Addendum No. 6

PROJECT:	**Brainerd Golf Course Pump Station Safety Improvements**
Project No.:	W-16-023-201
OWNER:	City of Chattanooga, Tennessee
ENGINEER:	BARGE DESIGN SOLUTIONS 1110 MARKET STREET, SUITE 200 CHATTANOOGA, TENNESSEE 37402
ISSUED DATE:	February 8, 2019
BID DATE:	February 14, 2019, 2:00 PM Local Time

ALL BIDS SHALL CONFORM TO THIS ADDENDUM:

This addendum is an amendment to the bid documents for the referenced project, and as such will be made part of the contract documents. Acknowledge receipt of this addendum on the Bid Proposal. Failure to do so may subject the bidder to disqualification.

SPECIFICATIONS

1. Refer to Specification Section 43 23 22 "Suction Lift Diesel Driven Pump". Section 2.1 has been revised to include the model numbers for the acceptable pumps per manufacturers or equal. Section 2.2 J has been revised to include the option of using a vendor provided swing check valve. Section 2.3 E has been revised to state that the primary fuel tank will also be accepted if it is galvanized treated.

2. Refer to Specification Section 46 09 25 "Instrumentation, Pump Control System & Remote Terminal Unit". Section 2.3A has been revised to state that only 5MB of user memory shall be provided for the PLC. Section 3.2 has been revised to include monitoring for the Suction Lift Diesel Driven Pump including run status, runtime, starts, common alarm, and level. The part number in Section 3.3 for the PLC & Communications has been revised to from IC695CPE330 to IC695CPE305.

QUESTIONS

1. **Question:** There is no detail for the 3" ARV, the 8" swing check valve and piping in the above grade portion of the pump discharge and how it gets to below grade. Please advise.

   Response: The orientation is dependent on the pump selection, however, refer to the attached sketch for general piping and valve layout. The 8"x6" eccentric reducer, 8" swing check valve, and the 3" ARV are all to be located above ground. Above grade piping to be flanged.

ATTACHMENTS:

- Revised Specification Section 43 23 22 "Suction Lift Diesel Driven Pump".
- Revised Specification Section 46 09 25 "Instrumentation, Pump Control System & Remote Terminal Unit".
- Sketch of general piping and valve layout for bypass pumping.

This addendum consists of 2 Pages and 3 Attachments.

CITY OF CHATTANOOGA, TENNESSEE

February 8, 2019
Date

Department of Public Works

Part 1 General

1.1 Scope

A. Work described in this Section includes furnishing all labor, equipment, materials, tools and incidentals required for a complete and operable installation for a six-inch sound attenuated diesel skid mounted pump. All equipment shall be installed and tested in accordance with these Specifications and the manufacturer's recommendations.

B. Pumps shall be specifically designed for pumping raw wastewater containing solids, rags, debris and other fibrous materials without clogging.

C. The pump shall be delivered to the owner within 16 weeks of contract commencement or as stated in the notice to proceed.

1.2 Design Requirements

A. It shall be the bidder's responsibility to carefully examine each item of the specification. All variances, exceptions, and/or deviations shall be fully described in the shop drawing submittal.

B. The pump specified in this section will be used to pump raw sewage.

C. The pump and accessories shall be supplied by the pump manufacturer.

D. The pump priming system shall be capable of generating 25 in Hg (28 feet) of vacuum at sea level.

E. The engine and pump shall be completely enclosed inside an acoustical enclosure to reduce pump and engine noise to 69 dBA or less at a distance of 23 feet (7 meters).

F. Units described shall be new, unused and of the current year's production. Unit shall be of the latest design and in current production, completely serviced, ready for work, and shall include all standard and optional equipment as specified herein.

G. Suppliers shall have a fully stocked parts and service facility within 100 miles of the City of Chattanooga.

H. A one-year Parts and Labor Warranty issued by the manufacturer on the backup pumping system shall be provided. This warranty must cover all pump parts, including the mechanical seal.

1.3 Submittals

A. Submit shop drawings in accordance with the requirements of Section 01 33 23 of these Specifications.

B. Shop drawings shall be prepared and assembled by the manufacturer. Shop drawings prepared and assembled by manufacturer's sales representatives, fabrication shops or other than the listed manufacturers will not be accepted.

C. Operation and maintenance manuals shall be furnished in accordance with the requirements of Section 01 78 23 of these Specifications.

D. A copy of the engine manufacturer's parts and labor warranty shall be furnished in accordance with the requirements of Section 01 78 36 of these Specifications.

E. Submit manufacturer's "Installation and Start-up Certification" in accordance with Section 01 75 16.

1.4 References

A. ANSI (16.5) - Standard for Cast Iron Pipe Flanges and Flanged Fittings

Part 2 Products

2.1 Acceptable Manufacturers

A. The pump shall be a Model NC150S, size 6" x 6" as manufactured by Godwin Pumps or Cornell 6NNT MODEL – DP74 6X6 as manufactured by Dragon.

2.2 Design Conditions

A. Pump shall be capable of the following:

Maximum Operating Speed	1,800 RPM
Impeller Diameter	11.3 inches
Suction Size	6 inches
Discharge Size	6 inches
Maximum Suction Lift	28 feet
Primary Duty Point (including 17-foot dynamic suction lift	875 GPM at 33 feet TDH

B. Pump shall be fitted with a fully automatic priming system incorporating an air compressor and air ejector assembly. The compressor shall be mounted as an integral part of the pump rotating assembly and be driven via an HTD cog belt off of the pump shaft. It shall be lubricated via the diesel engine oil pump. The compressor belt shall be tensioned via an adjustable belt tensioner. The belt shall be removable without separating the engine flywheel from the pump end. The priming system shall require no fail-safe protection float gear or any adjusting at high or low suction lifts.

The pump must be capable of running totally dry for periods up to 24 hours, then re-priming and returning to normal pumping volumes. Pump and priming system are capable of priming the pump from a completely dry pump casing. Equipment acceptance shall be contingent upon the pump's ability to run continuously at full speed in a completely dry condition.

C. Pump castings shall be cast iron. Pump design shall incorporate a direct suction flow path that is in axial alignment with the impeller eye. There shall be no turns, chambers, or valves between the suction flange and the impeller eye.

D. The impeller shall be of ASTM A-532 (Alloy III A) 25% chrome cast iron) or CD4 MCU impeller and wear ring, dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The screw-shaped leading edges of the impeller shall be hardened to HRC-30 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impellers and shaft fixing shall be splined.

E. Wearplates shall be fully adjustable and replaceable, fabricated of cast iron. Wear plate clearances shall have no relationship to the ability of the pump to achieve a prime. The front or inlet wear plate shall be a replaceable inert ring with a cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of (ASTM A-532 (Alloy III A) 25% chrome cast iron) and shall provide effective sealing between the multi-vane semi-open impeller and the volute.

F. Pump shall be fitted with a bearing bracket to contain the shaft and bearings. Bearings shall be roller bearings of adequate size to withstand imposed loads for sustained pumping at maximum duty points. Minimum ISO L10 bearing life to be 100,000 hours. The installation of the pump shaft and bearings shall not require shims or adjustment. The splined impeller shaft shall be fabricated of carbon steel.

G. Seals shall be high pressure, mechanical, self-adjusting type with silicon carbide faces capable of withstanding suction pressures up to 58 psi. The mechanical seal shall be cooled and lubricated in a liquid bath reservoir, requiring no maintenance or adjustment. The lip-seal shall ride on the mechanical seal sleeve and make no contact with the pump shaft. Pump shall be capable of running dry, with no damage, for periods up to 24 hours. All metal parts shall be of stainless steel. Elastomers shall be Viton.

H. Pump suction and discharge flanges shall be cast iron ANSI (16.5) Class 150, flat faced.

I. Pump gaskets shall be compressed fiber and/or Teflon.

J. Pump shall be supplied with a ball-type check valve or swing check valve mounted on the discharge of the pump, allowing unrestricted flow from the impeller. The check valve shall be able to hold 25" hg at sea-level and shall not drop below 2.45" hg 90-

seconds and prevent in-line return of flow when the pump is shut off.

K. The drive unit shall be a diesel water-cooled engine. The engine shall drive the pump shaft via an elastomeric drive plate and plug-in style hub coupling able to be easily separated for compressor belt replacement. Starter shall be 12VDC electric. Safety shut down switches for low oil pressure and high temperature shall be integrated into the engine control panel. Battery shall have 180-amp hour rating. Unit shall include a tachometer and an hour meter. Drive unit shall be a John Deere 4045TF290 Interim Tier 4 or equal, rated at 74HP (continuous) at 2200 R.P.M.

L. Governor shall be mechanical. Engine speed shall be adjustable to operate the pump between maximum and minimum design operation speeds.

M. Integral skid fuel tank capacity shall be sufficient to provide at least 24 hours of operating time at full load.

N. Exhaust system shall include a silencer sized to achieve 69dBA at 23-feet.

O. Unit shall be shop primed and finish painted at the place of manufacturer. Materials and dry film thickness for priming and finish paint shall be in accordance with manufacturer's standards.

P. The engine and pump shall be completely enclosed with fourteen and sixteen-gauge sheet metal panels backed with one inch and two-inch layers of polydamp acoustical sound-deadening material. The acoustical enclosure shall reduce pump and engine noise to 69 dBA or less at a distance of 23-feet. The enclosure shall be removable for easy access to the engine / pump for maintenance and repair. The enclosure doors shall all be equipped with latches that are keyed alike. For maintenance and service needs, the enclosure sides shall have hinged doors for quick access to the engine oil fill, fuel fill port, oil dipstick, and filters

2.3 UL Listed Skid Base

A. The pump base tank shall be a UL-142 approved double wall design constructed in accordance with Flammable and Combustible Liquids Code, NFPA 30; The Standard for Installation and use of Stationary Combustible Engine and Gas Turbines, NFPA 37; and The Standard for Emergency and Standby Power Systems, NFPA 110.

B. The tank design shall be a Closed Top Dike Pump Base Tank. It shall be of double wall construction having a primary tank to contain the diesel fuel, held within another tank or dike, which is intended to collect and contain any accidental leakage from the primary fuel tank. The completed base tank assembly is to incorporate pump mounting locations and must be able to support four times the rated load.

C. The primary tank shall be designed to withstand normal and emergency internal pressures and external loads. It shall be capable of withstanding internal air pressures of 3 to 5 psig without showing signs of excessive or permanent distortion and 25 psig hydrostatic pressure without evidence of rupture or leakage.

D. The primary and secondary tanks or dike shall have venting provisions to prevent the development of vacuum or pressure capable of distorting them as a result of the

atmospheric temperature changes or while emptying or filling. The vent shall also permit the relief of internal pressures caused by exposure to fires. The vent size shall be determined by using the calculated wetted surface area in square feet (the top is excluded) in conjunction with venting capacity table 10.1 of UL-142. The tank's vent shall also be equipped with a coupling device and shall be located to facilitate connection to a vent piping system. The dike's vent may be an opening for venting directly to the atmosphere and protection from the entrance of natural elements or debris shall be provided.

E. The primary tank is to be constructed of 7 gauge ASTM A569 or A-36 hot rolled steel. Galvanized treated will also be accepted. Internal baffles or reinforcement plates shall be located on a maximum of 24-inch centers in tanks up to 60-inch width and on a maximum of 19.5-inch centers in tanks over 60-inch width. At least one baffle shall separate the fuel suction pipe from the fuel return line.

F. The outer tank is to be constructed in a manner to be able to support four times the wet load of the pump and housing. All of the load is to be carried by the outer tank so no load or vibration stress is placed on the primary tank. If the pump base tank is wider than the pump set to be supported, structural rails are to be incorporated to span the width of the base tank so that the load is transferred to the side rails of the tank. Vertical reinforcements shall be welded to the outer sides of the secondary tank or dike at a maximum of 45-inch centers on tanks up to 30 inches high and on 24-inch centers on tanks greater than 30 inches high. At least one vertical reinforcement shall be positioned adjacent to each mounting hole location.

G. Both primary and secondary tanks shall be fitted with the proper welded pipe fittings to accommodate the requirements for the fill port and normal and emergency venting.

H. The completed assembly is to be cleaned with a heated pressure wash followed by a chromium free post treatment to ensure proper paint adhesion. The tank assembly is to be painted with an epoxy ester primer and high quality polyurethane enamel with total paint thickness of 3.5 mils. The painted tank assembly is to be baked at 180 degrees for 30 minutes to provide a hard durable finish.

I. Manufacturing and testing of this system shall be performed within the scope of Underwriters Laboratories, Inc. "Standard for Safety UL 142." A UL label shall be permanently attached to the tank system showing the following information:

1. The registered UL mark and the name: Underwriters Laboratories, Inc.
2. A control number and the word "listed"
3. The product's name as identified by Underwriters Laboratories Inc.
4. The serial number assigned by Underwriters Laboratories, Inc.
5. Other manufacturer's information may also be included.

K. Pump, engine, and base shall be shop primed and finish painted at the place of manufacturer. Materials and dry film thickness for priming and finish paint shall be in accordance with customer specifications.

2.4 Automatic Starting Control System

A. The engine shall be equipped with a factory installed microprocessor-based controller as supplied by the manufacturer and designed to start/stop the engine at a signal supplied by high and low level floats or a 4-20 mA transducer.

2.5 Engine and Pump Control

A. The engine shall be started, stopped, and controlled by a digital controller as supplied by the manufacturer. The controller shall be weather proof enclosed, and contain an external weatherproof 12-position keypad accessible without the need to remove or open any protective cover or enclosure. It shall be designed to start/stop the engine at a signal supplied by high and low level floats or a 4-20 mA transducer. The controller shall provide the following functions without modification, factory recalibration or change of chips or boards, by simply accessing the keypad.

1. The keypad shall be a capacitive touch sensing system. No mechanical switches will be acceptable. The keypad shall operate in extreme temperatures, with gloves, through ice, snow, mud, grease, etc. and maintain complete weather tight sealing of the controller.

2. In automatic mode, the unit shall conserve energy and go to "sleep".

3. The controller shall function interchangeably from float switches, pressure switch, or transducer as well as manual start/stop by selection at the keypad. No other equipment or hardware changes are required.

4. The controller shall be capable of varying the engine speed to maintain a constant level in a process without a change to the panel other than via the keypad.

5. The start function can be programmed to provide three separate functions each day for seven days (i.e. a start, warm up, exercise cycle on two separate days at different times and for a varying length of time all via the keypad).

6. The panel shall include a Manual-Automatic Button to switch between modes of operation.

7. In Manual Mode, the Manual "Start" button shall start the engine and run until the "Stop" button is depressed or an emergency shutdown occurs.

8. In Automatic Mode, start/stop sequencing is initiated by one normally-open and one normally closed narrow angler float switches, pressure switch, transducer, or a signal from a digital input.

9. The controller shall integrate the engine safety shut-off for low-oil temperature,

high- temperature, and provide over-speed protection.

10. The controller shall include standard, field-adjustable parameters for engine cycle crank timer, shutdown time delay, warm-up time delay, and cool-down time delay.

11. Standard components shall consist of (6) digital inputs, (8) analog inputs, (1) magnetic pick-up input, (6) 10-amp form "C" relays, (2) 20-amp form "C" relays, (1) RS485 port, (1) J1939 port, and (1) 320X240 pixel full graphic LCD display with backlight, (1) 12 position keypad, LCD lamps for visual indication of shutdown (red), warning (amber) and power (green).

12. The industrially-hardened controller shall withstand Vibration of 3 g, 3 axis, frequency swept 10-1000 Hz, in an operating temperature Range of 4° to 176°F (-20° to 80°C) and an operating humidity range of 0-95% non-condensing.

2.6 Accessories

A. One-normally open and one-normally closed narrow angle (10° to 20°) float switches integrate into automatic pump controller. The floats shall be constructed with tilt sensation switches enclosed within stainless steel. Each float will have a minimum 25-foot waterproof cable wired into a twist-lock wiring harness that connects directly to a controller or equivalent.

B. The drive unit shall be supplier with an integral 1000-Watt engine block heater. Heater to be supplied with three wire plug, 110 VAC required.

C. The unit shall include a fully automatic trickle charger powered by 6-amps, 1000W, 115 VAC.

Part 3 Execution

3.1 Installation

A. Installation shall be in strict accordance with the respective manufacturer's instructions and recommendations in the locations shown on the Drawings.

B. Installation shall include furnishing any required oil and grease in accordance with the manufacturer's recommendations.

3.2 Manufacturer's Services

A. Furnish the services of a factory representative during the installation phase of the equipment. The factory representative shall have full knowledge and experience in the installation of the type of equipment being installed.

B. Furnish the services of a factory representative having complete knowledge of proper start-up procedure, operation and maintenance requirements to inspect the final installation and supervise test operation of the equipment. The factory representative shall also conduct training to Owner's personnel on proper operation and

maintenance of the equipment for a period of not less than one half day.

C. Substituting a service representative from the local representative organization is not acceptable unless approved by the Owner or Engineer, based on documented training on the subject equipment. Decision of the Owner or Engineer is final.

D. The schedule of all services provided shall be in accordance with a schedule approved by the Owner.

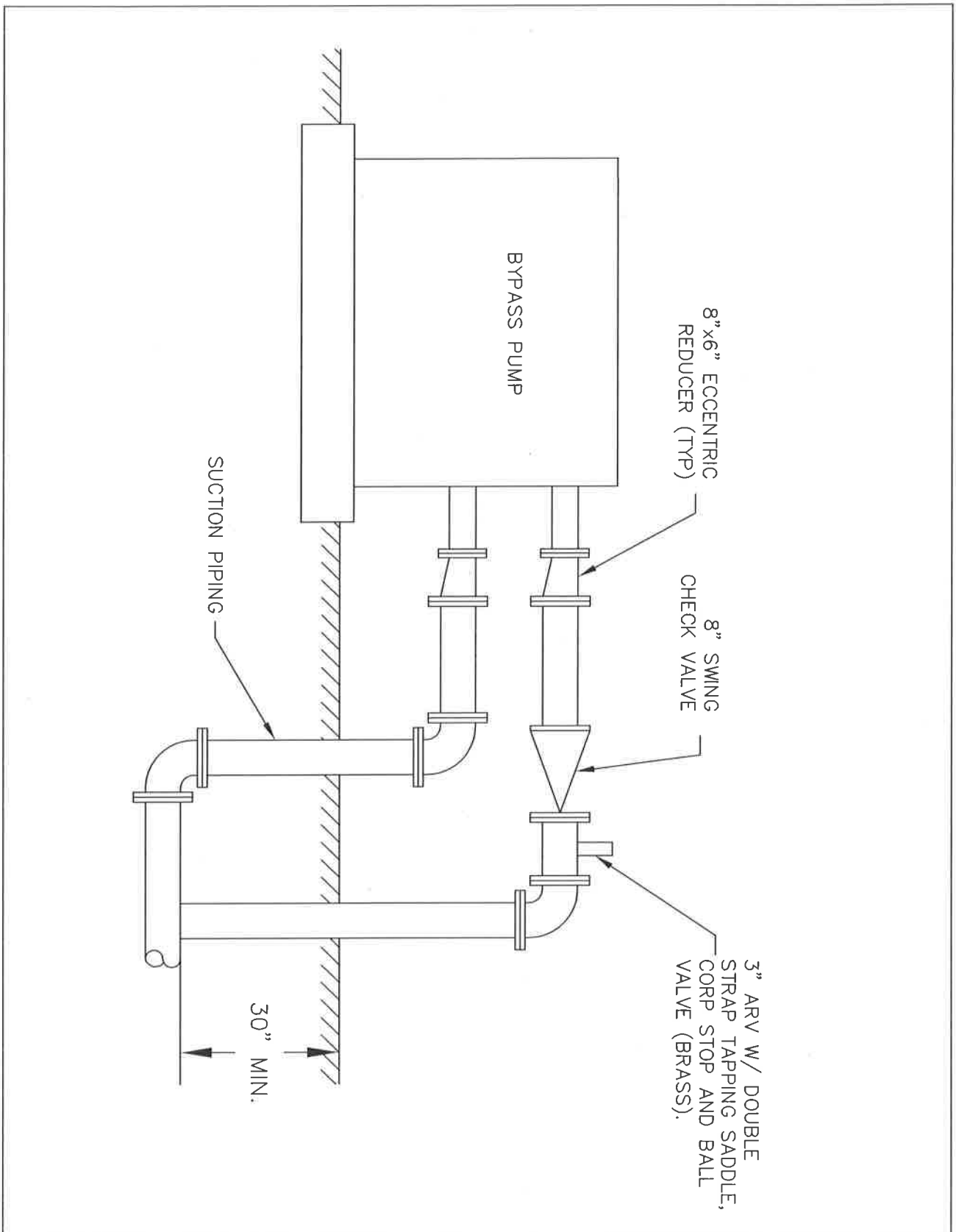
3.3 Equipment Startup

A. Provide startup services in accordance with Section 01 75 16 of these Specifications

3.4 Cleaning

A. Prior to acceptance of the work of this section, thoroughly clean all installed materials, equipment and related areas in accordance with Section 01 74 00 of these Specifications.

END OF SECTION



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PROJECT NO.:	DATE:
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GENERAL PIPING AND VALVE LAYOUT

BRAINERD GOLF COURSE

PUMP STATION SAFETY IMPROVEMENTS

CHATTANOOGA, TENNESSEE

BARGE DESIGN SOLUTIONS

1110 Market Street // Suite 200 // Chattanooga, Tennessee 37402
PHONE (423) 756-3025 // FAX (423) 756-8477

Part 1 General

1.1 Scope

A. Work includes: Pump Control Panel with hardware as required to monitor and control pumps.

B. Provide a local Operator Interface Terminal for pump station graphics, trending, historical data collection of all signals and runtimes.

C. Variable Frequency Drives.

D. Provide for communication interface to the VFDs to the PLC.

E. New Motorola Solutions Remote Terminal Unit (RTU) with hardware as required to monitor the pump station.

F. Communication to the pump station RTU will be via the city's 800MHz radio system and connectivity to the EPB's Fiber Optic Network, or the Verizon Cellular network, as required. At these sites provide communication transceivers, cables, single-mode or multi-mode fiber optic cable as required, terminate and testing of communications.

G. Modifications to the existing FEPs at the Moccasin Bend WWTP for the RTU.

H. Modifications to the city's existing SCADA System at the Moccasin Bend WWTP for the new pump station.

I. Field Instrumentation for flow and level.

J. Operations Training, Hardware & Software Maintenance Training.

K. I&C O&M Manuals.

1.2 Related Work

A. The following related sections may also be required for performance of this work.

1. Section 26 43 00 - Surge Devices
2. Section 26 05 26 - Grounding

1.3 Reference Standards

A. NFPA 70 - National Electrical Code (NEC)

B. ISA-S5.4 - Instrumentation Society of America (ISA)

C. UL-508A - Underwriters Laboratory Industrial Control Panel Certification

D. UL-698A - Underwriters Laboratory Industrial Control Panel Certification

1.4 Quality Assurance

A. The SCADA System additions, Control Panels, Instrumentation, communication panels, VFDs and Pump Controls and RTU shall be integrated systems and shall be provided by a single supplier that is responsible for the proper operation of the entire system.

B. The following System Suppliers are pre-approved:

1. Lord & Company, Inc. of Fort Mill, SC 803-802-0060, ext 107

C. The following criteria must be met by all approved System Suppliers without any exceptions. Claims stating equality but does not meet the required criteria listed below will not be accepted. For prequalification, proof of the below requirements including copies of the required submittals and O&M's must be submitted before three weeks prior to the bid opening date and approved within two weeks of the bid opening date. **Being pre-approved "named" above does not eliminate or discount any of the following requirements (no exceptions or substitutions will be taken):**

1. A minimum of ten years' experience providing similar operational systems of which a listing shall be requested. Two previous projects submittals, O&M's and drawings that meet the requirements specified herein in detail must be submitted as proof of prior experience. References, from the consulting engineer and end user, for the same projects must be provided.
2. Shall have been in business a minimum of ten years operating under the same company name with a minimum of ten full time design personnel specifically for SCADA Systems, Pump Control Systems and Instrumentation.
3. Shall have registered professional engineer, design engineers, service engineers and technicians that are full time employees of the System Supplier. No contract employees shall be used for any portion of the project.
4. Shall employ at least one full time registered professional engineer.
5. Shall employ a registered Project Management Professional "PMP" to manage the project.
6. To establish quality and standards, the System Supplier shall be CSIA "Certified" by the Control System Integrators Association, utilizing the "Best Practices and Benchmarks" process to provide performance standards in seven critical business areas for Control System Integrators and have passed all CSIA audits. CSIA Membership only is not acceptable or consider equal to "Certified".
7. Must have a full-time control panel assembly shop in-house that is UL-508A and UL-698A certified. Third party control panel shops will not be accepted.

D. Provide hardware, software and specified collateral services such as testing, calibration, start-up, operation and maintenance manuals, and operator training without additional cost to the Owner.

E. System Supplier shall coordinate with the contractor to obtain all necessary data from process equipment manufacturers supplied controls for operation, control and monitoring from the manufacturer's equipment.

F. All materials, equipment sizes, and capacities shall conform to the requirements of the NEC, the National Electric Manufacturer's Association, and to applicable regulations of the local electric codes.

G. Equipment shall be UL listed and Control Panels must be UL-508A certified or UL-698A certified for control panels with intrinsic safety barriers or in hazardous locations.

1.5 Responsibility for a Complete System

A. System Supplier shall provide for the design, supply, delivery, installation, certification, calibration and adjustment, software configuration, testing and start-up, of a complete, coordinated system. A single supplier shall provide SCADA System additions including RTU, pump controls, instrumentation and software.

1.6 Submittals

A. Provide in a PDF file format. Provide on a USB drive and a cloud based service for download and upload after review.

B. Will have a detailed index and easy to use tabs and bookmarks for BOM's, PLC I/O lists, drawings, Equipment Data Sheets, software or equipment manufacturer's literature, etc.

C. For all hardware and software, include manufacturer's technical published data descriptive literature with product specifications with a cover called an Equipment Data Sheet. The Equipment Data Worksheet is to be developed by the SI to show the exact part or model number with descriptive break down of the model number and specific information like supply voltage, size, options, etc. All pertinent information for the equipment or software shall be included on the Equipment Data Worksheet.

D. Submit schematics and system layout drawings.

E. Hardware Submittals:

1. Provide a block diagram and description of the system configuration showing components and their interconnections etc. Label each diagram and specify external power and communications interfaces. Diagrams shall be 11 X 17 format and be developed in Autocad DWG file format, no exceptions.

2. Provide an equipment list with descriptive literature identifying component name, manufacturer, model number, a description of the operation, quantity supplied and any special characteristics.

3. Drawings shall include, dimension details for each panel, console, etc., including internal and external arrangements and door mounted operator devices with nameplate designations. Elementary and wiring diagrams of equipment including field device connections shall be included with specific installation/wiring requirements identified. Provide detailed bills of materials with spare parts provided.
   a. PCS and RTU Submittals:
      1) System RF and Fiber Optic Network Diagram: Update the City's network diagrams to include the PCS and RTU. Show details of cabling or

wireless connections for the entire system. Show fiber and copper terminations including spares in fiber patch panels, network hubs/switches, routers, modems, wireless repeaters, etc. and necessary routing between PLC's, OIT's and HMI workstations.

2) PLC and RTU System Diagram: Provide a diagram showing PLC and network components in the PCS and RTU. Show the exact PLC rack layout with details of actual modules used and filler plates for spare slots. Identify components by manufacturer and model number. Show interconnecting cables with pin out details or model numbers of PLC manufacturers cables.

3) Bill of Materials: A list of all components. Group components by type and include:
   (a) Component manufacturer, model number and part number.
   (b) Component description.
   (c) Quantity supplied.
   (d) Reference to tag on drawings.
      (1) Descriptive Information: Provide catalog information, descriptive literature, performance specifications, internal wiring diagrams, power and grounding requirements, power consumption, and heat dissipation for equipment. Mark options and features or this project.
      (2) Interconnecting Wiring Diagrams: Show all PLC and control panel components, their interconnecting cables, wiring terminations, and terminations to interacting elements and subsystems. Terminations shall be numbered.
      (3) Outline Drawings: Show: external dimensions, enclosure materials, conduit connections, and installation requirements.

      (4) Installation Details: Provide any modifications or further details as may be required to supplement the Contract Documents and adequately define the installation of the PCS/RTU.

      (5) Input/Output List: Provide for each I/O point list point type, tag number of the source or final control element, equipment description, PCS/RTU number, terminal identification, and address.

b. OIT/HMI Software Submittals:
   1) Pre-submit graphics color chart with suggested colors for piping and equipment, etc. to be displayed on the OIT or HMI. Include the pre-submittal preliminary copies of reports, lists of I/O, alarms including internally generated and diagnostics alarms and ranges of all variables.

   2) include one day for a software submittal meeting with the owner and engineer at 90% completion. This will allow for owner preferences to be included in the final submittal. Submit within thirty (30) days after the meeting.

3) Submittal shall contain color graphics, database, control faceplates, alarm levels, alarm summary, historical configuration, live and historical trends, reports, diagnostics and help screens, scripts, configuration, communications, etc. Provide pdf file on USB drive or other agreed upon media.

1.7 Process Control Strategy Design Meeting and Submittals

A. A one-day process control strategy design meeting shall be held with the Engineer and Owner's personnel to discuss specific details of the control strategies that are to be developed for the system. The meeting shall be held at the Moccasin Bend WWTP.

B. Prior to the meeting the System Supplier shall submit a detailed narrative of the proposed control strategies to the Engineer for review.

1.8 PCS and RTU Operation & Maintenance Manuals

A. Provide a complete Operation and Maintenance Manuals for the PCS and RTU in an open software format compatible with any PC. At a minimum the O&M shall include:

1. Component Manufacturers' O & M Manuals: Include manuals to cover installation, operations, maintenance, troubleshooting, and calibration.
2. Operating instructions shall incorporate a functional description of the entire system, including the system schematics that reflect "as-built" drawings.
3. Provide system architecture diagram showing network communications including but not limited to all PCs, PLCs, RTUs hubs, switches, cables, radio paths, etc.
4. List of spare parts and expendables provided.
5. Panel equipment, field devices, and instruments data sheets, including complete "bill of materials" of PLCs, RTUs, control panel devices, computers, printers, software, field equipment, etc.
6. Communication Network Cable Testing documentation with actual tests of each fiber after terminations. Cable data shall be included on the form cable manufacturer, part number, cable tag and location, fiber number and color, testing procedures, test equipment utilized, actual readings and results, and personnel names with time and date testing was performed.
7. Instrument Calibration Worksheets showing actual calibration procedures performed with reading and results signed and dated by the Service Technician or Engineer.
8. Compact disk containing final PC configuration, backups of system files, HMI application, RTU, PLC and OIT (Operator Interface Terminal) programs. Disks shall be professionally labeled for their content, purpose, date and version number.
9. Complete operator instructions for PC, HMI, PLCs and OITs including download instructions and OIT menu map with details for functions and data entry.

10. Point lists for PLC inputs/outputs. Identify point number (tag), point description, point type, range in engineering units (if analog point), PLC number, rack and slot number, and point address.

11. The O&M Manual shall have an easy to use index and bookmarks for CAD drawings, Equipment Data Sheets, software or equipment manufacturers O&M literature, etc. Clicking on an item on the index shall immediately display Equipment Data Sheet and software or equipment manufacturers O&M for the item. Likewise clicking on a drawing shown on the index shall display the drawing. Other functions at a minimum shall include search, zoom and print page or selection features. All contents of the O&M may also be displayed with thumbnails. Clicking on the thumbnail shall immediately display the item, i.e. drawing, Equipment Data Sheet, instruction literature, etc.

12. O&M Manual shall be accessible from any PC on the City's LAN.

1.9 Software Licenses

A. Purchase software packages required for the system in the name of the end user. Software shall be delivered to the owner with original disks and original box.

1.10 Project Management Professional "PMP" Requirement

A. Project shall be managed by a registered Project Management Professional "PMP" that is a full-time employee of the Systems Integrator. The PMP's certification and qualifications must be submitted for approval.

B. PMP shall submit a project schedule developed in Microsoft Projects and shall indicate, at a minimum, all dates for each required project task, deliveries of all equipment and project team resources.

1.11 Factory Testing with Professional Engineer Approval and Seal

A. Factory testing shall be observed and certified by a registered Professional Engineer "PE" that is a full-time employee of the Hardware Systems Integrator.

B. Develop and submit a test plan, testing documentation and QA/QC check lists specific to the project requirements and each control panel or PLC/RTU. Test all specific functions, I/O and control loops, etc. Test specific functions including, but not limited to, the following:

1. Failure mode and backup procedures: power failure, auto restart, disk backup and reload, retentive outputs.

2. All network communications.

3. Human Machine Interface (HMI), all functions.

4. Operator Interface Terminal (OIT), all functions.

5. Completely simulate all possible field conditions and run in full automatic and manual.

6. Simulate existing systems being interfaced to with new programs and configurations. System supplier must own or acquire all hardware required for the simulation.

7. Provide certified factory testing documents showing all tests performed and results achieved.

   a. Submit the completed Professional Engineer "PE" stamped/signed factory testing documents showing all tests performed and results achieved plus all QA/QC check lists prior to shipment of the system, control panels and or PLC/RTUs. The documents will be "stamped" with the employee's PE's seal. The certified documents must be approved prior to shipment.

   b. Invite the General Contractor, Owner and Engineer to observe the factory testing of the system. A two-week notice of the testing date shall be provided.

1.12 Installation Assistance and Instructions

A. The System Supplier shall provide a qualified service engineer to be onsite for one day during the installation of the instrumentation and PCS/RTU for coordination and to assist and instruct the owner or contractor in methods of proper installation of the equipment.

1.13 Operations, Hardware & Software Maintenance Training.

A. After the project substantial completion, provide one day onsite for instruction for the Owner's personnel in the operation of the System and software and hardware training for the Owner's maintenance technicians in the maintenance of the system hardware and software. Training shall include:

1. Standard operational features of PC, HMI, OIT, PLC, RTU and VFD equipment provided.
2. Operation of each function or mode: For example, AUTO/MANUAL control, control set point settings, control mode selection, alarm acknowledgment and Constant Speed modes.
3. Interfaces with other controls and systems.
4. Emergency procedures.
5. Standard hardware features of the PC, HMI, PLC, RTU, OIT and field instrumentation, etc.
6. Specific training for the actual hardware configuration provided.
7. Test, adjustment, and calibration procedures.
8. Hardware troubleshooting, component removal and replacement, and periodic maintenance.
9. Standard software features of all software provided, including but not limited to HMI, PLC, RTU and OIT programming software.

10. Software troubleshooting, backups, restores, loading software and periodic maintenance.

11. Software O&M functions and features.
    a. Training sessions shall be video recorded and provided in DVD format and shall be capable of playing in a PC and a regular DVD player.
    b. Submit a training outline and agenda of specific topics and time to be used for each topic.

1.14 Product Delivery, Handling and Storage

A. Schedule the delivery of the equipment to coordinate with the project completion schedule.

B. Equipment shall be delivered by the System Supplier or a representation shall be onsite to observe and inspect the unloading of all the equipment by the owner or contractor.

C. Each item of equipment shall be tagged with identifying number shown on the Shop Drawings visible after packaging.

D. General Contractor's shall note that equipment has delicate components and extreme care shall be taken in handling to avoid internal and/or external damages.

E. Damaged equipment will not be accepted. Damaged equipment by the GC unloading or by inadequate storage shall be replaced by the GC. Damaged equipment prior to delivery or in transient shall be replaced by the System Supplier.

F. Equipment not for immediate use shall be stored inside an environmentally controlled building, with enclosures under protective coverings and shall be protected from moisture, extreme heat and vibration.

1.15 Spare Parts and Test Equipment

A. Include spare parts and specialized test equipment as shown in the equipment lists in Part 3 of this section.

1.16 Field Terminations and Communication Network Cable Installation and Testing

A. Conduit and wiring shall be provided, installed and terminated by the Electrical Contractor (EC) with the exception of communication cables (i.e. Fiber Optic, CAT 5, DeviceNet) provided by the System Supplier and all connections in the Pump Control Panel and the Motorola Solutions RTU.

B. The EC shall provide and install all signal cables for the instrumentation.

C. The EC shall be responsible for properly and professionally labeling all cables and shall assist the System Supplier as needed to locate and troubleshoot the field wiring during terminations and testing.

D. If fiber optic cable are required and provided, all fibers as shown on the detailed network drawing shall be terminated and tested by the System Supplier. System Supplier must provide certified training documentation for the System Supplier personnel performing the terminations and testing. Testing documentation shall be provided to prove the actual tests of each fiber after terminations. All cable data shall be included on the form including but not limited to cable manufacturer, part number, cable tag and location, fiber number and color, testing procedures, test equipment utilized, actual readings and results, and personnel name with time and date the testing was performed.

E. The completed Record Documentation shall be included in all forms of the O&M Manuals.

1.17 Instrument Calibration

A. All instrumentation supplied by the system supplier shall be calibrated to the specified ranges and requirements of the project.

B. Documentation in the form of an Instrument Calibration Worksheet shall be provided to prove the actual calibration of all instrumentation. All instrument data shall be included on the worksheet including but not limited to make, model, tag, zero, span, range, service, process, calibration procedures with actual readings and results. Worksheet shall be signed and dated by the service technician or engineer that performed the calibration.

C. The completed Instrument Calibration Worksheets shall be included in all forms of the O&M Manuals.

1.18 Service Reports

A. Service reports shall be provided for each day that a representative of the System Supplier is on site. The service reports shall include all tasks performed, time on site, instrument tags, instrument service and etc. Instrumentation Calibration Worksheets shall be provided and attached to the associated service reports.

1.19 Warranty

A. Systems supplier shall furnish a one-year onsite warranty for the system, providing for a 24-hour response time in normal working hours, five days per week for the length of a one-year warranty period. For any service visit during this period, provide the Owner and Engineer with a written report stating the reason for equipment failure and recommendations to prevent recurrence.

Part 2 - Products

2.1 General

A. All equipment and materials shall be new, unused and proven by previous use of similar products to be completely suitable for the service intended.

B. All of the equipment shall be the manufacturer's latest and proven design. Specifications and drawings call attention to certain features but do not necessarily cover all details for the design of the System.

C. Mount process indicators and Operator Interface Terminals (OIT) at eye level, 60" from floor to centerline of instrument.

D. Panel wiring for all 4-20mA analog input signals shall be two-conductor, shielded cable with drain. Cable and connectors shall be Belden No. 8760, UL Style 2092, 20 AWG minimum, or equal. Single conductors shall be tinned copper with 600V insulation, gauge as required.

E. PVC wiring duct shall be provided as required and shall have removable non-slip covers. Wiring duct shall contain 50% spare space. Wiring duct must be mounted with machine grade screws. Plastic and/or aluminum rivets are not acceptable. For consistency and standardization, wiring duct shall be by Panduit Corporation, no exceptions, color gray. All wiring in control enclosures not in wiring duct shall be bound with continuous type spiral windings or neatly bound with tie wraps not less than two inches apart consistently and shall not allow the shown wires to cross each other within the bundle.

F. All equipment mounted within the PLC/RTU enclosure shall be mounted on the enclosure back panel, neatly organized, labeled with a tag as shown on engineer-approved control panel drawings and shall be in accordance with the manufacturer's recommendations.

G. All fields wiring shall be mounted either at the bottom or side of the enclosure back panel, depending on where the I/O conduits penetrate the enclosure.

H. The field wiring terminals and panel wires shall be clearly labeled and identified and shown on the panel drawings.

I. Jumpers between adjacent terminal blocks shall be tinned copper jumper bars supplied by the terminal block manufacturer.

J. Interconnection drawings shall be provided along with wire numbers, terminal numbers, equipment tag numbers and panel physical layout drawings.

K. All systems and individual components, whether panel or field mounted units, that are located in different areas of the plant, one inside building to device outside of building, shall be protected from voltage and/or current surges.

L. Provide surge protectors for 120VAC power Phoenix Contact, Model PT 2 -PE/S 120AC-ST, or equal by SSI or Dehn. Units shall be DIN rail mounted with status LED.

M. Provide surge protectors for analog 4-20mA signals as Surge Cop, Model SCSP-30VDC-20mA or equal by Phoenix Contact or Transtector. All components, MOV's, Transzorbs, Silicon Avalanche Diodes, RF chokes, and resistors in the unit shall be redundant. Units shall be DIN rail mounted.

N. Control and instrumentation power supplies shall be adequately sized to provide 150% of that as required by the equipment served.

O. The input and output of each separate DC power supply shall be individually fused with easily accessible DIN-rail mounted fused switch. Provide separate fused disconnects for each PLC, OIT, each DC power supply, etc.

P. All power supplies shall be DIN Rail mounted and shall have screw terminals for all connections. Solder type connections will not be allowed. All screw terminal connections shall be finger safe.

Q. All pushbuttons, selector switches, and pilot light units shall be heavy duty, 30.5mm, NEMA type 4/4X, corrosion resistant, bulletin 800H by Allen-Bradley or equal by Sq D. Pilot lights shall be LED with Push-To-Test feature.

R. Terminal strips shall be mounted using DIN rails. Terminal strips shall be as manufactured by Wiedmueller, Phoenix, Entrelec, or approved equal.

S. All digital inputs and outputs, including spares, shall be isolated from field wiring through terminal strips and 24 VDC, interposing mechanical relays.

T. All mechanical control relays shall be DIN rail mounted. Minimum contact rating for mechanical control relays shall be 10 Amps at 250 VAC. All control and auxiliary relays shall have indicating LED's. Relays shall be by Potter & Brumfield, GE or Square D.

U. For all field Instrumentation provide surge protectors for 120VAC power mounted in a NEMA 4X junction box. Surge protectors shall be Phoenix Contact, Model PT 2 -PE/S 120AC-ST, or equal by SSI or Dehn.

V. For all field Instrumentation provide surge protectors for signals mounted in a NEMA 4X junction box. Surge protectors for analog 4-20mA signals shall be Surge Cop, Model SCSP-30VDC-20mA or equal by Innovative Technologies or Transtector. All components, MOV's, Transzorbs, Silicon Avalanche Diodes, RF chokes, and resistors in the unit shall be redundant. Units shall be DIN rail mounted.

W. For Pump Control Panels with integral motor controllers provide a Main Circuit breaker for utility power service with a through the door handle and disconnect mechanism. Main circuit breaker shall be equal to an A-B 140U Molded Case Circuit Breaker or equal by Sq D.

X. Provide a manual transfer switch with an external connection and receptacle for a portable generator, coordinate connector type with the end user for their portable generator. Provide the necessary size for the HP and FLA of the pump motors. Provide a separate Main Circuit breaker with a through the door handle and disconnect mechanism. Main circuit breakers shall a Molded Case Circuit Breaker type with short circuit current rating and size as shown on the electrical drawings. Provide breakers with a mechanical interlock between the service power and generator breakers. Breaker shall be Sq D with a walking beam mechanical interlock or equal.

Y. Provide instantaneous breakers for each motor controllers with type and size as required by the motor controller VFD, softstarter, etc. and motor. The circuit protector shall provide individual circuit protection and means of an isolating disconnect for each motor starter, softstart or VFD. Branch circuit protector shall be by Sq D or equal and as required by the devices.

Z. Provide a full size 30mm "Hand-Off-Auto" selector switch, "Run" & "Fail" Push-to Test LED Status light for each pump on the control panel front or dead front if control panel is located outside.

AB. Provide intrinsic safety barriers for floats switches and any instrumentation located within the wetwell. Acceptable manufacturers: MTL Instruments, Pepperl+Fuchs, Square-D, Schneider Electric or Turck, Inc.

AC. Provide Control Panel with UL-698A certification.

2.2 Control Panel Enclosures

A. Provide NEMA 4X rated enclosures with 3-point locking latch. NEMA rating and material as shown in the equipment schedules and or shown on the drawings. For outdoor installations provide stainless steel rain shields and sun shields. Provide units as freestanding or wall mounted according to drawings and based on physical limitations. Enclosures shall be manufactured by Hoffman or equal.

B. Sun shields shall be made of 0.125" aluminum plate that extends at least 12" past exterior top and sides of enclosure.

C. For outdoor enclosures with an operator interface terminal (OIT) provide a dead front panel for OIT and all switches and status indicators.

D. For outdoor enclosures with a PLC and or an operator interface terminal (OIT): Provide sun shield to inhibit glare from sunlight and to promote better viewing of OIT and provide protection from the heat from the sun. Viewing hood shall be made of 304 stainless steel or aluminum and shall extend from the enclosure approximately 18" and shall shroud the top and sides of OIT viewing area.

E. Mount process indicators and Operator Interface Terminals (OIT) at eye level, 60" from floor to centerline of instrument.

F. Provide an LED cabinet light with door switch for all control panels larger than 24" x 24".

2.3 Programmable Logic Controller (PLC)

A. Programmable logic controllers shall be GE RX3i system and shall be provided with 5MB of user memory, 10/100/1000 Ethernet port and a USB communication port, and required comm modules, I/O modules required.

B. Provide Ethernet communications module for the VFD's, SCADA System Motorola Solutions ACE3600 RTU and other devices.

C. The PLC shall be provided with a 12" touchscreen Operator Interface Terminal "OIT", GE QuickPanel+ with dual Ethernet ports. The OIT shall be capable of trending and logging data and storing historical data on a USB drive. Provide any needed programming software required to download programs and configuration.

D. PLC Programming Software shall be provided for the maintenance personnel to download the program, develop ladder logic and/or reprogram the programmable logic

controller (PLC) supplied under the scope of this project. Applicable if not already owned by the end user.

2.4 PLC & OIT Programming Software

A. Any necessary PLC or RTU Programming Software shall be provided for the maintenance personnel to download the program, develop ladder logic and/or reprogram the programmable logic controller (PLC) supplied under the scope of this project.

B. For programming the Operator Interface Terminals provide any needed latest version of the manufacturer's software with appropriate cables for communications with the OIT being supplied.

2.5 Remote Terminal Unit (RTU)

A. The RTU supplied for the Pump Station shall have the controller by Motorola Model ACE3600 with a model 3680 CPU and a 800 MHz Radio compatible with the existing radio system.

B. The RTU must have exceptional communication and security capability being able to communicate with many different methods, media and protocols for future growth and updates.

C. Communication Ports: Up to 5 ports per CPU

1. Serial - capacity of 4 x RS-232 ports. Provide two (2)
2. Multi-drop - capacity of 3 x RS485 ports
3. Ethernet - capacity of 2 x 10/100 MB ports and 1 x 10 MB port. Provide two (2) 10/100 MB Ports
4. Two-way radio/analog trunked radio - capacity of 2 x modem ports. Provide one (1) DPSK modem
5. Motorola Radio Support: Mobile two-way radio - CM200, CM340, GM3188, EM200, CDM750. Portable two way radio - HT750, GP320, GP328, PRO5150. Astro - XTL2500 (digital and analog trunk), XTS2500 (digital trunk). Dimetra - MTM800 (PD). Provide an 800MHz APX6500Li radio.
6. Third Party Radio Support: Compatible with two way radios, data radios, TETRA radio (PD)
7. Modem Support: Compatible with Dial-up modems, cellular modems (dial mode & PD)
8. Protocols : MDLC, TCP, UDP, IP, PPP, NTP, DHCP
9. Third Party Protocol: MODBUS RTU (master/slave, RS-232/RS-485), DF1 (Allen Bradley - Master on RS-232), User Protocol (in user program) Possible on RS-232, RS-485 and Ethernet port.
10. Other Features:
    a. Power PC based processor provides very high performance

b. VX-Works based real-time operating system
c. Up to three Ethernet ports
d. Up to four serial communication ports
e. Up to two radio modem ports
f. 0,3,5,7 or 8 I/O slot wall mount frames, 19" rack mount on 8 slot frame
g. Single and double density I/O modules
h. Hot Swap I/O replacement
i. Wide operating temperature range -40 to +70 °C
j. NEMA 4 / IP65 Housing, 40 x 40 cm and 50 x 50 cm
k. Two-way/trunking/ digital radio models
l. AC and DC controlled power supply
m. 6.5 or 10 Ah Backup battery, smart battery charger
n. GPS and NTP for time synchronization
o. System building tool for configuration and programming
p. Remote firmware and program download
q. Compatible with MOSCAD family of RTUs
r. Provide RTU with a Motorola APX6500 800MHz radio configured for the city's current 800MHz trunk system either analog or digital.
s. Provide any needed PLC/RTU Programming Software for the maintenance personnel to download the program, develop ladder logic and/or reprogram the PLC/RTU or OIT supplied under the scope of this project.

2.6 Directional YAGI Antenna for Remote Station Radio Modem

A. Meet the following requirements:

1. Frequency range: Appropriate to frequency of operation.
2. Gain: 10 dB, or as required, verify requirements with radio path study.
3. Maximum Power Input: 150 watts.
4. Lightning Protection: Direct ground protection to ground and Polyphaser surge arrester before entering the enclosure with radio.
5. Front-to-Back Ratio: 20 dB, minimum.
6. Connector: Type N, female.
7. Provide 316 stainless steel mounting hardware: Clamps, standoff hardware as required for the installation to tank, mast, tower, or building.
   a. Manufacturer shall be Decibel Products or equal.

2.7 Transmission Cable & Miscellaneous for Radios

A. Provide cable connecting the radio antenna port to the antenna, which is low-loss foam-dielectric type, 0.5 inch to 1.25 inch in diameter as required.

B. Provide weatherproof transmission cable, suitable for direct environmental exposure. Use "O" ring seals on connections.

C. Provide cable grounding kits, etc. as appropriate for particular installation.

D. Utilize appropriate bulkhead RF transmission cable surge suppression devices at cable entrances, Polyphaser or equivalent.

E. Provide cable as manufactured by Andrew Corp. or equal.

2.8 Uninterruptable Power Supply

A. A DC UPS shall be supplied for each PLC or Communications Panel.

B. The UPS shall be rated for a minimum of 480 VA and provide continuous DC power for all the devices in the control panel.

C. The DC Power UPS and batteries shall be DIN Rail mounted.

D. The 24 VDC uninterruptible power system wide operational temperature range with an input voltage range of 22.5 to 30.0 VDC.

E. The unit shall have screw terminations for all connections.

F. The unit shall have an automatic self-test feature that checks the UPS and battery functions. Battery charging occurs automatically when input DC power is applied. When power fails, the DC UPS will switch to battery back-up. If the battery is no longer useful, the UPS will sound an alarm and an LED indicator will illuminate and provide a contact output to the PLC.

G. UPS and DC Power System shall be by Sola SDN-P Power Supply, SDU 20-24 480 VA, 24V/20A DIN Rail DC UPS power module, SDU 24-BAT or SDU 24-BATEM 24V DIN Rail/Panel Mount Battery Module or SDU 24-BATEM as needed. Approval equal by PULS or Phoenix Contact.

2.9 Variable Frequency Drives

A. Acceptable Manufacturers: Danfoss VLT® AQUA Series VFD or equal by Schneider Electric Altivar.

B. VFD shall be NEMA 1 rated, mounted inside the NEMA 4X Pump Control Panel

C. VFD's are to be supplied and installed in the pump control panel with Danfoss. The VFD's will be installed in the pump control panel such that the rear heat sink fins of the VFD's shall dissipate the heat to the ambient outside air. This mounting method eliminates the VFD's as a primary heat source in the control panel enclosure eliminating the need for air conditioning units. Alternative mounting methods shall not be considered equal.

D. Provide Six Year Factory Drive Protection Warranty and show capability and program associated with the warranty.

E. General: Furnish complete VFD as specified herein or in the equipment schedule for loads designated to be variable speed. VFD's shall be both constant and variable torque rated.

F. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a

full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable. The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.

G. The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.

H. The manufacturer of the VFD shall demonstrate a continuous period of manufacturing and development of VFD's for a minimum of 30 years. VFD's that are brand-labeled are not acceptable.

I. The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping.

J. The VFD shall utilize VVCPLUS, an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VVCPLUS provides rated RMS fundamental voltage from the VFD. This allows the motor to operate at a lower temperature rise, extending its thermal life. VFD's that cannot produce rated RMS fundamental output voltage or require the input voltage to be increased above motor nameplate value to achieve rated RMS fundamental output voltage are not acceptable. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.

K. The VFD selected must be able to source the motor's full load nameplate amperage (fundamental RMS) on a continuous basis, and be capable of running the motor at its nameplate RPM, voltage, current, and slip without having to utilize the service factor of the motor.

L. A motor parameter that allows the total number of poles of a motor shall be programmed to optimize motor performance.

M. The VFD will be capable of running either variable or constant torque loads. In variable torque applications, the VFD shall provide a CT-start feature and be able to provide full torque at any speed up to the base speed of the motor. In either CT or VT mode, the VFD shall be able to provide its full rated output current continuously and 110% of rated current for 60 seconds.

N. An Automatic Energy Optimization (AEO) selection feature shall be provided in the VFD to minimize energy consumption in variable torque applications. This feature shall dynamically adjust output voltage in response to load, independent of speed. This feature shall incorporate power factor compensation. Output voltage adjustment based upon frequency alone is not acceptable for single motor VT configurations.

O. For multi-motor variable torque configurations, user-selectable load profile curves including VT-High, VT-Medium, and VT-Low shall be provided to ensure easy commissioning and improved energy efficiency. VFD's requiring the operator to assign load torque data-points to create a V/Hz profile are not acceptable.

P. An initial ramp function shall be available to provide a different beginning ramp time, up to 360 seconds, for applications requiring a faster or slower ramp than the normal ramp.

Q. An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation. Pipe fill mode shall have a programmable time to reduce water hammer in the system.

R. An embedded cascade pump controller shall be included to provide lead pump alternation, improved redundancy, and shall operate with unequal sized pumps.

S. Switching of the input power to the VFD shall be possible without interlocks of damage to the VFD at a minimum interval of 2 minutes.

T. Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

U. An Automatic Motor Adaptation function shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to spin the motor shaft or decouple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user-programmable.

V. The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

W. VFD shall provide full torque to the motor given input voltage fluctuations of up to ±10% of the rated input voltage. Additionally, sustained line voltage reductions up to 15% shall not cause the VFD to trip.

X. Harmonics

1. The VFD shall provide dual built-in DC link reactors to minimize power line harmonics and to provide near unity power factor.

2. The VFD shall be provided with line-side harmonic reduction, as required, to ensure that the current distortion limits, as defined in table 10.3 of IEEE 519-1992, are met. PCC1, defined as the low voltage side of the distribution transformer, is used for purposes of calculation and referred, by the turns ratio of the transformer, to the PCC defined by the IEEE Recommended Practices as the Consumer-Utility interface. The tables of limits set forth therein are with reference to the PCC (primary side of the main transformer).

3. Harmonic solutions shall be designed to withstand up to 2% line imbalances with the maximum Current Distortion not to exceed 11% at 100% load.

4. Harmonic solutions shall be capable of withstanding up to 2% ambient voltage distortion with the maximum Current Distortion not to exceed 12% at 100% load.

5. To ascertain the harmonic contribution of the VFD's at the PCC and to show compliance with IEEE 519-1992, harmonic analysis shall be performed and submitted with the bid package, provided that the VFD vendor is in receipt of the below listed information 10 working days prior to the bid date.
   a. kVA rating of the low voltage distribution transformer(s)
   b. X/R Ratio of utility low voltage distribution transformer(s)
   c. Primary voltage
   d. Secondary voltage

e. Secondary %IZ (impedance)
f. Length, size, & number of conductors between transformer LV side and distribution panel
g. System Single Line Diagram and electrical equipment list showing transformer and VFD detail
h. Total linear load kW to be connected to the distribution transformer
i. Anticipated maximum demand load (15 minute or 30 minute) on the distribution transformer (IEEE 519)
j. Protective Features:
k. VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3msec.
l. VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
m. VFD shall offer the ability to have back-up 24V power to keep control logic powered in the event of a power failure. Back-up power shall keep communications and drive logic available until power is restored.
n. VFD shall auto-derate the output voltage and frequency to the motor if an input phase is lost if it is desirable to maintain operation without decreasing the life expectancy of the VFD. The use of this feature shall be user selectable and export a warning during the event.
o. Broken shaft detection shall be available to detect a low load situation in the pumps. Shall be functional in closed loop control or when controlled by an external signal. A timer shall prevent nuisance tripping.
p. No Flow Detection shall be available to detect a no flow situation in pump systems where all valves can be closed. Shall be functional in closed loop control or when controlled by an external signal.
q. Dry pump detection shall be available to detect if the pump has run dry and trip the drive. A timer shall prevent nuisance tripping.
r. Low water detection shall be available to detect if the pumps are not submerged and trip the drive. A timer shall prevent nuisance tripping.
s. VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
t. VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event.
u. VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.
v. The VFD shall have the option of an integral RFI filter. Enclosures shall be made of metal to minimize RFI and provide immunity.
w. Interface Features:
    1) VFD shall provide an alphanumeric backlit display keypad which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.

2) VFD shall display all faults in plain text; VFD's which can display only fault codes are not acceptable.
3) The keypad shall feature a 6-line graphical display and be capable of digitally displaying up to five separate operational parameters or status values simultaneously (including process values with the appropriate engineering unit) in addition to Hand/Off/Auto, Local/Remote, and operating status.
4) Two lines of the display shall allow "free text programming" so that a description, or the actual name, of the equipment being controlled by the VFD can be entered into the display.
5) Keypad shall provide an integral H-O-A (Hand-Off-Auto) and Local-Remote selection capability, and manual control of speed locally without the need for adding selector switches, potentiometers, or other devices.
6) All VFD's shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable.
7) VFD keypad shall be capable of storing drive parameter values in non-volatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.
8) VFD Display shall have the Ability to display 5 different parameters about the VFD or load including: current, speed, DC bus voltage, output voltage, input signal in mA, or other values from a list of 92 different parameters.
9) VFD display shall indicate which digital inputs are active, and the status of each relay.
10) It shall be possible to toggle between three status read-out screens by pressing the Status key. Different Operating variables with different formatting can be shown in each status screen.
11) VFD display shall indicate the value of any voltage or current signal connected to the analog input terminals.
12) VFD display shall indicate the value of the current on the analog output terminals.
13) A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
14) Password protection shall be provided to prevent unauthorized changes to the programming of the VFD. The parameters can be locked via a digital input and/or the unit can be programmed not to allow an unauthorized user to change the parameter settings.
15) A quick setup menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning. Use of macros shall not be required.
16) A digital elapsed time meter and kilowatt hour meter shall be provided in the display.
17) VFD shall offer as standard an internal clock. The internal clock can be used for: Timed Actions, Energy Meter, Trend Analysis, date/time stamps on alarms, Logged data, Preventive maintenance, or other uses. It shall be possible to program the clock for Daylight Saving Time / summertime,

weekly working days or non-working days including 20 exceptions (holidays etc.). It shall be possible to program a Warning in case clock has not been reset after a power loss. Clock feature shall offer, as an option, back-up power to keep time during power interruptions. Drives with real time clock built into keypad shall not be acceptable.

18) VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.
19) All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
20) There shall be six fully programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. Two of these inputs shall be programmable as inputs or outputs.
21) The VFD shall have two analog signal inputs. Inputs shall be programmable for either 0 -10V or 0/4-20 mA.
22) One programmable analog output shall be provided for indication of a drive status. This output shall be programmable for output speed, voltage, frequency, motor current and output power. The analog output signal shall be 0/4-20 mA.
23) The VFD shall provide two user programmable relays with 31 selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.
24) The VFD shall have offer a relay option board that offers three additional Form 'C' 240V relays that are mounted inside the drive. Provide as required.
25) The VFD shall offer an I/O board as an option that adds 3-digital inputs, 2-digital outputs, 2-analog inputs, and 1-analog output. Provide as required.
26) Floating point control interface shall be provided to increase/decrease frequency in response to external switch closures.
27) The VFD shall accept a NC motor temperature over-temperature switch input, as well as possess the capability to accept a motor thermistor input.
28) The VFD shall store in memory the last 10 faults with time stamp and recorded data.
29) Run permissive circuit shall be provided to accept a "system ready" signal to ensure that the VFD does not start until isolation valves, seal water pumps or other types of auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.
30) The VFD shall be equipped with a standard RS-485 serial communications port and USB port utilizing either the Danfoss FC or ModBus RTU and also be capable of supporting the following communications protocols by the use of an integrally mounted, field-installable option board: Profibus DP, or DeviceNet
31) The VFD shall be supplied with a standard RS-485 serial communications data port. A Windows® compatible software to display all monitoring, fault, alarm, and status signals shall be available. This

software shall allow parameter changes, storage of all VFD operating and setup parameters, and remote operation of the VFD.

x. Adjustments:
   1) The VFD shall have an adjustable output switching frequency.
   2) Four complete programming parameter setups shall be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to be programmed for up to four alternate control scenarios without requiring parameter changes.
   3) In each programming set up, independent acceleration and deceleration ramps shall be provided. Acceleration and deceleration time shall be adjustable over the range from 0 to 3,600 seconds to base speed.
   4) The VFD shall have four programmable "skip frequencies" with adjustable bandwidths to prevent the driven equipment from running at a mechanically resonant frequency.
   5) VFD shall include an automatic acceleration and deceleration ramp-time function to prevent nuisance tripping and simplify start-up.
   6) In each programming setup, independent current limit settings, programmable between 50% and 110% of the drives output current rating, shall be provided.
   7) PID parameter settings shall be adjustable while the VFD is operating, to aid in tuning the loop at start up. The VFD will also be capable of simultaneously displaying set-point reference and feedback values with appropriate engineering units, as well as output frequency, output current, and run status while programming the PID function.
   8) The VFD will include a "loss of follower" function to detect the loss of process feedback or reference signals with a live-zero value, with a user-selectable choice of responses (go to set speed, min speed, max speed, stop, stop and trip).
   9) A Sleep Mode function shall be provided to reduce wear and heating of the pump and other equipment in periods where system demands are minimal. This function will operate in both open and closed loop modes:
   10) In closed loop process control, when the output speed drops to a user-programmed minimum value ("sleep frequency") for a specified time ("sleep mode timer"), the drive will enter sleep mode and either go into standby or boost mode before entering standby. The drive shall automatically restart the motor once the output of the PID processor exceeds a programmable value "wake up frequency".
   11) Boost mode shall prevent short-cycling of the motor by temporarily adjusting the set-point by a user programmable percentage. Upon reaching this valve, the unit will go into standby.
   12) In open loop, the drive shall be capable of entering sleep mode if the input reference drops below a user programmable value. When the input reference increases above a programmable reference, the drive will automatically start.

y. An integral motor alternation function shall be provided to enable the drives output to alternate between two motors. The alternation interval shall be programmable in hours. The function shall operate relays as required to control the motor alternation sequence. A dwell time shall be integral to the function to prevent damage to the motor contactors.

z. The VFD will include a user selectable Reset function, which enables the selection of between zero and twenty restart attempts after any self-clearing fault condition (under-voltage, over-voltage, current limit, inverter overload and motor overload), or the selection of an infinite number of attempts. The time between attempts shall be adjustable from 0 through 600 seconds.
aa. An automatic "on delay" function may be selected from 0 to 120 seconds.
ab. The VFD will include a user-selectable Auto-Restart function that enables the VFD to power up in a running condition after a power loss, to prevent the need to manually reset and restart the VFD.
ac. VFD shall catch a rotating motor operating either in forward or reverse at up to full speed.
ad. Service Conditions:
    1) Ambient Temperature of the VFD, -10 to 40°C (14 to 104°F)
    2) 0 to 95% relative humidity, non-condensing.
    3) Elevation to 1000 meters (3,300 feet) without derating.
    4) VFD's shall be rated for line voltage of 550 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with ±10% variation. Line frequency variation of ± 2% shall be acceptable.
    5) No side clearance shall be required for cooling of the units.
ae. Quality Assurance:
    1) The manufacturer shall be both ISO-9001 and ISO-14001 certified.
    2) All products shall be CE marked; UL labeled, and meet the requirements of UL-508C.
    3) To ensure quality and minimize infantile failures on the jobsite, all VFD's shall be completely tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed under elevated temperature conditions.
    4) All optional features shall be functionally tested at the factory for proper operation.
    5) Factory test documentation shall be available upon request.

2.10 Guided Wave Radar Level Transmitter

A. Provide a 2-wire, loop powered level or interface transmitter using TDR (Time Domain Reflectometry) technology. Microwave pulses are guided down a probe suspended in the process media. When the pulse reaches a defined level some energy is reflected and the time difference is converted to a distance.

B. The system consists of a detachable electronics head and guided wave probes. Several different probe types are available to work in easy to difficult tank geometries with interfering obstacles, long nozzles, or small tank connections.

C. Microprocessor-based transmitter shall produce DC signals proportional to level plus provide HART based digital communications capabilities.

D. Rosemount 3300 series with an Integral digital display.

E. Process and Environmental Conditions

1. Relative humidity: 0 to 100%.

2. Ambient temperature: -40 to 185 F without LCD display.

3. -4 to 185 F with LCD display.
4. Process temperature: -40 to 302 F.
5. Process pressure: Full vacuum to 580 PSIG.
6. Unaffected by temperature or pressure changes.
7. Unaffected by pH, density, dielectric, or conductivity changes.
8. Unaffected by dust, vapor, interfering obstacles, and turbulence.
9. Maximum measuring range: 10 to 77 feet, depending on the probe type.
   a. Electrical
      1) Loop powered (2-wire) 11 to 42 VDC.
      2) Dual compartment transmitter housing can be removed from the probe without opening the tank.
      3) Dual compartment transmitter housing isolates the electronic circuitry from the field wiring. Housing is polyurethane coated aluminum.
      4) 1/2"-14 NPT cable gland or conduit entry.
   b. Probes and Process Connections
      1) Coaxial probe (to 19.7 ft. length) for avoidance of foam, low dielectrics, small and long nozzles.
      2) Rigid single or twin probes (to 9.8 ft length) for high turbulence and fibrous liquids.
      3) Flexible single or twin probes (to 77 ft length) for longer measuring lengths.
      4) Single probes can tolerate coating medias.
      5) 316 SS probes which can be cut to fit for easy installation.
      6) Available in 1", 1-1/2" threaded or 2", 3", 4" or 6" 150# and 300# flanged mount.
   c. Outputs
      1) 4-20 mA output proportional to level, distance, or interface.
      2) HART digital communication over the 4-20 mA loop.
      3) Integral digital display can toggle between level, distance, volume, internal temperature, interface level, etc.
      4) Damping: 0-60 seconds
   d. Software Functionality
      1) Transmitter 4-20 mA loop output shall be capable of simultaneous HART digital communications.
      2) Transmitter shall perform continuous diagnostics, be capable of self-test functions, and be able to give specific diagnostic information.
      3) Configuration capabilities shall allow user to input and store information.
      4) PC setup software with installation wizard.
   e. Performance
      1) Accuracy: +/- 0.2 inch for probes less than or equal to 16.4 feet, +/- 0.1% of measured distance for probes greater than 16.4 feet.
      2) Repeatability: +/-0.04 inch.

2.11 Magnetic Flow Meter Systems

A. Provide magnetic flow meter in locations as indicated on the equipment schedule or as shown on the drawings.

B. Magnetic flow meter systems shall include a magnetic flow tube and a microprocessor-based "smart" transmitter that is capable of converting and transmitting a signal from the flow tube. Magnetic flow meters shall utilize the characterized field principle of electromagnetic induction, and shall produce DC signals directly proportional to the liquid flow rate.

C. Each meter shall be furnished with a stainless steel or carbon steel metering tube and carbon steel flanges with a polyurethane, ceramic, neoprene, or Teflon liner as required by the application and/or as specified herein. Liner shall have a minimum thickness of 0.125 inches. The inside diameter of the liner shall be within 0.125 inches of the inside diameter of the adjoining pipe. Liner protectors shall be available on all flow tubes.

D. The flow tube shall be provided with flush mounted electrodes or bullet nose as indicated in the equipment schedule. Ultrasonic electrode cleaning shall not be needed or acceptable.

E. Grounding rings shall be provided for all meters.

F. All materials of construction for metallic wetted parts (electrodes, grounding rings, etc.) shall be minimum 316 stainless steel, but shall be compatible with the process fluid for each meter in accordance with the recommendations of the manufacturer.

G. Flow tube shall be rated for pressures up to 1.1 times the flange rating of adjacent piping. System shall be rated for ambient temperatures of -30 to +65C. Meter and transmitter housings shall meet NEMA 4X requirements as a minimum. When meter and transmitter are located in classified explosion hazard areas, the meter and transmitter housings shall be selected with rating to meet the requirements for use in those areas. Non-metallic transmitter housings shall not be acceptable.

H. The transmitter shall provide pulsed DC coil drive current to the flow tube and shall convert the returning signal to a linear, isolated 4-20 mA DC signal. The transmitter shall utilize "smart" electronics and shall contain automatic, continuous zero correction, signal processing routines for noise rejection, and an integral LCD readout capable of displaying flow rate and totalized flow. The transmitter shall continuously run self-diagnostic routines and report errors via English language messages.

I. The transmitter's preamplifier input impedance shall be a minimum of 109-1011 ohms which shall make the system suited for the amplification of low-level input signals and capable of operation with a material build up on the electrodes.

J. The transmitter shall provide an automatic low flow cutoff below a user configurable low flow condition (0-10%). The transmitter's outputs shall also be capable of being forced to zero by an external contact operation.

K. Each flow tube shall be factory calibrated and assigned a calibration constant or factor to be entered into the associated transmitter as part of the meter configuration parameters. Manual calibration of the flow meter shall not be required. Meter configuration parameters shall be stored in non-volatile memory in the transmitter. An

output hold feature shall be provided to maintain a constant output during configuration changes.

L. Accuracy shall be 0.50% of rate over the flow velocity range of 0.3 to 10.0 m/s. Repeatability shall be 0.1% of rate; minimum turndown shall be 100:1. Minimum required liquid conductivity shall not be greater than 5 uS/cm. Maximum response time shall be adjustable between 1 and 100 seconds as a minimum. Transmitter ambient temperature operating limits shall be -10 to +50 degrees C. Power supply shall be 115 VAC, 60 Hz.

M. All flow tubes shall have continuous submergence protection up to 30 ft (IP68). All options use the sealed conduits to meet IP 68 protection requirements.

N. Flow tubes shall be 150-lb flange mounted unless otherwise noted. The cables for interconnecting the meter and transmitter shall be furnished by the manufacturer. Transmitter shall be mounted integrally on flow tube, wall, or 2-inch pipe mounted as shown in the Drawings and/or as specified.

O. Magnetic flow meter systems shall be as manufactured by ABB Watermaster with a remote mount transmitter.

2.12 Float Switches

A. Float switches shall be direct acting type constructed of chemical resistant polypropylene casing with mercury switches operating when float is in a horizontal position. The switch shall be rated at 20 amps at 115 volts resistive. Cable shall be permanently assembled to switch and float. Float switch shall have built-in weight. Float switch shall be Rotofloat Type S (suspended) or Type P (pipe mounted) as required by Anchor Scientific.

Part 3 - Execution

3.1 General

A. Indicator lights on the Control Panels and OIT/HMI Graphics shall conform to the following color convention:

Status / Alarm	Lens or Screen Color
Running or Open	Red
Ready, Stopped, Off or Closed	Green
Failure or Alarm	Amber
Generic Status	Blue or White

a. All control by the System shall be distributed to the local PLC and shall be capable of operating in an automatic mode completely independent of the OIT or SCADA HMI. All accumulative total values (i.e. Flow Total) and runtimes shall reside and be computed in the PLC and "read" by the OIT/HMI.
b. Running status shall be provided from auxiliary contacts provided with the motor contactors and/or Variable Frequency Drives or via remote type I/O for intelligent devices, VFD's RVSS and starters. Auto status shall be defined as H-O-A switch in the Auto position. Ready status shall be defined as in auto

mode with all interlocks satisfied (no failure conditions present). Failed status shall be defined as motor overload, over temperature, seal water failure, VFD failure, failure to run, etc.

c. Where setpoints, operating limits, and other control settings are provided by the functional descriptions, these settings shall be initial settings only and shall be used for assistance in the initial startup of the System and/or Pump Station. All such settings shall be fully adjustable and based on actual operating conditions.

d. All setpoint control shall be by PID control algorithms when applicable. All PLC controlled equipment shall be provided with individual PID instructions in the RTU/PLC and all associated variables/parameters shall be cascaded or repeated for each PID instruction set as required. All setpoints, sequence times, sequence orders, dead bands, PID tuning parameters, internal timers, range limits shall be accessible and alterable, with proper code or password, from local Operator Interface Terminal "OIT" or the SCADA System Computer.

e. Provide PLC programming standardization for communications, messages and data tables for addressing all discrete, analog signals and data from all remote and local plant PLC's.

3.2 Project Functional Description

A. The system monitors the following:

1. Instantaneous Wet Well Level
2. Redundant Wet Well Level (optional & selectable)
3. Instantaneous Station Flowmeter (optional & selectable)
4. Calculated estimated station flow based on wet well drawdown/fill or pump curve.
5. Station flow totalizer: Flow Volume for Daily, Yesterday, Weekly, Last Week, Monthly, Last Month and Accumulative Total
6. High Level Sensor/Float Switch, backup emergency relay control (Starts all pumps at 100%)
7. Low Level Sensor/Float Switch, backup emergency relay control (Stops all pumps at Low Level)
8. Status of Lead Pump Start control float switch
9. Status of Lag Pump Start control float switch
10. Status of Stop Pumps control float switch
11. Pumps Motor Run Status
12. Pumps Motor Runtime: Last Run, Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
13. Pumps Motor Starts: Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total

14. Station Runtime: Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
15. Station Starts (Number of Wetwell Cycles): Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
16. Pump Motor Failure Alarms (OL, fail to run, etc.) for each pump
17. Alarm for Number of Pump Starts per day, high and low
18. Motor Moisture/Seal Failure for each pump
19. Motor High Temperature Monitoring for each pump
20. H-O-A switch position for each pump.
21. VFD status for each pump
22. VFD failure for each pump
23. VFD speed for each pump
24. Motor amps for each phase of each pump or average amps
25. Motor voltage for each phase or average of each pump
26. High motor amps warning alarm for each pump
27. Low motor amps warning alarm for each pump
28. High voltage warning alarm for each pump
29. Low voltage warning alarm for each pump
30. Loss of phase alarm for each pump
31. Unbalanced phase alarm for each pump
32. Diesel Pump run status (if present)
33. Diesel Pump Runtime: Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
34. Diesel Pump Starts: Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
35. Diesel Pump common alarm (if present)
36. Diesel Pump level indication from Radar included with pump.
37. Transfer unit breaker or switch position (if present)
38. PCS/RTU Intrusion Alarm
39. Wetwell Hatch Intrusion Alarm (if present)
40. Site Intrusion Alarm (if present)
41. Common Station alarm
42. Loss of Power alarm (Internal to RTU)
43. Loss of Communication to VFD

44. Loss of Communication to PCS/RTU from SCADA (Internal to PCS/RTU-set to 2 hours, default this feature is disabled)

45. The system controls the following:
    a. Duplex Pump Station
    b. Alternation of pumps based on pump cycle or time (user configurable in hours)
    c. Remote alarm beacon and horn (User selectable alarms, default high level alarm only)
    d. The system setup menu provides for the following:
        1) Faceplate setup screen for entering pump start and stop level setpoints.
        2) Faceplate setup screen for entering desire alternation method, lead pump cycle, or time based: enter number in hours
        3) Setup screen for setting high and low amps alarms and high and low voltage alarms.
        4) Setup screen to select the alarms that will produce the remote audible and visual alarms
    e. The system calculates and indicates the following:
        1) Calculate # of pump starts per pump per day, trend and indicate Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total. The SCADA System and the local OIT will historically store all values. Allow end user to set alarm values for high and low starts per day.
    f. The PLC, OIT and SCADA HMI shall provide the following minimum features:
        1) Provide embedded programs and logic for PLC and OIT that will not require any programming or downloading of applications by the end user. Provide a menu driven question and answer end user setup from the OIT.
        2) Graphical overview screen for pump station, etc. Direct link from overview to each sub-screen for a device, pump, etc.
        3) Selectable graphical overview screen for the type of pump station: Submersible, Wet/Dry Well, Suction Lift or Tabular Alpha/Numeric Text Only.
        4) Provide easy to use screen navigation throughout the OIT/HMI.
        5) Main graphic screen menu showing all graphical screens and sub-screens with clickable link to each.
        6) Historical and live trends of all variables, level, flow, pressure, pump starts, wetwell fills, etc.
        7) The SCADA System and the local OIT will historically store all variables, runtimes and totalizers. The local OIT shall have enough memory for 3 months of data and the SCADA System shall be based on the specified hardware.
        8) Display Pumps and Generator Runtime, Last Run, Current Day, Yesterday, Current Week, Last Week, Current Month, Last Month and Total Runtime in hours and tens of hours. Runtimes are calculated, accumulated and stored in the PLC memory. The OIT/HMI will only display the values. Last Pump Runtime is displayed in minutes of the last run, it will begin when the pump starts, and hold after the pump stops, resetting when the pumps starts again.

9) Calculate and Display # of pump starts per pump per day and indicate today, and last 7 previous days. Historically collect values for reporting purposes.
10) Display Flow Totalizer, Current Day, Yesterday, Current Week, Last Week, Current Month, Last Month and Cumulative Total Flow Totalizer for each monitored flow signal with a minimum of six (6) digits being displayed and multiplier as specified. All Flow Totalizers are calculated, accumulated and stored in the PLC memory. The OIT/HMI will only display the values.
11) Display Wetwell Level and Volume. Volumes are calculated and stored in the PLC memory. The OIT/HMI will only display the values.
12) Alarm summary and history screen with silence of audible alarm and acknowledge of alarms.
13) Password protection for entering vital set points.
14) For redundant hardware; Instrumentation (wet well level transducers), PLC's, power supplies, networks, etc., continuously indicate status of primary and secondary units. Failure of a unit will create an alarm that can be silenced and will remain in the alarm summary until the failure is corrected or the unit is replaced.
15) Disable Alarms reporting to SCADA System while the PCP door intrusion alarm is activated. This will prevent operations personnel from receiving alarms while the PCP or pumps are being serviced.
16) Pump Fault data (common fault) is also counted for each pump on Daily, Yesterday, Current Week, Last Week, Current Month, Last Month, and Accumulative Total.
17) A Simulation Mode is provided to allow a simulated level to be entered and adjusted to facilitate testing/commissioning of the station. After a 15-minute time delay, the level will revert to the actual level.

g. The Pumps shall be locally controlled manually/automatically at the Pump Station and remotely monitored and controlled from any System HMI Workstation at the Plant. Provide an OIT/HMI faceplate secure with administrative access only for Pump Control System setup. All setpoints shall be adjustable from the OIT at the Control Panel or any Plant HMI Workstation.

h. Automatic Level Control Mode:
1) The PLC shall start and stop the one of the pumps as the Lead Pump and start and stop the second pump, as the Lag Pump respectively based on preset level setpoints entered at either of the HMI's or OIT and is compared to the actual wetwell level signal from the level transmitters (primary and backup) and vary the speed of the pumps/VFD's to maintain a preset and adjustable level setpoint.
2) The lead pump shall start at a preset and adjustable level setpoint and the speed varied to maintain the level in the wet well.
3) If a lag pump is required, the initial speed shall be calculated based on the pump curves and onsite testing to create a pump station discharge flow to be slightly greater, approximately 5-10%, than a single pump at 100% speed. Both pumps shall always be paced at the same speed to maintain the wet well level setpoint.
4) With all pumps at minimum speed and if the wet well level is below a preset and adjustable "lag stop" setpoint which is set below the primary

start level setpoint, the lag pump will be stopped and the lead pump will continue to operate to maintain the wet well level setpoint until the all pumps off setpoint is reached.

5) The lead pump shall alternate after each run cycle and at a predetermined schedule that is adjustable from the Pump Station setup screen on the OIT or any Plant HMI Workstation with proper security levels.
6) In the event that a pump failure alarm (O.L., O.T., O.V., Out of phase, high or low amps, High Motor Temp, VFD failure, etc.) occurs during a start or while in operation, an alarm shall be indicated and logged. The pump shall be locked out of the sequence until the alarm is manually cleared and reset by the operator. The PLC shall choose the next ready pump in the sequence as the lead or lag pump respectfully. The time and event shall be logged, etc.
7) If a pump's auto status PLC input is not detected then the PLC shall select the next ready pump.
8) A backup low level float switch shall stop all pumps and indicate a level instrument/pump control failure alarm. The time and event shall be logged, etc.
9) A backup high level float switch shall indicate a high, high level alarm and shall attempt to start all pumps, with a time delay between starts, and indicate a level control/pump control failure alarm. The time and event shall be logged, etc.
10) Three backup float switches shall be utilized in a Lead/Lag arrangement to control the pumps should a failure of the primary level controller occur.
11) A pump is considered available when the HOA is in the Auto position and no failures are present.

i. Manual Control Mode from OIT or HMI Workstation:
   1) The System shall allow for the pumps to be started in Hand from the HMI with proper security or locally from the OIT. If Hand control from the HMI is selected the control output from the PLC shall call for the pump to start. Hand status shall be displayed on all HMI's. Run or Fail status shall be displayed on all HMI's. The HOA selector switch on the Local Pump Station Control Panel will be in the Auto position for this control. The operator shall be able to adjust the speed of the VFD manually from the OIT.

j. On the OIT and HMI menu we have a Technical Support button, it would list the Applications, PLC and OIT, Software Versions, PCS/RTU Model, Site ID, Site IP address, and "Contact Information for Repairs, Spare Parts and Additional Equipment".

3.3 Equipment Schedules

TABLE A – Control Panels, PLC Control Panels, Network Comm Panels

Control Panels, PLC Control Panels, Network Communication Panels with construction, features, software and hardware as specified previously, shown on the drawings and I/O list, shall be provided to monitor and control at the specified locations:				
TAG	LOCATION	ENCLOSURE	PLC & COMMUNICATIONS	NOTES
Pump Control System	Pump Station	Nema 4X SS with Dead Front Panel, 3pt latch	GE RX3i IC695CPE305 Processor GE QuickPanel+ 12" Color Touchscreen OIT Ethernet/IP Communications to VFDs and RTU	(2) 15HP, 208 VAC, 3P VFD with NEMA 1 enclosure, door mounted HMI, and Ethernet communications to PLC. Provide generator plug compatible with the city's portable generator and mechanical walking beam interlock between the breakers. Provide intrinsic safety barriers for float switches
RTU	Pump Station	Nema 4	Motorola ACE3600 Controller; Ports:2 Ethernet, 2 RS-232 1 Modem/Radio Port APX6500li 800 MHz radio.	

TABLE B – INSTRUMENTATION SCHEDULE

INSTRUMENTATION WITH CONSTRUCTION, FEATURES, SOFTWARE AND HARDWARE AS SPECIFIED PREVIOUSLY, SHALL BE PROVIDED TO MONITOR AND CONTROL AT THE SPECIFIED LOCATIONS:				
TAG	LOCATION	SIZE/TYPE	CAL. RANGE	NOTES
LIT- 0001	PS Wetwell	Rosemount 3300 Guided Wave Radar	0–30___ Feet	
FIT/FE- 0001	PS Discharge Flow Meter	ABB 8" Watermaster Magnetic Flowmeter	0–2000___ Gpm	150lb Flanges, 316ss GND Rings, Submergence Resistance
LSL-0001	PS Wetwell	Float Switch		Low Level Alarm
LSM-0001A, 0001B, 0001C	PS Wetwell	Float Switch		Backup Pump Controls for Lead and Lag operation.
LSH-0001	PS Wetwell	Float Switch		High Level Alarm

End of Section