm thick], or heavier, carbon steel, stainless steel, or fiberglass. Cabinets shall be equipped with full size gasketed doors with hinges and a chromium-plated or stainless steel three-point latch. The cabinet shall have a hasp for accommodating a padlock. A screened vent shall be provided in the bottom of enclosures that contain pneumatic devices.

Floor stands shall be provided to support cabinets not fastened to a wall or other support. Floor stands shall be full-depth and shall have a minimum height of 12 inches. Floor stand material and finish shall match the cabinet.

All wall-mounted cabinets shall meet the requirements of the panel fabrication paragraph of this section.

Outdoor cabinets shall be provided with sunshades as indicated on the Drawings.

2-5. FIBER OPTIC TERMINATION CABINETS (FOTC). Not used.

2-6. FREESTANDING EIA 19-INCH RACK ENCLOSURES. Not used.

2-7. DATA SERVER ENCLOSURES. Not used.

2-8. WALL MOUNTED INSTRUMENT SUBPANELS. Not used.

2-9. CONTROL SYSTEM CONSOLES AND ENCLOSURES. Not used.

2-10. CONTROL SYSTEM FURNITURE. Not used.

PART 3 - EXECUTION

3-1. GENERAL INSTALLATION REQUIREMENTS. Installation requirements are specified in the Instrumentation and Control System section. In addition, equipment furnished under this section shall conform to the following manufacturing stipulations.

3-1.01. Piping. All tubing shall be run in horizontal and vertical planes and shall be rigidly supported to withstand handling and shipment. Flexible polyethylene tubing shall be used to connect devices mounted on hinged doors.

3-1.02. Wiring. All wiring shall be grouped or cabled and firmly supported inside the panel. Wiring shall be bundled in groups and routed in Panduit or similar nonmetallic slotted ducts. Ducts shall be readily accessible within the panel with removable covers and shall have a space of at least 40 percent of the depth of the duct available for future use after installation is complete and all field wiring installed. Sufficient space shall be provided between cable groups or ducts and terminal blocks for easy installation or removal of cables.

3-1.03. More Than One Panel. Where signal or loop wiring must be routed to more than one panel or device, the required circuit routing shall be as indicated on the one-line diagrams. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic Drawings.

End of Section

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Equipment Schedule 13570-S01
FREESTANDING VERTICAL PANELS

1.000	General					
1.010	Specification Section 13570					
2.000	Freestanding Vertical Panels					
2.010	Tag Number/Panel ID	30-CP-3B				
2.020	Structure					
	Back to wall					
	Hinged rear doors					
	60 inches wide					
	36 inches center to center					
	Hinged front door	X				
	Fixed front					
	Recessed base	X				
2.030	Conduit entrance					
	Bottom open					
	Removable top plates					
3.000	Exceptions, Clarifications, and Comments					
3.010	Interior-mounted UPS required	X				
	Exterior dimensions (H x W x D)	72"x60"x24"				
	NEMA 4X	X				
	316 Stainless Steel	X				

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Section 13755

CLEANING AND DISINFECTION OF STRUCTURES

PART 1 - GENERAL

1-1. SCOPE. This section covers the cleaning and disinfection of certain water-containing structures included in Plant 3 as specified herein.

Unless otherwise specified, disinfection work shall not be started until the repair and cleaning of structures have been completed.

Cleaning and disinfection of pipelines shall be as specified in the Cleaning and Disinfection of Water Pipelines section.

1-2. GENERAL.

1-2.01. Governing Standard. Cleaning and disinfection work shall conform to the requirements of ANSI/AWWA C652 and ANSI/AWWA C653, and as specified herein.

1-2.02. Disinfection Plan. Prior to starting any disinfection work, the Contractor shall prepare a detailed disinfection plan. The plan shall cover the method and procedure proposed, necessary coordination, sequence of operations, equipment to be used, the manner of filling and flushing of each structure specified herein to be disinfected, and the neutralization and disposal of wasted water (including location of disposal, rate and neutralization location/method and testing requirements). All procedures shall be subject to acceptance by the Owner.

1-2.03. Coordination. The Contractor shall coordinate disinfection work with adjacent work, and with the Owner's operation of the existing facilities, as necessary to preclude work interference or duplication of effort and to expedite the overall progress of the work.

1-2.04. Equipment and Facilities. The Contractor shall provide all necessary piping connections, temporary valves, sampling taps, pumps, disinfectant, neutralization agents, chlorine residual test apparatus, and all other items of equipment or facilities required to complete the disinfection work.

1-2.05. Water. Water required for cleaning and disinfection of structures will be furnished as stipulated in the Temporary Facilities section.

1-2.06. Chlorine Residual Tests. The Contractor shall provide the necessary apparatus for making chlorine residual tests by the drop dilution method in

accordance with Appendix A of ANSI/AWWA C652. Tests will be made by the Contractor with Owner staff present during sampling.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. CLEANING OF STRUCTURES. All structures designed to contain water shall be kept clean until they have been placed in service or until final acceptance by the Owner. All dirt, debris, rubbish, and construction materials shall be removed from the interior of structures.

All interior floor, ceiling, and wall surfaces of the structures specified to be disinfected shall be thoroughly scrubbed and hosed down in accordance with the governing standard. All water remaining in the structures after the scrubbing and hosing operations have been completed shall be removed by means of dewatering pumping equipment or other methods acceptable to the Engineer. All scrubbing and hosing down of the structures shall have been completed and the resulting water removed before disinfection work is started.

3-2. STRUCTURES AND FILTERS TO BE DISINFECTED. The following structures shall be disinfected as specified herein:

- a. Chlorine Contact Chamber
- b. Filters, media and associated channels
- c. Transfer Pump Station

3-3. DISINFECTION PROCEDURES FOR STRUCTURES. After all work, including testing, coating, and cleaning, has been completed, the interior of the structure shall be disinfected in accordance with AWWA C652-11, Chlorination Method 3. Sodium hypochlorite shall be used to acquire the required chlorine concentration.

After the disinfection is satisfactory, the Contractor will perform required bacteriological tests. The structure must satisfactorily pass the bacteriological tests before being placed in service.

3-4. DISINFECTION OF FILTERS, MEDIA and ASSOCIATED CHANNELS. After all work, including testing, coating, placement of the media and cleaning, has been completed, the interior of the filters and all of the media and channels shall be disinfected in accordance with AWWA C653-03. Disinfection shall be

accomplished by using sodium hypochlorite. The method that shall be used to achieve the elevated residual required in AWWA C653-03 is described in 4.4.4.2.

3-5. DISPOSAL OF CHLORINATED WASTEWATER. Any chlorinated water used in disinfecting the structures and filters that is to be discharged to waste shall be neutralized by chemical treatment (sodium thiosulfate) prior to discharge into the storm sewer or sanitary sewer. The chlorine residual of wasted water shall be 0.0 mg/L. The Contractor shall test the water prior to discharge to verify the chlorine residual and provide a copy of the test results to the Owner. Per the required Disinfection Plan: the manner and rate of disposal of wasted water shall be acceptable to the Owner.

End of Section

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Section 15010

VALVE INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation replacement of 56 new plant 3 filter valves and actuators..

Cleaning, disinfection, pressure and leakage testing, insulation, and pipe supports are covered in other sections.

The following specification sections are applicable to valves to be installed:

Title

AWWA Butterfly Valves
Valve and Gate Actuators

1-2. GENERAL. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. Coordination. When manufacturer's field services or installation check services are provided by the valve manufacturer, Contractor shall coordinate the services with the valve manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services.

Submittals for equipment that will be furnished by others under each procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3-1. INSPECTION. All valves and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and re-cleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3-2. INSTALLATION.

3-2.01. General. Valves shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the valve for in-place maintenance. Installation shall be in accordance with the valve manufacturer's recommendations.

Unless otherwise indicated on the Drawings or specified, all valves installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches [1.3 m] or less above the finish floor shall be installed with their operating stems vertical. Valves installed in horizontal runs of piping having centerline elevations between 4 feet 6 inches [1.3 m] and 6 feet 9 inches [2 m] above the finish floor shall be installed with their operating stems horizontal. If adjacent piping prohibits this, the stems and operating handwheel shall be installed above the valve horizontal centerline as close to horizontal as possible. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as reviewed by Engineer.

3-2.02. Installation Checks. When specified in the valve sections, the valve manufacturer will provide installation checks. For installation checks, the manufacturer's field representative will inspect the valve installation immediately following installation by Contractor. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.

Contractor shall perform no work related to the installation or operation of materials or equipment furnished by others without direct observation and guidance of the field representative, unless Engineer and manufacturer furnishing such materials concur otherwise.

3-2.03. AWWA Butterfly Valves. Butterfly valves shall be installed with the shaft horizontal unless otherwise necessary for proper operation or as acceptable to Engineer.

Whenever an actuator must be removed to permit installation of a valve, the actuator shall be promptly reinstalled and shall be inspected and readjusted by a representative of the valve manufacturer.

3-3. VALVE ACTUATORS. Valve actuators and accessories shall be factory mounted on the valve, calibrated, and tested by the valve manufacturer.

3-4. FIELD QUALITY CONTROL.

3.4.01. Field Testing. After installation, all valves shall be exercised and tested to ensure that all valves and actuator assemblies are functioning and operating as required.

3-4.01.01. Pressure Tests. Pressure testing shall be in accordance with AWWA C504 governing section.

3-4.01.02. Leakage Tests. All valves shall be free from leaks. Each leak that is discovered within the warranty period stipulated in the valve procurement package shall be repaired by and at the expense of the valve manufacturer. This requirement applies whether pressure testing is required or not.

3-5. ADJUSTING. After installation, the opening and closing time shall be adjusted as needed for each pneumatic, hydraulic and electric actuated valve.

End of Section

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Section 15101

AWWA BUTTERFLY VALVES

PART 1 – GENERAL

1-1. SCOPE. This section covers furnishing of AWWA butterfly valves for cold water service as indicated in the AWWA Butterfly Valve Schedule.

AWWA butterfly valves shall be furnished complete with actuators and accessories as specified herein, as indicated in the schedule, and as specified in the Valve and Gate Actuators section.

All AWWA butterfly valves shall be sourced from the same manufacturer without exception.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

Valves shall be furnished with all necessary parts and accessories as specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of valves.

The valve supplier shall supply the valve and actuator as an assembled unit and is responsible for ensuring the proper coupling between the actuator and valve utilizing anticorrosive compound for assembly. The valve supplier shall also be responsible for the proper operation of the assembled unit.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

1-2.01. Governing Standard. Except as modified or supplemented herein, all butterfly valves and manual actuators shall conform to the applicable requirements of ANSI/AWWA C504 (the “governing standard”).

1-2.02. Marking. Supplementing the requirements of Section 6.1 of the

governing standard, the country of origin of all castings and an identifying serial number shall be stamped on a corrosion-resistant plate attached to the valve body.

1-2.03. Temporary Number Plates. Each butterfly valve shall be tagged or marked in the factory with the identifying number listed in the AWWA Butterfly Valve Schedule.

1-2.04. Identification. AWWA butterfly valves shall be tagged or marked per the AWWA Butterfly Valve Schedule and in accordance with the Equipment and Valve Identification section.

1-2.05. Permanent Tags. All valves that have been assigned a number in the valve schedule, shall be provided with a permanent number plate. Tags shall be permanently attached to valves with stainless steel mechanical fasteners or with stainless steel chains. Numerals shall be ¾ inch high and shall be on an anodized aluminum plate.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the valves and their appurtenances shall be submitted by Contractor to Engineer in accordance with the Submittals Procedures section. Included in the submittal shall be drawings by the valve manufacturer to indicate the position of the valve actuator and valve shaft.

Certified copies of test results for tests described in Section 5 of the governing standard, shall be submitted to and approved by Engineer before the valves are shipped. Valves with mounted actuators shall be performance and leak tested as an assembly in accordance with the governing standard. An affidavit of compliance with the governing standard for valves 72 inches and smaller shall be provided as indicated in Section 6.3 of ANSI/AWWA C504.

A Supplier Declarations Form shall be submitted that includes the name of the manufacturer of the valve and actuator as part of the bid submittal.

PART 2 - PRODUCTS

2-1. ACCEPTABLE PRODUCTS. Butterfly valves shall be by the manufacturers listed below or approved equal.

DeZurik
Pratt (Mueller)
Rodney Hunt

M&H
Val-Matic

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of butterfly valves shall conform to the requirements of the governing standard, and per NSF-61 requirements.

Acceptable shop coatings are listed in the following table.

Epoxy	
For Raw or Treated Water Service in potable water facilities (NSF certified)	PPG Amercoat "Amerlock 400 High Solids Epoxy", Carboline "Carboguard 891", Sherwin-Williams "Macropoxy 646NSF" or Tnemec "Series N140 Pota-Pox Plus".
Rust-Preventive Compound	As recommended by manufacturer.

2-3. VALVE CONSTRUCTION.

2-3.01. Valve Bodies. Valves shall be cast iron short-body type unless otherwise specified in the AWWA Butterfly Valve Schedule. The use of a stop or lug cast integrally with or mechanically secured to the body for the purpose of limiting disc travel by means of direct contact or interference with the valve disc (in either the open or closed position) will not be acceptable.

2-3.02. Flanges. Flanges shall conform to the requirements of the governing standard and shall be finished to true plane surfaces within a tolerance limit of 0.005 inch [125 µm]. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot (0.017 percent) of flange diameter.

2-3.03. Mechanical Joint Ends. Not used.

2-3.04. Valve Shafts. Valve shafts shall be fabricated of AISI Type 304 or 316 stainless steel. The use of shafts having a hexagonal cross section will not be acceptable. The connection between shaft and disc shall be in accordance with the governing standard.

The connection between the shaft and the disc shall be mechanically secured by

means of solid, smooth sided, stainless steel or monel taper pins or dowel pins.

Each taper pin or dowel pin shall extend through or shall wedge against the side of the shaft and shall be mechanically secured in place. The use of set screws, knurled or fluted dowel pins, expansion pins, roll pins, tension pins, spring pins, or other devices instead of the pins specified herein will not be acceptable.

2-3.05. Valve Seats. Seats for all valves in filter air scour service shall be EPDM rated for 250°F, the seats for the rest of the valves shall be EPDM. Acceptable seating surfaces mating with EPDM are AISI Type 304 or 316 stainless steel, monel, or plasma-applied nickel-chrome overlay for all valves; bronze for 20 inch [500 mm] and smaller valves; and alloy cast iron for 20 inch [500 mm] and smaller manually operated valves.

Seats shall be located on the valve body. Valve seat configurations which rely on the mating pipe flange to hold the seat in position in the valve body will not be acceptable.

Valve disc shall be 316 stainless steel, CF8M, or equivalent.

2-3.06. Shaft Seals. Shaft seals shall be of the chevron type. Shaft seals for valves in filter air scour service shall be EPDM rated for 250°F, and the shaft seals for the rest of the valves shall be EPDM.

2-3.07. Thrust Bearings. Each valve shall be provided with one or more thrust bearings in accordance with the governing standard. Thrust bearings which are directly exposed to line liquid and which consist of a metal bearing surface in rubbing contact with an opposing metal bearing surface will not be acceptable. Bearings for valves in filter air scour service shall be rated for 250°F.

2-4. VALVE ACTUATORS. Requirements for valve actuators shall be as specified herein, as indicated in the AWWA Butterfly Valve Schedule, and as specified in the Valve and Gate Actuators section. Valve actuator types for all valves shall be pneumatic vane types and each valve shall also be equipped with manual override actuator operating handwheels.

All 8 inch [200 mm] and larger valves shall have geared actuators.

If valves with an AWWA class designation higher than specified are furnished, actuator torque capabilities shall be increased accordingly and shall be acceptable to Engineer.

Valve actuators and accessories shall be factory mounted on the valve, calibrated, and tested by the valve manufacturer. The valve actuators and

accessories shall be properly paired with the butterfly valve to provide a functioning assembly that works seamlessly as though it were a single unit.

2-4.01. Actuator Sizing. The valve manufacturer shall size the actuator in accordance with the governing standard, and the operating conditions and requirements indicated in the AWWA Butterfly Valve Schedule and the valve manufacturer's requirements.

Unless otherwise indicated or specified, actuator torque requirements shall be based on a maximum differential pressure across the valve equal to the maximum pressure associated with the valve class and a maximum velocity through the valve of 16 feet per second [4.9 m/s].

Valves with operating stands shall have actuator torques increased by 25 percent. Actuator torques determined by the above requirements shall be increased by any design factors required by paragraph 4.2.8 of ANSI/AWWA C504 for valves 72 inches [1800 mm] and smaller, or as specified herein.

2-5. SHOP PAINTING. All interior and exterior ferrous metal surfaces, except finished surfaces, bearing surfaces, and stainless steel components, of valves and accessories shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

Surfaces shall be painted as follows:

Unfinished Surfaces	
Interior Surfaces	Epoxy.
Exterior Surfaces of All Other Valves	Universal primer.
Polished or Machined Surfaces	
Flange Faces	Rust-preventive compound.
Other Surfaces	Epoxy.

Interior coatings shall comply with ANSI/AWWA C550 and shall be free of holidays, as verified by holiday testing of the interior coatings of each valve in the shop. The total dry film thickness of shop-applied coatings shall be not less than:

Type of Coating	Minimum Dry Film Thickness
Epoxy	10 mils [250 µm]
Universal Primer	3 mils [75 µm]

2-6. ACCESSORIES. Requirements for extension stems and stem guides, position indicators, floor boxes, operating stands, torque tubes, valve boxes, extension bonnets, and pneumatic piping shall be as indicated in the AWWA Butterfly Valve Schedule and the Pneumatic Piping Detail Sheet specified in the Valve and Gate Actuators section.

Extension bonnets are required for the filter influent valves as specified in the AWWA Butterfly Valve Schedule. Actuators shall be mounted on a totally enclosed 304 stainless steel extension. The centerline of valve to top of extension is 84 inches. The extensions shall come equipped with all necessary stainless-steel accessories, bolts, couplings, and fittings to properly install a functioning assembly.

2-7. EXTENDED WARRANTY. The valve manufacturer shall warrant all valve and actuator assembly's against faulty or inadequate design, defective materials, defective workmanship, and improper assembly for a period of three years from the date of delivery to the Peace River Facility.

PART 3 - EXECUTION

3-1. PREPARATION FOR SHIPMENT. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.

Grease and lubricating oil shall be applied to all bearings and similar items.

3-1.01. SHIPPING. Before shipping each item of equipment shall be tagged or marked as identified in the AWWA butterfly valve schedule or on the manufacturers approved Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

3-2. INSTALLATION. Valves shall be installed in accordance with the Valve Installation section.

3-2.01. Installation Check. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation and shall revisit the job site as often as necessary until any problems are corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping and appurtenances; and has been operated under full load conditions and that it has operated satisfactorily.

3-3.02. Training. The valve manufacturer shall offer 4 hours of onsite training to Authority staff on servicing, repair and any associated preventative maintenance on filter valves and actuators. Training shall be coordinated with Contractor and Authority staff 1 week in advance.

All costs for these services shall be included in the Work.

End of Section

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1.010	1.020	1.030	1.031	1.040	1.041	1.045	1.060	1.070	1.080	1.090	6.010	6.020	6.030	6.040	6.050	8.010	8.020	8.040	8.041	8.050	8.060
Tag Number	Size	Type of Service(1)	Application	Type of Installation(2)	Pneumatic Vane Actuator	Manual Actuator Type and Size	AWWA Class(3)	Maximum Non-Shock Shutoff Pressure	Maximum Differential Pressure	Maximum Velocity	Remote Control Station (11)	Power for Solenoid Valve	Limit Switches(6)	Position Transmitter	Single Acting Spring Return	Extension Stems	Position Indicator for Buried Valve Actuators	Cast Iron Operating Stands	Fabricated Steel Operating Stands	Torque Tubes	Extension bonnet
	(in)					(in)		(psi)	(psi)	(ft/s)		V/PH									
30-FCV-30A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-30B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-31A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-31B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-32A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-32B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-33A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-33B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-34A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-34B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-35A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-35B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-36A	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-36B	12	O-C	Filter Influent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						Yes
30-FCV-30C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-30D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-31C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-31D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-32C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-32D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-33C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-33D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-34C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-34D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-35C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-35D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-36C	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-36D	24	O-C	Filter Backwash	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-30F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-30G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-31F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-31G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-32F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-32G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						

30-FCV-33F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-33G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-34F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-34G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-35F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-35G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-36F	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-36G	24	O-C	Filter Effluent	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-30E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-31E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-32E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-33E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-34E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-35E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-36E	6	O-C	Filter Air Scour	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-30J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-31J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-32J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-33J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-34J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-35J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						
30-FCV-36J	14	O-C	Filter to Waste	IP	Yes	14 HW	150B-F			16		120/1	WP	No	No						

Notes:

(1) Actuators designated "O-C" are for "Open-Close" service. Actuators designated "M" are for "Modulating" service.

(2) Abbreviations for installation types are as follows:

B4	Buried, depth of 4 feet [1.2 m] or less
B20	Buried, depth greater than 4 feet [1.2 m] but 20 feet [6.1 m] or less
Bxx	Buried, depth greater than 20 feet [6.1 m], actual depth of xx feet
SV20	Submerged or vaulted, depth 20 feet [6.1 m] or less
SVxx	Submerged or vaulted, depth greater than 20 feet [6.1 m], actual depth of xx feet
IP	In plant

(3) Suffix letters define valve ends as follows:

F	Flanged
W	Wafer
MJ	Mechanical joint
S	Single Flange

(4) Abbreviations for actuator types are as follows:

WN	Wrench Nut
LVR	Lever
CW	ChainWheel
HW	HandWheel

(5) If a value is indicated, the leakage test shall be performed using this pressure value rather than the pressure indicated by the AWWA class.

(6) Abbreviations for limit switches on manual and cylinder operated valves.

EOT	End of travel (open - close)
PSS	Pump start - stop (two intermediate positions)
ELSCH	See electrical schematics

(7) Abbreviations for electronic or electric actuator housing.

WP	Weatherproof
SUB	Submersible [xx = depth of submergence] (SUBxx)
EXP	Explosion proof

(8) Cylinder actuators shall have torque safety factors applied in accordance with AWWA C504.

(9) Abbreviations for control devices are as indicated.

Table 1: Control Devices				
Abbreviations	Open-Close Push Button	Open-Stop- Close Push Button	Local-Off-Remote	Red and Green Indicator Lights
A	Required		Required	Required
B	Required		Required	
C		Required	Required	Required
D		Required	Required	
E		Required		
F	Required			
G	Required			Required
H		Required		Required

(10) Abbreviations for electric actuator types are as follows:

SE Standard Electric

IE Intelligent Electric

NE Networked Electric

END OF SCHEDULE

(11) Abbreviation for remote control station types:

CS Control Station without Indicating Lights

CIS Control Station with Indicating Lights

Section 15180

VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1-1. SCOPE. This section covers furnishing of manual and powered valve and gate actuators and accessories as specified herein.

1-2. GENERAL. Equipment provided under this section shall be fabricated and assembled in full conformity with specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Authority's representative, Black & Veatch, hereto referred to as Engineer.

Actuators shall be furnished by the valve supplier with all necessary parts and accessories as specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.

All actuators shall be sourced from the same manufacturer without exception.

1-2.01. Governing Standards. Except as modified or supplemented herein, cylinder and vane type actuators shall conform to applicable requirements of ANSI/AWWA C541.

Except as modified or supplemented herein, actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.

Except as modified or supplemented herein, manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

Except as modified or supplemented herein, actuators for cast-iron slide gates shall conform to the applicable requirements of ANSI/AWWA C560.

Except as modified or supplemented herein, actuators for open channel slide gates and weir gates shall conform to the applicable requirements of ANSI/AWWA C513.

Except as modified or supplemented herein, actuators for stainless steel slide gates shall conform to the applicable requirements of ANSI/AWWA C561.

Except as modified or supplemented herein, actuators for composite slide gates shall conform to the applicable requirements of ANSI/AWWA C563.

1-2.02. Power Supply. Not used.

1-2.03. Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

1-2.04. Temporary Number Plates. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule.

1-3. SUBMITTALS. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted to Engineer by the Contractor. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.

Submittal drawings shall include separate wiring diagrams for each controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.

For cylinder actuators, certified copies of reports covering proof-of-design testing of the actuators as set forth in Section 5 of ANSI/AWWA C541 or ANSI/AWWA C542 respectively, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C541 or ANSI/AWWA C542 respectively, shall be submitted to and approved by Engineer before the actuators are shipped.

A Supplier Declarations Form shall be submitted that includes the name of the manufacturer of the valve and actuator as part of the bid submittal.

PART 2 - PRODUCTS

2-1. PERFORMANCE AND DESIGN REQUIREMENTS.

2-1.01. General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.

Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

2-1.02. Valve Actuators. Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the

maximum pressure differential across the valve and maximum velocities through the valve where indicated in the respective valve schedules.

Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise by Engineer in writing.

When valves are to be buried, submerged, or installed in vaults; the actuators and accessories shall be sealed to prevent the entrance of water. The design water depth shall be as indicated in the respective valve schedules but not less than 20 feet.

2-1.03. Gate Actuators. Not used.

2-1.04. Limit Switches. Limit switches shall be provided as indicated in the valve and gate schedules.

For manual or cylinder type actuators, each limit switch shall be heavy duty type, with a cast NEMA Type 4 enclosure, a spring return roller lever, and four isolated contacts (two normally open and two normally closed) rated 10 amperes at 120 to 480 volts ac and 5 amperes at 125 volts dc. The switches shall be Allen Bradley "802T" or Square D "9007 Type C".

2-2. MATERIALS. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of the applicable governing standard(s).

2-3. VALVE MANUAL ACTUATORS.

2-3.01. General. Manual actuators of the types listed in the valve specifications or schedules shall be provided by the valve manufacturer.

Each valve shall be equipped with a manual actuator and shall be equipped with an operating handwheel. See the Valve Schedule for additional data.

The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body or actuator shall have cast thereon the word "Open" and an arrow indicating the direction to open.

The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating

mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.

Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.

Valves for throttling service shall be equipped with an infinitely variable locking device or a totally enclosed gear actuator.

Actuators shall produce the required torque with a maximum pull of 80 lbs on the lever, handwheel, or chain. Actuator components shall withstand, without damage, a pull of 200 lbs on the handwheel or chainwheel or an input of 300 foot-lbs on the operating nut.

2-3.02. Handwheels. Handwheel diameters are listed in the Valve Schedule. Handwheels shall be constructed of solid material and shall not be tubing.

2-3.03. Chainwheels. Unless otherwise specified in the valve schedules, all valves with center lines more than 7'-6" above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized or zinc plated carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

2-3.04. Levers. Levers shall be capable of being locked in at least five intermediate positions between fully open and fully closed. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.

2-3.05. Chain Levers. Suitable actuator extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized carbon steel and shall be looped to extend to within 4 feet of the floor below the valve.

2-3.06. Wrench Nuts. Unless otherwise specified in the valve schedules, wrench nuts shall be provided on all buried valves and on all valves that are to be operated through floor boxes. Unless otherwise directed by Owner, all wrench nuts shall comply with Section 4.4.13 of ANSI/AWWA C500. At least two operating keys shall be furnished for operation of the wrench nut operated valves.

2-3.07. Operating Stands. Operating stands shall be provided in the locations as indicated in the valve and gate schedules. Operating stands shall support the handwheel approximately 36 inches above the floor. A sleeve made from standard weight galvanized steel pipe shall be provided for the opening in the floor beneath each operating stand. When stems are 10 feet or longer, a suitable thrust bearing shall be provided in each operating stand to carry the weight of the extension stem.

2-3.08. Wall Brackets. Wall brackets shall be provided to support manual actuators in the locations indicated in the respective valve schedules. The horizontal face of the bracket shall be predrilled to accept the actuator and the stem without modification. The top of the bracket shall extend sufficiently to bear on and transfer thrust loads to the top of the supporting structure.

2-4. GATE MANUAL ACTUATORS. Not used.

2-5. INTELLIGENT ELECTRIC ACTUATORS. Not used.

2-6. STANDARD ELECTRIC ACTUATORS. Not used.

2-7. HYDRAULIC CYLINDER ACTUATORS. Not used.

2-8. AIR CYLINDER ACTUATORS. Not used.

2-9. VANE TYPE PNEUMATIC ACTUATORS.

2-9.01. General. Vane type pneumatic actuators as listed in the Valve Schedule shall be provided for all valves by the valve manufacturer.

2-9.02. Vane Type Pneumatic Actuators. Vane type actuators shall be sized to provide a safety factor of 25% for open-close service and 50% for modulating service, shall be designed to provide satisfactory operation using dry, oil free instrument air at 80 psig pressure, and shall be shop tested at 225 psig. Pneumatic vane type actuators shall be as manufactured by Kinetrol, Ltd. or K-Tork International, without exception.

Actuator shaft and vane shall be a single machined part. Vane lip seals shall be constructed by the dual opposed injection molded method. Stainless steel expanders shall be fitted beneath the vane lip seals to ensure continual seal-to-case contact. All actuators shall be fitted with stainless steel threaded travel stops allowing adjustment at each end of actuator stroke.

Manufacturer shall provide all linkages, brackets, mounting accessories, and couplings required for a complete installation of the actuator to the valve. All components, except stainless steel, shall have the specified external coating.

2-9.03. Control Devices. When open-close service is specified in the respective valve schedule, a solenoid valve shall be provided to control the operation of each vane type pneumatic actuated valve. Each solenoid valve shall be a heavy-duty, single solenoid, two-position type rated for a differential operating air pressure as required. Each valve shall be designed and constructed for exceptionally long life, with forged brass body; poppet type seats and discs; continuous duty, molded, Class F coil; NEMA Type 4 solenoid enclosure; and 1/2 inch threaded conduit connection. Solenoid valves shall be rated for use with a power supply as indicated in the respective valve schedule and the air pressure specified herein and shall be ASCO series 8344 4-way pilot operated solenoid valves with manual override features. The Solenoid valve shall be unenergized while the valve it is controlling is in its normal state (Filtering).

Each air connection on each vane type actuator shall be equipped with an adjustable flow control valve. The flow control valves and connecting piping shall be arranged to permit control of the flow rate of exhaust air from the actuator and to permit independent adjustment and control of valve opening and closing speeds. Control valves shall be sized so that the time required for the vane to complete its stroke is adjustable between 20 and 120 seconds, with an air supply pressure of 80 psig. Flow control valves shall be manufactured from brass or stainless steel and shall be Parker Hannifin "Colorflow F Series" or Mead "Dyla-Trol".

As an alternative to a separately mounted solenoid valve and flow control valves, actuators for open-close service may be provided with solenoid valves having integral flow controls, that are directly mounted to the actuator body. Solenoid valves shall be provided with NEMA 4 enclosures, with manual override, and 1/2 inch threaded conduit connection. Solenoid valves shall be rated for use with a power supply as indicated in the respective valve schedule and the air pressure specified herein.

An externally mounted gauge manifold with gauges shall be provided on each actuator to monitor and display air supply pressure and actuator output pressure.

Where specified for modulating service in the respective valve schedule, pneumatic vane type actuators shall be provided with an electro-pneumatic positioner provided by the actuator manufacturer. Positioner shall have an output shaft to allow direct mounting to the actuator. The positioner shall accept a 4-20 mA control signal and a nominal 80 to 100 psig air supply. Steady state air consumption shall not exceed 0.5 scfm. Linearity of the actual valve position as compared to the control signal shall be within ± 0.7 percent of span. Repeatability

and hysteresis of the valve position as compared to the control signal shall be ± 0.7 percent of span. Positioners shall have gauges for signal pressure and positioner output pressures. Positioner enclosures shall be NEMA 4X.

Each positioner shall provide a 4-20 mA dc analog position transmitter feedback output capable of driving an external load of 0 to 500 ohms and shall be directly coupled to the actuator mechanism. Linearity shall be ± 2 percent as compared to actual valve position. Repeatability and hysteresis shall be ± 0.5 percent of span.

Pneumatic air piping by the Manufacturer shall be 316SS tubing and configured as shown on FIG 1 -15180 - Typical Double Acting Pneumatic Actuator attached herein.

Each actuator shall be equipped with limit switches for electrical position feedback to the plant control system to indicate when the valve is in the opened and closed position.

2-9.04. Single Acting-Spring Return Pneumatic Vane Type Actuators. Not used.

2-9.05. Actuator Assembly. Each actuator shall be factory assembled with piping and all required accessories including solenoid valve, positioner, flow control valves, and other accessories required for a properly operating system.

2-9.06. Remote Vane Type Pneumatic Actuator Control Station. Not used

2-9.07. Extended Warranty. The pneumatic actuator manufacturer shall warrant the actuators against faulty or inadequate design, defective materials, defective workmanship, and improper assembly for a period of three years from the date of delivery to the Peace River Facility.

2-10. AIR-OIL CYLINDER ACTUATORS. Not used.

2-11. PORTABLE ELECTRIC ACTUATORS. Not used

2-12. PORTABLE HYDRAULIC ACTUATORS. Not used

2-13. ACTUATOR ACCESSORIES.

2-13.01. Extension Stems. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease-filled protective boot. All stem connections shall be pinned.

At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet, whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. The length of the stem extension shall be as necessary to position the valve operator 12 inches above the maximum liquid level in the immediate area.

Extension stems for buried valve actuators shall extend to within 6 inches of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.

Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.

2-13.02. Position Indicators. Unless otherwise specified, each valve actuator shall be provided with a position indicator to display the position of the plug or disc relative to the body seat opening.

For quarter turn plug, ball, or cone type valves installed in interior locations, the indicating pointer shall be mounted on the outer end of the valve operating shaft extension and shall operate over an indicating scale on the operating mechanism cover. Where the shaft passes through the cover, a suitable stuffing box or other seal shall be provided to prevent the entrance of water.

Each actuator for butterfly valves, except where located in manholes, buried, or submerged, shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon.

2-13.02.01. Position Indicators for Buried Actuators. Not used.

2-13.03. Floor Boxes. Not used.

2-13.04. Torque Tubes. Not used.

2-13.05. Valve Boxes. Not used.

2-14. SPARE PARTS. Manufacturer recommended spare parts shall be provided.

2-15. SHOP PAINTING. All ferrous metal surfaces, except bearing and finished surfaces and stainless-steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.

The following surfaces shall be painted:

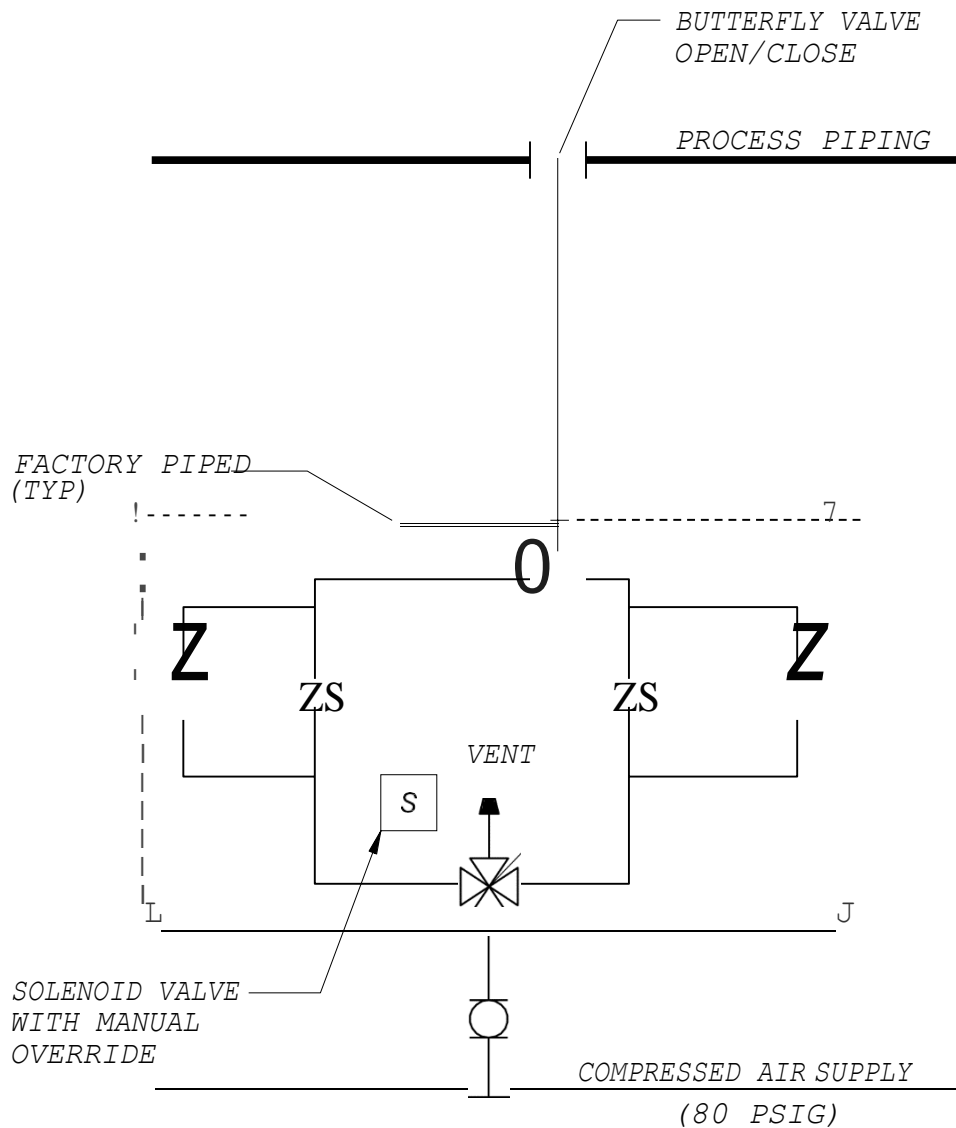
Polished or Machined Surfaces	Rust-preventive compound.
Other Surfaces	Epoxy.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3-1. INSTALLATION. Actuators will be installed on the valves in accordance with the AWWA Butterfly Valves section. All ports, thread holes or orifices not in use but that can collect rainwater shall be plugged and made water tight.

End of Section

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TYPICAL DOUBLE ACTING PNEUMATIC
AIR CYLINDER OR VANE TYPE ACTUATOR
(OPEN/CLOSE) DETAIL

NO SCALE

Black & Veatch
Engineers - Architects



PROJECT

TYPICAL DOUBLE ACTING PNEUMATIC
AIR CYLINDER OR VANE TYPE ACTUATOR
(OPEN/CLOSE) DETAIL

FIG 1 - 15180

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Section 16050

ELECTRICAL

PART 1 - GENERAL

1-1. SCOPE. This section covers the furnishing and installation of all equipment and materials needed for the electrical requirements of this Contract. It also covers conduit, wiring, and terminations for electrical equipment installed under Electrical Equipment Installation section.

This section covers the installation and interconnection of electrical equipment furnished under other sections, except electrical items designated to be installed under those sections.

1-2. GENERAL. Electrical apparatus on all equipment shall be installed complete and placed in readiness for proper operation.

Electrical materials furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all equipment provided under this section. If requirements in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence

1-2.02. Seismic Design Requirements. Not Used.

1-2.03. Coordination. Electrical work shall conform to the construction schedule and the progress of other trades.

1-2.04. Anchor Bolts and Expansion Anchors. All anchor bolts, nuts, washers, and expansion anchors shall comply with Anchorage in Concrete and Masonry section, except smaller than 3/4 inch will be permitted to match NEMA standard size bolt holes on motors and electrical equipment.

1-2.05. Drawings. Supplementing this section, the Drawings indicate locations of equipment and enclosures and provide one-line and schematic diagrams regarding the connection and interaction with other equipment.

1-3. CODES AND PERMITS. All work shall be performed, and materials shall be furnished in accordance with the NEC - National Electrical Code, the NESC - National Electrical Safety Code, and the following standards where applicable:

ANSI	American National Standards Institute.
ASTM	American Society for Testing and Materials.
AWG	American Wire Gauge.
Fed Spec	Federal Specification.
ICEA	Insulated Cable Engineers Association.
IEEE	Institute of Electrical and Electronics Engineers.
IESNA	Illuminating Engineering Society of North America.
NEIS	National Electrical Installation Standards
NEMA	National Electrical Manufacturers Association.
NFPA	National Fire Protection Association.
UL	Underwriters' Laboratories.

Equipment covered by this section shall be listed by UL, or by a nationally recognized third-party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of Contractor. If no third-party testing laboratory provides the required listing, an independent test shall be performed at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to be used.

1-4. SEISMIC DESIGN REQUIREMENT. Not Used.

1-5. IDENTIFICATION.

1-5.01. Conduit. Conduits in manholes, handholes, building entrance pull boxes, junction boxes, and equipment shall be provided with identification tags. Identification tags shall be 19 gage stainless steel, with 1/2-inch stamped letters and numbers as indicated on the Drawings. Identification tags shall be attached to conduits with nylon tie wraps and shall be positioned to be readily visible.

1-5.02. Conductors. All conductors in power, control, and instrumentation circuits shall be identified and color coded as described herein.

1-5.02.01. Conductor Identification Number. Except for lighting and receptacle circuits, each individual conductor in power, control, and instrumentation circuits shall be provided with wire identification markers at the point of termination.

The wire markers shall be of the heat-shrinkable tube type, with custom typed identification numbers.

The wire numbers shall be as indicated on the equipment manufacturer's drawings.

The wire markers shall be positioned to be readily visible for inspection.

1-5.02.02. Conductor Color Coding. Power conductors shall be color coded as indicated below. For conductors 6 AWG and smaller, the color coding shall be the insulation finish color. For sizes larger than 6 AWG, the color coding may be by marking tape. The equipment grounding conductor shall be green or green with one or more yellow stripes if the conductor is insulated.

The following color-coding system shall be used:

120/240V single-phase — black, red, and white
120/208V, three-phase — black, red, blue, and white
120/240V, three-phase — black, orange, blue, and white
277/480V, three-phase — brown, orange, yellow, and gray

Where 120/240 and 120/208 volt systems share the same conduit or enclosure, the neutral for either the 120/240 volt system or the 208 volt system shall be white with a permanent identifiable violet stripe.

Control and instrumentation circuit conductors shall be color coded as indicated in the Cable Data Figures at the end of this section.

1-5.03. Motor Starters. Not used.

1-5.04. Control Stations. Not used.

1-5.05. Circuit Breakers. Not used.

1-5.06. Disconnect Switches. Not used.

1-5.07. Arc Flash Hazard Labels. Not used.

1-6. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the work performed by the Contractor, shall be submitted in accordance with the Submittals Procedures section. The drawings and data shall include, but shall not be limited to, the following:

Drawings and data.
Operating manuals.
Samples.

1-6.01. Submittal Identification. Information covering all materials and equipment shall be submitted for review in accordance with the Submittals Procedures section. Each sheet of descriptive literature submitted shall be clearly marked to identify the material or equipment as follows:

- a. Lamp fixture descriptive sheets shall show the fixture schedule letter, number, or symbol for which the sheet applies.
- b. Equipment and materials descriptive literature and drawings shall show the specification paragraph for which the equipment applies.
- c. Sheets or drawings covering more than the item being considered shall have all inapplicable information crossed out.
- d. A suitable notation shall identify equipment and materials descriptive literature not readily cross-referenced with the Drawings or Specifications.
- e. Schematics and connection diagrams for all electrical equipment shall be submitted for review. A manufacturer's standard connection diagram or schematic showing more than one scheme of connection will not be accepted, unless it is clearly marked to show the intended connections.

Contractor shall submit the name and qualifications of the Engineering and Testing Services firm proposed to perform the coordination study and the on site testing.

Within 90 days after the Notice to Proceed, Contractor shall furnish a submittal for all types of cable and conduit to be provided. The submittal shall include the cable manufacturer and type, and sufficient data to indicate that the cable and conduit meet the specified requirements.

In addition to the complete specifications and descriptive literature, a sample of the largest size of each type of cable shall be submitted for review before installation. Each sample shall include legible and complete surface printing of the cable identification.

1-7. PROTECTION AND STORAGE. During construction, the insulation on all electrical equipment shall be protected against absorption of moisture, and metallic components shall be protected against corrosion by strip heaters, lamps,

or other suitable means. This protection shall be provided immediately upon receipt of the equipment and shall be maintained continuously.

PART 2 - PRODUCTS

2-1. POWER SERVICE ENTRANCE. Not used.

2-2. TELEPHONE SERVICE ENTRANCE. Not used.

2-3. CABLE. All cables of each type (such as lighting cable or 600 volt power cable) shall be from the same manufacturer.

All types of cable shall conform to the Cable Data Figures at the end of this section and as described herein.

2-3.01. Lighting Cable. Lighting cable (Figure 1-16050 THHN-THWN) shall be provided only in lighting and receptacle circuits operating at 277 volts or less. Lighting and receptacle circuits, 8 AWG or larger, shall be as specified for 600 volt (Figure 2-16050 XHHW-2) power cable.

2-3.02. 600 Volt Power Cable. Cable in power, control, indication, and alarm circuits operating at 600 volts or less, except where lighting, multiconductor control, and instrument cables are required, shall be 600 volt (Figure 2-16050 XHHW-2) power cable.

2-3.03. Instrument Cable. Cable for electronic circuits to instrumentation, metering, and other signaling and control equipment shall be two- or three-conductor instrument cable twisted for magnetic noise rejection and protected from electrostatic noise by a total coverage shield. Types of instrument cables shall be (Figure 4-16050 single pair).

2.3.04. Multiconductor Control Cable. Not used.

2-3.05. Medium Voltage Power Cable. Not used.

2-3.06. Tray Cable. Not used.

2-4. CONDUIT. Conduit and raceways shall be as described in the following paragraphs:

2-4.01. Rigid Steel Conduit. Rigid steel conduit shall be heavy wall, hot-dip galvanized, shall conform to ANSI C80.1, and shall be manufactured in accordance with UL 6.

2-4.02. Intermediate Metal Conduit (IMC). Not used.

2-4.03. Liquidtight Flexible Metal Conduit. Liquidtight flexible metal conduit shall be hot-dip galvanized steel, shall be covered with a moistureproof polyvinyl chloride jacket, and shall be UL labeled.

2-4.04. Utility (PVC) Duct. Not used.

2-4.05. Rigid Nonmetallic (PVC) Conduit. PVC conduit shall be heavy wall, Schedule 40, UL labeled for aboveground and underground uses, and shall conform to NEMA TC-2 and UL 651.

2-4.06. PVC-Coated Rigid Steel Conduit. The conduit shall be rigid steel. Before the PVC coating is applied, the hot-dip galvanized surfaces shall be coated with a primer to obtain a bond between the steel substrate and the coating. The PVC coating shall be bonded to the primed outer surface of the conduit. The bond on conduit and fittings shall be stronger than the tensile strength of the PVC coating. The thickness of the PVC coating shall be at least 40 mils.

A chemically cured two-part urethane coating, at a nominal 2 mil thickness, shall be applied to the interior of all conduit and fittings. The coating shall be sufficiently flexible to permit field bending the conduit without cracking or flaking of the coating.

Every female conduit opening shall have a PVC sleeve extending one conduit diameter or 2 inches, whichever is less, beyond the opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit before coating. The wall thickness of the sleeve shall be at least 40 mils.

All fittings, condulets, mounting hardware, and accessories shall be PVC-coated. All hollow conduit fittings shall be coated with the interior urethane coating described above. The screw heads on condulets shall be encapsulated by the manufacturer with a corrosion-resistant material.

PVC coated rigid steel conduit shall be manufactured by Ocal, Perma-Cote, or Robroy.

2-4.07. Electrical Metallic Tubing (EMT). Not used.

2-4.08. Rigid Aluminum Conduit (RAC). Rigid aluminum conduit and fittings shall be manufactured of 6063-T1 alloy, shall conform to ANSI C80.5, and shall be manufactured in accordance with UL 6A.

2-5. WIRING DEVICES, BOXES, AND FITTINGS. Concealed conduit systems shall have flush-mounted switches and convenience outlets. Exposed conduit systems shall have surface-mounted switches and convenience outlets.

2-5.01. Conduit Boxes and Fittings.

- a. Galvanized or cadmium plated, threaded, malleable iron boxes and fittings shall be manufactured by Crouse-Hinds, Appleton, or O Z Gedney. In applications utilizing aluminum conduit systems, aluminum boxes and fittings manufactured by Crouse-Hinds, Appleton, or O Z Gedney shall be installed.
- b. Rigid PVC device boxes and fittings shall be manufactured by Carlon or Cantex.
- c. Sheet steel device boxes shall be manufactured by Appleton, Racor, or Steel City.
- d. PVC coated device boxes shall be manufactured by Ocal, Perma-Cote, or Robroy Industries.
- e. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement to avoid unnecessary bends and fittings.

2-5.02. Device Plates. Not used.

2-5.03. Wall Switches. Not used.

2-5.04. Receptacles. Not Used.

2-5.05. Special Outlets. Not used.

2-6. JUNCTION BOXES, PULL BOXES, AND WIRING GUTTERS. Indoor boxes (larger than switch, receptacle, or fixture type) and gutters shall be constructed of sheet steel, shall be galvanized after fabrication, and shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts.

Indoor boxes and gutters in corrosive areas indicated on the Drawings and outdoor boxes and gutters shall be NEMA Type 4X, ABS or stainless steel and shall be rigidly supported by PVC-coated or stainless steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.

Bolt-on junction box covers 3 feet square or larger, or heavier than 25 lbs, shall have rigid handles. Covers larger than 3 by 4 feet shall be split.

Where indicated on the Drawings, junction and pull boxes with a removable side opposite the underground conduits shall be provided over building ends of underground conduit banks. Boxes shall be sized in accordance with the National Electrical Code, including space for full size continuations of all underground conduits not originally continued. Conduit arrangement shall leave maximum space for future conduits.

2-7. LIGHTING FIXTURES. Not used.

2-8. LIGHTING PANELS. Not used.

2-9. POWER PANELS. Not used.

2-10. SURGE PROTECTIVE DEVICES. Not used.

2-11. SEPARATELY ENCLOSED MOTOR STARTERS. Not used.

2-12. SEPARATELY ENCLOSED MANUAL STARTERS. Not used.

2-13. CONTROL STATIONS. Not used.

2-14. SEPARATELY ENCLOSED CIRCUIT BREAKERS. Not used.

2-15. DISCONNECT SWITCHES. Not used.

2-16. LIGHTING AND AUXILIARY POWER TRANSFORMERS. Not used.

2-17. POWER CENTERS. Not used.

2-18. POWER FACTOR CORRECTION CAPACITORS. Not used.

2-19. LIGHTING CONTACTORS. Not used.

2-20. PHOTOELECTRIC CONTROLS. Not used.

2-21. RELAY ENCLOSURES. Not used.

2-22. ALARM HORN AND BEACON. Not used.

2-23. HEAT-TRACED PIPING. Not used.

2-24. DOOR ENTRY SWITCHES. Not used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All material, equipment, and components specified herein shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

3-2. ARC FLASH HAZARD ANALYSIS. Not used.

3-3. COORDINATION STUDY. Not used.

3-4. POWER AND SERVICE ENTRANCE INSTALLATION. Not used.

3-5. TELEPHONE SERVICE ENTRANCE INSTALLATION. Not used.

3-6. CABLE INSTALLATION.

3-6.01. General. Except as otherwise specified or indicated on the Drawings, cable shall be installed according to the following procedures, taking care to protect the cable and to avoid kinking the conductors, cutting or puncturing the jacket, contamination by oil or grease, or any other damage. Circuits to supply electric power and control to equipment and devices, communication and signal circuits as indicated on the one-line diagrams shall be installed continuous and may not be spliced unless approved by the Engineer.

- a. Stranded conductor cable shall be terminated by lugs or pressure type connectors. Wrapping stranded cables around screw type terminals is not acceptable.
- b. Stranded conductor cable shall be spliced by crimp type connectors. Twist-on wire connectors may be used for splicing solid cable and for terminations at lighting fixtures.
- c. Splices may be made only at readily accessible locations.
- d. Cable terminations and splices shall be made as recommended by the cable manufacturer for the particular cable and service conditions. All shielded cable stress cone terminations shall be IEEE Class 1 molded rubber type. Shielded cable splices shall be tape or molded rubber type as required. Shielded cable splices and stress cone terminations shall be made by qualified splicers. Materials shall be by 3M Company, Plymouth/Bishop, or Raychem Electric Power Products.

- e. Cable shall not be pulled tight against bushings nor pressed heavily against enclosures.
- f. Cable-pulling lubricant shall be compatible with all cable jackets; shall not contain wax, grease, or silicone; and shall be Polywater "Type J".
- g. Cables operating at more than 2000 volts shall be fireproofed in all cable vaults, manholes, and handholes. Fireproofing shall be applied with a half-lapped layer of 3M "Scotch 77 Arc-Proofing Tape", anchored at each end with a double wrap of 3M "Scotch 69 Glass Cloth Tape" or with equivalent tape by Anixter or Plymouth/Bishop.
- h. Where necessary to prevent heavy loading on cable connections, in vertical risers, the cable shall be supported by Kellems, or equal, woven grips.
- i. Spare cable ends shall be taped, coiled, and identified.
- j. Cables shall not be bent to a radius less than the minimum recommended by the manufacturer. For cables rated higher than 600 volts, the minimum radius shall be 8 diameters for nonshielded cable and 12 diameters for shielded cable.
- k. All cables in one conduit, over 1 foot long, or with any bends, shall be pulled in or out simultaneously.
- l. Circuits to supply electric power and control to equipment and devices are indicated on the one-line diagrams. Conductors in designated numbers and sizes shall be installed in conduit of designated size. Circuits shall not be combined to reduce conduit requirements unless acceptable to Engineer.

3-6.02. Underground Cable Pulling Procedure. Not used.

3-6.03. Cable Insulation Test. Not used.

3-7. CONDUIT INSTALLATION. Contractor shall be responsible for routing all conduits. This shall include all conduits indicated on the one-lines, riser diagrams, and home-runs shown on the plan Drawings. Conduits shall be routed as defined in these Specifications. Where conduit routing is shown on plans, it shall be considered a general guideline and shall be field verified to avoid interferences.

Except as otherwise specified or indicated on the Drawings, conduit installation and identification shall be completed according to the following procedures.

3-7.01. Installation of Interior and Exposed Exterior Conduit. This section covers the installation of conduit inside structures, above and below grade, and in exposed outdoor locations. In general, conduit inside structures shall be concealed. Large conduit and conduit stubs may be exposed unless otherwise specified or indicated on the Drawings. No conduit shall be exposed in water chambers unless so indicated on the Drawings.

Unless otherwise indicated on the Drawings, Contractor shall be responsible for routing the conduit to meet the following installation requirements:

- a. Conduit installed in all exposed indoor locations, except corrosive areas indicated on the Drawings, and in floor slabs, walls, and ceilings of hazardous (classified) locations, shall be rigid steel. Exposed conduit shall be rigidly supported by hot-dip galvanized hardware and framing materials, including nuts and bolts.
- b. Conduit installed in floor slabs and walls in non-hazardous locations shall be rigid Schedule 40 PVC.
- c. Conduit installed in all exposed outdoor locations shall be Rigid Aluminum, rigidly supported by type 316 Stainless Steel framing materials. Mounting hardware, which includes nuts, bolts, and anchors, shall be stainless steel. All damaged coatings shall be repaired according to the manufacturer's instructions.
- d. Final connections to dry type transformers, to motors without flexible cords, and to other equipment with rotating or moving parts shall be liquid tight flexible metal conduit with watertight connectors installed without sharp bends and in the minimum lengths required for the application, but not longer than 6 feet unless otherwise acceptable to Engineer.
- e. Terminations and connections of rigid steel and intermediate metal conduit shall be taper threaded. Conduits shall be reamed free of burrs and shall be terminated with conduit bushings.
- f. Exposed conduit shall be installed either parallel or perpendicular to structural members and surfaces.
- g. Two or more conduits in the same general routing shall be parallel, with symmetrical bends.
- h. Conduits shall be at least 6 inches from high temperature piping, ducts, and flues.
- i. Conduit installed in corrosive chemical feed and storage areas as indicated by Area Type on the Drawings shall be rigid Schedule 40 PVC.

- j. Rigid Schedule 40 PVC conduit shall have supports and provisions for expansion as required by NEC Article 352.
- k. Metallic conduit connections to sheet metal enclosures shall be securely fastened by locknuts inside and outside.
- l. Rigid Schedule 40 PVC conduit shall be secured to sheet metal device boxes using a male terminal adapter with a locknut inside or by using a box adapter inserted through the knockout and cemented into a coupling.
- m. Conduits in walls or slabs, which have reinforcement in both faces, shall be installed between the reinforcing steel. In slabs with only a single layer of reinforcing steel, conduits shall be placed under the reinforcement. Conduits larger than 1/3 of the slab thickness shall be concrete encased under the slab.
- n. Conduits that cross structural joints where structural movement is allowed shall be fitted with concrete tight and watertight expansion/deflection couplings, suitable for use with metallic conduits and rigid Schedule 40 PVC conduits. The couplings shall be Appleton Type DF, Crouse-Hinds Type XD, or O-Z Type DX.
- o. Conduit shall be clear of structural openings and indicated future openings.
- p. Conduits through roofs or metal walls shall be flashed and sealed watertight.
- q. Conduit installed through any openings cut into non-fire rated concrete or masonry structure elements shall be neatly grouted. Conduit penetrations of fire rated structure elements shall be sealed in a manner that maintains the fire rating as indicated on the Architectural Drawings.
- r. Conduits shall be capped during construction to prevent entrance of dirt, trash, and water.
- s. Exposed conduit stubs for future use shall be terminated with galvanized pipe caps.
- t. Concealed conduit for future use shall be terminated in equipment or fitted with couplings plugged flush with structural surfaces.
- u. Where the Drawings indicate future duplication of equipment wired hereunder, concealed portions of conduits for future equipment shall be provided.

- v. Horizontal conduit shall be installed to allow at least 7 feet of headroom, except along structures, piping, and equipment or in other areas where headroom cannot be maintained.
- w. Conduit shall not be routed across the surface of a floor, roof, or walkway unless approved by Engineer.
- x. PVC-coated rigid steel conduit shall be threaded and installed as recommended by the conduit manufacturer's installation procedure using appropriate tools.
- y. All conduits that enter enclosures shall be terminated with acceptable fittings that will not affect the NEMA rating of the enclosure.
- z. Nonmetallic conduit, which turns out of concrete slabs or walls, shall be connected to a 90 degree elbow of PVC-coated rigid steel conduit before it emerges. Conduits shall have PVC-coated rigid steel coupling embedded a minimum of 3 inches when emerging from slabs or walls and the coupling shall extend 2 inches from the wall.
- ab. Power conductors to and from adjustable frequency drives shall be installed in steel conduit.

3-7.02. Underground Conduit Installation. Not used.

3-7.03. Sealing of Conduits. After cable has been installed and connected, conduit ends shall be sealed by forcing nonhardening sealing compound into the conduits to a depth at least equal to the conduit diameter. This method shall be used for sealing all conduits at handholes, manholes, and building entrance junction boxes, and for 1 inch and larger conduit connections to equipment.

3-7.04. Reuse of Existing Conduits. Existing conduits may be reused subject to the concurrence of Engineer and compliance with the following requirements:

- a. A wire brush shall be pulled through the conduit to remove any loose debris.
- b. A mandrel shall be pulled through the conduit to remove sharp edges and burrs.

3-8. WIRING DEVICES, BOXES, AND FITTINGS INSTALLATION. Metallic and nonmetallic conduit boxes and fittings shall be installed in the following locations:

3-8.01. Conduit Boxes and Fittings.

- a. Galvanized or cadmium plated, threaded, malleable iron boxes and fittings shall be installed in concrete walls, ceilings, and floors; in the outdoor faces of masonry walls; and in all locations where weatherproof device covers are required. These boxes and fittings shall also be installed in exposed rigid steel and intermediate metal conduit systems.
- b. Galvanized or cadmium plated sheet steel boxes shall be installed in the indoor faces of masonry walls, in interior partition walls, and in joist supported ceilings.
- c. Rigid PVC device boxes shall be installed in exposed nonmetallic conduit systems.
- d. PVC coated boxes and fittings shall be installed in PVC coated conduit systems.

3-8.02. Device Plates. Not used.

3-8.03. Wall Switches. Not used.

3-8.04. Receptacles. Not Used.

3-8.05. Special Outlets. Not Used

3-9. EQUIPMENT INSTALLATION. Except as otherwise specified or indicated on the Drawings, the following procedures shall be used in performing electrical work.

3-9.01. Setting of Equipment. All equipment, boxes, and gutters shall be installed level and plumb. Boxes, equipment enclosures, metal raceways, and similar items mounted on water- or earth-bearing walls shall be separated from the wall by at least 1/4 inch thick corrosion-resistant spacers. Where boxes, enclosures, and raceways are installed at locations where walls are not suitable or available for mounting, concrete equipment pads, framing material, and associated hardware shall be provided.

3-9.02. Sealing of Equipment. All outdoor substation, switchgear, motor control center, and similar equipment shall be permanently sealed at the base, and all openings into equipment shall be screened or sealed with concrete grout to keep out rodents and insects the size of wasps and mud daubers. Small cracks and openings shall be sealed from inside with silicone sealant, Dow-Corning "795" or General Electric "SCS1200".

3-10. GROUNDING.

3-10.01. General. The electrical system and equipment shall be grounded in compliance with the National Electrical Code and the following requirements:

- a. All ground conductors shall be at least 12 AWG soft drawn copper cable or bar, bare or green-insulated in accordance with the National Electrical Code.
- b. Ground cable splices and joints, ground rod connections, and equipment bonding connections shall meet the requirements of IEEE 837, and shall be exothermic weld connections or irreversible high-compression connections, Cadweld "Exothermic" or Burndy "Hyground". Mechanical connectors will not be acceptable. Cable connections to bus bars shall be made with high-compression two-hole lugs.
- c. Ground cable through exterior building walls shall enter within 3 feet below finished grade and shall be provided with a water stop. Unless otherwise indicated, installation of the water stop shall include filling the space between the strands with solder and soldering a 12 inch copper disc over the cable.
- d. Ground cable near the base of a structure shall be installed in earth and as far from the structure as the excavation permits, but not closer than 24 inches. The tops of ground rods and ground cable interconnecting ground rods shall be buried a minimum of 30 inches below grade, or below the frost line, whichever is deeper.
- e. All powered equipment, including lighting fixtures and receptacles, shall be grounded by a copper ground conductor in addition to the conduit connection.
- f. Ground connections to equipment and ground buses shall be made with copper or high conductivity copper alloy ground lugs or clamps. Connections to enclosures not provided with ground buses or ground terminals shall be made with irreversible high-compression type lugs inserted under permanent assembly bolts or under new bolts drilled and inserted through enclosures, other than explosion proof enclosures, or by grounding locknuts or bushings. Ground cable connections to anchor bolts; against gaskets, paint, or varnish; or on bolts holding removable access covers will not be acceptable.

- g. The grounding system shall be bonded to the station piping by connecting to the first flange inside the building, on either a suction or discharge pipe, with a copper bar or strap. The flange shall be drilled and tapped to provide a bolted connection.
- h. Ground conductors shall be routed as directly as possible, avoiding unnecessary bends. Ground conductor installations for equipment ground connections to the grounding system shall have turns with minimum bend radii of 12 inches.
- i. Ground rods not described elsewhere shall be a minimum of 3/4 inch in diameter by 10 feet long, with a copper jacket bonded to a steel core.
- j. Test wells and covers for non-traffic areas shall be molded high density polyethylene. Test wells for traffic areas shall be precast concrete construction rated for traffic duty with concrete or cast iron covers.

3-10.02. Grounding System Resistance. Each system shall comply with the maximum resistance of 5 ohms to ground. Contractor shall confirm the system grounding resistance with the results of the testing specified herein. Systems exceeding the maximum resistance specified shall be supplemented with additional grounding provisions and retested until the maximum specified resistance is achieved.

3-10.03. Grounding System Testing. Not used.

3-11. LIGHTING FIXTURE INSTALLATION. Not Used.

3-12. POWER FACTOR CORRECTION CAPACITOR INSTALLATION. Not used.

3-13. MODIFICATIONS TO EXISTING EQUIPMENT. Modifications to existing equipment shall be completed as specified herein and indicated on the Drawings. All existing facilities shall be kept in service during construction. Temporary power or relocation of existing power and control wiring, equipment, and devices shall be provided as required during construction. Coordination and timing of outages shall be as specified in other sections of these Specifications. Electrical power interruptions will only be allowed where agreed upon in advance with Owner, and scheduling at times of low demand may be required.

3-13.01. Demolition. Unless otherwise specified or indicated on the Drawings, all cable and all exposed conduit for power and control signals of equipment indicated to be removed shall be demolished. Conduit supports and electrical equipment mounting hardware shall be removed, and holes or damage

remaining shall be grouted or sealed flush. Conduit partially concealed shall be removed where exposed and plugged with expanding grout flush with the floor or wall. Repairs shall be refinished to match the existing surrounding surfaces. Demolished equipment shall be discarded or salvaged as indicated on the Drawings and as specified in other sections of these Specifications.

End of Section

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STANDARD SPECIFICATIONS

REFERENCE: UL 83, ICEA S-95-658 (NEMA WC70).

CONDUCTOR: Solid, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, UL 83, Type THHN and THWN, ICEA S-95-658.

SHIELD: None.

JACKET: Conductor: Nylon, 4 mils (100 µm) minimum thickness, UL 83.

FACTORY TESTS: Cable shall meet the requirements of UL 83 for Type THHN and THWN.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm ²		in.	µm	in.	mm
12	4.0	1	0.015	380	0.17	4.32
10	6.0	1	0.020	510	0.20	5.08

*The average thickness shall be not less than that indicated above. The minimum thickness shall not be less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, THWN or THHN, conductor size, and 600 volt.

600 Volt, Single Conductor Lighting Cable (600-1-PVC-THHN-THWN)

BLACK & VEATCH

Cable Data

Figure 1-16050

STANDARD SPECIFICATIONS

REFERENCE: ICEA S-95-658 (NEMA WC 70).

CONDUCTOR: Concentric-lay, uncoated copper; strand Class B. Wet/dry maximum operating temperature 90°C.

INSULATION: Cross-linked thermosetting polyethylene, ICEA S-95-658, Paragraph 3.6.

SHIELD: None.

JACKET: None.

FACTORY TESTS: Cable shall meet the requirements of ICEA S-95-658.

Cable Details

Size		Number of Strands	Conductor Insulation Thickness*		Maximum Outside Diameter	
AWG or kcmil	mm ²		in.	μm	in.	mm
14	2.5	7	0.030	760	0.17	4.32
12	4.0	7	0.030	760	0.19	4.83
10	6.0	7	0.030	760	0.21	5.33
8	10.0	7	0.045	1140	0.27	6.86
6	16.0	7	0.045	1140	0.31	7.87
4	25.0	7	0.045	1140	0.36	9.14
2	35.0	7	0.045	1140	0.42	10.67
1	40.0	19	0.055	1400	0.48	12.19
1/0	50.0	19	0.055	1400	0.52	13.21
2/0	70.0	19	0.055	1400	0.57	14.48
4/0	95.0	19	0.055	1400	0.68	17.27
250	120.0	37	0.065	1650	0.75	19.05
350	185.0	37	0.065	1650	0.85	21.59
500	300.0	37	0.065	1650	0.98	24.89
750	400.0	61	0.080	2030	1.22	31.00
1,000	500.0	61	0.080	2030	1.37	34.80

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 90 percent of the values indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, XLP, XHHW-2, conductor size, and voltage class.

600 Volt, Single Conductor Lighting/Power Cable (600-1-XLP-NONE-XHHW-2)

BLACK & VEATCH

Cable Data

Figure 2-16050

STANDARD SPECIFICATIONS

REFERENCE: UL 62, UL 1277.

CONDUCTOR: 16 AWG (1.5 mm²), 7-strand, concentric-lay, uncoated copper. Maximum operating temperature 90°C dry, 75°C wet.

INSULATION: Polyvinyl chloride, not less than 15 mils (380 μm) average thickness; 13 mils (330 μm) minimum thickness, UL 62, Type TFN.

LAY: Twisted pair with 1-1/2 inch to 2-1/2 inch (38.10 mm - 63.5 mm) lay.

SHIELD: Cable assembly, combination aluminum-polyester tape and 7-strand, 20 AWG (0.5 mm²) minimum size, tinned copper drain wire, shield applied to achieve 100 percent cover over insulated conductors.

JACKET: Conductor: Nylon, 4 mils (100 μm) minimum thickness, UL 62.

Cable assembly: Black, flame-retardant polyvinyl chloride, UL 1277, applied over tape-wrapped cable core.

CONDUCTOR IDENTIFICATION: One conductor black, one conductor white.

FACTORY TESTS: Insulated conductors shall meet the requirements of UL 62 for Type TFN. Assembly jacket shall meet the requirements of UL 1277. Cable shall meet the vertical-tray flame test requirements of UL 1277.

Cable Details

	Assembly Jacket Thickness*		Maximum Outside Diameter	
	in.	μm	in.	mm
Single Pair	0.045	1140	0.34	8.64

*The average thickness shall be not less than that indicated above. The minimum thickness shall be not less than 80 percent of the value indicated above.

A durable marking shall be provided on the surface of the cable at intervals not exceeding 24 inches (600 mm). Marking shall include manufacturer's name, Type TC, Type TFN, conductor size, single pair, and voltage class.

600 Volt, Single Pair, Shielded Instrument Cable (600-SINGLE-PAIR-SH-INSTR)

BLACK & VEATCH

Cable Data

Figure 4-16050

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Section 16100

ELECTRICAL EQUIPMENT INSTALLATION

PART 1 - GENERAL

1-1. SCOPE. This section covers the installation of electrical equipment.

1-2. GENERAL. Equipment specified to be installed under this section shall be erected, and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.

The electrical equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.

1-2.01. Coordination. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 14 days prior to the need for manufacturer's field services furnished by others.

Submittals for equipment furnished under the original procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

1-3. DELIVERY, STORAGE, AND HANDLING.

1-3.01. Delivery. When sills are required for electrical equipment, they shall be shipped ahead of the scheduled equipment delivery to permit installation before concrete is placed.

1-3.02. Storage. Upon delivery, all equipment and materials shall immediately be stored and protected by Contractor in accordance with Product Storage and Handling Requirements section, and in accordance with manufacturer's written instructions, until installed in the Work. Equipment shall be protected by Contractor against damage and exposure from the elements. At no time shall the equipment be stored on earth or grass surfaces or come into contact with earth or grass. Contractor shall keep the equipment clean and dry at all times.

Openings shall be plugged or capped (or otherwise sealed by packaging) during temporary storage.

1-3.03. Handling. Electrical equipment shall be moved by lifting, jacking, or skidding on rollers as described in the manufacturer's instructions. Special lifting harness or apparatus shall be used when required. Lifting and jacking points shall be used when identified on the equipment. Contractor shall have required unloading equipment on site to perform unloading work on the date of equipment delivery.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3-1. INSTALLATION, TESTING, AND COMMISSIONING. All installation work shall be in accordance with manufacturer's written instructions.

All material, equipment, and components specified to be installed according to this section shall be installed, tested, and commissioned for operation in compliance with NECA 1000 – NEIS Specification System. Where required in NECA 1000, testing and commissioning procedures shall be followed prior to energizing equipment.

Electrical equipment cubicles and vertical sections shall be installed plumb and level. Drawout equipment carriages, circuit breakers, and other removable components shall operate free and easy without binding or distortion.

Unless otherwise indicated or specified, all indoor floor-mounted electrical equipment and control cabinets shall be installed on concrete equipment pads four inches in height.

Indoor metalclad switchgear shall be bolted to steel floor channels which are installed level and flush with the top of the concrete floor or equipment pad.

Outdoor metalclad switchgear and interrupter gear with integral floor channels or beams shall be secured to concrete pads with anchor bolts and clips.

Motor control centers with integral floor sills shall be secured to concrete floors or equipment pads with anchor bolts.

Adequate bracing shall be provided for seismic forces.

3-1.01. Cleaning. All deposits of oil, grease, mud, dirt or debris shall be cleaned from the electrical equipment following installation and field wiring. A detergent water based solution, or other liquid cleaners not harmful to material or equipment finishes, shall be used as recommended by the manufacturer.

End of Section

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Section 16220

COMMON MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 – GENERAL

1-1. SCOPE. This section covers single and three-phase, small (fractional) and medium (integral) horsepower, alternating current motors rated 500 horsepower and less (NEMA MG1).

Motors shall be designated and coordinated with the driven equipment and shall be located as indicated on the Drawings.

1-2. GENERAL. Motors furnished under driven equipment Specification sections shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer.

1-2.01. General Equipment Stipulations. The General Equipment Stipulations section shall apply to all motors, unless otherwise specified. If requirements in this section differ from those in the General Equipment Stipulations section, the requirements specified herein shall take precedence.

1-2.02. Seismic Design Requirements. Not used.

1-2.03. Governing Standards. Motors furnished under this section shall be designed, constructed, and tested in accordance with the latest version of NEMA MG 1, NEMA MG 10, and IEEE 112, Test Method B.

1-2.04. Nameplates. All motor nameplate data shall conform to NEMA MG 1 requirements.

1-3. SUBMITTALS. Complete assembly, foundation, and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the motor shall be submitted in accordance with the Submittals Procedures section. The drawings and data shall include, but shall not be limited to, the following:

Motors

Name of manufacturer.

Type and model.

Type of bearing and method of lubrication.

Rated size of motor, hp [kW], and service factor.
Temperature rise and insulation rating.
Full load rotative speed.
Efficiency at full, 3/4, and 1/2 load.
Full load current.
Locked rotor current.
Motor temperature switch data, where applicable.
Motor Shaft Grounding Ring data, where applicable.
RTD data, where applicable.

Seismic Design Requirements

Confirmation of compliance with the requirements of the
Meteorological and Seismic Design Criteria section.

1-4. OPERATION AND MAINTENANCE DATA AND MANUALS. Adequate operation and maintenance information shall be supplied. Operation and maintenance manuals shall be submitted in accordance with the Submittals Procedures section.

Operation and maintenance manuals shall include the following:

- a. Assembly, installation, alignment, adjustment, and checking instructions.
- b. Lubrication and maintenance instructions.
- c. Guide to troubleshooting.
- d. Parts lists and predicted life of parts subject to wear.
- e. Outline, cross-section, and assembly drawings; engineering data; and wiring diagrams.
- f. Test data and performance curves, where applicable.

PART 2 - PRODUCTS

2-1. SERVICE CONDITIONS. Service conditions for motors shall be as specified in the driven equipment Specification sections. Motors shall be designed for special conditions such as area classification, altitude, frequent starting, intermittent overload, high inertia, mounting configuration, or service environment. Where site elevation and ambient temperature is not specified in the driven equipment Specification sections, the motors shall be designed for the following.

Site elevation	Below 500 ft
Ambient temperature	50 °C

Unless specified otherwise, all motors shall be designed for full voltage starting and to operate from an electrical system that may have a maximum of 5 percent voltage distortion according to IEEE 519.

The number of starts per hour for motors shall be rated for the load cycling requirements of NEMA MG 10.

2-2. PERFORMANCE AND DESIGN REQUIREMENTS. Design and construction of each general-purpose motor shall be as specified herein. Motor voltage, frequency, speed, service factor, and insulation class shall be as follows.

Motor voltage.	460, 3 phase for ½ horsepower and larger, 120, single phase for smaller than ½ horsepower
Frequency.	60 Hz
Speed.	Constant speed
Service factor.	1.0 , except for AFD driven motors which shall be 1.15
Insulation class and temperature rise above 40° C design ambient (by resistance method.	Class H with 105° C rise at 1.0 SF
Enclosure.	Totally enclosed fan cooled
Main conduit box sized to include.	Main motor leads and space heater leads where space heaters are specified

2-2.01. Nameplate Horsepower. Motor nameplate horsepower [kW] shall be equal to or greater than the maximum load imposed by the driven equipment.

2-2.02. Enclosures. All motors shall be self-ventilated. All self-ventilated open type motors, including those with dripproof, splashproof, and weather protected enclosures, and the fan covers of totally enclosed fan cooled motors shall meet NEMA MG 1 requirements for a fully guarded machine.

2-2.02.01. Totally Enclosed Motors. Totally enclosed motors shall be furnished with drain holes and rotating shaft seals. Frames, bearing brackets, external

terminal housings, and fan covers for fan cooled motors shall be cast iron. External cooling fans for fan cooled motors shall be fabricated of brass, bronze, aluminum alloy containing not more than 0.2 percent copper, malleable iron, or plastic. All plastic fans shall be fabricated of a reinforced thermosetting plastic and shall be UL approved.

2-2.02.02. Outdoor Motors. Outdoor motors shall have NEMA weather protected enclosures. All exposed metal surfaces shall be protected, where practical, with a corrosion resistant polyester coating. Exposed uncoated surfaces shall be of a corrosion resistant metal. Enclosure exterior and interior surfaces, air gap surfaces, and windings shall be protected with a corrosion resistant polyester, polyurethane or epoxy coating.

2-2.02.03. Motors for Hazardous Locations. Motors for hazardous locations shall be in accordance with the NEC and of the correct type enclosures for the particular service as specified in NEMA MG 1. Motors shall meet the requirements of UL 674.

2-2.02.04. Encapsulated Windings. Motors shall be provided with encapsulated windings meeting the requirements of NEMA MG1-1.27.2.

2-2.02.05. Severe Duty Chemical Service Motors. Not used.

2-2.03. Main Conduit Boxes. The main conduit box shall be in accordance with NEMA MG 1. The main conduit boxes shall be diagonally split for easy access to the motor leads, and designed for rotation in 90-degree increments. A gasket shall be furnished between the halves of the box. Conduit openings in the main conduit box shall match the size and quantity of conduits indicated on the one line Drawings.

The main conduit box shall be oversized at least one size larger than NEMA standard. The main conduit box shall be sized for all indicated accessory leads.

Motors furnished in NEMA 320 frame series and larger shall have conduit boxes designed and constructed to permit motor removal after installation without disconnecting raceways.

2-2.04. Leads. Motor power leads shall be wired into the main conduit box. Unless otherwise specified, space heater leads shall be wired into the main conduit box. All motor leads and their terminals shall be permanently marked in accordance with the requirements of NEMA MG 1, Part 2. Each lead marking shall be visible after taping of the terminals.

All motors rated 100 horsepower [74 kW] and larger, and all vertical motors shall have the direction of rotation marked by an arrow mounted visibly on the stator frame near the terminal housing, or on the nameplate, and the leads marked for phase sequence T1, T2, T3, to correspond to the direction of rotation and supply voltage sequence.

Leads for dual-voltage rated or for multispeed motors shall be easily connected or reconnected in the main conduit box for the operating voltage or for the specified speeds. Permanent instructions for making these connections shall be furnished inside the main conduit box or on the motor frame or nameplate.

2-2.05. Terminals. Cable type leads shall be provided with Burndy Type YA or acceptable equal compression type connectors.

2-2.06. Grounding Connections. All motors shall be furnished with a ground connection.

2-2.07. Bearings. All bearings shall be self-lubricating, shall have provisions for relubrication, and shall be designed to operate in any position or at any angle.

Motor bearings shall be antifriction type with L₁₀ life rating of 40,000 hours in accordance with ABMA Standards.

All bearing mountings shall be designed to prevent the entrance of lubricant into the motor enclosure or dirt into the bearings, and shall be fitted with pipes, drain plugs, and fittings arranged for safe, easy relubrication from the outside of the motor while the motor is in service, as necessary.

2-2.07.01. Insulated Bearings. Motors over 100 horsepower controlled by an adjustable frequency drive shall be furnished with one insulated bearing. The insulated bearing shall be installed on the non-drive end of the motor.

2-2.08. Rotors. All induction motors shall have squirrel-cage rotors adequately sized to avoid overheating during acceleration of the motor and driven equipment. Rotors shall be dynamically balanced to 0.08 in./sec [2.03 mm/s] or less.

2-2.09. Shafts. Shafts shall be furnished with corrosion resistant treatment or shall be of a corrosion resistant material.

2-2.10. Torque Characteristics. Motors rated 200 horsepower [149 kW] and less shall have torques and locked-rotor current in accordance with NEMA MG 1, Part 12.

2-2.11. Motor Space Heaters. Not used.

2-2.12. Temperature Sensing Devices. Not used.

2-2.13. Motor Shaft Grounding Ring. Not used.

2-2.14. Assembly. All motors shall be completely assembled with the driven equipment, lubricated, and ready for operation.

2-2.15. Efficiency. Motors shall be premium efficiency type and shall have a NEMA nominal efficiency nameplate value equal to or greater than values indicated in the following table. Efficiency shall be determined in accordance with IEEE 112, Test Method B.

Motor		Nominal Efficiency Values				Nominal Efficiency Values			
kW	hp	Open Drip Enclosure				TEFC Enclosure			
		3600 rpm	1800 rpm	1200 rpm	900 rpm	3600 rpm	1800 rpm	1200 rpm	900 rpm
0.7	1	84.0	85.5	82.5	75.0	77.0	85.5	82.5	75.5
1.1	1.5	84.0	86.5	86.5	78.0	84.0	86.5	87.5	80.0
1.5	2	85.5	86.5	87.5	86.5	85.5	86.5	88.5	85.5
2.2	3	85.5	89.5	88.5	89.5	87.0	89.5	89.5	86.5
3.7	5	86.5	89.5	89.5	89.5	88.5	89.5	89.5	85.5
5.6	7.5	88.5	91.0	90.2	88.5	90.0	91.7	91.0	86.5
7.5	10	89.5	91.7	91.7	91.0	91.0	91.7	91.0	91.0
11.2	15	90.2	93.0	91.7	91.0	91.0	92.4	92.0	91.0
14.9	20	91.7	93.0	92.4	92.0	92.0	93.0	92.0	91.0
18.7	25	92.4	93.6	93.0	92.0	92.0	93.6	93.0	91.0
22.4	30	93.0	94.1	93.6	93.0	92.4	93.6	93.0	93.0
29.8	40	93.0	94.1	94.1	93.0	92.4	94.1	94.1	93.0

Motor		Nominal Efficiency Values				Nominal Efficiency Values			
kW	hp	Open Drip Enclosure				TEFC Enclosure			
		3600 rpm	1800 rpm	1200 rpm	900 rpm	3600 rpm	1800 rpm	1200 rpm	900 rpm
37.3	50	93.0	94.5	94.1	93.0	93.0	94.5	94.1	93.0

2-3. ACCESSORIES.

2-3.01. Special Tools and Accessories. Motors requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Each motor shall be provided with lifting eyebolts or lugs and appropriate fittings for adding bearing lubricant. Grease lubricated units shall be provided with a means of venting the casing. Oil lubricated units shall be provided with constant level oilers or with sight glasses arranged to indicate operating and static oil levels.

2-4. ANCHORS. Contractor shall furnish suitable anchors for each item of equipment as required for driven equipment.

2-5. BALANCE. All rotating parts shall be accurately machined and shall be in as nearly perfect rotational balance as practicable. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided. In any case, the unfiltered vibration displacement (peak-to-peak), as measured at any point on the machine, shall not exceed the limits as required by NEMA MG 1. At any operating speed, the ratio of rotative speed to the critical speed of a unit or its components shall be less than 0.8 or more than 1.3.

PART 3 - EXECUTION

3-1. INSTALLATION. Each motor shall be installed in accordance with the Equipment Installation section.

End of Section

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