**SECTION 13420**

**CONTROLS & INSTRUMENTATION**

1. **GENERAL**
   1. **WORK INCLUDED**
      1. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specification sections, apply to this section.
   2. **RELATED WORK**
      1. Division 16 – Electrical.
   3. **SUBMITTALS**
      1. Equipment data shall be submitted for the pressure transducers, radio modems with antennas, operator interface terminals, programmable logic controllers, and supporting equipment. Provide listing of radio telemetry frequencies identified with site approved by FCC.
   4. **SYSTEM INTEGRATOR**
      1. The PSA shall integrate the systems. No other integrators shall be permitted to work on PSA telemetry/SCADA equipment or systems, unless given prior authorization by the PSA.
   5. **EQUIPMENT COMPATIBILITY**
      1. This project interfaces with existing water system equipment including pump stations and water tanks. Radio telemetry and controls systems are in place at all existing pump station and tanks. In order to maintain compatibility with the existing systems, the control and radio equipment used in this project shall be that specified to the extent feasible considering product updates and shall be fully compatible with the existing system components. The main control point for the system that requires communication back from each pump station or water tank is located at the Carfax Water Treatment Plant. Determine if the existing pump stations and tank sites will be needed as radio telemetry repeaters to allow communication throughout the PSA sites back to the Carfax Water Treatment Plant. Provide new repeaters, antenna, etc., as determined necessary.
      2. Prior to bid, the contractor shall confirm that a radio signal from the Carfax Water Treatment Plant may be obtained at the proposed site and will transmit all data to be sent:
      3. Provide antenna installations as determined from the radio signal path surveys.
   6. **SCOPE OF WORK** 
      1. General: the contractor shall furnish and install all instruments, appurtenant equipment, piping and accessories, as shown on the drawings and specified herein to provide a fully functional system.
      2. Work to be included. The following work, equipment, and services shall be included in this contract:
         1. Prepare and submit for approval system diagrams.
         2. Perform tests, adjustments, and calibration.
         3. Perform system start‑up including generator operation.
         4. Furnish and install all other materials and perform all related work necessary to accomplish the intent of the scope of the work as represented on the drawings and specified herein in order to produce a complete operational system.
         5. Provide instruction and training in the operation, repair, and maintenance of all new control equipment, instrumentation, and all related equipment.
         6. Provide all special tools and test equipment required to test, adjust, calibrate, and maintain the new equipment.
      3. Install radio RTU and antenna and provide programming for all equipment for all specified locations to communicate with Carfax Water Treatment Plant.
      4. Data Points
         1. All pump stations shall transmit the following information to the Carfax Water Treatment Plant as a minimum:
            1. Suction pressure.
            2. Discharge pressure.
            3. Low suction alarm.
            4. High suction alarm
            5. Normal power loss
            6. Generator status (on/off/fail)
            7. Generator alarms
            8. Pump fail
            9. Low level
            10. High level
            11. VFD status (on/off/fail)
            12. Each pump status (on/off/fail)
            13. Each control valve status (open/closed/fail) (fail due to valve time out on opening delay).
         2. All tanks shall transmit the following information to the Carfax Water Treatment Plant as a minimum:
            1. Utility power loss (if powered by commercial power)
            2. Solar low battery voltage (if powered by solar power)
            3. Low water level
            4. High water level
            5. Altitude valve status (if applicable)
            6. Additional points may be required and will be evaluated on a case-by-case basis. A list of specific data points required shall be outlined on the plans.
      5. In addition to tanks, other system components, such as flow control valves, pressure reducing valves, flow meters, or others, may be specified to be connected to the SCADA system. When such items are required, a list of specified data points for each location shall be outlined on the plans.
      6. Provide local reset button at each pump station, tank, or other system component to reset alarms. Same reset function shall be provided through radio system from Carfax Water Treatment Plant.
      7. Provide modifications, software updates/upgrades, and reprogramming to the existing equipment or provide additional new equipment at the Carfax Water Treatment Plant to provide interface as described herein. System software shall have 25% spare capacity for future expansions. Operator shall be capable of selecting each pump station to view on screen for status and alarms. Operators shall also have access through cell phones to view pump station status and alarms. When a pump station alarms, the operator at the water treatment plant computer shall be notified in addition to calling cell phones (determined by owner). User passwords shall be required for computer access and cell phone access to pump stations. Water treatment plant computer shall be capable of moving markers on screen to view trends back and forth.
      8. Update existing radio frequency license to allow communication of all radio telemetry specified herein.
      9. Spare equipment is to be provided to be stored at Carfax Water Treatment Plant as follows:
         1. 24-volt power supply,
         2. Battery backup,
         3. Analog I/O card,
         4. Digital I/O card,
         5. SCADAPACK RTU
         6. Connector cables for each type of equipment listed above.
            1. Contractor shall provide a telemetry equipment list for each station including product manufacturer, model numbers, and manufacturer’s contact phone number.
            2. Contractor shall prepare a typical prototype graphic screen for new sites for review and acceptance.
2. **PRODUCTS**
   1. **RADIO MODEM AND ANTENNA**
      1. The model numbers contained in the following are intended to reflect the features required. Over time, model numbers may have changed, an updated version of the products has been issued, and/or the product has been discontinued. The SCADA integrator is responsible for coordinating the requirements below with the PSA to ensure compatibility with existing systems and availability of required features.
      2. Tank and pump station sites shall be equipped with a licensed radio modem and antenna with appropriate surge protection to provide the telemetry function.
      3. The modem shall be Calamp Viper SC+ VHF with frequency range of 136-174 MHz, and 12.5 KHz channel bandwidth. Performance shall be:
         1. -116dBm@8kpbs
         2. -109dBm@16kpbs;
         3. -102dBm@24kpbs
         4. -95dBm@32kpbs
         5. No substitutions are allowed.
      4. The antenna shall be one of the following depending upon the conditions:
         1. PCTEL MYA 1505,
         2. PCTEL MFB 1503, or;
         3. TELEWAVE ANT150F6.
      5. A 24-volt power supply shall be provided, and shall be Phoenix Contact model TRIO-UPS/1AC/24DC/5, no substitutions allowed.
      6. Each site shall have manual operation from the Carfax Water Treatment Plant. Sites equipped with permanent generators shall provide generator status through the telemetry to the Carfax Water Treatment Plant.
      7. Tanks shall have analog signal surge protection with remote signal contact to transmit to Carfax Water Treatment Plant.
      8. Pump stations shall have radio telemetry connected and programmed to send generator status through the telemetry to Carfax Water Treatment Plant.
      9. Control panels
         1. Control panels shall be UL 508 listed.
         2. Enclosure: NEMA 4x enclosure for outdoor installations and NEMA 12 enclosures for indoor installations.
         3. A battery backup shall be provided and shall be Phoenix Contact model QUINT-BAT/24DC/7.2AH, no substitutions allowed.
         4. Suitable lightning and voltage transient protection shall be provided for AC power connections as recommended by the PLC manufacturer. Remote signal contact to transmit to Carfax Water Treatment Plant.
      10. Amplifiers
          1. Provide radio frequency amplifiers, TPL Communications model PA3-1AC-N for Carfax Water Treatment Plant and any other sites as required.
          2. Provide NEMA 4x for outdoor enclosures or NEMA 12 for indoor enclosures for amplifier and power supply.
          3. Provide power supply and 48-hour battery backup.
      11. PLC/RTU
          1. PLC/RTU’s are to be Schneider Electric SCADPACK, with no exceptions. Models are as follows:
             1. Model SCADAPACK 350, Part number TPUB350-1A20-AA00 for tank sites
             2. Model SCADAPACK 350, Part number TPUB350-1A20-AA10 for pump stations
             3. Model 5414-24, Part number TBUX297378 digital input card
      12. Pressure Transducers
          1. Pressure transducers shall be capable of providing 4-20ma output signal and have a minimum pressure range of 0-500 psi. The transducers shall have a 1/4 inch male NPT connection. Transducers shall be Rosemount model 2088 or approved equal.
   2. **ELECTROMAGNETIC FLOWMETERS**
      1. General:
         1. Electromagnetic flow meters shall be a full bore meter with a magnetic field traversing the entire cross section of the flow tube. Insertion meters or multiple single point probes inserted into a spool piece are not acceptable.
         2. Meters shall operate based on Faraday’s law based on Faraday’s law, using a pulsed dc type coil excitation with high impedance electrodes.
         3. Meter unit shall consist of a flow tube, transmitter, and interconnection cables
         4. Meter shall only require one cable and conduit between sensor and transmitter. Cable and termination strips shall be color coded to allow for easy installation.
      2. Service:
         1. Meters shall be capable of service for potable water and wastewater service as required
      3. Performance:
         1. Meters shall have a range of 1500 to 1.
         2. Meters shall be high accuracy factory calibrated to +/- 0.2 % of rate for flow rates above 2.8 fps.
         3. Meters shall have a repeatability of +/-0.05% or +/-0.0008 ft/s, whichever is greater.
      4. Process Connection:
         1. Meters shall be flanged connection ASME Class 150 up to 24 inch unless otherwise specified
         2. Flanges shall carbon steel
         3. Meters shall be fully rated to the same design pressure as the flanges.

* + 1. Flow Tube:
       1. Meter Tube material shall be 304 stainless steel
       2. Liner material shall be Hard Rubber unless otherwise specified.
       3. Electrodes shall be conical and self-cleaning
       4. Electrodes shall be 316 stainless steel unless otherwise specified.
       5. Flow tube shall be rated for submersible continuous to 30 ft and direct burial to16 ft (IP68, NEMA 6P)
       6. Housing material shall be aluminum or epoxy coated carbon steel
       7. Grounding rings or grounding electrodes shall be provided per manufacturer’s recommendation
       8. Sensors in all sizes shall be provided with full bore design to reduce pressure loss.
    2. Transmitter:
       1. Transmitter shall be supplied by either 120 V AC or 24 V DC power as specified.
       2. Transmitter shall have a three line back-lit graphical display with capacitive keys that allows for external configuration without removing covers and compromising the integrity of environmental classifications.
       3. Transmitter shall provide for bi-directional flow with forward and reverse flow indication and have a total and rate 2x10-digit user configurable display.
       4. Transmitter shall have three 9 digit totalizers for forward, reverse, and net.
       5. Transmitter enclosure shall be made of Aluminum and rated IP67, NEMA 4X
       6. Transmitter shall have “Through The Glass Control” with capacitive keys (no push button key pad)
       7. Transmitter shall have HART protocol standard with Optional Modbus and Profibus available when noted.
       8. Transmitter shall be rotatable up to 270 degrees without tools
       9. Transmitter shall have type “P” continuous self-checking capabilities (not just on start-up)
       10. Redundant data storage shall be provided both in sensor and transmitter with continuous replication of calibration factors, meter size, serial numbers, and site-specific settings.
       11. Transmitter shall be equipped with an infrared service port for meter configuration and diagnostic interrogation and shall have capability to connect to laptop
       12. Operator shall be able to configure as keypad image, Hart or HyperTerminal and shall be able to perform remote trouble shooting from remote location with computer laptop packages such as PC anywhere.
    3. Calibration:
       1. Test Mode: Provide the ability to verify the accuracy of the unit and the integrity of the current loop without any external equipment.
       2. Meter calibration shall be in accordance with OIML R49 Type P, self-calibration requirements.
       3. Meter must be able to periodically generate simulated signals that verify that the output is within predefined limits.
       4. Coil inductance and resistance along with electrode voltage and impedance must be verifiable through diagnostic functionality
       5. Warnings and Alarms: Shall be classified to NAMUR NE 107 standards. Meter must have ability to display severity of warning with "maintenance, check-function, failure and out of spec” warning indications.
       6. Alarm priorities shall be classified as: “None; Maintenance; Out-of-spec; Function check; and Error.”
       7. For alarms, must be able to read quantity of occurrences, total time duration of the alarm occurrences, and time since last occurrence.
       8. All replacement transmitters shall be interchangeable without need for programming sensor calibration factors, meter size, site information, and serial numbers
       9. In-situ Calibration Verification: This system shall be used to verify in a quantifiable manner the meter’s current conditions vs. the meters condition when originally manufactured. This calibration verification of the meter shall be performed without need for physical access to the meter flow tube. Method must be able to print out hard copy of verification and diagnostic reports.
       10. Meters to be designed, manufactured, and calibrated in an ISO9001, UKAS/NAMAS, NIST, or NATA certified or traceable facility. Flow facility must be certified by volume or weight certified provers. Facility must have the capability to hold the flow rate at the specified calibration points for a minimum of five minutes to allow stabilization for flow and repeatability point checks.
    4. Acceptable Manufacturers:
       1. Meters are to be ABB WaterMaster with no exceptions.

1. **EXECUTION**
   * 1. Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment and similar devices shown on the drawings are approximate only. Exact locations shall be as approved by the PSA/engineer during construction. Obtain in the field all information relevant to the placing of process control work; and, in case of any interference with other work, proceed as directed by the PSA/engineer and furnish all labor and materials necessary to complete the work in an approved manner.
     2. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances, and regulations, contractor shall bear full responsibility for such violations and assume all costs arising there from.
     3. Brackets and hangers required for mounting of equipment shall be provided as required. They shall be done in a workmanlike manner and not interfere with any other equipment.
     4. Training
        1. The PSA requires that its staff be trained prior to the commencement of installations. No installations will be permitted until systems training is completed.
        2. Vendor shall perform all training using the PSA system equipment.
        3. All training shall be performed at a site designated by the wise county PSA.
        4. Vendor shall provide training checklist in order to review training topics covered. Upon completion of review both vendor and appropriate utility personnel shall initial checklist.
        5. The PSA may desire and shall be permitted to videotape training sessions for internal use. Vender shall cooperate to ensure quality video records of classroom and field training sessions. The PSA shall be responsible for all cost associated with videotaping.

END OF SECTION