



May 18, 2022

**ADDENDUM NO. 2**  
**CITY OF ABERDEEN**  
**RAILBIRD ALLEY WATER BOOSTER PUMP STATION**

Engineering Project No. 11201446

**Modifications to the Contract Documents:**

1. **REPLACE:** Section 00410 Bid Form with Section 00410 Bid Form – Addendum No. 2.
2. **REPLACE:** Section 01010 Summary of Work with Section 01010 Summary of Work – Addendum No. 2.
3. **REPLACE:** Section 11380 Pre-Engineered Municipal Booster Pump Station with Section 11380 Pre-Engineered Municipal Booster Pump Station – Addendum No. 2.
4. **REPLACE:** Section 11990 OEM Control Panels with Section 11990 OEM Control Panels – Addendum No. 2.
5. **REPLACE:** Section 16420 Utility Service Entrance with Section 16420 Utility Service Entrance – Addendum No. 2.

**END OF ADDENDUM 2**

**DOCUMENT 00410 – BID FORM**

PROJECT IDENTIFICATION: Railbird Alley Water Booster Pump Station

CONTRACT NUMBER AND IDENTIFICATION: 11201446

**ARTICLE 1 – BID RECIPIENT**

1.01 This Bid is submitted to:

***City of Aberdeen  
Attn: Shawn Brogan, Procurement Officer  
60 North Parke Street  
Aberdeen, MD 21001***

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

**ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS**

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

**ARTICLE 3 – BIDDER’S REPRESENTATIONS**

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to

existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

#### **ARTICLE 4 – BIDDER'S CERTIFICATION**

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
  - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

## ARTICLE 5 – BASIS OF BID

### 5.01 GENERAL

- A. The total work to be performed under this contract shall be performed under the pay items listed hereinafter. Any equipment or materials called for in the Specifications or shown on the Drawings and necessary for a complete and satisfactory installation, but which are not specifically mentioned in this basis of payment section, shall be included in the appropriate pay item by the CONTRACTOR at no additional expense to the OWNER.
- B. It shall be understood that all pay items shall include the costs to the CONTRACTOR for tools, labor, equipment, insurance, workman's compensation, licenses, permits (including street cut permits), taxes, general overhead and profit, transportation, temporary utilities, start-up and testing, and all other expenses incidental to or necessary for the prosecution of the work. It shall be further understood that all pay items shall include the costs for the loading, transporting, unloading, handling, storing and protecting of all furnished equipment and materials under the pay items.
- C. The cost of removing and/or relocating storm drainage facilities and related structures removed or relocated at the CONTRACTOR's own volition to facilitate construction, shall be borne by the CONTRACTOR.
- D. The CONTRACTOR shall obtain such permits as may be required by local and other governmental agencies and pay the necessary fees and charges. Contractor will comply with all EPA, MDE and Harford County regulations in regards to disposal of any and all materials.
- E. In addition to the Federally recognized holidays the Contractor will not be allowed to work on the following days: after noon the Friday before Memorial Day, after noon on the day before the Fourth of July, after noon the Friday before Labor Day, the Friday after Thanksgiving, after noon on December 24<sup>th</sup> and December 31<sup>st</sup> and after noon on Good Friday.
- F. The Contractor is responsible for maintaining and/or supporting any underground or above ground facilities associated with this project. The Contractor is responsible for providing any and all temporary service(s) during construction and/or replacement of any facilities affected by the construction. All costs associated with this work will be included in the appropriate pay item.
- G. Contractor is reminded that all Utilities shown on the Contract Drawings are for informational purposes only. The Contractor is required to comply with all provisions of the Miss Utility Call System for locating utilities. Contractor will protect and maintain all

underground and above ground utilities during construction. Contractor will endeavor to locate all facilities in advance of all work. The location of any new underground utilities may be adjusted depending on the final field location of any existing utilities. The City of Aberdeen does not know the exact location or exact routing of all sanitary sewer, potable water utilities, stormwater utilities, gas utilities, electrical utilities or communication utilities located within the work site. The City of Aberdeen will, to the best of their abilities, mark utilities to the extent they can. Contractor is required to test pit to locate underground utilities in the area of work prior to commencing work or the layout of new underground facilities. The cost of this work is included in the lump sum cost for the base bid.

- H. Contractor will place protective mats under the tracks of all equipment when working in paved areas or utilize rubber tread equipment. Damage to the existing roadway due to improper temporary paving, improper maintenance of trench lines after excavation and backfill, contractor's negligence, or failure to follow this standard, shall be repaired at the sole cost of the contractor.
- I. Contractor will provide "As-Built" survey data as specified in Document 01700.
- J. The Contractor shall be responsible for finding fill site(s) for spoils. If the site(s) is not currently covered by an Erosion & Sedimentation Control Plan, Contractor is responsible for securing such approvals prior to using the site(s) for disposal of spoils, at no cost to the Owner.
- K. Contractor is required to coordinate with the City of Aberdeen operations staff during cut-in to existing City of Aberdeen water line. City of Aberdeen personnel will perform all valve closures and operations on existing watermains.
- L. The BIDDER signifies that he/she understands that NO blasting is permitted on this project.
- M. The BIDDER signifies that he/she understands that temporary access over open trenches will be provided at the end of each work day on this project.
- N. Contractor understands that all water main work performed in conditions where freezing temperatures are possible, will require complete backfilling and/or protection of the main against freezing as deemed appropriate by Engineer or City of Aberdeen.
- O. Contractor understands that six (6) inches of screened topsoil is required to be placed on all disturbed areas prior to final seeding and mulching. Contractor also understands that all mulch placed for stabilization and/or seeding shall be tacked or crimped to prevent movement of mulch materials.

#### 5.02 BID ITEM 1 – BASE BID LUMP SUM PRICE

- A. The Lump Sum Bid price shall include the cost for providing equipment and materials for the project, complete in place. ~~The lump sum work price shall be based on the Maryland Prevailing wage rates.~~
- B. The Lump Sum Bid price includes all material, labor, and equipment necessary for the construction of a new potable water pre-packaged booster pump station, concrete foundation, new electric service, telemetry, emergency generator, yard piping, gate valves, fire hydrants, site clearing and grading, erosion control, security fence, paving, restoration, and other appurtenances as shown on the drawings and as specified.

- C. This item shall include site preparation, removal of all materials from the project, including removal of surface materials; disposal of excess material; test pitting for existing utilities; saw cutting and removal of all pavement; furnishing, installing, and removing sheeting, shoring and bracing as required; concrete reaction backing; loading, hauling and stockpiling material; preparation of subgrade; all backfilling and grading; removal, disposal and backfill for any boulders encountered during excavation; rock removal; removing and wasting unsuitable material will be disposed of in accordance with MDE and EPA regulations; removal and disposal of any concrete encasement; furnishing and installation of stone bedding and backfill material; any and all excavation dewatering; accommodations of drainage; cleanup; maintenance of trenches after backfilling; furnishing and installing detection tape; all stormwater facilities; all erosion and sedimentation control; all temporary and permanent lawn restoration; all topsoil, soil supplements, seeding and mulch (Hydroseeding); all parking line striping; all new sidewalk; all new security fence; etc.

5.08 BASIS OF BID

- A. The basis of award will be based shall be the lump sum bid price.

**ARTICLE 6 – TIME OF COMPLETION**

- 6.01 Bidder agrees that the Work will be substantially complete within 270 calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 300 calendar days after the date when the Contract Times commence to run.

- 6.01 Bidder accepts the provisions of the Agreement as to liquidated damages.

**ARTICLE 7 – ATTACHMENTS TO THIS BID**

- 7.01 The following documents are submitted with and made a condition of this Bid:

- A. Required Bid security;
- B. List of Proposed Subcontractors;
- C. List of Proposed Suppliers;
- D. List of Project References;
- E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
- F. Contractor's License No.: [REDACTED] [or] Evidence of Bidder's ability to obtain a State Contractor's License and a covenant by Bidder to obtain said license within the time for acceptance of Bids;
- G. Required Bidder Qualification Statement with supporting data; and
- H. Non-Collusion Affidavit, Document 00320;

- 7.02 Communications concerning this Bid shall be addressed to the City of Aberdeen.

**ARTICLE 8 – DEFINED TERMS**

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

**ARTICLE 9 – TAX ID**

9.01 BIDDER to enter federal tax ID where requested.

**END OF BID FORM**

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01. RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specifications, apply to this Section.

1.02. PROJECT DESCRIPTION

- A. The Work includes all materials, labor, and equipment necessary for the installation of a pre-packaged water booster pump station, including new electric service, telemetry, emergency generator, yard piping, gate valves, fire hydrants, site clearing and grading, erosion control, security fence, paving, restoration, and other miscellaneous work shown on the Drawings and as specified.
- B. Project Location: **415 Railbird Alley, Aberdeen, MD 21001.**
- C. Owner: **City of Aberdeen, 60 North Parke Street, Aberdeen, MD 21001.**
- D. Contract Documents were prepared for the Project by GHD, 1240 North Mountain Road, Harrisburg, PA 17112. Phone (717) 541-0622 Attention: Chad M. Angle, P.E.

1.03. CONTRACTOR'S RESPONSIBILITIES

- A. Miscellaneous:
  - 1. Temporary utilities as specified in Section 01500 – Temporary Facilities.
  - 2. Contractor is responsible for its own general conditions including trailer, telephone, barricades, storage sheds, portable toilets, etc. and all costs associated with general conditions.
  - 3. Contractor is responsible for preparing the project construction schedule.
  - 4. Any support materials and equipment necessary to support construction activities such as heat tracing, insulation, metering pumps, sheds, etc. shall be furnished and installed by Contractor.
  - 5. Builders Risk policy.
  - 6. Utility bills for any Contractor temporary facilities.
  - 7. Contractor is responsible for locating all underground utilities and facilities associated with the work. The Contractor will perform test pits, utility line tracing, or other means as necessary to accurately locate all existing underground utilities associated with the project work.
  - 8. Contractor is responsible for all their restoration including paving, concrete and trench restoration associated with their work.



9. Pipe connections and restraint. Contractor shall be responsible for designing all special/temporary restraints required to execute the work and test the completed piping systems. Contractor may use megalugs, reaction backings, Field-Lok gaskets, etc. to meet project objectives.
10. Contractor shall test pit all connections prior to ordering materials. Reference Section 02700 – Piped Utilities.
11. Contractor is required to coordinate with Owner for operation of any existing water valves. Only Owner's personnel will open or close existing water valves.
12. **Contractor is required to coordinate directly with the Owner's selected testing agencies. Contractor shall notify testing agency, Owner and Engineer when testing is required. Contractor's coordination of testing includes:**
  - a. **Section 02300-3.18.D: geotechnical soil compaction testing**
  - b. **Section 03300-3.15.D: onsite concrete testing and concrete specimen samples for compression testing.**

 **ADD #2**

#### 1.04. CONSTRUCTION SEQUENCE

- A. Construction sequence provided hereinafter is general in nature and shall provide the basis of preparation of a detailed construction schedule by Contractor.
  1. Conduct MISS Utility Call.
  2. Install Erosion and Sedimentation controls.
  3. Clear, grub and rough grade site.
  4. Complete yard piping, electrical conduit and French drain installation.
  5. Construct pre-manufactured building and emergency generator concrete foundations.
  6. Set pre-manufactured and emergency generator and complete pipe, electrical and telemetry connections.
  7. Install pre-manufactured roof and exterior veneer.
  8. Install and connect HVAC units.
  9. Fill and disinfect all piping and components in accordance with AWWA C651-14.
    - a. The Contractor is responsible for coordinating, obtaining, and paying for water quality samples with a state-certified lab that is a certified sampler and analyzer. The booster pump station cannot be placed into service until the samples have been submitted to MDE water supply program and authorization to place facility in service is received from MDE. The Contractor will be responsible for all submittals to MDE to obtain authorization to place facility in service. Owner must have representatives on-site during sample acquisition.
  10. Complete facility testing, startup and operator training.

11. Complete final restoration, paving, concrete sidewalk, and security fence installation.
- B. The Construction schedule, once approved, shall be binding on the Contractor.
- C. Construction Schedule:
1. Submit paperwork for the transfer of permits and notifications to agencies regarding the beginning of construction activities, where applicable.
  2. Mobilization.
  3. Complete MISS Utility call.
  4. Install E&S controls.
  5. Construct new pre-manufactured booster pump station, emergency generator, yard piping.
  6. Disinfect new facility.
  7. Perform testing, startup, and training.
  8. Perform all restoration, paving, placement of topsoil, seeding and mulching, concrete, and security fence.
- D. The above general outline of principal features does not in any way limit the responsibility of the Contractor to perform all work and furnish the required materials, equipment, labor, and means as shown on the drawings or required by the Contract Documents.

1.05. CONTRACT METHOD

- A. Construct the Work in accordance with the Bid form for the bid lump prices shown.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

## SECTION 11380

### PRE-ENGINEERED MUNICIPAL BOOSTER PUMP STATION

#### PART 1 GENERAL

##### 1.01. DESCRIPTION

- A. Purpose: To provide a single source responsible for the manufacture and warranty of a prefabricated, skid mounted, fully automatic variable speed pumping system and system building enclosure. The pumping system shall automatically maintain a constant discharge pressure regardless of varying flow demands within the station rating.
- B. The pumping system shall conform to the specifications herein in all aspects. This specification covers the minimum requirements but should not be considered to be all inclusive. It is the successful vendor's responsibility to include all necessary appurtenances to provide for a complete, smooth operating, and reliable pump system. The manufacturer shall supply a complete set of general arrangement drawings, electrical power schematics, and control schematics in the operation and service manual.
- C. Manufacturers seeking authorization to furnish their product shall be a registered **ISO9001:2008** manufacturer and shall hold a current Quality Management Certificate for the assembly of custom packaged pumping systems and controls for use in commercial, irrigation, municipal, industrial, and fire applications.
- D. All components in contact with water must be NSF 61 approved.

##### 1.02. REFERENCES

- A. National Sanitation Foundation (NSF)
- B. American National Standards Institute (ANSI)
- C. American Society for Testing and Materials International (ASTM):
  - 1. A36: Standard Specification for Carbon Structural Steel.
  - 2. A48: Standard Specification for Gray Iron Castings.
  - 3. A53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 4. A105: Standard Specification for Carbon Steel Forgings for Piping Applications.
  - 5. A276: Standard Specification for Stainless Steel Bars and Shapes.
  - 6. A307: Carbon Steel Bolts and Studs.
  - 7. A582/A582M: Standard Specification for Free-Machining Stainless Steel Bars.
  - 8. B148: Standard Specification for Aluminum-Bronze Sand Castings.
- D. American Society of Mechanical Engineers (ASME):

1. ASME B16.5: Pipe Flanges and Flanged Fittings.
- E. American Water Works Association (AWWA).
- F. American Petroleum Institute (API).
- G. Hydraulic Institute (HI).
- H. National Electric Code (NEC).
1. National Electrical Manufacturers Association NEMA – MG1.

#### 1.03. MANUFACTURER

- A. The Booster Pump Station basis of design is by USEMECO, Inc. The station manufacturer shall be certified to provide a UL listing for both the control panel and the pump station as a complete system, to ANSI-NSF-61 certification standards. The primary line of business of the pump station manufacturer shall be the design & manufacture of centrifugal pump booster stations. Consideration of a substitution will be made in accordance with Section 01631. Information required in addition to what is stipulated in Section 01631 shall include the following for the Pre-Engineered Municipal Booster Pump Station:
1. A complete specification for the pumping system proposed as an equal.
  2. A statement of full conformance to the specifications signed by an authorized representative of the manufacturer.
  3. A D-size layout drawing showing overall dimensions and all piping discharge locations.
  4. Complete submittal data for all major equipment such as pumps, motors, control components, valves, and motor starters.
  5. A D-size one-line electrical schematic showing power wiring.
  6. Manufacturer's electrical control panel UL508A file number.
  7. A copy of the manufacturer's certificate of insurance showing as a minimum, general liability coverage of \$1,000,000 and an excess liability coverage of \$5,000,000.

#### 1.04. SUBMITTALS

- A. General - Submittals shall be furnished in accordance with Section 01300 - Submittals. All submittals shall include the following:
1. Component Data: Submit the manufacturer's technical data sheets for all system components including but not limited to valves, piping accessories, control devices, variable speed drives that are furnished, including dimensions, capacities, electrical characteristics, material finishes and performance data. Installation & startup procedures must be included as well.
- B. Shop Drawings: Submit shop drawings for the variable speed packaged pumping system including but not limited to the following information:

1. System Engineering Data Sheet.
2. Autodesk Inventor 2010 suite including the following modules:
  - a. Mechanical desktop.
  - b. Solids Works 3D AutoCAD.
  - c. FEA analysis tools.
  - d. Hydraulic modeling tools.
  - e. BIM Compliant drawings.
3. Piping & instrumentation drawings (P&ID) showing all system instruments included in this specification.
4. Bill of Material with a complete detailed description of the function and a manufactures specification sheet of each component. Components include but are not limited to pipe, fittings, strainers, flexible connectors, type of pipe, sensors, transmitters, variable speed drives, pumps, control valves, manually operated valves, check valves, pumps, air separators, expansion tanks, switches, control boards, hoist, trolley, PLC, HMI, etc.
5. Complete wiring diagram of the power wiring including conduit size, wire size and all components.
6. Complete wiring diagram of the control system including all control and sensing components. Clearly define what is to be field installed and what will be factory installed and tested.
7. Written description of the sequence of operation.
8. General arrangement drawing showing all system dimensions including footprint, customer interface dimensions for supply & return piping, electrical connections with each component labeled and described on the drawing.
9. Manufacturer's pump data sheet including:
  - a. Pump curve including design point.
  - b. Materials of construction.
  - c. Construction drawing.
  - d. Human Machine Interface (HMI) software and equipment & layout including menu structure and points list.
  - e. Controller equipment including PLCs, HMI and all instrumentation factory or field installed.
10. Manufacturer shall submit a certificate of product liability insurance for no less than five million dollars (\$5,000,000.00). Furnish a written certification that the manufacturer's listing with Underwriters Laboratories is an approved manufacturer of factory assembled packaged pumpingsystems.

#### 1.05. DELIVERY, STORAGE & HANDLING

- A. The complete packaged pumping station shall be manufactured and tested as a complete unit
- B. Systems that require modular construction to allow access to the site due to freight restrictions shall be shipped in separate modules and re-assembly at the jobsite is the responsibility of the contractor. The modular system will be approved by the engineer and coordinated between the contractor and the station manufacturer.
- C. Drain plugs shall be removed from the system to prevent freezing during storage and shipping.
- D. Comply with all Hydraulic institute standards and station manufacture submittal data for storage of the station.
- E. Comply with the station manufacture's recommendations for transportation, rigging and off loading

#### 1.06. OPERATION & MAINTENANCE MANUALS

- A. The Owner shall be provided with electronic copies of the operation & maintenance manuals. The electronic manual shall be in Adobe Acrobat 9.0 format and include the following information:
  - 1. Name and contact information for the design engineer, installing contractor, index of equipment including the vendors name and contact information.
  - 2. Complete specification sheets, manufacturing drawings, brochures and bill of material for each component provided. Bill of material shall contain part specific model numbers and manufacturer.
  - 3. Operational sequence of operation.
  - 4. P&ID and general arrangement drawings.
  - 5. Electrical power and control wiring diagrams including all the information required for the owner to troubleshoot repair and expand the system.
  - 6. Complete operation & maintenance manuals from the manufacturers for all major station components.

#### 1.07. QUALITY ASSURANCE

- A. The manufacturer of the pumping station shall be listed by Underwriters Laboratories as an approved manufacturer for packaged pumping stations under category "QCZJ" including all controls, pumps, motors, piping specialties, valves and fittings. In addition, the control panel shall be listed by Underwriters Laboratories U.L. 508A (Industrial Control Panels). Proof of the listing shall be provided as part of the submittals and operation and maintenance manuals.
- B. The manufacturer of the pumping station shall provide as part of the submittals published catalog data that the packaged pumping station is part of the standard product line.
- C. The manufacturer of the pumping station shall have a minimum of 20 years' experience in the manufacturing and application of packaged pumping station and shall be responsible for the proper operation of the complete station.

- D. The manufacturer of the pumping station and the control system shall be one in the same. The pumpstation and control system shall be manufactured in the same facility. The use of commercial grade controllers shall not be acceptable.
- E. The packaged pumping station manufacturer shall have in place a quality control /quality assurance program to ensure the quality of the engineering, design and manufacture of the pump station. The manufacturer of the pump station shall provide with the submittals documentation of the program including the complete testing procedure for the system.
- F. The station manufacturer shall perform a factory performance test prior to shipment. The test shall demonstrate the system ability to perform at 25, 50, 75 and 100% of the station rated flow rate. Efficiency, flow, system dynamic head and KW shall be recorded for each point listed above.
- G. The complete testing stand shall be traceable to National Institute for standards and testing (NIST).

#### 1.08. WARRANTY

- A. The system shall as a minimum be warranted for a period of 12 months from substantial completion.
- B. The manufacturer's warranty shall cover all equipment, components, and systems provided in or with the station by the manufacturer of the station.

### PART 2 PRODUCTS

#### 2.01. PERFORMANCE AND DESIGN REQUIREMENTS

- A. The intent of the BPS is to boost water from a lower hydraulic grade line (HGL) to a higher HGL in a potable water distribution system. The following provides guidance on the anticipated HGLs at the entrance to the BPS suction side, and the anticipated discharge side HGL at the discharge point of the BPS.
  - 1. Suction side HGL:
    - a. Min: 240.00.
    - b. Max: 258.00.
  - 2. Discharge side HGL:
    - a. Min: 365.00.
    - b. Max: 370.00.
  - 3. Approximate centerline elevation of proposed BPS pumps: 73.00.
  - 4. The working pressure of all BPS piping and components shall be 135 psi.
  - 5. All sample taps and water supply to the utility sink shall be provided with pressure reducing valves with discharge pressure set at 60 psi.
- B. The pump manufacturer shall provide the following information in accordance with the

submittal requirements:

1. Single pump performance curve and data.
  2. Multi-speed pump performance curve data:
    - a. Manufacturer shall provide the recommended operating range within the multi-speed curve indicating the minimum operating range for each speed curve.
  3. Duplex pump performance curve data.
  4. Pump performance data sheet.
- C. The following design criteria is provided based on the above HGLs and pump discharge. The manufacturer shall confirm design criteria and pump selection based on the above information and the final piping, valves, and appurtenance layout for the proposed station. Primary design point TDH is based on lowest suction side HGL and highest discharge side HGL and projected pump station system losses.

Parameter	Value
Number of pumps	3
Primary design point simplex (gpm)	313
Primary design point TDH simplex (feet)	163
Primary design point efficiency (%)	81.42
NPSH required at design point (feet)	25
Efficiency at BEP (%)	81.42
Maximum shutoff head (feet)	188
Secondary design point duplex parallel (gpm)	625
Secondary design point duplex parallel TDH (feet)	165
Suction (inches)	2.5
Discharge (inches)	2
Maximum operating speed (rpm)	3530
Motor maximum HP	20
Drive	VFD
Load classification	Uniform
Ambient environment	Indoors
Ambient temperature (degrees F)	0 to 120
Fluid temperature (degrees F)	32 to 90
Fluid service	Chlorinated potable water
Fluid pH range	6.5 to 8.5



## 2.02. MECHANICAL

- A. The pump station shall be a completely built by a single manufacturer. All equipment including but not limited to pumps, motors, valves, instrumentation and controls mounted within a pre-engineered and manufactured building to form a complete operating system.
- B. Structural steel base:
  - 1. All components shall be mounted on a structural carbon steel base of open construction. The base shall be designed to support all the systems components including but not limited to pump, drivers, piping, valves and controls. The base shall be designed to be incorporated into the overall pre-engineered and manufactured building. Steel shall be ASTM A-36, prime steel stored inside to avoid rust or pitting.
- C. Pumps:
  - 1. To ensure stable operation, the pump curve shall be constantly rising from run out to shut off. To ensure cavitation free operation, each pump NPSHr must be low enough to permit stable continuous operation at 120% of greater of the BEP (best efficiency point). Each pump shall be capable of continuous operation without producing noise in excess of Hydraulic Institute and OSHA guidelines:
    - a. Pumps shall be of the close coupled end suction type designed to deliver the scheduled flowrate at the specified total dynamic head (in feet):
      - 1) Pumps shall be close grained cast iron fitted with a replaceable bronze impeller. All pumps shall be of the back pull out design so the rotating element can be removed from the casing without disconnection from the suction or discharge piping.
      - 2) Pump impeller shall be of the enclosed type of cast bronze and shall be statically and dynamically balanced. Impeller diameter shall be trimmed for the project specific design conditions.
      - 3) Shaft shall be sealed, fitted with a leak less mechanical seal suitable for the pressures and temperature scheduled.
  - 2. Acceptable pumps:
    - a. Grundfos
    - b. Aurora
- D. Motors:
  - 1. The motors shall be sized to operate continuously without exceeding the horsepower rating as outlined on the equipment schedule regardless of the flow and head throughout the operating range of the "System Curve".
  - 2. Motors shall be of the horsepower and speed shown on the pump schedule. Pumps requiring a larger horsepower(s) shall not be acceptable. Pumps shall be close coupled to a 3 phase, 60 hertz, 460, TEFC, premium efficiency motor with a 1.15 service factor, 400 C ambient.
  - 3. Motors in variable speed applications shall be equipped with grounding rings to

prevent electro- mechanical-grounding (EMD), fusion craters and pitting of the bearings. The grounding rings shall safely divert shaft and bearing currents to ground increasing the motor and bearing life.

E. Piping:

1. Piping 6" diameter and smaller shall be 304L, S40 stainless steel ASTM A312, fittings shall be ASTM A 403, and flanges shall be ASTM A 182.
2. Piping 8" and larger shall be carbon steel ASTM A53; grade B, type E (electrical resistance welded). Pipe fittings shall be ASTM A234, and flanges shall be ASTM A105. All piping shall be internally coated with an ANSI/NSF-61 approved fusion bonded epoxy (FBE) coating for potable water per AWWA C213-07.
3. Piping that is to be coated internally shall be hydrostatically tested prior to coating application and all results recorded on a hydrostatic test report.
4. Suction and discharge headers shall be supplied with drains at all low points and automatic air release valves at the high points in the system.
5. Drains shall be provided above all check valves to accommodate draining the system.
6. All welding shall be performed by ASMR section IV certified welders. All welding documentation shall be included in the submittal information including WPS, PQR and WPQ.
7. Copper tubing or pipe shall be Type L or K in accordance ASTM B 88.
8. PVC tubing shall be NSF 61 approved.
9. All piping shall be hydrostatically tested to 150% of working pressure or 150 PSI whichever is greater. All results shall be recorded on a hydrostatic test report.

F. Couplings, Adapters and Dismantling Joints:

1. Couplings, adapters, and dismantling joints shall be provided where indicated on the drawings.
2. Components shall be provided in accordance with City of Aberdeen's approved supplier list and materials.
3. All couplings, adapters, and dismantling joints shall be restrained.
4. Coating shall meet NSF 61 requirements.

G. Gate Valves:

1. The valves shall be designed, manufactured and tested in accordance with American Water Works Association (AWWA) standard C-509.
2. Valves shall be supplied with flanges in accordance ANSI B16.1, Class 125.
3. All gate valves shall be in accordance with AWWA C-509 and installed as indicated on the drawings. Valves shall be certified to ANSI/NSF-61 Drinking Water System Components.

4. The valves shall have a cast or ductile iron body, bonnet and wedge. The wedge shall be totally encapsulated with rubber.
5. The valves shall be rising stem. Valves mounted above 7' AFF shall be equipped with chain operator.
6. All internal parts shall be accessible without removing the body from the line.
7. Suppliers shall be in accordance with City of Aberdeen's approved supplier list.

H. Non-Slam Check Valves:

1. Check valves shall be located on the discharge of each pump and anywhere else as indicated on the drawings.
2. Valves shall be of the silent operating type that begins to close as the forward velocity diminishes and be fully closed at zero velocity preventing reverse flow.
3. The check valve bodies shall be ASTM A126, grade B cast iron, or better. And shall be free from blow holes, sand holes or other impurities.
4. The check valve design shall be center guided, spring-loaded poppet guided at opposite ends, and shall have a short linear stroke that generates a flow area equal to the pipe diameter.
5. The internals shall be machined bronze disc seat, and stem guide. The seat shall contain a Buna-N seal to provide zero leakage.
6. The valves shall be sized to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.0 PSIG.

I. Pressure Relief Valves:

1. The pressure relief valve shall be a pilot operated diaphragm valve designed to automatically relieve upstream pressure to an external discharge to atmosphere to protect pumps and other equipment from high pressure conditions.
2. The main valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern valve. Y-pattern valves shall not be acceptable. The valve shall contain a disc and diaphragm assembly that forms a sealed chamber below the valve cover, separating the operating pressure from line pressure. The diaphragm shall be constructed from nylon reinforced Buna-N and shall not seal directly against the valve seat and shall be fully supported by the valve body and cover.
3. The main valve body shall be ductile iron ASTM A536, and all internal cast components shall be ductile iron or CF8M (316) stainless steel. All ductile iron components, including the body and cover, shall be lined and coated with ANSI/NSF-61 approved epoxy coating allied by the electrostatic heat fusion process. The main valve throttling components (valve seat & disc guide) shall be stainless steel. The valve and cover must be machined with a 360-degree locating tip to ensure proper alignment.
4. The disc and diaphragm assembly shall contain a Buna-N synthetic rubber that is securely retained on 3-1/2 sides by a disc retainer and disc guide. Diaphragm assemblies utilizing bolts or cap screws for component retention will not be permitted.

5. Pilot control systems for valves 3" and smaller shall contain a flow clean strainer, fixed orifice closing speed, adjustable speed control and pressure reducing pilot. Pilot control systems for valves 4" and larger shall contain an external Y-strainer, fixed orifice closing speed, Pressure reducing pilot and isolation ball valves on all body connections. All pilot control systems shall utilize stainless steel braided flexible tubing and brass fittings regardless of valve size. The adjustment range of the pressure reducing pilot shall be 30-300 PSI. Initial pressure setting shall be 140 psi.

J. Air Release Valve:

1. Air release valves shall be provided on high points of booster pump station suction and discharge piping.
2. Air release valve shall be sized by the station manufacturer.
3. Air release discharge shall be piped to floor drain or pipe drain as indicated on the drawings.
4. Suppliers shall be in accordance with City of Aberdeen's approved supplier list.

K. Gauges:

1. Pressure gauges shall be provided at the suction and discharge connections of each pump as well as the suction and discharge headers. Gauges shall be mounted at the control module. Gauges mounted on the pumps shall not be acceptable. Gauge range shall be a minimum of 0 to 160 psi.
2. All gauges shall be a minimum of 4-1/2" diameter, liquid filled, brass connection port, stainless steel case and bayonet ring and be in accordance with ASME B40-100, grade 1A.
3. Gauge accuracy shall be +/- 1% of span throughout the full range. Gauges shall be selected to read at mid-point when operating at design conditions.
4. Gauge operating temperature shall be -40°F to 140°F (-40°C to +60°C) ambient and +140°F (+60°C) medium maximum.
5. Gauges shall be furnished with stainless steel shut-off valve and pulsation dampener to protect gauges from surges and solids. Gauges, shut-off valves, and pulsation dampener shall be assembled using schedule 40 stainless steel pipe.

L. Magnetic Type Flow Meter:

1. The system shall be equipped with a magnetic type flow meter and shall provide a high resolution signal to the station controller.
2. Electromagnetic flow meter shall include a polyurethane liner, ANSI B16.5 flanged ends, 316 SS electrodes, and includes 0.5% calibration. Meter shall be NSF 61 approved.
3. Meter shall include a Nema 4X housing and require a 24VDC power supply, output of the meter shall be 4-20mA based on full scale range.
4. Meter to include grounding rings mounted in each end of the meter. Grounding rings are not required if the internal potable coatings have been removed.

5. Meter shall be as sized on the drawings. Meter output shall be displayed on the station HMI.
6. Flow meter shall be installed per the manufacturer's recommendations for upstream and downstream clear piping requirements.

M. Pressure Transducers:

1. Pressure transducers shall be provided on the suction and discharge headers.
2. Pressure transducer process-wetted parts shall be 316SS and NSF 61 approved.
3. Non-wetted parts shall be NEMA 4X.
4. Transducer range shall be 0 to 200 psi, -40 to 85 degree C operating temperature, IP65 rating, 4-20 mA output with minimum 0.075% accuracy.
5. Pressure transducers shall be mounted on the common gauge panel in accordance with the drawing details.
6. Transducers shall be furnished with stainless steel shut-off valve and pulsation dampener to protect transducer from surges and solids. Shut-off valves and pulsation dampener shall be assembled using schedule 40 stainless steel pipe.
7. Pressure transducers shall be:
  - a. Foxboro
  - b. Rosemount
  - c. Endress and Hauser

N. Pressure reducing valves

1. Pressure reducing valves shall be provided for all sample taps and utility sink lines.
2. Pressure reducing valve shall be NSF 61 approved.
3. Valve shall have a minimum inlet pressure design of 150 psi.
4. Valve shall be isolated from source pipe by an isolation ball valve.
5. Pressure reducing valves shall be Apollo, Zurn, or Watts.

O. Sample Taps

1. A sample tap shall be provided on the suction and discharge headers, for a total of two (2) sample taps.
2. Sample tap shall be provided with shut-off ball valve, pressure reducing valve and sample hose bib.
3. All components shall be NSF 61 approved.

P. Ball Valves

1. Valve shall be two-piece stainless steel or bronze.
2. Stem seal shall PTFE.
3. Valve shall be full port, level operated, stainless steel ball and stem.
4. Valve shall be minimum 200 psig rated.
5. Valve shall be NSF 61 approved.

Q. Future Chemical Injection Ports

1. A total of four (4) chemical injection ports shall be provided. Two (2) on the suction header and two (2) on the discharge headers.
2. Port shall be ½" FNPT.
3. Provide all ports plugged with system tested in accordance with the hydrostatic testing requirements.

2.03. CONTROLS

A. Provide complete electrical distribution, control and instrumentation to automatically start, stop and modulate the stations pumps to smoothly, efficiently and reliably deliver designed flow rates at a constant discharge pressure. The electrical system shall provide alarms, and safety features needed to protect the equipment, piping system and personal.

1. The electrical distribution, control panel and instrumentation design, installation and testing along with integration of component parts shall be the responsibility of the pump station manufacturer.
2. Control panels must be manufactured in the same facility as the pump station. The manufacturer of the control panel and pump station shall be one in the same. Control panels not designed and manufactured by the manufacturer of the pump station shall not be accepted.
3. The control panel shall bear the U.L. 508A label for Industrial Control Panels and shall meet the requirements of IEEE 519.
4. All electrical distribution, instrumentation and controls shall be in accordance with NEC 70 latest edition.

B. Control Panel:

1. The manufacturer of the pump station shall assemble the complete control panel in accordance with NEC 70 latest edition and be so authorized under U.L. 508A. All components and wiring shall be housed within a U.L. listed electrical enclosure. All components shall be labeled for proper identification. Adjustment of all operating parameters shall be accomplished from the front of the panel through an industrial grade HMI (human interface machine). A complete wiring diagram shall be permanently affixed to the inside door of the control panel including a legend and. All wiring terminations shall be numbered with pre-laminated wire labels.
2. OEM Controls are provided in Section 11990.

△ ADD #2

- ~~3. The control system shall be microprocessor based Direct Digital Control (DDC) and shall have stand alone capability. The controller shall be completely wired, programmed and fully tested before shipment. All testing shall be recorded on the appropriate quality control documents and be provided as part of the IO&M manual.~~
  - ~~4. All the control panel components shall be housed in a Nema 4/IP55 enclosure. Enclosure shall be manufactured from carbon steel and have a polyester power coating applied to the interior and exterior, quarter turn latches and full seamless gasket.~~
  - ~~5. The programmable logic controller (PLC) shall be equal to Eaton Corporation PB14ELC or better. The PLC shall provide program capacity to a minimum of 15 steps, shall have (2) built in serial ports, (1) RS485 port and 512 local I/O points as a minimum. The PLC shall be capable of supporting Ethernet, Modbus, Devicent and Profibus communications.~~
  - ~~6. The system operator shall be capable of starting or stopping the pumps manually and allowing the system to operate automatically via a signal from the operator. The pump controller shall include individual H-O-A switches mounted on the panel face.~~
- ~~G. 6" Color Human interface machine (HMI) for local interface. The unit shall be mounted in the controller door and shall not affect the Nema rating of the enclosure. The HMI shall be microprocessor based and hold its firmware in EPROM memory. Online programmable data entries such as system set points, calculated results and totalization shall be stored in non-volatile memory. All data and set points shall be field adjustable through an escalating series of passwords. All the set points shall be modifiable through the controller mounted HMI using standard engineering units such as system flow (GPM), system pressure (PSI), elapsed pump runs time and feet of head. The program shall be modifiable by remote operator as well via optional SCADA system.~~
- ~~1. The operator display shall be provided in a single integrated graphic display screen with a separate processor for control. The processor shall be an industrial PLC as manufactured by Eaton Corporation. The use of a computer for process control is not acceptable.~~
  - ~~2. The HMI shall be suitable for mounting in a door a Nema 4 enclosure so that it maintains the enclosure's Nema 4 rating.~~
  - ~~3. The HMI shall be mounted at a suitable height to assure proper visibility and easy access by the operator.~~
  - ~~4. The HMI shall provide as a minimum the following:
    - ~~a. CPU: Minimum 32 bit Micro controller / 206.4 MHz.~~
    - ~~b. System memory: 8Mb:
      - ~~1) Program: 7Mb.~~
      - ~~2) History: 360Kb.~~
      - ~~3) Recipe: 128 Kb.~~
      - ~~4) Alarm: 16Kb.~~~~~~

- 5) ~~Data: 64Kb volatile/1Kb non-volatile.~~
- 6) ~~Backup memory: 512Kb.~~
- c. ~~Storage memory: SM card and USB memory disk capable.~~
- d. ~~Serial ports: Total 3, with at least two (2) ports configurable for RS232/422/485.~~
- e. ~~Ethernet Expansion Module: provides Ethernet RJ-45 connector port with Auto-MDI/MDX, 10/100 mps auto detection.~~
- f. ~~The HMI shall be industrial rated and certified for the following conditions:~~
  - 1) ~~Relative humidity 10% to 90% @0-40°C, 10% 55% @41-50°C~~
  - 2) ~~Vibration: 30G@ 11msec~~
  - 3) ~~The HMI shall be industrial rated and certified for agency approval for the following:~~
  - 4) ~~IP65 /Nema 4/CE/UL/CUL/C-TICK~~
  - 5) ~~The HMI shall be certified for compliance with electromagnetic immunity susceptibility forthe following:~~
    - a) ~~EMC directive 89/336/EEC + 92/31/EEC + 93/68/EEC, EN61132.~~
- 5. ~~The system controller shall include a pump failure alarm for each pump. The pump alarm shall consist of a differential pressure switch of the current switch type with adjustable time delay, alarm light and manual reset. When pump failure is detected, the pump shall be stopped and locked out of service until the alarm is manually reset via a panel mounted reset button. The control system will upon pump failure replace the failed pump with the next pump in the sequence~~
- 6. ~~U.L./C-U.L. 508 Label:~~
  - a. ~~Single point power connection.~~
  - b. ~~Through door control power disconnect with safety interlock to prevent door from being opened while in ON position.~~
  - c. ~~Fused 120-V AC control voltage transformer.~~
  - d. ~~Fused 24-V DC power supply, 1 Watt.~~
  - e. ~~Suction and system pressure transducers:~~
    - 1) ~~All wetted parts are to be stainless steel.~~
    - 2) ~~4-20 mA signal with a minimum accuracy of ±0.075%.~~
  - f. ~~Micro Controller: PLC with non-volatile memory (battery backup not required).~~



- g. ~~Operator interface: 6-inch blue scale touch screen HMI (Human Machine Interface) including but not limited to the following:~~
  - 1) ~~Main Screen with the following features:~~
    - a) ~~Individual pump HOA (Hand Off Auto) switches.~~
    - b) ~~Pump run indication, including current % speed.~~
    - c) ~~Pump Failure indication.~~
    - d) ~~Current pressures readings in psig (suction and system).~~
    - e) ~~Current flow in GPM.~~
    - f) ~~Adjustable manual (hand) speed setting.~~
    - g) ~~Direct access to menu screen.~~
  - 2) ~~Menu screen providing direct access to all system settings and status screens.~~
  - 3) ~~Pump settings screen displays current settings and allows user changes:~~
    - a) ~~Lead and lag pump start and stop pressures, psig.~~
    - b) ~~Lead and lag pump ON and OFF delay times, seconds.~~
  - 4) ~~Alarm settings screen displays current settings for all alarms and allows user changes:~~
    - a) ~~Low suction alarm setting. Initial setting 70 psig~~
    - b) ~~Low Low suction alarm setting. Initial setting 65 psig~~
- h. ~~Low suction pressure, psig.~~
- i. ~~Low Low suction pressure, psig.~~
- j. ~~ON and OFF delays, seconds.~~
- k. ~~Manual or automatic reset:~~
  - 1) ~~Low system alarm setting.~~
  - 2) ~~Low Low system alarm setting.~~
- l. ~~Low system pressure, psig. Initial setting 124 psig.~~
- m. ~~Low Low system pressure, psig. Initial setting 120 psig.~~
- n. ~~ON and OFF delays, seconds.~~
- o. ~~Manual or automatic reset:~~

- 1) ~~High system alarm setting.~~
- 2) ~~High High system alarm setting.~~
- p. ~~High system pressure, psig. Initial setting 135 psig.~~
- q. ~~High High system pressure, psig. Initial setting 140 psig.~~
- r. ~~ON and OFF delays, seconds~~
- s. ~~Manual or automatic reset:~~
  - 1) ~~High suction economy mode.~~
- t. ~~Economy mode suction pressure, psig.~~
- u. ~~Economy mode enable / disable.~~
- v. ~~ON and OFF delays, seconds:~~
  - 1) ~~Separate Alarm Silence and Alarm Reset buttons.~~
  - 2) ~~Current system status screen displays:~~
    - a) ~~Pump(s) currently running.~~
    - b) ~~Active alarms and warning messages.~~
  - 3) ~~System event history screen displays a minimum of the last 10 system events, including pump start /stops, alarm conditions and alarm acknowledgements.~~
  - 4) ~~Pump run time screen displays the total operating time for each pump. Provide individual resets for each pump run time.~~
  - 5) ~~Lead pump alternation options will include:~~
    - a) ~~Automatic alternation on lead pump shutdown.~~
    - b) ~~Manual alternation when operator touches alternate button~~
    - c) ~~Timed alternation:~~
      - i. ~~Daily (user specified time of day)~~
      - ii. ~~Weekly (user specified day of week and time of day)~~
      - iii. ~~Monthly (first week of month on user specified day of week and time of day)~~
  - 6) ~~Multi-Level Security:~~
    - a) ~~8 Password protected security levels (field changeable passwords).~~

~~7) Common alarm relay provides dry contacts for customer monitoring.~~

~~8) Alarm horn, 85 db, announces all alarm conditions.~~

## 2.04. VARIABLE SPEED DRIVES

### A. Description

1. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.
2. The drive manufacturer shall supply the drive and all necessary options as herein specified. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacturer.

### B. Referenced Standards:

1. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
2. UL508C.
3. ICS 7.0, AC Adjustable Speed Drives.
4. IEC 16800 Parts 1, 2 and 3.
5. NEC 430.120, Adjustable-Speed Drive Systems.
6. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156.

### C. Qualifications:

1. VFDs and options shall be UL listed as a complete assembly. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.
2. CE Mark – The VFD shall meet product standard EN 61800-3 for the First Environment restricted level. (RFI / EMI Filter spec).
3. The entire VFD enclosure, including the bypass shall be seismically certified and labeled in accordance with the IBC 2006 International Building Code:
  - a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
  - b. Seismic importance factor of 1.5 rating is required and shall be based upon actual shake test data as defined by ICC AC-156.
  - c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion by a certified lab.

- D. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, (enclosures with only NEMA ratings are not acceptable):

1. Environmental operating conditions: 0 to 40<sup>0</sup> C (32 to 104<sup>0</sup> F) continuous. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformalcoating.
2. Enclosure shall be UL rated and shall be UL listed as a plenum rated VFD.

E. All VFDs shall have the following standard features:

1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
2. The keypad shall include Hand-Off-Auto selections and manual speed control. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
3. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients.
4. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120.
5. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus.

F. All VFDs to have the following adjustments:

1. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. A minimum of two separate safety interlock inputs shall be provided. When any safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close.
2. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates.
3. The VFD shall include a fireman's override input. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run at a preset speed or in a separate PID mode.

G. Serial Communications:

1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet

MS/TP. The use of third party gateways and multiplexers is not acceptable. All protocols shall be “certified” by the governing authority (i.e., BTL Listing for BACnet).

H. EMI / RFI filters. All VFD’s shall include EMI/RFI filters. The onboard filters shall allow the entire VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted. No Exceptions.

I. Bypass Controller:

1. A complete factory wired and tested bypass system consisting of a door interlocked, pad lockable circuit breaker, output contactor, bypass contactor, and fast acting VFD isolation fuses.
2. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the “Off” position before either enclosure may be accessed.
3. The VFD and bypass package shall have a UL listed short circuit current rating (SCCR) of 100,000 amps and this rating shall be indicated on the UL data label.
4. The drive and bypass package shall be seismic certified and labeled to the IBC: Seismic importance factor of 1.5 rating is required and shall be based upon actual shake test data as defined by ICC AC-156.
5. Drive Isolation Fuses - To ensure maximum possible bypass operation, fast acting fuses, exclusive to the VFD, shall be provided to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. This maintains bypass operation capability in the event of a VFD failure. Bypass designs, which have no such fuses will not be accepted.
6. The system (VFD and Bypass) tolerated voltage window shall allow the system to operate from a line of +30%, -35% nominal voltage range. The system shall incorporate circuitry that will allow the drive or bypass contactor to remain “sealed in” over this voltage tolerance at a minimum.
7. The bypass shall maintain positive contactor control throughout the voltage tolerance window of nominal voltage +30%, -35%. This feature is designed to avoid contactor coil failure during brown out / low line conditions and allow for input single phase operation when in the VFD mode. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
8. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
9. The bypass system shall NOT depend on the VFD for bypass operation. The bypass system shall be designed for standalone operation and shall be completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair / replacement. Serial communications shall remain functional even with the VFD removed.
10. Serial communications – the bypass shall be capable of being monitored and/or controlled via serial communications. On-board communications protocols shall

include Modbus, Johnson Controls N2, Siemens Building Technologies FLN (P1), and BACnet MS/TP.

11. The bypass control shall include a programmable time delay for bypass start and keypad indication that this time delay is in process. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. The time delay shall be field programmable from 0 – 120 seconds.
12. The user shall be able to select the text to be displayed on the keypad when an external safety opens. Example text display indications include “FireStat”, “FreezStat”, “Over pressure” and “Low suction”. The user shall also be able to determine which of the up to four (4) customer safety contacts is open over the serial communications connection.
13. Smoke Control Override Mode (Override 1) – The bypass shall include a dedicated digital input that will transfer motor from VFD mode to bypass mode upon receipt of a dry contact closure from the Fire / Smoke Control System. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties as required by UL 864/UUKL. All keypad control, serial communications control, and normal customer start / stop control inputs will be disregarded. This Smoke Control Mode shall be designed to meet the intent of UL864/UUKL.
14. Fireman’s Override Mode (Override 2) – the bypass shall include a second, programmable override input which will allow the user to configure the unit to acknowledge selectable digital inputs. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for “Run-to-Destruction”. The user may also force the unit into Override 2 via the serial communications link.

J. Warranty:

1. The VFD Product Warranty shall be 24 months from the date of certified start-up. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

K. VFDs shall be ABB to match existing Owner VFDs.

2.05. ELECTRICAL

- A. All power and control wiring shall be provided in accordance with Section 16110.
- B. Connections to all motors or other equipment subject to vibration, thermal movement or requiring the flexibility to be moved aside during maintenance shall be made with liquid-tight flexible conduit with proper end fittings. The length of the flexible conduit shall not exceed 36”
- C. Splices shall not be permitted in power, lighting, control or instrumentation wiring.
- D. No run of conduit shall contain more than the equivalent of four 90 degree bends for a total of 360 degrees including those immediately at outlets or fittings. Bend in the conduit shall be made without reducing the internal diameter of the conduit.
- E. All conduit runs shall be rigidly supported. Each conduit shall be supported within 1 foot of junction boxes and fittings. Piping shall not be utilized for conduit support.

## 2.06. FINISHING

- A. The system manufacturer shall operate and maintain a coating application facility that is in compliance with EPA, OSHA and all local & state code requirements. All coating technicians shall have current OSHA documentation stating they have been tested for the use of approved respirators in the application of industrial coatings.
- B. All equipment nameplates including but not limited to pumps, motors, vessels, control panels shall be masked off prior to coating. The masking shall be removed prior to shipment leaving a clean and legible nameplate.
- C. All steel components shall be cleaned, degreased and coated per the specification below:
  - 1. Moderate Exposure Surface Preparation – SSPC-SP10 abrasive blasting to a near white metal finish resulting in a 1.5 to 2.5 mil surface profile. First Coat - Polyester Urethane applied at 3-5 MDFT directly to prepared substrate.

## 2.07. TESTING

- A. Testing Facility:
  - 1. The manufacturer of the packaged pumping system shall maintain an operating testing facility at the point of manufacturer of the pumping system. The complete pumping systems subsystems shall be completely tested as a unit. This includes but is not limited to hydrostatic, electrical and performance tests. The test shall include each component and feature of the assembled unit including all remote mounted instruments. The complete testing facility shall include flow meters, pressure gauges, watt meters, digital multimeter, tachometer, and differential pressure transmitters for measuring system performance. The entire testing facility shall be traceable to NIST standards and have documentation of yearly calibration of instruments as required.
- B. Factory Tests:
  - 1. After factory assembly is complete the entire pumping system shall be hydrostatically tested as a complete unit. The system shall be tested at 150 PSIG or 150% of working pressure whichever is higher for a minimum of one hour.
  - 2. Each pump on the system shall be individually tested for performance at full speed. Pump performance measurements shall include shut-off pressure and pump TDH and motor FLS (full load amps) at 25%, 50%, 75% and 100% of the pumps design capacity.
  - 3. Each pumping system controller must be designed, built and tested at a U.L. 508A facility that is the same as the pumping system manufacturer prior to integrating with the pumping system. Testing shall be in accordance with U.L.508A procedures and include as a minimum verification of wiring, component operation, programming and sequencing.
  - 4. The pumping system shall be connected to a test tank of sufficient capacity to perform the testing. The tank shall be coated with an NSF approved coating so as not to impart contaminants into the pumping system. The system shall be connected to the tank with all the actual components, valves and sensors specific to this project. During the test any calibrations or adjustments that are required for correct system operation shall be performed. All controls, sequencing and alarms shall be tested verified and documented prior to removal from the testing facility. These tests may be

witnessed by the contractor, commissioning agent, owner or engineer if required.

5. All testing shall be performed with NIST traceable equipment. The NIST traceable instrumentation shall be independently calibrated and tested in accordance with NIST and Hydraulic Institute standards.

C. Inspections Verification and Performance:

1. The manufacturer of the pumping station shall provide access to the owner or his representative to the manufacturing facility at any time during the fabrication of the pumping system. All testing and production documents shall be made available to the owner or his representative at his request.
2. Upon completion of fabrication and system testing a written report certified by a company officer of the manufacturing company shall be provided to the owner's representative. This form may be requested prior to release of the system for shipping but shall not affect the payment terms of the contract.

2.08. SEQUENCE OF OPERATION

A. Pump VFD:

1. Each pump VFD shall have a Hand-Off-Auto switch:
  - a. In Auto, the pump(s) shall run in accordance with the Auto control summary below and in accordance with selected control settings.
  - b. In Hand, the pump(s) run continuous based on a manually selected pump speed.
  - c. In the Off position, the pump(s) will not run and be locked out of control.

B. Functional Description:

1. Auto Control:
  - a. The system controller shall operate equal capacity variable speed pumps to maintain an operator selected discharge rate (system set-point). The system controller shall receive a 4-20 mA analog signal from the factory installed flow transmitter on the suction header, indicating the actual system discharge. When the operating pump reaches an adjustable percent of full speed, to be determined by system manufacturer, a second pump will be started and will increase speed until the system set-point is achieved. When the system discharge is equal to the system set-point, all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system set-point discharge is maintained. When both pumps in operation are running at low speed, the system controller shall switch off a pump when a single pump is able to maintain system set-point. Only two pumps will operate at one time, with the third pump as a standby pump.
  - b. The system controller shall be capable of switching pumps on and off to satisfy system set-point without the use of flow switches, motor current monitors or temperature measuring devices.



- c. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump changeover shall be field adjustable.
  - d. High Pressure Shutdown - The system shall be equipped with a high pressure shut down setting via pressure transducer on common discharge header to shut down the pumping system in the event of a high pressure condition. The high pressure setting shall stop all pump operation during a high pressure event. Pumps can only return to service after high pressure fault has been manually cleared by plant operations staff. Preliminary factory high pressure setting shall be 140 psi.
  - e. Low Pressure Alarm - The system shall be equipped with a low pressure alarm via a pressure transducer located on the common suction header. The low pressure switch shall alarm during a low pressure event. Preliminary factory high pressure switch setting shall be 65 psi.
  - f. Low Speed Limit - The pump system VFD controls shall include a low speed limit that is established by the pump manufacturer. The low speed limit will establish the minimum allowable operation speed that cannot be automatically or manually by-passed.
2. Hand Control - The system controller shall provide a Hand control selection for each pump VFD for operator selected pump operation and speed settings. High pressure and low pressure alarms shall function the same in Hand control of pumps and require manual clearing off alarms. Pump speed minimum selection shall be limited by the manufacturer's recommended low speed limit setting.

## PART 3 EXECUTION

### 3.01. INSTALLATION

- A. The contractor shall off load, store, locate, level, anchor, pipe & wire the system and the remote components in accordance with the manufacturers recommendations.
- B. Alignment: The system shall be set in place in a level state. The base mounted pumps shall be aligned by the contractor after installation of all associated piping and wiring. The pump alignment shall be performed by a qualified millwright and documentations stating such shall be submitted as part of the warranty activation program.
- C. The owners' representatives or the contractor shall confirm in writing that all the components necessary for a complete and proper startup and commissioning are installed, piped, wired and operational prior to scheduling startup. A system startup request form shall be filled out and signed by the contractor or owner's representative and returned to the factory to certify readiness. This document is part of the warranty activation program as well.
- D. All piping shall be thoroughly cleaned and free of debris, dirt, welding slag, sand and other impurities. The piping and pump system shall be filled, and pressure tested with potable water. The system shall be disinfected in accordance with AWWA C651-14 and water quality samples taken in accordance with MDE requirements. The system can be placed on-line for testing once the system has been certified to be disinfected in accordance with Section 01010 requirements.

- E. During initial start up the contractor shall under the supervision and assistance of the manufacturer or his authorized representative, adjust all mechanical and electrical components to make the system operate properly under actual site conditions.
- F. Demonstration – After all field adjustments have been completed, the owner and/or his representatives will receive a through demonstration of the system operation and will receive training in the correct operation, adjustment of all components as well as component maintenance.
- G. The system manufacturer and his representative shall provide up to two (2) 8 hour training days, during not more than one (1) trip to the jobsite for startup, adjustment and training of the owner's personal on the operation and maintenance of the packaged pumping equipment.

END OF SECTION

## SECTION 11990

### OEM CONTROL PANELS

#### PART 1 GENERAL

##### 1.01. SECTION INCLUDES

- A. This section includes requirements for Original Equipment Manufacturer's (OEM) control panels provided as part of packaged systems.
- B. This section shall set minimum quality standards that must be met or exceeded.
- C. Equipment furnished under this Contract shall be installed in an industrial type environment and powered from an electrical source that may include harmonic distortion, surges, sags, and other electrical noise under normal operating conditions. The Contractor shall verify that all equipment furnished shall function correctly in an environment where electrical noise of the types referenced are common during normal operations. If the equipment is found to be unable to operate in this environment, the Contractor shall furnish additional and/or replacement equipment, surge protection, power line conditioners, uninterruptible power supplies (UPS), or other equipment required to correct this problem at no additional cost to the Owner.
- D. OEM-supplied PLC and OIT programming requirements.
- E. Control panels shall be furnished with related installation, calibration, configuration and manufacturer's startup and training services as specified.

##### 1.02. RELATED SECTIONS

- A. Section 01300 – SUBMITTALS
- B. Section 01640 – EQUIPMENT – GENERAL
- C. Section 01660 – TESTING AND STARTUP
- D. Section 01700 – PROJECT CLOSEOUT
- E. Section 11380 – PRE-ENGINEERED MUNICIPAL BOOSTER PUMP STATION
- F. All Division 16 specifications

##### 1.03. REFERENCES

- A. Material and installation shall be in accordance with the latest revisions of the following:
  - 1. National Electric Code - NEC
  - 2. National Electrical Manufacturers Association - NEMA
  - 3. Underwriters Laboratories, Inc. – UL-508A

##### 1.04. QUALITY ASSURANCE

- A. Qualifications of Manufacturer - All equipment furnished under this section shall be furnished by manufacturers who meet the quality, workmanship, and experience requirements as specified in Divisions 11, and 16 of this contract.
- B. Control Panel Supplier
  - 1. The control panel supplier shall be responsible for providing control panels, systems, and motor control panels. The control panel supplier shall regularly engaged in the business of industrial control panels and shall be responsible for the furnishing, coordination and the installation of the equipment and specified herein either in-house or through an outside industrial control panel shop.
  - 2. The control panel supplier shall be responsible for all resources associated with the control panel manufacture, fabrication, and integration to include but not be limited to engineering, drafting, analog and digital control systems and wiring design, construction, wiring, labeling, component configuration, test/demonstration configuration and operation of panel, project management, quality control, field engineering and training.
  - 3. Control panels shall be fabricated by an actively-listed UL 508/508A certified panel shop.

#### 1.05. DEFINITIONS

- A. Plant Programmable Logic Controller (PLC) - PLC provided by others that facilitates monitoring and/or control of processes. PLC may communicate to other PLCs directly, which requires compatibility between the Plant PLCs and PLCs supplied herein.
- B. Supervisory Software - Software application that facilitates monitoring, control, historization, alarming, and other supervisory functions of the treatment plant. Sometimes referred to as SCADA/HMI software, HMI application, Front-End software, or GUI software.
- C. Operator Interface Terminal (OIT) - Panel-mounted graphic terminals that facilitate monitoring and control of the supplied application graphically. OITs communicate with and obtain the status of data from the supplied PLC.
- D. Specified Communication Protocol - On this project, all communication shall be Allen-Bradley Ethernet/IP. PLCs specified herein shall natively communicate to other plant PLCs and the supervisory software via the specified communication protocol, without exception.
- E. Supervisory Control and Data Acquisition (SCADA) System - A centralized system that facilitates monitoring and control of an entire site(s) through communication between computer-based applications and a network of controllers, including PLCs. Also referred to as a Process Control System (PCS) or Industrial Control System (ICS).
- F. PLC Memory Map – Excel-based document that contains all pertinent information required for monitoring key data registers within a PLC including process data, alarms, and alarm and control setpoints.
- G. OEM – Original Equipment Manufacturer responsible for providing PLC-based control panels to monitor/control packaged systems and all PLC and OIT programming required to enable the packaged system to function as specified in the Contract Documents.

#### 1.06. SUBMITTALS

- A. Submittals shall be in accordance with Section 01300, Submittals, and as described herein.
- B. Prior to ordering and/or procuring any materials in connection with this section, detailed shop drawings on all material shall be submitted to the Engineer, reviewed, and formally returned to the Contractor as Approved or Approved as Corrected. Procurement of materials in advance of submittal approvals will not influence the Engineer in approving materials. Proposed alterations to the Contract Documents will not be considered when they include materials that were procured in advance of the Engineer's formal, written approvals.
- C. Submittals for equipment and materials shall be clearly marked or noted with specific features, standard options, and wiring diagrams to indicate compliance with Contract Documents. Terminal board wiring diagrams including terminal numbers and conductor color codes shall be indicated.
- D. Where deviations to Contract Documents are proposed, submit a list of deviations. Provide a detailed description and explanation for each deviation.
- E. Shop drawings shall present complete and accurate information relative to all working dimensions, equipment weights, assembly, and section views, and all necessary details pertaining to coordinating the work of the contract. Shop drawings shall contain information such as special tools and other items of information that are required to demonstrate detailed compliance with the Contract Documents.
- F. Submit shop drawings which shall include the following:
  - 1. Submittals shall include verification that panels will be fabricated to UL 508A standards and labeled as such. Submit short circuit current ratings (SCCR) for each individual control panel assembly.
  - 2. Submittals shall contain the NEMA-type designation and manufacturer data describing the enclosures and showing its compliance with specifications and associated standards.
  - 3. Control panel assembly drawings detailing panel cut-out locations and sizes, back panel and device layout and locations.
  - 4. Using AutoCAD 2020, or higher, provide these drawings for each control cabinet in the following order. Label all components with manufacturer and complete model numbers on the drawings. Typical drawings are not acceptable.
    - a. Scaled enclosure layout drawings in 11-inch by 17-inch format, detailing locations of all components on the subpanel, door, and all other enclosure faces. Label each view as "Enclosure Door", "Enclosure Subpanel", "Enclosure Side", etc. Drawing shall display layout of completed assemblies, including, but not limited to, PLC backplane, PLC I/O modules, empty slots, radios, UPS, Ethernet switches, autodialers, terminal blocks, installed spare equipment, power supplies, power line isolators, surge suppression, grounding lugs, wireway, disconnect switches, fuses, control relays, acceptable regions for conduit penetrations of both AC and DC wiring separately, and external power. Illustrate handles, hasps, hinges, and dimensions of exterior mounted devices. Identify equipment manufacturer and model numbers by placing a number next to the piece of equipment on the drawing and cross-referencing with the Bill of Materials. In addition to the Bill of Materials cross-reference labeling, label PLC I/O modules on the drawing with the manufacturers complete model numbers.

- b. Elementary diagram drawings in 11-inch by 17-inch format, detailing all enclosure electrical components including, but not limited to, power line isolators, surge suppression, UPS, power supplies, fuses, duplex receptacles, indicating lights, switches, and control relays. Diagrams shall include terminal point designations, line reference numbers, and wire numbers. All wires shall maintain the same wire number for the entire contiguous segment of wire. Diagrams shall illustrate all network cabling and DC and AC electrical distribution. Drawing shall illustrate all available instrument terminations, both used and unused, and be labeled with the manufacturer's terminal point label as will be found on the installed instrument. Provide a legend on this sheet for all symbols and general notes used on this sheet and on the PLC I/O module detail drawings.
  - c. Where PLCs are used, submit scaled PLC I/O module detail drawings, in 11-inch by 17-inch format, for each card installed in the PLC backplane. Detail the wiring of all terminations on the PLC I/O module including, wiring of all I/O points and power. Illustrate all termination points for each signal including termination points for terminal blocks, relays, etc. Identify each wires color and wire number. Utilize NFPA 79 standards to illustrate termination points: to an MCC, to a device terminal, to a control panel terminal, to fused blocks, to surge suppressor blocks, etc. Label the each point on PLC I/O modules with the PLCs physical address. Utilize NFPA 79 standards for illustration of wiring: internal to the PLC enclosure, outside the PLC panel, and integral to a device. Progression of I/O modules detail drawings shall be in the order of the orientation of the I/O modules in the PLC backplane (e.g. Slots 1 and 2 on sheet 7, Slots 3 and 4 on sheet 8, etc.). Not more than two card details shall be shown on any single drawing. Each I/O module shall be labeled with the installed rack and slot number. Illustrate installed spare I/O modules, but it is not necessary to detail slot filler cards.
  - d. Catalog cuts and user's manuals for all PLC system components.
  - e. Other materials, as required, to fully describe the control panel operation.
5. Submit a Process Controls Narrative (PCN) that details the proposed sequence of operation for each control panel. PCN shall include a sequential table of the startup and shutdown process for each system. OEM shall Integrate all user-adjustable time delays into the PCN. PCN shall be reviewed and approved prior to scheduling in-field deployment of work related to the packaged system.
  6. Bill of Materials for all equipment and accessories.
  7. Manufacturer's catalog information for all components and accessories.
  8. Submit heat load calculations for each enclosure to quantify the need for panel heating or cooling measures, including louvers, forced ventilation, or air conditioners. Provide heating/cooling systems herein when calculated temperatures will exceed the specified limitations of the supplied components.
  9. Manufacturer's standard wiring diagrams including all available terminal connections for each component.
  10. Spare parts list (including specified spare parts to be furnished by the Contractor and manufacturer's recommended spare parts list for each type of unit).

11. Project specific installation instructions and mounting details for each component. Materials of construction for supports, brackets, and mounting hardware shall be provided with details for each type of equipment mounting rack.
12. All machine engraved and computer printed nameplates shall be submitted indicating their materials of construction, method of fabrication, background and font colors, label dimensions, and exact label wording.
13. Submit field testing schedule and field-testing reports.
14. Process Control System Coordination - Submit the following information within 30 days after Engineer-approval of the respective manufacturer's PLC-control panel shop drawing. The following materials shall be submitted for Engineer review and startup dates shall not be scheduled until these submittals have been approved by the Engineer.
  - a. PLC Memory Maps - PLC memory maps identify PLC memory register locations of specific data that will be utilized in the SCADA/HMI application. These data may be used to display the current operating state of individual equipment and processes. These data may be used in software-based alarm notification programs, automatic generation of Excel-based reports, and historized and trended through the HMI interface.
    - 1) DESCRIPTIONS - Utilize accurate and unique descriptions for each key datapoint. Descriptions of alarms in the PLC memory map shall match those used in the respective OIT verbatim.
    - 2) DATATYPE - Identify the datatype for each datapoint (i.e. Boolean, Integer, Double Integer, Floating Point/Real, etc)
    - 3) SCALING - Include Scaling/Range of values for all analog datapoints (i.e., 0 to 60 Hz, 0 to 10.00 mg/L, etc.)
    - 4) UNITS - Identify Engineering units for all analog datapoints
    - 5) PACKED DATA - Configuration details for any "packed" integers that contain operational data for multiple equipment items or articulate alternative configurations. Like those used to indicate Lead, Lag1, Lag2, Standby status of systems; Hand-Off-Auto/Remote for handswitches; etc.
    - 6) STATE DETAILS - Identify the value of Boolean/Discrete values when they are "Active", i.e., alarm active when True or alarm active when False.
    - 7) ALARMS
      - a) Clearly identify alarm conditions to be monitored and displayed in the supervisory software and differentiate alarms that should be output to the plant alarm dialer (that contacts operating personnel during unstaffed shifts).
      - b) All alarm conditions shall be in Boolean datatype memory registers. Alarming on physical I/O or on an

analog tag is not acceptable. This is a limitation of the programs being used.

- 8) CONTROL - Key operating setpoints useful to the Operating Staff to view remotely. All setpoints are not required, rather just the few that the OEM anticipates the Operator to periodically tweak through the OEM's Local Operator Interface (OIT). It is not intended to make these set points writeable through the supervisory software. These setpoints will be historized and trended to visualize how the entered setpoint affects the performance of your system.
  - 9) FORMAT - Preferred format is Microsoft Excel, however PDF is acceptable when a PLC has fewer than 25 datapoints.
  - 10) Due to limitations of certain HMI software programs, all supplied datapoints shall be accessible via PLC memory registers. The HMI shall not be required to monitor the status of physical inputs nor scale data from within the HMI application.
  - 11) OITs - Should include datapoints for any and all data present in any OEM-supplied OIT. PLC memory map shall identify datapoints utilized in the OIT program.
- b. Submit operator interface graphic displays (screen shots) for each HMI graphic display for the completed program.
  - c. Submit test reports identifying individual tests that were performed during System Acceptance Testing as specified herein. Testing and demonstration include either Owner or Engineer sign-off and date/time of the testing/demonstration.

#### 1.07. OPERATION & MAINTENANCE

- A. Submit operation and maintenance manuals for control panel equipment and components.
  1. Operation and maintenance manual shall include directions on how to load the PLC and OIT programs from uninstalled spare SD card into a new or existing PLC and/or OIT.
- B. Provide all tools, information, and equipment required to fully maintain or modify the provided OEM panels shall be provided. Tools and equipment shall include, but not be limited to:
  - 1) Documented PLC/HMI source code and configuration files in electronic format.
  - 2) Licensed PLC/HMI development software with installation media.
  - 3) Connecting cables.
  - 4) Network interface devices.
- C. Submit complete and fully annotated PLC and OIT programs. Where the PLC source code contains verifiable copyrighted material, the OEM may submit a formal request to the Engineer and Owner that distribution of the source code be limited. However, electronic copies of the completed (tested, tuned, debugged) PLC and OIT programs shall still be supplied to the Owner to enable them to independently maintain all aspects of the supplied



system, including the ability to upload, download, review logic documentation, and edit all sections of the controller's code and OIT applications.

#### 1.08. PROJECT RECORD DOCUMENTS

- A. Wiring Diagrams - A complete hardcopy set of PLC wiring diagrams shall be provided and permanently attached to the inside door of each control panel. The wiring diagram shall include all shop drawing and field changes and revisions performed during construction.

#### 1.09. COORDINATION

- A. The PLC-based control panel provided per this specification section shall communicate with the plant-wide SCADA system via the Specified Communication Protocol.
- B. Ethernet Addressing - Coordinate IP addressing of all Ethernet networked devices with the Engineer, utilizing IP addresses supplied by the Engineer. Engineer-supplied IP addresses shall be coordinated and configured in networked devices prior to shipment of equipment to the project site. IP address shall be entered into networked devices under this specification section. In the event equipment arrives at the job site without the Engineer-issued IP addresses in-place and fully-functional, the OEM shall bear all costs to promptly send an independently capable programmer to the site with all software and equipment necessary and correct the IP-addressing. Shipping devices to the OEM for such changes is not permissible.
- C. Exchange of System Data with Other PLCs - Coordinate the exchange of data between the PLCs supplied herein and the SCADA system with the Engineer. Coordination shall identify the supplied system's and SCADA system's need for data for operation of the respective systems and shall identify specific data points that need to be communicated, PLC memory addresses where the data will reside, and data point details (data type, range, units, etc.). When peer-to-peer messaging between the OEM's PLC and another PLC is required, the OEM is responsible for composing the PLC logic required to exchange data with other PLCs outside the OEM's scope of supply.
- D. Exchange of System Data with SCADA - Coordinate the exchange of data between the PLCs supplied herein and the plant-wide SCADA/HMI application with the Engineer. OEM shall coordinate data for full monitoring and control of the supplied system's via the plant-wide SCADA/HMI application by way of a PLC memory map. PLC memory map shall be developed and maintained by the OEM. Complete PLC memory maps shall be submitted via shop drawings and approved by the Engineer prior to shipment of PLC-based control panels to the project site. OEM is required to record and send modifications to the PLC memory map within one week of any such changes.

#### 1.10. SPARE PARTS

- A. Each control panel shall be provided with the following spare parts:
  - 1. Ten fuses of each size and type provided.
  - 2. Two lighting fixture lamps.
  - 3. Two PLC power supplies for each type provided.
  - 4. One PLC processor for each type provided.
  - 5. Two discrete input modules for each type provided.

6. Two discrete output modules for each type provided.
7. Two analog input modules for each type provided.
8. Two analog output modules for each type provided.
9. Two 24 VDC Power Supplies for each type provided.
10. Provide one uninstalled spare SD card with the final, debugged program loaded onto it for each supplied PLC and OIT. Label each SD card with the devices to which they are associated.

## PART 2 PRODUCT

### 2.01. GENERAL

- A. Control panels shall include any assembly of electrical components shop assembled in enclosures.
- B. The control panels and associated controls and instrumentation equipment shall be furnished as a coordinated assembly requiring only field connections of the power and control circuits for a complete and operating installation as specified and shown on the Contract Drawings.
- C. Electrical equipment and controls shall be provided as required to perform the control function as shown on the Contract Drawings and specified herein. Controls shall include motor starters, control power transformers, circuit breakers and power disconnecting devices and hardware, control relays, timing relays, intrinsically safe relays, and miscellaneous controls as required, or as specified. Electrical equipment and controls shall be provided in accordance with the specifications contained herein and in Division 16.
- D. The control panel enclosure, components, and controls shall be UL Listed and Labeled. Control panels shall conform to the requirements of UL 508.

### 2.02. ENCLOSURE HVAC

- A. General
  1. Where heat load calculations show a need for enclosure HVAC, provide louvers, ventilation fans, or AC units as specified herein.
  2. Where fans, heaters, or AC units are provided, provide surface mount type thermostats with a temperature range of 40 to 120 degrees F (field adjustable over the entire range). Thermostats shall be provided with a stainless-steel shell. Thermostat contacts shall be rated a minimum of 10 amperes at 120 VAC. Contacts shall close on temperature rise for cooling and open on temperature rise for heating equipment. Insulation bushings and mounting hardware shall be provided as required to mount the thermostats.
- B. Louvers
  1. Control panel louvers shall be constructed of the same material as the enclosure.
  2. Intake louvers shall be provided with washable aluminum air filters used for ventilation. Provide one can of filter spray adhesive for every enclosure.

3. Louvers shall be placed in the rear of the enclosure unless the rear of the control panel is directly adjacent to a wall. For enclosures mounted with the rear of the panel directly adjacent to a wall, place louvers on the side or front of the panel.
- C. Ventilation Fans - Provide forced ventilation fans, with washable aluminum air filters and finger guards. Fans motors shall be operated on 115 VAC, 60 Hertz. power, and shall be provided with integral thermal protection. Motors shall be rated for 20,000 hours of continuous operation without lubrication or service. Fan noise shall not exceed 50 db at 5 feet.
- D. Internal temperature Sensor
1. Characteristics
    - a. Provide one wall mount temperature sensor for each PLC enclosure. Provide all mounting, power supplies and cable needed to connect the sensor to an analog input card on the PLC.
    - b. The temperature range shall be 0 to 135 degrees F.
    - c. The output shall be 4-20 mA.
    - d. The input power shall be 24 Vdc.
  2. Manufacturer – OMEGA EWS-TX or equal

### 2.03. CONTROLS

- A. Contractor shall coordinate with the manufacturers or suppliers of equipment specified in this section to provide an integrated and complete control system.
- B. System control panel shall communicate to the SCADA system through the specified communication protocol.
- C. Where PLC-based control panels are provided:



**ADD #2**

1. PLC manufacturer and model shall be Allen-Bradley, CompactLogix. **The PLC shall provide program capacity to a minimum of 15 steps, shall have (2) built in serial ports, (1) RS485 port and 512 local I/O points as a minimum. The PLC shall be capable of supporting Ethernet, Modbus, Devicent and Profibus communications.**
2. **The control system shall be microprocessor based Direct Digital Control (DDC) and shall have stand alone capability. The controller shall be completely wired, programmed and fully tested before shipment. All testing shall be recorded on the appropriate quality control documents and beprovided as part of the IO&M manual.**
3. **All the control panel components shall be housed in a Nema 4/IP55 enclosure. Enclosure shall bemanufactured from carbon steel and have a polyester power coating applied to the interior and exterior, quarter turn latches and full seamless gasket.**
4. **The system operator shall be capable of starting or stopping the pumps manually and allowing thesystem to operate automatically via a signal from the**

**operator. The pump controller shall include individual H-O-A switches mounted on the panel face**

5. The PLC-based controls for the system shall be based on an open programming environment which allows the Owner to make changes after the warranty period ends. The programming software shall be RS Logix.
6. Local monitoring and control of the system shall be through an 6" OIT panel mounted to the system control panel.
  - a. OIT manufacturer and model shall be Magelis, 2-Line LCD resistive touch screen.
  - b. OIT shall be furnished with an SDRAM card sized large enough to accommodate the historical storage duration as specified herein.
  - c. OIT shall be door mounted with a centerline height 5 feet 0 inches above the finished floor.
  - d. Communications between the OIT and PLC shall be via Ethernet through an Ethernet switch in the system control panel.
  - e. Furnish one licensed copy of the associated OIT configuration software.

**D. The unit shall be mounted in the controller door and shall not affect the Nema rating of the enclosure. The OIT shall be microprocessorbased and hold its firmware in EPROM memory. Online programmable data entries such as system setpoints, calculated results and totalization shall be stored in non-volatile memory. All data and set points shall be field adjustable thought an escalating series of passwords. All the set points shall be modifiable though the controller mounted OIT using standard engineering units such as system flow (GPM), system pressure (PSI), elapsed pump runs time and feet of head. The program shall be modifiable by remote operator as well via optional SCADA system.**

 **ADD #2**

1. **The operator display shall be provided in a single integrated graphic display screen with a separate processor for control.**
2. **The OIT shall be suitable for mounting in a door a Nema 4 enclosure so that it maintains theenclosures Nema 4 rating.**
3. **The OIT shall be mounted at a suitable height to assure proper visibility and easy access by theoperator.**
4. **The OIT shall provide as a minimum the following:**
  - a. **CPU: Minimum 32 bit Micro-controller / 206.4 MHz.**
  - b. **System memory: 8Mb:**
    - 1) **Program: 7Mb.**
    - 2) **History: 360Kb.**
    - 3) **Recipe: 128 Kb.**

- 4) Alarm: 16Kb.
  - 5) Data: 64Kb volatile/1Kb non-volatile.
  - 6) Backup memory: 512Kb.
- c. Storage memory: SM card and USB memory disk capable.
  - d. Serial ports: Total 3, with at least two (2) ports configurable for RS232/422/485.
  - e. Ethernet Expansion Module: provides Ethernet RJ-45 connector port with Auto MDI/MDX, 10/100 mps auto detection.
  - f. The HMI shall be industrial rated and certified for the following conditions:
    - 1) Relative humidity 10% to 90% @0-40°C, 10%-55% @41-50°C
    - 2) Vibration: 30G@ 11msec
    - 3) The HMI shall be industrial rated and certified for agency approval for the following:
      - 4) IP65 /Nema 4/CE/UL/CUL/C-TICK
      - 5) The OIT shall be certified for compliance with electromagnetic immunity susceptibility for the following:
        - a) EMC directive 89/336/EEC + 92/31/EEC + 93/68/EEC, EN61132.
5. The system controller shall include a pump failure alarm for each pump. The pump alarm shall consist of a differential pressure switch of the current switch type with adjustable time delay, alarm light and manual reset. When pump failure is detected, the pump shall be stopped and locked out of service until the alarm is manually reset via a panel mounted reset button. The control system will upon pump failure replace the failed pump with the next pump in the sequence
  6. U.L./C-U.L. 508 Label:
    - a. Single point power connection.
    - b. Through door control power disconnect with safety interlock to prevent door from being opened while in ON position.
    - c. Fused 120 V AC control voltage transformer.
    - d. Fused 24 V DC power supply, 1 Watt.
    - e. Suction and system pressure transducers:
      - 1) All wetted parts are to be stainless steel.
      - 2) 4-20 mA signal with a minimum accuracy of  $\pm 0.075\%$ .

- f. **Micro Controller: PLC with non-volatile memory (battery backup not required).**
- g. **Operator interface: 6-inch blue scale touch screen OIT including but not limited to the following:**
  - 1) **Main Screen with the following features:**
    - a) **Individual pump HOA (Hand – Off – Auto) switches.**
    - b) **Pump run indication, including current % speed.**
    - c) **Pump Failure indication.**
    - d) **Current pressures readings in psig (suction and system).**
    - e) **Current flow in GPM.**
    - f) **Adjustable manual (hand) speed setting.**
    - g) **Direct access to menu screen.**
  - 2) **Menu screen providing direct access to all system settings and status screens.**
  - 3) **Pump settings screen displays current settings and allows user changes:**
    - a) **Lead and lag pump start and stop pressures, psig.**
    - b) **Lead and lag pump ON and OFF delay times, seconds.**
  - 4) **Alarm settings screen displays current settings for all alarms and allows userchanges:**
    - a) **Low suction alarm setting. Initial setting 70 psig**
    - b) **Low Low suction alarm setting. Initial setting 65 psig**
- h. **Low suction pressure, psig.**
- i. **Low Low suction pressure, psig.**
- j. **ON and OFF delays, seconds.**
- k. **Manual or automatic reset:**
  - 1) **Low system alarm setting.**
  - 2) **Low Low system alarm setting.**
- l. **Low system pressure, psig. Initial setting 124 psig.**
- m. **Low Low system pressure, psig. Initial setting 120 psig.**

- n. **ON and OFF delays, seconds.**
- o. **Manual or automatic reset:**
  - 1) **High system alarm setting.**
  - 2) **High High system alarm setting.**
- p. **High system pressure, psig. Initial setting 135 psig.**
- q. **High High system pressure, psig. Initial setting 140 psig.**
- r. **ON and OFF delays, seconds**
- s. **Manual or automatic reset:**
  - 1) **High suction economy mode.**
- t. **Economy mode suction pressure, psig.**
- u. **Economy mode enable / disable.**
- v. **ON and OFF delays, seconds:**
  - 1) **Separate Alarm Silence and Alarm Reset buttons.**
  - 2) **Current system status screen displays:**
    - a) **Pump(s) currently running.**
    - b) **Active alarms and warning messages.**
  - 3) **System event history screen displays a minimum of the last 10 system events, including pump start /stops, alarm conditions and alarm acknowledgements.**
  - 4) **Pump run time screen displays the total operating time for each pump. Provide individual resets for each pump run time.**
  - 5) **Lead pump alternation options will include:**
    - a) **Automatic alternation on lead pump shutdown.**
    - b) **Manual alternation when operator touches alternate button**
    - c) **Timed alternation:**
      - i. **Daily (user specified time of day)**
      - ii. **Weekly (user specified day of week and time of day)**
      - iii. **Monthly (first week of month on user specified day of week and time of day)**

- 6) **Multi-Level Security:**
  - a) **8 Password protected security levels (field changeable passwords).**
- 7) **Common alarm relay provides dry contacts for customer monitoring.**
- 8) **Alarm horn, 85 db, announces all alarm conditions.**

1. Ethernet Switch

a. General

- 1) Provide DIN-rail mounted Ethernet switches in each PLC-based control panel with a minimum of 6 copper Ethernet ports.
- 2) Specifications
  - a) Unmanaged, industrial grade switch
  - b) DIN-rail mounted, fanless design.
  - c) Manufacturer-rated for industrial use, including temperatures of 0 to 60 degrees C, humidity 10 to 95 percent non-condensing, and an Mean Time Between Failures (MTBF) manufacturer rating greater than 40 years.
  - d) IEC 60068-2-27 conformity for shock. Capable of withstanding 18 shocks at 15 g of 11 ms in duration.
  - e) IEC 60068-2-6 conformity for vibration.
  - f) EN 61000-4 conformity for immunity to electro-magnetic interference (EMI).
  - g) Removable terminal blocks with screw compression.
  - h) Capable of being powered from redundant/dual DC power supply sources.
  - i) LEDs for Link and Activity per port. Failure LED for switch.
- 3) Manufacturers shall be:
  - a) Allen-Bradley, Stratix 2000 Series.
  - b) Phoenix Contact, 1000 Series.
  - c) Moxa, EDS-408 Series.
  - d) Or equal.



e) N-Tron equipment is not acceptable

2. SCADA System Integration

- a. All status, control, and alarm functions shall be accessible through the SCADA system. At minimum, all monitoring, control, and functionality accessible from the system's OIT shall be available through the SCADA system via communication between the plant's HMI application and the supplied PLC program.
- b. All calculations and derived conditions shall be accessible in registers within the PLC. All scaling shall be performed within the PLC to ensure that scaled values are accessible to SCADA directly from registers within the PLC.
- c. Coordinate data to be shared with the SCADA system through the PLC memory maps and static OIT graphic prints specified to be provided by the manufacturer herein.
- d. Controls shall allow for alarm acknowledgement through the SCADA system. The manufacturer's programmer shall be available for a minimum two-week duration to coordinate and test the alarms and remote datalogging of the system.

2.04. ELECTRICAL SYSTEMS

1. Fuses

- a. Provide fuses as required and specified for protecting individual control circuits and systems. Fuse ratings shall be sized to protect the equipment served per the requirements of the National Electric Code.
  - b. Each PLC I/O Module shall be individually fused.
2. Surge Protection - Each control panel shall be provided with transient voltage surge arresters on the incoming power supply as required to protect the equipment from voltage surges. Control and Instrument circuits which enter/exit the building or structure shall be furnished with surge protective devices.

B. Terminal Blocks

1. General

- a. Terminal blocks shall be feed through, single level, and suitable for DIN rail mounting. Terminal blocks shall be fabricated complete with marking strip, covers, end plates, partitions, and screw type pressure connectors. Terminal blocks shall be screw connector type, tin-plated copper.
  - b. Terminal blocks shall be UL listed, rated for 600 VAC, 35 amperes unless otherwise noted.
  - c. Not less than 25 percent installed spare terminals shall be provided.
  - d. Terminal blocks for external connections shall be suitable for No. 12 AWG wire.
2. Terminal blocks for low voltage instrumentation circuits shall be rated for 300 VAC, 10 amperes.

3. Separate terminals shall be used for AC and DC voltages. These terminals shall be labeled AC and DC and shall be provided with two distinct colors. Separate wireways shall be installed for AC and DC voltages. AC and DC wiring shall be kept separate at all times.
  4. Fuse terminal blocks shall be provided with LED blown fuse indicators and shall be capable of being disconnected without the use of any special tools.
  5. Ground terminals shall be green.
  6. Terminal blocks shall be located in the bottom of the panel, except where otherwise shown or noted. Terminal blocks shall be located near the doors or access panels of the enclosures to facilitate field wiring connections. Minimum spacing between terminal blocks shall be 5 inches and a minimum of 4 inches all around. Duplicate terminals shall be used to limit the number of wires at one terminal to two.
  7. Terminals shall be labeled to agree with identification shown on OEM's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable.
    - a. Wires shall be numbered using wire markers. Wire numbers shall agree with terminal numbers, submittals, and remote equipment wiring designations.
    - b. Terminal blocks shall be numbered with a high resolution, wipe resistant label. Phoenix Zack strip or equal.
  8. Provide a screwdriver with blade suitable for operating each type of terminal screw provided.
  9. Terminal blocks shall be as manufactured by:
    - a. Phoenix Contact.
    - b. Equal.
- C. Internal Wiring
1. Internal instrument and component device wiring shall be as normally furnished by the manufacturer.
  2. Wiring, except where noted, shall terminate on panel terminal blocks. Wiring shall be from terminal to terminal with no splices. Wiring from external devices shall terminate at the panel's field termination terminal blocks.
  3. Instrumentation circuits shall be shielded.
  4. Tie-wraps used for bundling wire shall be cinched carefully to eliminate grooving the insulation.
  5. Each control loop or system shall be individually fused, and fuses and circuit breakers shall be clearly labeled and located for easy maintenance.
- D. Circuit Identification

1. Devices mounted on or within the enclosures shall be permanently identified. The device and terminal identifications shall agree with those shown on the Contract Drawings.
  2. Circuit identification shall be as specified in the Section 16050, Electrical General.
- E. Device, junction, pullboxes and other conduit system accessories shall be as specified in the Section 16050, Electrical General.
- F. Grounding
1. Enclosures shall be provided with two grounding lugs located on opposite sides of the enclosure for connection to external grounding system.
  2. Provide a ground bus in each cabinet or panel for the shield and signal grounding circuits.

## 2.05. ANCILLARY EQUIPMENT

### A. 24 VDC Power Supply

1. Provide a sufficient quantity of 24 VDC power supplies as necessary to power PLC equipment and instrumentation connected to the PLC.
2. Power supplies shall be manufactured by PULS, Phoenix Contact, Allen-Bradley, or equal. Power supplies shall meet, or exceed, the following requirements.
  - a. UL 508 listed, CE approved.
  - b. DIN-rail mounted.
  - c. Removable, pluggable connections for input and output power.
  - d. Local output status indication light.
  - e. Overload Protection - Current limited to a preset value.
  - f. 89 percent efficient.
  - g. Output Voltage - 24 VDC +5 percent adjustable.
  - h. Temperature Range - -20 to 50 degrees C.
  - i. Mean lifetime of 500,000 hours.
  - j. Two-year warranty.
  - k. Ripple and Noise - 24 mV RMS, 200-mV peak to peak.
  - l. Accept input voltages of both 120 VAC and 240 VAC.
  - m. Fully enclosed, touch-safe.
  - n. Integral LEDs indicating DC Power ON.

## 2.06. CONTROL PANEL IDENTIFICATION

- A. Control panels and enclosures shall be provided with nameplates on the exterior of each enclosure identifying the application function of the equipment enclosed such as "Filters 4, 5, and 6 Control Panel ". Nameplates shall be mounted directly above equipment.
- B. In addition, for selector switches and/or pushbuttons, a factory installed legend plate shall be provided to indicate the function each station performs, such as "On" or "Off."
- C. Nameplates shall be engraved 1/4-inch high (1/2-inch high for enclosure titles) black capital letters on a 1/8-inch thick plastic black tag with white letters mechanically attached to enclosure. Lettering shall be in capitals except as shown. Nameplate text shall be as shown or scheduled on the Contract Drawings.
- D. Legend plates shall be metal with black lettering mechanically attached to control panel.
- E. Interior mounted components and equipment shall be provided with nameplates. Nameplates shall be located adjacent to, but not on, the given device and visibility shall not be obstructed by wire bundles or other equipment. Nameplates shall include device identification number as well as descriptive name.
- F. Enclosures shall be provided with instruction plaques indicating any warnings or special instructions required by the component manufacturers. Warning plaques shall be red with white lettering.
- G. Control panels that contain wiring fed from multiple external power sources shall be provided with a nameplate on the front of the enclosure indicating:

"WARNING - THIS PANEL IS FED BY MULTIPLE POWER SOURCES"

- 1. Nameplates shall be permanently secured to enclosures and back panels.
- 2. Each panel shall be provided with short circuit current rating information included on the nameplate.

## PART 3 EXECUTION

### 3.01. CONTROL PANEL FABRICATION

- A. General
  - 1. Fabricate control panels, install instruments and components plumb, and wire in the factory. Test wiring and check plumbing prior to shipment.
  - 2. Use panel fabrication techniques that allow for removal and maintenance of all equipment after installation.
  - 3. Cut, punch, or drill cutouts for panel-mounted instruments and smoothly finish with rounded edges.
  - 4. Place knockouts for the wiring of freestanding panels either at top or bottom of the panel. Cover holes for future devices with a plastic plate.

- B. Wiring - Panel wiring shall be installed by the panel manufacturer and shall be brought out to identified terminal blocks. Interwiring between panel sections shall be from terminal blocks to terminal blocks. Terminal blocks for panel wiring shall be correlated with those for the electrical equipment by the panel manufacturer.
- C. Component Location
  - 1. Equipment shown or specified to be furnished with the panels shall be mounted by the panel manufacturer. Panel-mounted controls shall be located such that they are easily accessible. Panel-mounted controls and components shall be mounted a minimum of 42 inches above grade or finished floor and a maximum of 72 inches above finished floor. The panels shall be furnished as completely assembled units, requiring only field connections of power and control wiring.
  - 2. The location for intake and exhaust louvers shall be coordinated with the panel and adjacent panels and existing conditions to avoid short circuiting of air flow and to avoid putting louvers adjacent to walls.

### 3.02. PROGRAMMING

- A. The following programming requirements are intended to supplement the functionality and performance required in the OEM's system specification(s).
- B. Test recovery of each uninstalled spare SD card provided on the running process of each supplied PLC and OIT prior to supplying SD cards to the Owner. Each supplied SD card shall be tested to validate that recovery from the SD card is all that is required to restore a device to fully operational condition, including the appropriate IP address and tested/tuned/debugged alarm and control setpoints. Testing of SD card recovery shall be witnessed by Owner.
- C. PLC Programming
  - 1. All logic, calculations, and specified functions shall be performed in the PLC/microprocessor, not in the OIT.
  - 2. Derived Conditions – At a minimum, provide the following derived conditions for each instance of the following inputs:
    - a. Run Indication – From an equipment's running/not running status, derive:
      - 1) Running Runtime Hours – Resettable, free-running totalization of the equipment's total runtime hours, accurate to the tenths. Accumulated total shall be capable of being over-written by writing to the same register used to display the running total, i.e. manipulation of external datapoints shall not be required to reset the total. Datatype: Floating Point
      - 2) Running Start Counts – Resettable, free-running totalization of the quantity of start counts. Increase start counts by 1 each time the run status transitions from False to True. Datatype: Integer.
    - b. PLC Clock and Hours – Provide access to the PLC clock hours and minutes datapoints that control timed functions within the PLC logic, including logic that resets Daily Running Flow Totals. Provide one datapoint for PLC Clock Hours and separate datapoint for PLC Clock Minutes. Provide a third Clock

Synchronization datapoint to facilitate reset of the PLC clock to 03:00 hours upon transition from False to True. PLC logic shall automatically reset the Clock Synchronization datapoint to 1, 10-seconds after the clock is reset.

- c. Flow Totalization – For each flow signal, both derived as well as physical, derive:
  - 1) Running Flow Total - Resettable, free-running totalization of flow in units of gallons, thousands of gallons (kgal), or millions of gallons (MG). Accumulated total shall be capable of being over-written by writing to the same register used to display the running total, i.e. manipulation of external datapoints shall not be required to reset the total. Datatype: Floating Point
  - 2) Daily Running Flow Total – Non-resettable totalization of flow over a 24 hour period to be selected by the Engineer, Default: midnight. Datatype: Floating Point.
  - 3) Yesterday's Flow Total – Non-resettable display of accumulated flow over the previous 24 hours, as such, datapoint shall only change in value once per day at a time that correlates to the reset time for the Daily Running Flow Total. In short, at the reset time for the Daily Running Flow Total, transition the accumulated total from the Daily Running Flow Total into Yesterday's Flow Total immediately prior to resetting/zeroing the Daily Running Flow Total. Datatype: Floating Point.
3. Program logic shall allow all setpoints that are adjustable through the OEMs OIT to be adjusted from the plant's SCADA/HMI application. Through the PLC/microprocessor memory map coordination, offer recommendations on setpoints that: are commonly adjusted, should only be adjusted locally, and those that may be adjusted with limitations.
4. Software Protection – All programs shall be the property of the Owner and the Owner reserves the right to review, modify, and support all aspects of the supplied PLC/microprocessor and OIT programs by businesses of their choosing, which may not be the original equipment manufacturer in all circumstances. Electronic copies of all developed programs shall not be password protected nor utilize functions that may only be edited with external software not supplied with the system.
5. Annotation – All PLC logic shall be annotated to describe purpose of individual coils, function blocks, and contacts; and function of individual programs and subroutines. All annotations shall be in English.

D. Local Operator Interface Terminal (OIT) Programming/Configuration

1. The OIT application shall utilize three specific regions of the overall OIT screen for the following functions: Title Bar, Main Graphic Region, and Navigation Region. Regions shall occupy the identical regions as graphics are navigated from screen-to-screen, meaning that the margins of each region shall not appear to shift between screens during navigation.
  - a. Title Bar – Facilitate security login and logout functions, display currently logged in user, display date/time in MM/DD/YY HH:MM AM/PM format, and an alarm banner displaying the most recent 5 alarms. Alarm banner shall display

acknowledge status, date and time alarm initially became active, and the approved description of the alarm condition.

b. Main Graphic Region – Main region to display individual graphics. At a minimum, provide the following Main Graphics:

- 1) System Overview – Animated process flow diagram of the OEM's supplied process illustrating the operational states of major components and key process values.
- 2) Unit Overview (as applicable) – Graphical interfaces that are normal for the OEM core offering and conform to the requirements specified herein.
- 3) Alarm Summary/History – Complete list of alarms identifying date and time original alarm time, acknowledged status, alarm description, and current alarm state, i.e. Normal or Active.
- 4) Trending Screens – Provide multi-pen trends to demonstrate the status and performance of the overall system, individual unit processes, and key process data. Provide access to a minimum of 10 days of historical data locally. At a minimum, all analog input data, key derived process data, and all run statuses shall be trended.
- 5) About Screen – This is the only permissible location to display the OEM's name. Graphic shall also display: Programmer's company, address, and contact information; Install Date; PLC program software version; and OIT software version.
- 6) Security Login/Logout Screen – Controls to login and logout and setpoints to adjust the PLC clock time and date.
- 7) Equipment status animation colors shall be as follows:

Function	Color
Equipment running	Green
Equipment Off (Ready)	Red
Failure / Fault	Yellow

- 8) exceeds the quantity of buttons that may be listed across the bottom of the screen in a single row, provide Main Menu and Setpoints buttons that launch a Main Graphic Region window that provides button links to all Main Graphic Region windows.
- 9) If the quantity of Main Graphic Region graphics may be linked in a single row of buttons across the bottom Navigation bar, then do so.
- 10) Buttons shall always appear in the same relative position between screens.
- 11) When the currently selected screen is open/presented, button text shall appear different to indicate that it is the currently open window.

2. Historization – OIT shall be provided with a removable SDRAM card for the storage of data collected by the respective OIT. SDRAM card shall be appropriately sized to accommodate the required configuration that follows:
  - a. Storage Duration – 30 days
  - b. Storage Frequency – 30 seconds maximum.
  - c. Historized Data – Where the following data exists in the supplied system, historize the following: Running/Not Running Statuses, equipment staging statuses (lead/lag/standby, primary/standby, etc), analog levels, flows, analytical process data, temperatures, speeds, and derived runtime and flow totalization data.
3. Alarms shall be synchronized between all Filter system OITs such that at any given instant the same alarms and alarm states appear in each OIT alarm banner.
4. Configuration of each Filter System OIT shall be such that removal of any single OIT shall not affect the ability of other OITs from being fully functional. As such, all OIT datapoints shall reference the appropriate PLC directly, rather than referencing data from other OITs.
5. OEM shall program user-adjustable time delays accessible through the respective system's OIT as necessary to mitigate nuisance operation of alarms.

### 3.03. INSTALLATION

#### A. General

1. Contractor shall verify placement of panel prior to fabrication and all shipping splits shall be provided.
2. Panels shall be grounded and all equipment and circuits included in the panels, as shown or required to be grounded, shall be connected to the grounding conductors.
3. The panels shall be installed as shown and directed. The final control panel locations shall be coordinated by the Contractor to avoid interference with standard operation and maintenance practices of the adjacent equipment. Wiring shall enter the panels as shown or specified.
4. Wall-mounted control panels butting to masonry walls shall be provided with closure strips to seal the opening between the panel and the masonry.

#### B. Wire Labeling

1. All wiring shall be labeled within 1.0-inch of stripped sheathing.
2. Wire label text shall be visible in its installed location without manual manipulation.
3. Wire shall carry the same wire number for an entire contiguous segment.
4. Wires shall be labeled via machine-generated print on polyester or polyvinyl film.



5. In the event that labels begin to fall off or text begins to smudge, or otherwise begin to become illegible, within one year of panel delivery to the site, the Contractor shall remove all labels within the panel with new labels at the Contractor's own expense. In this case, the Engineer must approve replacement labels.
- C. Device Labeling - All subpanel mounted devices shall be labeled.
1. Devices that do not require external power (24 VDC or 120 VAC) shall be labeled via machine-generated print on polyester or polyvinyl film. Print shall not be capable of being washed off, smudged, or erased. Labeled components include, but are not limited to, individual terminal blocks, control relays, individual fuses, individual I/O surge suppressors, and grounding bars.
  2. Devices that require 24 VDC external power or 120 VAC shall be labeled via machine engraved plastic nameplates utilizing white text on black background. Nameplates shall be secured to the subpanel via permanent adhesives. Labeled components include, but are not limited to, disconnect switches, TVSS, power supplies, PLC backplanes, circuit breakers, DIN-rail strips, radios, Ethernet switches, UPSs, and convenience receptacles.
  3. Exemptions – Individual PLC I/O modules only.
- D. OEM-Fabricated Cabling – All cabling fabricated by the panel fabricator.
- E. Control Wiring - Contractor shall include time to install/replace/provide additional control and interlock components and wiring for each starter/VFD assembly as directed by the Engineer in the field. Modifications shall be performed as required to provide electrical interlocks and interface wiring to obtain a complete and operating control system.

#### 3.04. SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Installation - A manufacturer-approved field technician shall inspect the equipment installation and confirm installation is in accordance with manufacturer's recommended installation requirements. If installation is found to not follow manufacturer's recommended mounting methods, Contractor shall modify installation per manufacturer's recommendation at no additional expense.
- B. Final Acceptance – An OEM-approved field technician shall perform the following tests:
1. After the OEM's programmer has completed installation of the new PLC logic and tested/tuned/debugged the PLC programs and OIT programs the OEM shall perform a final witnessed demonstration to the Owner and Engineer. OEM's technician shall demonstrate the all alarming and user-adjustable alarm and control setpoints function as specified in the Contract Documents.
  2. Upon completion of the final witnessed demonstration, disconnect all power from the OIT and PLC to demonstrate that setpoint values persists. Power down the OIT in each filter control panel demonstrate that the remaining filter control panel OIT remains capable of adjusting the associated setpoints and monitoring the status of the unified filter system. Demonstration shall be witnessed by Owner and documented.
  3. System Acceptance Testing (SAT) - The OEM's representative shall be capable, prepared, and authorized to modify the PLC program, OIT program, navigate the OIT program, perform testing of control panel wiring, and perform testing of network

communications as required to demonstrate that the SCADA system HMI application accurately monitors the status of data generated by the supplied system.

- a. Through this SAT, the OEM's representative shall lead a structured process of triggering each data point of the supplied system monitored and/or controlled by plant SCADA system. The OEM-supplied PLC memory map, which serves as the basis for monitoring and control of the supplied system in the supervisory program, will be utilized as a guide for data points to be tested. A SCADA system programmer will participate in the SAT by monitoring the plant's supervisory application remotely and will communicate the success of each demonstrated data point to the manufacturer's representative by mobile phone.
  - b. The OEM's representative shall be capable of performing these services without remote technical support. Services shall be scheduled by the Engineer in writing and shall be performed within four weeks of the Engineer's request. This on-site time may be requested to be split up into separate day-long visits and do not count towards, and may not be combined with, other on-site time specified herein. All time is expressed as on-site time and, as such, travel to and from the project site shall not apply towards the specified onsite time.
- C. Training – Provide onsite training to the Owner on to demonstrate recovering specific device programs loaded onto uninstalled spare SD cards. Utilize the approved version of the O&M manual as a handout during the onsite training session.
- D. FIELD QUALITY CONTROL
- E. Field Testing and Demonstration - Control panels shall be tested for proper operation and operational sequencing. Proper operation of control panels shall be demonstrated to the Engineer. Testing and demonstration shall be performed by a qualified service representative of the control panel fabricator or manufacturer. Submit field test reports.

### 3.05. TESTING AND STARTUP

- A. Testing and startup shall be performed in accordance with Sections 01660, Testing and Startup and as specified herein unless otherwise noted.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Control Panel Testing
  1. Contractor shall demonstrate the successful operation of the following pump control panel features for each individual pump and/or system:
    - a. Control Panel Power Distribution
      - 1) Energization Test
      - 2) Circuit Breakers
      - 3) Dc Power Supply
      - 4) Fusing
      - 5) E-Stops

- b. Pilot Devices
  - 1) Pilot Lights – PTT Feature
  - 2) Elapsed Time Meter
  - 3) Digital Indicator Operation
  - 4) Alarm / Strobe Lights
- 2. The control panel shall be tested for proper operation and operational sequencing. Testing and demonstration shall be performed by a qualified service representative of the OEM.
  - a. Hand Operation
  - b. Automatic Operation
  - c. Power Failure Cycle/Restoration – Demonstrate that cycling power to PLCs and OITs shall not clear alarm and control setpoints upon power restoration.
  - d. Alarm Sequencing
    - 1) Alarm Annunciation – Visual
    - 2) Alarm Annunciation – Remote Supervision
    - 3) Alarm – Silencing
    - 4) Alarm Acknowledgement
    - 5) Alarm Reset
  - e. Equipment Fault Conditions
    - 1) All actuator failure conditions
  - f. System Interlocks



END OF SECTION

SECTION 16421

UTILITY SERVICE ENTRANCE

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. ~~New electrical service from existing Outdoor Service Equipment (to be installed by the Owner in anticipation of this Contract) as indicated to new Electric Building.~~
-  **ADD #2** B. ~~This includes temporary overhead pole line to existing Operations Building, Temporary Backup Generator and Manual Transfer Switch at the Operations Bldg.~~
- C. ~~Removal of temporary service provisions after new permanent service extensions are installed by this Contractor or directed by the Engineer.~~
- D. Scheduling.
-  **ADD #2** E. **Underground service entrance.**
- F. **All coordination and scheduling with Electric company.**

1.02. RELATED SECTIONS

- A. All sections of Division 1- General Requirements.
- B. Section 02300 – Earthwork.
- C. Section 02700 – Piped Utilities.
- D. Section 16050 – General Electrical Work.
- E. Section 16110 – Raceways.
- F. Section 16120 - Conductors.
- G. Section 16196 - Electrical System Identifications.
- H. Section 16442 - Disconnects and Safety Switches.
- I. Section 16620 - Packaged Engine Generator Systems.

1.03. REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.
- B. First Energy / Met-Ed Electric - Information and requirements for electric service.

1.04. SYSTEM DESCRIPTION

- A. Utility Company (Electric) – Baltimore Gas and Electric (BGE):
  - 1. 277/480 Vac, 3-phase, 4-wire, 60 Hertz, minimum 200amperes.

2. Service Entrance - Underground.
3. BGE Account #479943181. New Business Call Center – 800.233.1854. Service Request #05192686.
4. The Utility will have completed their work associated with the new Electric Service.

#### 1.05. SUBMITTALS

- A. Submit under provisions of Sections 01300 - Submittals and 16050 - Electrical General.

#### 1.06. QUALITY ASSURANCE

- A. Perform work in accordance with utility company written requirements.
- B. Maintain one copy of utility company and inspection agency documents on site.

#### 1.07. REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70 (electric) or NFPA 54 (natural gas fuel).
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. or other third-party testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.
- C. Conform to requirements of the utility.

#### 1.08. FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on utility company drawings.

#### 1.09. EXISTING SYSTEM

- A. The Contractor shall schedule and coordinate his work so that at no time shall service to any existing equipment or other customers be interrupted, except when specifically approved by the utility or the Owner.

### PART 2 PRODUCTS (NOT APPLICABLE)

### PART 3 EXECUTION

#### 3.01. EQUIPMENT INSTALLATION

- A. Install service disconnect and, meter socket and pullbox as indicated on the drawings.
- B. Install conduits and wires to the point of utility connection.
- C. Provide sufficient slack of wires on the top of the pole. Final connection by utility company.

#### 3.02. EXAMINATION

- A. Verify conditions under provisions of Section 01040 - Project Coordination.

- B. Verify that electric service equipment and generator are ready to be connected and energized.
- C. Provide inspection certificates.

3.03. PREPARATION

- A. Coordinate location of utility companies' facilities to ensure proper access is available.

END OF SECTION