

**SECTION 13440 – SCADA
SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM**

GENERAL

1.1 PROJECT DESCRIPTION

A. Description of Work

The work to be accomplished under this section shall consist of furnishing the equipment necessary for a complete automatic control and monitoring system to function as specified herein and as shown on the drawings. The system integrator shall furnish a completely integrated all solid-state radio telemetry base Supervisory Control and Data Acquisition (SCADA) system. It shall be the system integrator's responsibility to supply a system that is compatible with existing Micro-Comm equipment, new equipment supplied by others as part of this contract, and equipment supplied in other contracts. The complete system shall be designed, fabricated, programmed, tested, started up, and warranted by a single supplier to insure a single source of responsibility.

B. Scope of Work

This section covers upgrading the existing Micro-Comm radio telemetry-based SCADA System to include:

- Scranton Booster Pump Station PLC-RTU,
- New Holland Booster Pump Station PLC-RTU,
- Daniels Booster Pump Station PLC-RTU,
- (1) Office/Ponzer WTP Central Terminal Unit Modifications. Reuse existing CSX computer workstation(s).
- (1) Virtual graphical screen meeting with engineer, owner, and Micro-Comm to develop graphical/function screens.
- (1) Micro-Comm project manager onsite start-up/implementation meeting. Micro-Comm to work with electrical contractor replacing/starting up hardware as required.

C. General/Electrical Contractor Shall Supply

1. All equipment required in other sections of the specifications.
2. All labor for the electrical installation of the system.
3. Access and easements as needed for all sites.
4. 120VAC power at all sites.
5. Pressure sensing taps for all sensing points in the system.
6. Meter pits for sensing tank levels or line pressures in the system.

D. System Integrator Shall Supply:

1. Engineering submittal and shop drawings prior to installation.
2. All the paperwork and fees necessary to obtain an FCC radio license in the name of the Owner.
3. All user licenses and fees for software supplied in this system with licenses in the name of the owner.

4. Operation and maintenance manuals, as detailed in this section.
5. All start-up labor and services, as required for equipment specified in this section.
6. Operator training as detailed in this section.

1.2 QUALITY ASSURANCE

A. System Integrator Qualifications

The system specified herein shall be the product of a system integrator who can demonstrate at least ten (10) years of satisfactory experience in furnishing and installing comparable radio-based telemetry/control systems for water and wastewater installations.

The system integrator shall maintain a 24-hour available inventory of all replaceable modules to assure the Owner of prompt maintenance service and a single source of responsibility.

B. Approved System Integrators

The approved system integrator for this project is:

Micro-Comm, Inc.
15895 S. Plfumm Rd
Olathe, KS 66066

Local Representative:
Robert L. Carlson, Inc.
Tel: (704) 905-7352 / Doug Carlson mobile.

1.3 SUBMITTALS:

- A. Complete submittal shall be provided to the engineer for approval prior to equipment fabrication. The submittal data shall include the following:
 1. Product Data - Provide product data sheets for each instrument and component supplied in the system. The data sheets shall show the component name as used on reference drawings, manufacturer's model number or other product designator, input and output characteristics, scale or ranges selected, electrical or mechanical requirements, and materials compatibility.
 2. Shop Drawings - Provide drawings for each panel showing the wiring diagrams for control circuits and interconnections of all components. The drawings shall include wiring diagrams for all remote devices connected to the panel.
 3. Panel Layout Drawings - A front panel and sub-panel layout shall be included as part of each control panel drawing. Components shall be clearly labeled on the drawing.
 4. Installation Drawings - Typical installation drawings applicable to each site in the system shall be included.
 5. Operator Interface Software - The submittal shall include a generic but detailed technical description of the Operator's Interface Software as proposed for this system including:
 - a. Sample text screens and menus
 - b. Sample graphics screens
 - c. Sample report logs and printed graphs

1.4 MAINTENANCE INFORMATION

A. Maintenance Data Manuals

Submit maintenance manuals and "as built" drawings on all items supplied with the system. The manuals and drawings are to be bound into one or more books as needed. In addition to "as built" engineering submittal data and drawings, the manual shall include trouble shooting guides and maintenance and calibration data for all adjustable items.

1.5 DELIVERY, STORAGE, & HANDLING

- A. All items shall be stored in a dry sheltered place, not exposed to the outside elements, until ready for installation. All items shall be handled with appropriate care to avoid damage during transport and installation.

1.6 SEQUENCING & SCHEDULING

A. Coordination

The Systems Integrator shall coordinate with other electrical and mechanical work including wires/cables, raceways, electrical boxes and fittings, controls supplied by others, and existing controls, to properly interface installation and commissioning of the control system.

B. Sequence

Sequence installation and start-up work with other trades to minimize downtime and to minimize the possibility of damage and soiling during the remainder of the construction period.

1.7 DISTRIBUTED CONTROL OPERATION

A. General

The control system shall use "Programmable Logic Controllers" (PLCs) at all locations in the system as detailed later in these specifications. Each site in the system shall have a unique digital address. The Central Processing Units (CPUs) and Input/Output (I/O) cards used in each of the PLCs shall all be identical, fully interchangeable without reprogramming by the operator. The PLCs shall be "self-initializing" and "self-restoring" so that operator intervention is not required after power interruptions, transients from lightning storms, or component changes.

The system shall be composed of a Central Terminal Unit (CTU) that monitors and or controls the operation of multiple Remote Terminal Units (RTUs). The CTU shall be composed of a PLC (as described above) and one or more Operator Display Consoles (ODCs) with Human-Machine-Interface (HMI) software to display, alarm, record, all data received and for operator input for changes to the system.

The control system shall be capable of implementing multiple modes of communications in a single system to include radio, leased phone-line, dial-up phone-line, high-speed data highway, fiber optic, and Ethernet communications as details in these specifications. The individual sites in the system shall simultaneously support both Master-Slave and Peer-to-Peer communications as needed implement the distributed control features listed in these specifications.

1.8 RADIO CHANNEL DATA OPERATION

A. General

The control system shall be specifically designed for radio channel data communications. The core of the system shall be over FCC licensed radio frequency spectrum intended for SCADA and remote-control purposes. The systems integrator shall be responsible of obtaining the necessary FCC licenses for one or more frequencies as needed to establish both supervisory and distributed control.

All the equipment required for operation of the system shall be directly owned by the Owner and included as part of this contract. Systems using third party repeaters, trunking masters, or leased equipment will not be allowed. The Systems Integrator shall select radio equipment as detailed below to ensure reliable operation and be able to implement all software features listed in this specification whether currently required or described as a "shall be capable" feature.

The overall system design and operation shall provide a 20db pad over the minimum required for operation on all primary data paths (primary paths may include data relays) to insure a 98% reliability of communications. Remote site communications for distributed peer-to-peer communications shall provide 30db of pad to ensure operation under all weather conditions and provide a 99.9% communications reliability. The 20db and 30db pad requirements and FCC rule compliance shall be demonstrated (at no additional cost) to the Engineer at his request. The testing shall be accomplished using an IFR AM/FM 1000S communications analyzer or equal equipment.

B. FCC Licensing

The system manufacturer/supplier shall be responsible for collecting all information, generating all paperwork, and paying all fees required obtaining a license on behalf of the Owner.

PART 2 - PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLERS & LOCAL I/O EQUIPMENT

A. General

Industrial Programmable Logic Controllers (PLCs) shall be used at all locations. The PLCs shall have an operational range of 0-60degC and 5-95% relative humidity. The PLCs shall all be from the same family of controllers, scalable from very small to very large applications, and programmed from identical programming software used for all processors. The PLCs shall be Micro-Comm M1650 controllers.

The M1650 PLC shall support both local and remote I/O. Input/Output cards shall be mounted on a DIN rail channel. The PLC inputs, outputs, and operator interface shall be as follows: .

1. DISCRETE OUTPUTS - The discrete outputs shall be isolated relay outputs rated at 5.0A continuous @ 240VAC. LEDs on the front of the PLC base unit or expansion module shall indicate the status of each output point. Interposing relays shall be provided if the voltage or current of the external load on a contact exceed the 5.0A 240VAC ratings. Each output shall be provided with operator settable software ON and OFF time delays.
2. DISCRETE INPUTS - The discrete inputs shall be optically isolated and provide for 24VDC excitation to remote sensors and switches. Each input shall be separately fused or current limited such that accidental grounding shall not render the other inputs non-functional. LEDs on the front of the input module shall indicate the status of each input point.
3. ANALOG INPUTS - The analog inputs shall provide filtered and scalable analog to digital conversion of input signals. The analog inputs shall be switch selectable from 0-5VDC to 0-20mADC and provide a minimum of 0.3% resolution and 0.5% accuracy over the temperature range of 0-70degrees C. The PLC shall provide separately fused 24VDC excitations to the remote sensors.
4. ANALOG OUTPUTS - The analog outputs shall provide a 4-20mA isolated signal to other panels and devices as specified.
5. PULSE INPUTS - The high-speed counter/pulse inputs shall provide for pulse rates up to 1KHz direct from flow meter transmitter heads without interposing equipment. The pulse input shall include fused 12VDC excitation to the meter transmitter.
6. POWER SUPPLY - Each PLC assembly shall include an integral power supply. Power supplies shall be designed for 12VDC or 24VDC input power and suitable for use in battery back-up operations. DC/DC converters shall be required to ensure that both the 12VDC and 24VDC are regulated separately from the common source.

7. KEYPAD & DISPLAY UNIT - The optional keypad & display unit shall have a 4x20 back-lighted LCD display to display the status of all local inputs and the tank level of the associated control water tower level. The 5x5 keypad shall provide for operator input of set points and timer settings. The operator interface shall be menu driven and provide for dedicated keys for cursor position and input functions. The operator interface shall provide for up to 50 screens of data display. The keypad & display unit shall be supplied and mounted on the front of the PLC enclosure if detailed in the specific PLC I/O requirement list. The keypad & display unit shall maintain the Nema 4 rating of the PLC enclosure.

B. Enclosures

The remote unit enclosures for indoor mounting shall meet all the requirements for NEMA Type 12 enclosures. The enclosures body shall be made of a minimum 16-gauge steel with continuously welded seams and be furnished with external mounting feet. The enclosure door shall be made of a minimum 14-gauge steel with have a 14-gauge steel hinge. Enclosures larger than 16x14 shall have a rolled lip on 3 sides of the door for added strength. The door opening shall have a rolled edge on 4 sides to protect the door gasket. The door gasket shall be heavy neoprene and attached to the door with oil resistant adhesive. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The subpanels shall be finished in white. Nema 12 enclosures shall be Hoffman "CH" or "CONCEPT" wall mount enclosures.

Remote site installations requiring equipment to be mounted outside shall have a lockable NEMA 3R enclosure. The NEMA 3R enclosure shall be constructed of 14-gauge galvanized steel, with a drip shield top and seems free sides front and back, and a stainless-steel hinge pin. The enclosure finish shall be gray polyester powder coating inside and out over phosphatized surfaces. The NEMA 3R enclosure shall be Hoffman Bulletin A-3.

The remote unit enclosures mounted in damp corrosive areas (such as concrete meter vaults) shall be NEMA Type 4X rated enclosures. The enclosures shall be made of molded fiberglass polyester and be furnished with external mounting feet. The door shall have a seamless foam-in-place gasket and corrosion-resistant hinge pin and bails. Sub-panels shall be 14-gauge steel for 16x14 enclosures and 12 gauge for larger enclosures. The enclosure finish shall be a light gray inside and out. The subpanels shall be finished in white. Nema type 4X enclosures shall be Hoffman "Fiberglass Hinged Cover".

Refer to Appendix for specific enclosure requirements.

C. Local Control Functions

In general, the PLC shall be programmed to provide generic control functions as detailed earlier and to work in concert with the CTU. The integrator shall be responsible to meet with the owner and the engineer to develop the automatic control strategy required for the system.

Refer to Appendix for special input and output control requirements.

2.2 RADIO TRANSCEIVERS & ACCESSORIES

A. General

The radio transceivers shall be standard "un-modified" radios that can be tuned, aligned, and repaired at any two-way radio shop. Interface to external data modems shall be through the front panel microphone jack. The radios shall be synthesized and fully field programmable and include a built-in time-out timer to disable the transmitter after 0-60seconds. The units shall be tuned to FCC specifications for the specific frequency assigned. The radio equipment shall be FCC type approved and the system capable of operation on the 3KHz to 6KHz narrow band splinter frequencies (154 or 173MHz) in the Industrial/Business radio service.

B. VHF Radio Transceiver (154Mhz or 173Mhz)

The system manufacturer shall supply a 25-watt VHF radio transceiver to insure a high level of quality and reliability. The radios shall be adjustable to 4 watts output power as may be required by the FCC for ERP (Effective Radiated Power) restrictions. All connections to the radio shall be plug-in. The radio transceivers shall be a Motorola Radius CM200D.

C. Antenna & Coaxial Cable

The radio antennas at all locations shall be a five element Yagi, constructed with 3/8" diameter solid aluminum rod elements and 1-1/16" diameter aluminum pipe element support with a type N coaxial connector. The antenna shall have a minimum 8.0db forward gain with a 20.0db front-to-back ratio. The antenna shall be wind rated for a 100-MPH wind speed. The VHF antennas shall be MC-Yagi, Decibel Products DB292, or Celwave PD390S. The UHF antennas shall be MC-Yagi or Celwave PD688S.

D. Antenna Lightning Protection

Coaxial connection to remote and central unit enclosures shall be by means of a coaxial type of bulkhead lightning arrestor. The units shall be rated at 1 kilowatt with a minimum 500V and maximum 2000V-breakdown voltage. Coaxial lightning arrestors shall be a PD-593 or PolyPhaser IS-B50LN-C1.

E. Antenna Mounting Systems

Antennas shall be mounted at a height above ground that is consistent with FCC rules and regulations and provides adequate signal fade margin as described earlier.

Antennas must be a minimum of 15 feet above ground and mounted as follows:

1. The antenna shall be mounted on a 30' high Class II power pole with a 10' long X 1-1/2" galvanized mast secured to the side of the pole and extending 5' above the pole or a 20' high free-standing antenna tower. A 1.25" rigid conduit with a weather-head shall be provided from the below ground vault to a location 10 feet up the power pole for the coaxial cable.

2.3 INSTRUMENTATION & ACCESSORIES

A. General

All items in the control system (electronic cards, power supplies, radios, time delays, relays, etc.) shall be of plug-in construction, make use of a plug-in wiring harness, use plug-in terminal blocks, and be interchangeable without recalibration. To ensure field repair-ability by non-technical personnel, equipment that must be un-wired for replacement will not be accepted.

The following instrumentation devices and techniques shall be used as specifically called for in the RTU and CTU input/output sections of this specification.

B. Power Supplies

The DC power supplies shall provide $\pm 0.1\%$ line and load regulation with $\pm 10\%$ input variations. They shall have a temperature coefficient of $\pm 0.02\%$ per degree C. The input/output isolation shall be 100 M ohms DC (900Volts AC) with output transient response of 50 microseconds maximum. The power supplies shall be sized to operate the remote unit equipment with or without the back-up battery in place. Power Supplies shall be a Power One Series MAP130, Sola SLS, or approved equal.

C. Battery Back-up Operation

The remote units indicated shall be supplied with battery back-up operation. The rechargeable batteries shall be the sealed solid gelled electrolyte types, designed for float or standby service. Unless noted otherwise in the RTU descriptions, batteries shall be sized to maintain 24-hour service at water tower remotes and 8 hour service at pump stations and other remotes. The remote shall include a charging module to recharge the battery when power is resumed, maintain the charge between outages, and provide a low voltage cut-off to protect the battery from excessive discharge during prolonged outages. All discrete, analog, and pulse inputs (i.e. switch closures, pressure, level, flows, etc.) shall continue to function on battery back up. Batteries shall be Globe Gel/Cell or approved equal.

D. Single Phase 120VAC Surge Protective Device

A 120VAC surge protective device (SPD) shall be installed on the 120V incoming power in the RTU panel power supply. The SPD unit shall be UL 1449 Third Edition Listed, pre-wired with conductor leads a minimum of 24-inches in length and contain LED indicator lights to indicate power is applied to the SPD and all is OK (Green). Surge Current Capacity shall be 50kA minimum, L-N and N-G protection, and the Voltage Protection Rating (VPR) shall be 600V for 120VAC.

E. Pressure Transducers

Pressure transducers shall be of the all solid-state two-wire transmitter type with a 4-20mA output from a 10.5-24VDC excitation. The units shall be powered from the RTU power supply. The transducers shall have a combined error (linearity and hysteresis) of $\pm 0.25\%$ full scale and be temperature compensated to $\pm 2.5\%$ per 100 degrees Fahrenheit. Zero and span adjustments shall be standardized so that transducers are interchangeable without recalibration. All exposed or wetted parts shall be series 316 stainless steel, PVC, or Buna-N. The units shall be capable of a three times full

scale over pressure without damage or change of calibration. Pressure transducers shall be Micro-Comm L5N series.

PART 3 - EXECUTION

3.1 SYSTEM START-UP

The manufacturer shall supply "Factory" personnel for start-up service as needed to insure satisfactory operation. Subsequent trips to the job site to correct defects shall be made at no charge to the Owner during the warranty period.

3.2 TRAINING

The system manufacturer shall supply "factory" personnel to conduct two separate on-site training sessions, totaling a minimum of three days of training.

The initial training session shall be conducted during start-up as needed until the Owner and Engineer are satisfied that the operators are comfortable with the operation and maintenance of the system. Training shall be done on site with the owner's personnel.

Three to six months after the Owner commencing system operation, the system manufacturer shall supply "factory" personnel to conduct follow-up training of the Owner's personnel. The follow-up training shall be conducted on-site and consist of reviewing the operation and maintenance of the system. The Owner shall be contacted a minimum of two weeks in advance, prior to scheduling the training session to allow proper coordination.

3.3 SUBSTANTIAL COMPLETION

The Engineer will grant substantial completion only after completion of the start-up and initial training phase of the project. The Engineer shall inspect the system to determine the status of completion. Substantial completion will be awarded only when the system is providing usable service to the Owner. If the system is commissioned in phases, the Contractor may request substantial completion for the completed phases.

3.4 WARRANTY/SUPPORT PROGRAM

The control system manufacturer shall supply a FIVE (5) year parts and labor warranty and comprehensive support program for all items and software supplied under this section (including PLC/RTU front panel displays, except as noted below). Power surges and lightning damage shall be included as part of the warranty.

The warranty shall begin from the time of "substantial completion" as issued by the engineer. The manufacturer shall provide a 24-hour response to calls from the Owner. The manufacturer, at his discretion, may dispatch replacement parts to the Owner by next-day delivery service for field replacement by the Owner. Any damage to the control system caused by the actions of the Owner in attempting these field replacements shall be the sole responsibility of the manufacturer. If, during the warranty period, satisfactory field repair cannot be attained by field replacement of parts by the Owner, the manufacturer shall dispatch "factory" personnel to the job site to complete repairs at no cost to the Owner.

PART 4 - APPENDIX A: DETAILED SCADA EQUIPMENT DESCRIPTION

4.1 SCRANTON BPS SITE REQUIREMENTS:

A) RTU Panel and instrumentation items to be shipped to pump station manufacturer for installation:

Micro-Comm will ship the PLC-RTU enclosure and instrumentation for factory installation in the pump station building. The Hoffman Concept wall mount (24"x20"x10") PLC-RTU enclosure shall include an internal power switch, bulkhead coaxial cable lightning arrestor, PLC, radio, and a power line lightning arrestor as specified earlier.

Micro-Comm will ship L5A pressure transducers for monitoring suction & discharge pressures. All other instrumentation items are to be supplied by the pump station manufacturer.

B) Installation Requirements (to be completed by General/Electrical Contractor):

The electrical contractor will be responsible for demo of the existing antenna & coax and installation of the new antenna & coax. The antenna shall be mounted on a 10' long X 1-1/2" diameter mast secured on a power/light pole, as detailed in the electrical drawings.

C) Instrumentation and radio network materials (specified earlier) to include:

1. Discharge Pressure Transducer
2. Suction Pressure Transducer
3. Flow Meter (Provided by pump station)
4. Door Entry Switch (Provided by pump station)
5. VHF radio & modem
6. Antenna & coax

D) Pump control and monitoring functions shall include:

1. Pump control and VFD speed control based off the discharge pressure/flow rate/tank level.
2. Pump H/O/A switch monitoring.
3. Pump/VFD Failure
4. Generator/transfer switch monitoring.
5. Door entry alarm.

4.2 NEW HOLLAND BPS SITE REQUIREMENTS:

A) RTU Panel and instrumentation items to be shipped to pump station manufacturer for installation:

Micro-Comm will ship the PLC-RTU enclosure and instrumentation for factory installation in the pump station building. The Hoffman Concept wall mount (24"x20"x10") PLC-RTU enclosure shall include an internal power switch, bulkhead coaxial cable lightning arrestor, PLC, radio, and a power line lightning arrestor as specified earlier.

Micro-Comm will ship L5A pressure transducers for monitoring suction & discharge pressures. All other instrumentation items are to be supplied by the pump station manufacturer.

B) Installation Requirements (to be completed by General/Electrical Contractor):

The electrical contractor will be responsible for demo of the existing antenna & coax and installation of the new antenna & coax. The antenna shall be mounted on a 10' long X 1-1/2" diameter mast secured on a power/light pole, as detailed in the electrical drawings.

C) Instrumentation and radio network materials (specified earlier) to include:

1. Discharge Pressure Transducer
2. Suction Pressure Transducer
3. Flow Meter (Provided by pump station supplier-1375A)
4. Door Entry Switch (Provided by pump station supplier-1375A)
5. VHF radio & modem
6. Antenna & coax

D) Pump control and monitoring functions shall include:

1. Pump control and VFD speed control based off the discharge pressure/flow rate/tank level.
2. Pump H/O/A switch monitoring.
3. Pump/VFD Failure
4. Generator/transfer switch monitoring.
5. Door entry alarm.

4.3 DANIELS BPS SITE REQUIREMENTS:

A) Installation Requirements (to be completed by General/Electrical Contractor):

Micro-Comm will ship the PLC-RTU enclosure and instrumentation to the job site for the electrical contractor to install. The Hoffman Concept wall mount (24"x20"x10") PLC-RTU enclosure shall include an internal power switch, bulkhead coaxial cable lightning arrestor, PLC, radio, and a power line lightning arrestor as specified earlier.

Micro-Comm will ship L5A pressure transducers for monitoring suction & discharge pressures. All other instrumentation items are to be supplied by the pump station manufacturer.

The electrical contractor will be responsible for demo of the existing antenna & coax and installation of the new antenna & coax. The antenna shall be mounted on a 10' long X 1-1/2" diameter mast secured on a power/light pole, as detailed in the electrical drawings.

B) Instrumentation and radio network materials (specified earlier) to include:

1. Discharge Pressure Transducer
2. Suction Pressure Transducer
3. Flow Meter (Provided by pump station supplier-1375A)
4. Door Entry Switch (Existing)

5. Antenna & coax

C) Pump control and monitoring functions shall include:

1. Pump control based off the associated tank level.
2. Pump H/O/A switch monitoring.
3. Pump/motor starter Failure
4. Generator/transfer switch monitoring.
5. Door entry alarm.