

**Part 1 GENERAL****1.01 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. New Motorola Solutions Remote Terminal Unit (RTU) with hardware as required to monitor the pump station
- D. 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.
- E. Modifications to the existing FEPs at the Moccasin Bend WWTP for the RTU.
- F. Modifications to the city's existing SCADA System at the Moccasin Bend WWTP for the new pump station.
- G. Field Instrumentation for level.
- H. Operations Training, Hardware & Software Maintenance Training.
- I. I&C O&M Manuals.

**1.02 RELATED WORK**

- A. The following related sections may also be required for performance of this work.
  - 1. Section 26 43 10 - Surge Devices
  - 2. Section 26 05 26 - Grounding

**1.03 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

**1.04 QUALITY ASSURANCE**

- A. The SCADA System additions, Instrumentation, communication panels, 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. For standardization and quality purposes the following System Suppliers are pre-approved: RMJ, Diversified Integration, and MR Systems.

**1.05 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.
- B. Provide in a PDF file format. Provide on a USB drive and a cloud based service for download and upload after review.
- C. Will have a detailed index and easy to use tabs and bookmarks for BOM's, RTU I/O lists, drawings, Equipment Data Sheets, software or equipment manufacturer's literature, etc.
- D. 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.
- E. Submit schematics and system layout drawings.
- F. 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: If applicable, 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.

## Instrumentation, Pump Control System &amp; Remote Terminal Unit

- (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 of this project.
  - (2) Interconnecting Wiring Diagrams: Show all 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. HMI Software Graphics 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) 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.

**1.06 PCS AND RTU OPERATION & MAINTENANCE MANUALS**

- A. Submit Operation & Maintenance Manuals in accordance with Specifications.
- B. All O&M's will be provided in a PDF file format. Provide a cloud based service for download and upload for and after review, or provide a USB drive with the O&M's if that is the preferred method.
- C. Provide a complete Operation and Maintenance Manuals for the Pump Control Panel 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 PC's, PLC's, RTU's hubs, switches, cables, radio paths, etc.
  4. All Control Panel drawings.
  5. List of spare parts and expendables provided.
  6. Panel equipment, field devices, and instruments data sheets, including complete "Bill of Materials" of PLC's, RTU's, control panel devices, computers, printers, software, field equipment, etc.

7. Provide manufacturer's O&M literature and 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, options, etc. All pertinent information for the equipment or software shall be included on the Equipment Data Sheet.
8. Communication Network Cable Testing documentation with 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.
9. Instrument Calibration Worksheets showing actual calibration procedures performed with reading and results signed and dated by the Service Technician or Engineer.
10. Provide a USB Drive and a 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.
11. Final copy of PLC/RTU programs on CD and USB drive shall have descriptive documentation and explanation for each ladder rung or and sub routine within ladder programs.
12. Complete operator instructions for all PC, HMI, PLC's and OIT's including download instructions and OIT menu map with details for functions and data entry.
13. Point lists for all 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.
14. The complete O&M shall be provided with an easy to use pdf file with a detailed index with tabs and bookmarks for BOM's, PLC I/O lists, drawings, Equipment Data Sheets, software or equipment manufacturers O&M literature, etc. A compact disk shall be provided with O&M files including the drawings, Equipment Data Sheets, software or equipment manufacturers O&M literature, etc. The Software O&M may be printed by the end user if desired. Clicking on an item on the index shall immediately display the 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.

#### **1.07 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.

#### **1.08 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.

#### **1.09 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.

#### **1.10 INSTALLATION ASSISTANCE AND INSTRUCTIONS**

- A. The System Supplier shall provide a qualified service engineer to be onsite for one (1), day during the installation of the instrumentation and PCS/RTU for coordination and to assist and instruct the contractor in methods of proper installation of the equipment.

#### **1.11 OPERATIONS, HARDWARE & SOFTWARE MAINTENANCE TRAINING.**

- A. After the project substantial completion, provide 2 hours 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 PCP, SCADA System, RTU and 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. Specific training for the actual hardware configuration provided.
6. Hardware troubleshooting, component removal and replacement, and periodic maintenance.
7. O&M functions and features.

#### **1.12 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 transit 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.

#### **1.13 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.

#### **1.14 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.

### **1.15 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.

### **1.16 WARRANTY**

- A. Systems supplier shall furnish a one-year on site 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**

### **2.01 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.

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- 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 or Eaton.
- X. Provide a manual transfer switch/main circuit breakers for utility power and generator power with an external connection and receptacle for a portable generator, coordinate connector type with the city to be compatible with their portable generator. Provide the necessary size for the HP and FLA of the pump motors. 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.



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- 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.
- Y. Provide NEMA Contactors with adjustable overloads.
- Y. 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.
- Z. If pump station does not have a separate 120VAC service, provide a minimum 3KVA transformer, or size as shown in the schedules, inside the control panel with circuit protection and dedicated circuit for a 120VAC GFCI receptacle.
- AA. Provide intrinsic safety barriers for floats switches and any instrumentation located within the wetwell. Acceptable manufacturers: PR Electronics, Pepperl+Fuchs, Square-D, Schneider Electric or Turck, Inc.
- AB. Provide Control Panel with UL-698A certification.

**2.02 CONTROL PANEL ENCLOSURES**

- A. Provide NEMA 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".

**2.03 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 aAPX6500Li radio 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

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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 a 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.

**2.04 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.

## 2.05 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.

## 2.06 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

### 3.01 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.

- e. Follow programming standardization for communications, messages and data tables for addressing all discrete, analog signals and data from RTU.

### 3.02 PROJECT FUNCTIONAL DESCRIPTION

#### A. The SCADA System monitors the following:

1. Pumps Motor Run Status
2. Pumps Motor Runtime: Last Run, Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
3. Pumps Motor Starts: Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
4. Station Runtime: Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
5. Station Starts (Number of Wetwell Cycles): Daily, Yesterday, Current Week, Last Week, Current Month, Last Month and Accumulative Total
6. Pump Motor Overload Alarm for each pump
7. High, High Float Switch
8. Radar level transmitter (GP:50 Submersible Level Transmitter, Model 311-M351)
9. High Level Float Switch
10. Low Level Float Switch
11. Alarm for Number of Pump Starts per day, high and low
12. Motor Moisture/Seal Failure for each pump
13. Motor High Temperature Monitoring for each pump
14. PCS/RTU Intrusion Alarm
15. Wetwell Hatch Intrusion Alarm (if present)
16. Site Intrusion Alarm (if present)
17. Common Station alarm
18. Loss of Power alarm (Internal to RTU)
19. Loss of Communication to VFD
20. Loss of Communication to PCS/RTU from SCADA (Internal to PCS/RTU-set to 2 hours, default this feature is disabled)
21. Instantaneous Wet Well Level
22. Pump station flow meter

#### B. The system controls the following:

- a. Two 1.5 HP Pumps
- b. Alternation of pumps based on pump cycle
- c. Remote alarm beacon and horn (User selectable alarms, default high level alarm only)
- d. The system setup menu provides for the following:

- 1)
- h. Automatic Level Control Mode:
- 1) The controls 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 wetwell level and the activation of the float switches.
  - 2) The lead pump shall alternate after each run cycle.
  - 6) In the event that a pump failure alarm occurs during a start or while in operation, an alarm shall be indicated and logged on the SCADA System. The pump shall be locked out of the sequence until the alarm is manually cleared and reset by the operator. The other pump shall start as the lead immediately.

## C. RTU I/O:

- 1 PUMP 1 RUNNING
- 2 PUMP 2 RUNNING
- 3 PLC OK
- 4 PUMP 1 FAULT
- 5 PUMP 2 FAULT
- 6 ESTOP ACTIVE
- 7 POWER FAIL
- 8 PUMP 1 SEAL FAIL
- 9 HIGH HIGH WETWELL FLOAT SWITCH ALARM
- 10 HIGH WETWELL FLOAT
- 11 LOW WETWELL FLOAT
- 13 OPERATOR ASSIST
- 14 PUMP 2 SEAL FAIL
- 15 SITE INTRUSION
- 16 FLOW METER
- 17 WETWELL LEVEL FROM RADAR LEVEL TRANSMITTER

**3.03 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 Panel	Big Ridge No. 2 Pump Station	Nema 4X SS with Dead Front Panel, 3pt latch		(2) 1.5HP, XXX VAC, 3P, NEMA 0 contactor with OL. 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 SCADA RTU connections Dry contacts to field per I/O list
RTU	Big Ridge No. 2 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- 101	PS Wetwell	Radar Level Transducer	0–_40_ Feet	Provide termination box and gortex filter for vent tube
LSL-101	PS Wetwell	Float Switch		Low Level Alarm
LSH-101	PS Wetwell	Float Switch		High Level Alarm
LSHH-102	PS Wetwell	Float Switch		High Level Alarm
FIT-101	PS Flow Meter	Mag flow meter	0 – 4000 GPM	ABB Watermaster

END OF SECTION