

SECTION 25 13 13

SCADA TELEMETRY SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Items required include but are not necessarily limited to the following:
 - a. Radios.
 - b. Antennas, masts, and associated appurtenances.
 - c. RTUs (Remote Terminal Units).

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Federal Communications Commission (FCC):
 - a. 47 CFR 15 - Radio Frequency Devices, Section 15.247 - Operation within the bands 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz.
 2. International Electrotechnical Commission (IEC):
 - a. 61131-3 - Programmable Controllers, Part 3: Programming Languages.
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 802.3, Information Processing Systems - Local Area Networks - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 4. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
 - a. 222-G, Structural Standards for Steel Antenna Towers and Antenna Supporting Structures.
 5. Underwriters Laboratories, Inc. (UL):
 - a. 508A, Standard for Safety Industrial Control Panels.

1.3 DEFINITIONS

- A. ARQ (Automatic Resend Query): Method of error correction where the receiver initiates an order to retransmit data blocks that are determined to be corrupted in transmission.
- B. BER (Bit Error Rate):
1. Ratio of the number of bits received in error to the total number of bits transmitted.
 2. Used as a measure of quality for data links.
- C. CRC (Cyclic Redundancy Check):
1. A method utilized for detecting errors in data transmission or storage.
 2. A number is calculated on the originating end based on the message contents, and then appended to the message before transmission.
 3. The CRC is re-calculated on the receiving end, and compared to the previously calculated value.

4. A match of the two (2) calculated values indicates a high probability that the message was received correctly.
- D. Omnidirectional Antenna: An antenna that radiates maximum power uniformly 360 degrees in the horizontal plane.
- E. RTU (Remote Terminal Unit):
1. A remotely located device that collects data, codes the data into a format that is transmittable and transmits the data back to a central Supervisory Control and Data Acquisition (SCADA) system.
 2. The RTU also receives communication from the SCADA system and implements processes as directed.
- F. Spread Spectrum:
1. Communications technique whereby a radio frequency signal is spread (modulated) in order to generate an expanded bandwidth signal.
 - a. Frequency Hopping Spread Spectrum: Communications technique where the frequency of the radio signal repeatedly “hops” from one (1) frequency to another in accordance with a random but predictable sequence.
 - b. Direct Sequence Spread Spectrum: Communications technique whereby the stream of information (data signal) is combined with a higher data-rate bit sequence, or chipping code, that divides the user data according to a spreading ratio.
- G. Yagi Antenna:
1. A uni-directional radio antenna, consisting of a driven element, a reflector, and one or more directors.
 2. The antenna is primarily used for frequencies above 10 MHz and are used only in point-to-point applications.

1.4 SUBMITTALS

- A. Shop Drawings:
1. Refer 01 33 00 Submittals.
 2. Product technical data:
 - a. As required by 01 33 00 Submittal.
 - b. Annotated hard copies of RTU software programs.
 - 1) Annotate program listing to include the following (as applicable):
 - a) Descriptive titles for all subroutine functions.
 - b) Reference to control loop numbers.
 - c) Reference to instrumentation and equipment tag numbers.
 - 2) Define all function blocks used in program.
 - 3) Provide listing of all addresses referenced in logic diagram with description of data associated with each address.
 - c. Manufacturer's installation instructions.
 3. Submit all panel fabrication drawings and associated wiring diagrams for RTUs .
- B. Miscellaneous:
1. Radio site survey results including the following minimum information:
 - a. Electromagnetic noise level at each site.

- b. Data rate for each radio.
- c. Received radio signal strength at installed antenna height for each radio.
- d. Fade margin in dB (difference between weakest signal the radio can read and actual received signal strength).
2. List of all recommended spares for maintenance purposes with each item separately priced.
 - a. List shall include all special tools and test equipment necessary for the maintenance of the complete system.
3. Results of factory testing procedures.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

2.2 RADIOS

- A. Acceptable Manufacturers:
 1. Microwave Data Systems (MDS),
 - a. GE MDS 900 Radio, M/N EL8MD9X1AFCSONN
- B. Design and Fabrication:
 1. Communication:
 - a. Type:
 - 1) High speed Ethernet.
 - 2) Ethernet communication in accordance with IEEE 802.3.
 - b. Ports:
 - 1) Ethernet: 10 BaseT Ethernet.
 - 2) Serial: RS-485 serial interface.
 - c. Data throughput: 230 Kbps.
 2. Security: 128-bit data encryption.
 3. Range: Up to 15 miles at specified data communication rate.
 4. License free and/or FCC licensed, as required.
 5. Frequency hopping spread spectrum or direct sequence spread spectrum.
 6. Frequency: 450-470 MHz, 928-952 MHz, 902-928 MHz, 2.4-2.4835 GHz, as required.
 7. Diagnostics:
 - a. Provide capability for remote diagnostics monitoring.
 - 1) Provide licensed copies to the Owner of any software required for remote diagnostics.
 8. Configuration:
 - a. Provide remote configuration capability.
 - 1) Provide licensed copies to the Owner of any software required for remote configuration.
 9. Receiver sensitivity:
 - a. -92 dBm at 512 Kbps with 0.000001 (10^{-6}) BER.
 - b. -96 dBm at 230 Kbps with 0.000001 (10^{-6}) BER.
 - c. -108 dBm at 115 Kbps with 0.000001 (10^{-6}) BER.

10. Error detection/correction: 16 bit CRC with ARQ (Automatic Re-send Query).
11. Temperature: -22 to +140 DegF.
12. Humidity: 90 percent at 104 DegF noncondensing.
13. Input power: 10.5-24 Vdc.
14. Case: Aluminum.
15. Agency approvals: FCC 47 CFR 15.247.

2.3 RTUS (REMOTE TERMINAL UNITS)

- A. Acceptable Manufacturers:
 1. Allen-Bradley CompactLogix - latest model (Must have Ethernet capability)
- B. Processor Design and Fabrication:
 1. Communication via radio to central SCADA System.
 2. Communication ports:
 - a. One (1) RS232.
 - b. One (1) RS485.
 - c. 10 BaseT or 10 BaseTx Ethernet.
 - d. As required to meet requirements of Contract Documents.
 3. Capable of being remotely programmed via radio from central SCADA System.
 4. All application programming in IEC 61131-3 compliant language.
 - a. Program RTU utilizing ladder diagram programming language.
 - b. Protect program via removable key switch or password to prevent unauthorized changes.
 - c. Capable of on-line and off-line programming.
 5. Memory:
 - a. Non-volatile program storage via flash EPROM.
 6. Environmental ratings:
 - a. Temperature: -40 DegF to 158 DegF.
 - b. Humidity: 5 to 95 percent non-condensing humidity range.
 7. Processor shall include diagnostic indicators for power, mode, low battery, communications ports, and memory and I/O errors.
 8. Input power: 120 Vac or 24 Vdc.
 9. Power supply sized to supply power to processor, I/O modules, and control loops.
- C. Inputs and Outputs:
 1. I/O modules shall be provided as required to accommodate the types and quantities of I/O points identified.
 2. Each I/O module shall include visible diagnostic indicators for point status (discrete points), fault condition, and active condition.
 3. I/O modules shall be capable of being replaced while under power.
 4. All I/O modules shall report to the CPU should a terminal block fail or be removed.
 5. Analog output modules shall have a minimum resolution of 12 bits.
 6. Provide electric isolation between logic and field device.
 7. Input and output modules shall be capable of withstanding low energy common mode transient to 1000 V without failure.
 8. Install 20 percent spare points for each module type.
 9. Discrete outputs shall be fused:

- a. Provide one (1) fuse per common or per isolated output.
 - b. Provide blown fuse indication.
- D. Connection Requirements:
1. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
 2. Prewire I/O modules to terminal blocks.
 3. Field wiring shall not be disturbed when removing or replacing an I/O module.
 4. Provide terminations in accordance with requirements of Section 13448.
- E. Internal Panel Wiring: Provide internal panel wiring in accordance with requirements of Section 13448.
- F. Grounding Requirements: Provide grounding in accordance with requirements of Section 13448.
- G. Component Mounting and Placement: Provide in accordance with requirements of Section 13448.
- H. Environmental Controls: Provide environmental controls in accordance with requirements of Section 13448.
- I. Power Supply Units:
1. Provide regulated power units to provide power to:
 - a. All RTU components.
 - b. All I/O circuits not powered from the field.
 - c. Other devices as indicated on Drawings or Specifications.
 2. Provide power distribution as specified in Section 13448.
 3. Electrical service to RTU system is 105 to 125 V, 60 Hz, +/- 10 percent, 1 PH power.
 4. Size battery backup to maintain DC power for all DC power users for a minimum of 20 minutes upon the loss of AC power to ensure transient surges and dips do not affect the operation of the RTU.
- J. Internal Panel Lighting and Service Receptacles: Provide in accordance with requirements of Section 13448.
- K. Surge Protection:
1. Provide Type IC1 SPD (surge protection device) per Section 13449 in the 120 Vac power supply circuit for the RTU.
 2. Provide Type IC3 or IC7 SPD (as applicable) per Section 13449 in all discrete output signal circuits.
 3. Provide Type IC4 SPD at each field mounted analog device (4-20 mA signal type) per Section 13449.
 4. Provide Type IC5 SPD in the control panel for each analog input per Section 13449.
 5. Type IC6 SPD at each 120 Vac powered 4-wire analog device with 4-20 mA signal per Section 13449.
- L. RTU Enclosure:
1. Furnish enclosures in accordance with all requirements of Section 13448.
 - a. Enclosures shall meet all requirements of UL 508A.
- M. RTU Software and Programming:

1. Provide all hardware and programming required to accomplish the control requirements of the loop descriptions, Drawings, and Specifications.
2. Provide two (2) copies of fully documented control logic program on CD.
3. Programming software shall be directly supported by RTU manufacturer.
4. Copies of all software utilized for programming RTU or associated components (e.g., radios and/or microprocessor based flat panels) shall be licensed to the Owner.
5. On/off line programming.
6. Two (2) step commands requiring operator verification prior to deletion of any programming.

2.4 WIRELESS I/O RADIOS

- A. Acceptable Manufacturers: (Must include Transnet Radio with **GE SCADA Crypt M/N 97-4577A01**)
 1. OMNEX Controls.
 2. Phoenix Contact Wireless I/O.
 3. Elpro Technologies.
- B. Design and Fabrication:
 1. Transmission of data:
 - a. Type: Hardwired I/O In and Out.
 - b. Serial protocol: Allen Bradley DF-1. Other as required.
 - c. Serial communication: RS-485 serial interface, RS-422 serial interface, or RS-232 serial interface.
 - d. Data throughput: 19.2 Kbps.
 - e. New SCADA installations and all changes to existing SCADA shall be replicated on all Existing AW monitoring systems. (Telemetry) (Wireless I/O Radio) (Design and Fabrication) (E)
 2. Range:
 - a. Up to 600 to 1000 FT without line-of-sight.
 - b. Up to 4 to 5 miles with line-of-sight.
 - c. Up to 15 miles with a raised, 6dB gain antenna.
 3. License free, frequency hopping spread spectrum.
 4. Frequency: 902-928 MHz.
 5. Provided with a whip antenna and 6 FT of flexible coaxial antenna cable for each radio.
 - a. The antenna and cable supplied shall provide the ranges of transmission as listed in Paragraphs 2.3B.2.a. and b.
 6. Diagnostics:
 - a. Provide capability for remote diagnostics monitoring.
 - 1) Provide licensed copies to the Owner of any software required for remote diagnostics.
 7. Configuration:
 - a. Provide remote configuration capability.
 - 1) Provide licensed copies to the Owner of any software required for remote configuration.
 8. Error detection/correction: 16 bit CRC with ARQ (Automatic Re-send Query).
 9. Output accuracy: 0.2 percent of full scale.
 10. Temperature: -40 to +158 DegF.

11. Humidity: 90 percent at 104 DegF noncondensing.
12. Input power: 10.5-24 Vdc.
13. Case: Aluminum.
14. Agency approvals: FCC 47 CFR 15.247.

2.5 CELLULAR-BASED RTU'S

- A. Acceptable Manufacturers:
 1. Mission Communications.
- B. Design and Fabrication:
 1. Transmission of data:
 - a. Type: Cellular service provider.
 2. RTU asset monitoring service:
 - a. Update times:
 - 1) Analog input data snapshots at intervals such as 1, 5 or 10 minutes to be configurable for transmission.
 - a) Significant changes to be transmitted to the cellular service within 2 seconds of the change.
 - 2) Discrete input changes-of-state to be reported to the monitoring service upon detection.
 - b. Data logging capabilities to include time of day and number of occurrences of discrete input changes such as such as pump starts and stops and operator site visits.
 - 1) Examples of analog data logging and reporting to include, high and low values of analog inputs and time of day they occurred.
 - c. Monitoring service shall provide a paging and phone call feature to notify selected personnel of alarm situations.
 - 1) The service shall allow for a rotational schedule of phone/pager numbers to be called and shall be configurable from the web site.
 - d. Data throughput: 19.2 Kbps.
 - e. Data communication to the Client's SCADA system via private socket connections.
 - f. Virtual Private Network solution required.
 3. Antenna and flexible coaxial cable shall be provided with the RTU.
 - a. An option of ordering a longer run of antenna cable and a higher gain antenna with the RTU shall be available.

2.6 ANTENNAS, TOWERS AND MASTS

- A. Design and Fabrication:
 1. All steel antenna towers and supporting structures shall be in accordance with TIA/EIA/ANSI 222-G.
 2. Type:
 - a. Yagi antenna for point-to-point applications.
 - b. Omnidirectional antenna for point-to-multipoint or multipoint-to-multipoint applications.
 3. Lightning protected: Mast or tower direct connected to ground.
 4. Materials:
 - a. Antenna:
 - 1) Aluminum or aluminum with Teflon impregnated powder coat finish.

- 2) Aluminum or aluminum covered by polyurethane painted fiberglass radome.
- b. Mounting hardware:
 - 1) 316 stainless steel or aluminum.
- c. Towers and masts:
 - 1) Aluminum.
5. Frequency range: specified by manufacturer to match frequencies at which radios operate.
6. Provide foundation(s) adequate for the tower(s) and/or mast(s) including any specified future expansion.
7. Provide all masts, supports, lightning suppressors, and other apparatus required to make a complete and operable radio telemetry system.

2.7 TRANSMISSION CABLE AND MISCELLANEOUS

- A. Acceptable Cable Manufacturers:
 1. Andrew Corp. LDF Series.
 2. Times Microwave Systems LMR Series.
- B. Provide low-loss foam-dielectric type cable connecting radio antenna port(s) with the antenna.
 1. Cable: 1/2 IN or larger diameter as required to prevent signal losses in cable from degrading performance.
 2. Weatherproof, suitable for direct environmental exposure.
 - a. Use "O" ring seals on connections.
- C. Provide "superflexible" transmission cable (length as required) at the radio antenna port.
 1. Provide standard Type N connectors for connection to a continuous piece of cable extending to the antenna.
- D. Provide antenna surge suppressor and connect to coaxial cable in cabinet housing radio.
 1. Acceptable manufacturer:
 - a. Polyphaser.
- E. Provide grounding connections to the antenna mast and cable in accordance with manufacturer's recommendations.

2.8 ACCESSORIES

- A. Provide all accessories required to furnish a complete telemetry system to accomplish the requirements of the Drawings and Specifications.

2.9 SOURCE QUALITY CONTROL

- A. Provide a performance test after factory completion and prior to shipment.
 1. Conduct a test where the RTU is operated continuously and checked for correct operation.
 2. Conduct testing with dummy I/O's to verify each control loop operation.
 3. Allow for Owner and Engineer representatives to witness testing program.
 - a. Provide minimum of 15 days notice prior to testing.
 4. Do not ship prior to successful completion of this testing program.

2.10 MAINTENANCE MATERIALS

- A. Furnish Owner with the following extra materials:
 - 1. One (1) spare I/O card of each card type for every 10 cards or fraction thereof installed.
 - 2. One (1) spare RTU processor of each type installed.
 - 3. One (1) spare power supply of each type for every 10 power supplies or fraction thereof installed.
 - 4. One (1) spare radio of each type installed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor to provide SCADAcrypt, AW will program SCADAcrypt for contractor to install.
- B. Install telemetry system as shown on Drawings in accordance with manufacturer's written instruction.
- C. Provide documentation verifying the data communication rate (actual throughput), signal strength and signal quality for each radio.

3.2 FIELD QUALITY CONTROL

- A. Conduct startup of equipment and perform operational checks.
- B. Maintain and submit an accurate daily or weekly log of all commissioning and startup functions.
 - 1. All commissioning/startup functions may be witnessed by the Engineer.
 - 2. All reports shall be signed and dated by the Contractor.
- C. Provide Owner with a written statement that equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.3 DEMONSTRATION

- A. Demonstrate system to the satisfaction of the Owner.

3.4 TRAINING

- A. On-site Training:
 - 1. Provide employee of the manufacturer or certified representative to provide one day of operating and maintenance training at the Project site after the system has successfully undergone all field testing and acceptance procedures.
 - a. As a minimum, training shall cover:
 - 1) Hardware overview.
 - 2) Software overview.
 - 3) Maintenance.
 - 4) Troubleshooting.
 - 5) Operation, e.g., changing set points, passwords, etc.

- B. For additional requirements regarding training, refer to Specification Section 13440.

END OF SECTION