

SECTION 13300
SUPERVISORY CONTROL & DATA ACQUISITION (SCADA) SYSTEM
GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01. Scope of Work

- A. The overall system general requirements are given in this section. These requirements apply to each additional section of these specifications as noted herein and as specified in the associated sections.
- B. Work includes engineering, furnishing, installing, testing, documenting and placing in operation upgrades, including a new Supervisory Control and Data Acquisition (SCADA) system, for the North Bay Village, Florida's wastewater collection system. The wastewater collection system comprises four lift stations which together supply raw sewage to Miami-Dade Utilities for treatment and disposal.
- C. All work covered by this specification shall be performed by Barney's Pumps/Unitron, Lakeland, Florida or approved equal, henceforth referred to as the SYSTEM SUPPLIER. Contact Kevin Perdomo 863-860-3601
- D. The Work generally includes the following major elements:
 - 1. New Pump Station Control Panels (PSCP) at the following four lift stations:
 - a. Main Pump Station - equipped with two Variable Frequency Drive (VFD) driven pumps.
 - b. Hispanola Pump Station - equipped with two VFD driven pumps.
 - c. Village Hall Pump Station - equipped with two VFD driven pumps.
 - d. South Treasure Drive Pump Station - equipped with two constant speed pumps.
 - 2. A new Personal Computer (PC) based SCADA master station at the City's Operations Facility.
 - 3. Equipment at all 4 locations shall communicate via a cellular phone network.
- E. The Work is specified in this Section and as further specified in the following sections:
 - 1. Specification Section 13310: Field Instruments.

2. Specification Section 13315: Control Panels.
 3. Specification Section 13325: SCADA System Hardware.
 4. Specification Section 13326: SCADA System Programming.
- F. The SYSTEM SUPPLIER shall provide all equipment, materials, programming, software, modifications to existing equipment, calibrations and services that are required to successfully install and place into operation a digital computer-based SCADA configured as shown on the Contract Drawings, and as specified herein.
- G. The SYSTEM SUPPLIER may duplicate software logic code and database and graphics applications, as required, while still meeting the functional specifications. The ENGINEER may require modifications to the submitted graphics, reports and control logic without change to the contract price. All engineering development required by the SYSTEM SUPPLIER will be in accordance with the Conditions of this Contract.
- H. It is the intent of these Contract Documents that the SYSTEM SUPPLIER be retained by the CONTRACTOR to have overall responsibility for designing, furnishing, interfacing, adjusting, testing, documenting, and starting-up the various SCADA equipment described in the Contract Documents. The specified intent is that the SYSTEM SUPPLIER will have overall responsibility for making sure the various systems, trades, suppliers, vendors, subcontractors, etc. come together as a complete coordinated system which will reliably perform the specified functions.
- I. The CONTRACTOR shall ensure that the SYSTEM SUPPLIER coordinates closely with suppliers of other specialty equipment to ensure the required inputs and outputs for the SCADA are available.
- J. Division of Work. It is the ultimate responsibility of the CONTRACTOR to furnish a complete and fully operable SCADA that reliably performs the specified functions. The CONTRACTOR is to assume full responsibility for additional costs which may result from unauthorized deviations from the specifications. The CONTRACTOR is to establish the actual division of work with the minimum requirements as specified herein
- K. The SYSTEM SUPPLIER shall be responsible for:
1. The integration of the system including the panel layouts and wiring, PLC programming, VFD programming and configuration, network communications programming, and computer system application software setup.
 2. All application software configuration including all operator interface screens, reports, and database(s).
 3. All hardware and software submittals. The SYSTEM SUPPLIER shall develop the panel shop drawings, wiring diagrams, plumbing diagrams, PLC and computer hardware configuration drawings and layouts,

software documentation, and all other submittals defined herein and in the specification sections identified in paragraph 1.01E hereof. Coordination with the CONTRACTOR and other subcontractors shall be the responsibility of the SYSTEM SUPPLIER.

4. The final system operation and reliability. All required tests and training shall be under the on-site supervision of the SYSTEM SUPPLIER.
 5. Ordering, fabrication, assembly, delivery and start-up of the SCADA. All panel fabrication defined in Specification Section 13315 shall be performed at the SYSTEM SUPPLIER's shop.
 6. Obtaining from the CONTRACTOR the required information on those field elements, equipment starters, local control panels, and other control equipment or devices that are required to be interfaced with, but that are not provided with the SCADA in order to provide full system coordination regarding interface, function, testing, and adjustment requirements.
 7. Providing accessory devices including furnishing and installation of networking interface cards, interposing relays, control switches and signal converters necessary to perform the intent as described by the control strategies and services necessary to achieve a fully integrated and operational system as shown on the Contract Drawings and defined in the Specifications.
 8. Coordinating all interface requirements with mechanical and electrical system suppliers and furnishing any signal isolation devices that might be required In order to insure compatibility between all equipment.
 9. Providing any special manufacturer's cables required.
 10. Defining the final installation and connection requirements of the SCADA at the jobsite through development of interconnection diagrams.
 11. Verifying correctness of all final power and signal connections to the SCADA. The SYSTEM SUPPLIER shall make final adjustments to and calibrate all field elements provided with the SCADA.
 12. Ensuring that:
 - a. All components provided under this section are properly installed.
 - b. The proper type, size and number of control wires with their conduits and junction boxes are provided and installed.
 - c. Proper electric power circuits are provided for all components and systems.
- L. The CONTRACTOR shall be responsible for:
1. Including within the electrical subcontractor's scope:

- a. Provision, installation and termination of field and power wiring to SCADA supplied control panels and field elements. Termination shall be made in accordance with final accepted interconnection diagrams developed by the SYSTEM SUPPLIER. The electrical subcontractor shall mark on the interconnect diagram the field wire numbers used for each termination point. The SYSTEM SUPPLIER shall finalize the interconnect diagrams by including these field wire numbers in the final as built version.
 - b. Installation and termination of all specialty cables furnished by the SYSTEM SUPPLIER.
2. Including within the mechanical subcontractor's scope installation of any in-line instrumentation. Installation shall be made in accordance with the manufacturer's recommendations and under the direction of the SYSTEM SUPPLIER.
3. Equipment storage and protection until installed following the storage and handling instructions recommended by the SYSTEM SUPPLIER. Anti-static and winterization requirements shall be per the SYSTEM SUPPLIER's instructions and the SYSTEM SUPPLIER shall periodically verify that these instructions are followed.
4. Incorporating all necessary components into the system. Schedules included in the referenced specification sections do not necessarily indicate the complete component requirements of the SCADA.
5. Ensuring that the SYSTEM SUPPLIER coordinates work with other Divisions and Sections of the Specifications.
6. Requiring the SYSTEM SUPPLIER to observe and advise on the installation of equipment furnished by SYSTEM SUPPLIER and installed by CONTRACTOR to the extent required to certify, with the operational check-out tests, that the equipment will perform as required.
7. Ensuring that information on equipment provided under other Divisions and needed by the SYSTEM SUPPLIER to coordinate the SCADA is provided in a timely manner.
- M. Equipment found to be defective prior to system acceptance shall be replaced and installed at no additional cost to the OWNER.
- N. In the bid price, the SYSTEM SUPPLIER shall provide for obtaining the services of authorized field personnel from the manufacturer's of specialty instruments and from the suppliers of application software packages as necessary. Should these personnel be required during installation, start-up and checkout of the respective portions of the SCADA, such services shall be provided at no additional cost to the OWNER.

1.02. Related Work

- A. Division 15 – Mechanical. Installation of all mechanical piping and fittings, as well as in-line instruments supplied with and/or supplied for the SCADA.
- B. Division 16 - Electrical. All conduits are provided and installed under Division 16, Electrical. With the exception of certain specified special manufacturer's cables, all wiring and cables are provided and installed under Division 16, Electrical.
- C. Field devices such as motorized valves, pump motors, solenoid valves, etc. and local control panels for specialized subsystems such as chemical feed systems, etc. are supplied and installed under other Divisions of these Specifications.

1.03. System Description

- A. Each PSCP shall be furnished in a NEMA 4X, 316 stainless steel, rack mounted/supported dead-front enclosure as shown on the Contract Drawings and meeting the requirements for outdoor panels set forth in Specification Section 13315.
- B. PSCP shall comprise three sections, each furnished with doors, as follows:
 - 1. The first section shall contain the RTU defined in Specification Section 13325 together with relays, field termination blocks, UPS, etc. This shall include the dead-front panel mounted RTU Operator Interface Terminal (OIT).
 - 2. The second section shall contain Variable Frequency or Soft Starts for the pumps as defined in Division 16. This shall include the dead-front panel mounted control units.
 - 3. The third section shall contain Main Breakers, line filters, 480 VAC distribution, etc. as defined in Division 16.
- C. PSCP shall include the following major elements as shown on the Contract Drawings and further defined within Division 13:
 - 1. Variable Frequency Drives (VFDs) or Full Voltage across the Line starters as applicable by site.
 - 2. An external AC unit for stations with or VFDs.
 - 3. An Operator Interface Terminal for local monitoring and control.
 - 4. A PLC functioning as a SCADA Remote Telemetry Unit (RTU).
 - 5. A GSM modem for interconnecting the RTU with the SCADA master station via an externally mounted antenna.
 - 6. Back-up, float switch driven relay logic to control pump operations in the event of a loss of RTU control.

7. An Uninterruptible Power Supply for control system components.
 8. Power distribution and conversion components.
 9. Surge suppression on all power and signaling wires entering or leaving the panel.
- D. A SCADA Interface Panel (SIP) shall be furnished at the Operations Facility to interconnect the RTU and the SCADA master station. The SIP shall be a wall-mounted NEMA 12 steel enclosure containing the following major elements:
1. A Master Telemetry Unit (MTU).
 2. A GSM modem for interconnecting the MTU with the RTU via an externally mounted antenna.
 3. An Ethernet switch for interconnecting the SCADA master station equipment and the MTU.
 4. An Uninterruptible Power Supply for all SIP components.
- E. The SCADA master station equipment shall comprise the following elements interconnected with each other and the MTU via the Ethernet switch in the SIP:
1. A tower PC SCADA server/workstation running VTScada HMI software and equipped with an Uninterruptible Power Supply.
 2. A color laser printer.

1.04. System Integration Plan

- A. Prior to any other shop drawing submittals the SYSTEM SUPPLIER shall submit a System Integration Plan (SIP). Other submittals received before this submittal will be returned without review.
- B. The SIP shall identify, and provide details of, all SCADA functions. This shall include the following elements:
1. Field.
 2. PLC.
 3. System Inputs and Outputs.
 4. HMI system.
- C. Field. Provide an Excel spreadsheet that covers all field instruments. For each instrument define the following:
1. Tag Number.
 2. Instrument Type.

3. Specification Section supplied under.
 4. Signal Type.
 5. Range or On/Off states as applicable.
- D. PLC. Provide an Excel spreadsheet that covers all PLC. For each, define the following:
1. PLC Designation Number.
 2. Location.
 3. A list of I/O modules.
- E. System Inputs and Outputs (I/O). Provide an Excel spreadsheet that lists all system I/O for the complete SCADA. For each point, the list shall include the following:
1. SCADA database tag number.
 2. Signal Description.
 3. I/O Type.
 4. Range or On/Off state as applicable.
- F. HMI system. This shall provide the following information:
1. Listing of HMI system hardware upon completion of the Work.
 2. HMI system block diagram.
- G. Following PLC programming, revise the system I/O spreadsheet to include all pseudo points (differentiated from physical I/O) that are used by the HMI.
- H. Provide a fully updated SIP as part of the final system documentation.

1.05. Submittals

- A. Furnish, as prescribed under the General Requirements, all required submittals covering the items included under this section and its associated sections of the work.
- B. Submit complete, neat, orderly, and indexed submittal packages. Handwritten diagrams are not acceptable and all documentation submittals shall be made using CADD generated utilities.
- C. Partial submittals or submittals that do not contain sufficient information for complete review or are unclear will not be reviewed and will be returned by the Engineer as not approved.

- D. All submitted component data sheets shall be marked to specifically identify the model/part numbers to be furnished.
- E. Provide all shop drawing submittals on thumb drive in PDF format.
- F. In addition to the shop drawing submittals required in the related specification sections, submit the submittals defined below covering the complete system.
 - 1. System Performance. This submittal shall be a written description of how the operator will control the system and the system's subsequent response. Every piece of controllable equipment shall be separately described and the following information included:
 - a. Use of local manual controls.
 - b. Use of OIT/HMI software controls.
 - c. Use of automatic controls.
 - 2. Each functional description shall specifically identify any interlocks (hardware and software) and OIT/HMI alarms generated.
 - 3. Operator Screens. This submittal shall include color copies of all proposed new and modified OIT/HMI operator screens. Modified graphics shall specifically indicate the revised portions.
 - 4. Field Acceptance Test Plan. This submittal shall define the steps to be conducted during the required witnessed acceptance testing. The test shall be conducted in accordance with the general requirements set forth in Part 3 hereof. The submitted plan shall meet the following requirements:
 - a. Each of the equipment covered in the system performance submittal shall be tested.
 - b. For each equipment test, the required operator control actions and system response shall be demonstrated on the complete system, including each operator action, the response and appropriate HMI display/alarm updates.
- G. The Contractor and System Supplier are hereby specifically advised that the above submittals shall be Approved or Approved As Noted prior to any witnessed performance testing.
- H. Loop Diagram Submittal. This submittal may be made in conjunction with the submittals required under related specification sections. Loop diagrams, consisting of complete wiring and/or plumbing diagrams for each control loop showing all terminal numbers, the location of the dc power supply, the location of any booster relays or common dropping resistors, surge arrestors, etc. The loop diagrams shall be divided into four areas for identification of element locations: SCADA I/O point(s), panel face, back-of-panel, and field, respectively.

- I. Test Procedures: Submit the procedures proposed to be followed during all required testing. Procedures shall include test descriptions, forms, and check lists to be used to control and document the required tests.
- J. Test Reports: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures to the Engineer.

1.06. Final Documentation

- A. After the demonstration tests have been completed and as a part of the final acceptance requirements, submit the SCADA record drawings. Record drawings shall include, corrected for any changes that may have been made up through Substantial Completion:
 - 1. System block diagram.
 - 2. Network architecture diagram.
 - 3. Instrument loop wiring diagrams.
 - 4. Panel wiring diagrams.
 - 5. Panel elevations.
 - 6. Interconnection diagrams showing terminal numbers at each wiring termination.
- B. Record drawings shall be developed or converted to AutoCAD Version 2021. Provide AutoCAD files on a USB flash drive.
- C. Operating and Maintenance (O&M) Manuals: Provide the specified number of complete sets of three-ring bound O&M manuals in accordance with Division 1. Provide separate manuals for each Specification Section, clearly marked. Include descriptive material, drawings, and figures bound in appropriate places. Include:
 - 1. Cross references to 3rd party O&M manuals.
 - 2. Additional operating and maintenance instructions in sufficient detail to facilitate the operation, removal, installation, adjustment, calibration and maintenance of each component provided with the SCADA.
 - 3. Internal wiring diagrams (not already shown on the panel wiring diagram record drawings) for all components provided in the SCADA that clearly show all terminal block number designations and wire numbers.
 - 4. Bill of Materials identifying the manufacturer and complete part number of all components.
 - 5. All the submittal data for each component from the approved shop drawing submittals with corrections made on approved as noted items.

- 6. A USB flash drive containing the shop drawing data in PDF format in the binder sleeve.
- D. Provide a final System Integration Plan.
- E. Refer to the individual specification sections of the SCADA for final documentation requirements that are in addition to the above.

1.07. Quality Control

- A. Base bids for the SYSTEM SUPPLIER shall be as listed in the Contract Proposal. SYSTEM SUPPLIERS seeking ENGINEER approval shall have extensive experience in systems of similar size and complexity. Panel fabrication shop shall be a UL listed panel shop. Acceptance of alternates shall be made based on price, location of the fabrication shop, accessibility of personnel, PLC programming knowledge, and OWNER confidence. The SYSTEM SUPPLIER shall be subcontracted by and paid by the CONTRACTOR.
- B. The SYSTEM SUPPLIER shall meet all of the requirements of these specifications, and, unless specifically stated otherwise, no prior acceptance of any subsystem, equipment, or materials has been made.
- C. All equipment furnished by the SYSTEM SUPPLIER shall be of the latest and most recent design and shall have overall accuracy as guaranteed by the manufacturer.
- D. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
- E. Component equipment shall be as supplied by one of the manufacturers named in the individual specification sections or approved equal. The design of the SCADA is based on the first-named manufacturer's equipment if there is a difference.
- F. To facilitate the OWNER's operation and maintenance, products shall be of the same major manufacturer, with panel mounted devices of the same type and model as far as possible.
- G. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems, and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained.
- H. The SYSTEM SUPPLIER shall designate a single point of contact for interface with the ENGINEER on this project. The ENGINEER reserves the sole right to approve or reject this point of contact.
- I. The SYSTEM SUPPLIER's selected project personnel shall meet the following requirements:

1. Project engineer shall have at least 10 years' experience in installing similar systems and shall have a minimum of secondary education in the field of electronics or similar technical discipline.
 2. Project technician assisting the project engineer for field element calibration and check out shall have at least five years experience in installing similar systems.
 3. Key staff resumes shall be submitted for ENGINEER's approval with the Project Plan as further detailed under submittals.
- J. Service Facility: The SYSTEM SUPPLIER shall have an established service facility from which qualified technical service personnel and parts may be dispatched upon call. Such a service facility shall be no more than six (6) hours travel time from the jobsite.
- K. The SYSTEM SUPPLIER shall provide experienced personnel on-site to coordinate and/or perform installation, termination, and adjustment; on-site testing; OWNER training; and startup assistance for the SCADA.
- L. The SYSTEM SUPPLIER shall provide, on-site, an experienced project engineer to supervise and coordinate all of the on-site SCADA activities. An experienced technician may be provided to assist the project engineer in field element installation, field calibration, and checkout tests. The SYSTEM SUPPLIER's project engineer shall be on-site during the period required to effect all of the critical on-site activities related to the SCADA, particularly the software debugging, SCADA training, and witnessed testing activities.

1.08. Standards

- A. The design, testing, assembly, and methods of installation of the wiring materials, electrical equipment and accessories proposed under this Contract shall conform to the National Electrical Code and to applicable state and local requirements. UL listing and labeling shall be adhered to under this Contract.
- B. Any equipment that does not have a UL, FM CSA, or other approved testing laboratory label shall be furnished with a notarized letter signed by the supplier stating that the equipment furnished has been manufactured in accordance with the National Electric Code and OSHA requirements.
- C. Any additional work needed resulting from any deviation from codes or local requirements shall be at no additional cost to the OWNER.
- D. International Society of Automation (ISA) and National Electrical Manufacturers Association (NEMA) standards shall be used where applicable in the design of the SCADA.
- E. All equipment used on this project to test and calibrate the installed equipment shall be in calibration at the time of use. Calibration shall be traceable to National Institute of Standards (NIS - formally NBS) calibration standards.

- F. For the purposes of uniformity and conformance to industry standard, provide analog signal transmission modes of electronic 4-20 ma DC. No other signal characteristics are acceptable.
- G. Discrete signals are two-state logic signals. Use 120V ac sources on all discrete signals unless otherwise noted or shown.
- H. Provide appropriately sized electrical transient protection devices for all electrical elements of the system as further defined in the individual specification sections. For field mounted devices, provide protector enclosures to the electrical Subcontractor for mounting and installation.

1.09. Warranty and Guarantees

- A. In accordance with Division 1, the SYSTEM SUPPLIER shall furnish to the OWNER a written two year guarantee commencing with final acceptance, that all equipment and parts thereof, material and/or workmanship for the field elements, instruments, and control panels are of top quality and free from defects.
- B. The SYSTEM SUPPLIER shall guarantee all equipment whether or not of his own manufacture.

1.10. Spares and Expendables

- A. Obtain from the manufacturer(s) and provide the recommended critical spare parts as part of the work. Refer to the individual requirements listed in the associated specification sections for the SCADA for specific parts to be provided as a minimum. The spare parts are the property of the OWNER.
- B. Obtain from the manufacturer(s) and furnish any special tools, calibration equipment and testing apparatus required for the proper adjustment and maintenance of the material provided.

PART 2 - PRODUCTS

THIS PART NOT USED

PART 3 - EXECUTION

3.01. Sequence of Work

- A. Prerequisite Activities and Lead Times: Do not start the following key project activities until the listed prerequisite activities have been completed and lead times have been satisfied:
 - 1. Hardware Purchasing, Fabrication, and Assembly: Associated design related submittals completed (no exceptions, or approved as noted).
 - 2. Shipment: Completion and approval of all design related submittals.

3. Startup: Operational Checkout Tests.
 4. OWNER Training: Owner training completed and O&M manuals delivered.
 5. Demonstration Tests: Operational Check-out Tests, Startup, OWNER Training, and Demonstration Test Procedures must be complete. Give 4 weeks' notice prior to the planned test start date.
- B. Consoles, Panels, and Panel Mounted Equipment: Consoles, panels, and panel mounted equipment shall be assembled as far as possible at the SYSTEM SUPPLIER's shop. No work, other than correction of minor defects or minor transit damage, shall be done on the panels at the jobsite.

3.02. Payments

- A. General: All work provided under this Section and its associated Sections for the SCADA shall be paid for in accordance with the approved payment Schedule of Values submitted by the CONTRACTOR. The approved Schedule of Values will be the basis for partial payment for work provided for the SCADA.
- B. Partial Payment for Work Completed: The breakdown in the Schedule of Values allows for the partial payment of work completed for the SCADA. Before partial payment is considered for approval, each specific activity must be completed.
- C. Substantial Completion: Substantial Completion for the project is as defined in the General Conditions. However, the following requirements must be fulfilled before consideration will be given for Substantial Completion of the SCADA:
1. All SCADA submittals have been completed.
 2. The SCADA has successfully completed the Demonstration Tests.
 3. The required Owner training has been implemented.
 4. All spares, expendables, and test equipment have been received by OWNER.
- D. Final Acceptance: SCADA final acceptance is defined as the date when the ENGINEER issues a written notice of final acceptance. For this Section, the following must have been completed before consideration will be given to the issuance of notice of final acceptance:
1. All punch-list items have been checked off.
 2. Revisions to the SCADA O&M Manuals have been made (that may have resulted from the Demonstration Tests).
- E. Partial Payment Limits: The partial payments for work provided for the SCADA shall satisfy the following limiting maximum criteria (percentages of the lump sum pay item for the SCADA):

1.	Submittals (not including O&M Manuals).....	15%
2.	Training	5%
3.	O&M Manuals.....	5%
4.	Demonstration Tests	10%

3.03. Product Handling

- A. Store and protect equipment until installation following the storage and handling instructions recommended by the equipment manufacturers. Place special emphasis on proper anti-static protection of sensitive equipment.
- B. Protection During Construction: Throughout this Contract, provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the SYSTEM SUPPLIER's recommendations.
- C. Corrosion Protection: Protect all consoles, panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, from corrosion through the use of corrosion-inhibiting vapor capsules. Prior to shipment, include capsules in the shipping containers, and equipment as recommended by the capsule manufacturer. During the construction period, periodically replace the capsules in accordance with the capsule manufacturer's recommendations. Replace all capsules just prior to Final Acceptance.
- D. ESD Protection: Provide for the proper handling, storage, and environmental conditions required for the SCADA components deemed static sensitive by the equipment manufacturer. Utilize anti-stat wrist straps and matting during installation of these items to prevent component degradation. Flooring used in control areas shall be reviewed and approved by the SYSTEM SUPPLIER.
- E. Adequately pack manufactured material to prevent damage during shipping, handling, storage and erection. Pack all material shipped to the project site in a container properly marked for identification. Use blocks and padding to prevent movement.
- F. Ship materials that must be handled with the aid of mechanical tools in wood-framed crates.
- G. Ship all materials to the project site with at least one layer of plastic wrapping or other approved means to make it weatherproof. Anti-stat protection shall be provided for all sensitive equipment.
- H. Inspect the material prior to removing it from the carrier. Do not unwrap equipment until it is ready to be installed. If any damage is observed,

immediately notify the carrier so that a claim can be made. If no such notice is given, the material shall be assumed to be in undamaged condition, and any subsequent damage that is discovered shall be repaired and replaced at no additional expense to the OWNER.

- I. The CONTRACTOR shall be responsible for any damage charges resulting from the handling of the materials.

3.04. Installation

- A. **Material and Equipment Installation:** Install the SCADA in locations indicated on the Drawings and follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturers' instruction and these Contract Documents, follow ENGINEER's decision, at no additional cost. Keep copy of manufacturers' instructions on the jobsite available for review at all times.
- B. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance. Coordinate I&C work with the OWNER and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the existing plant during construction.
- C. Provide finish on instruments and accessories that protects against corrosion by the elements in the environment in which they are to be installed. Finish both the interior and exterior of enclosures. Provide extra paint of each color used in the material from the manufacturer for touch-up purposes.
- D. **Equipment Finish:** Provide materials and equipment with manufacturer's standard finish system. Provide manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment with light gray color.
- E. **Cleaning and Touch-up Painting:** Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. Clean and polish the exterior of all panels and enclosures upon the completion of the demonstration tests.

3.05. System Operating Criteria

- A. **Stability:** After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two (2) cycles per minute or a magnitude of movement of 0.5 percent full travel.

- B. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
- C. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 2 percent of full scale over a 6:1 operating range.
- D. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position final element.
- E. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 percent of full scale.
- F. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

3.06. Training

- A. The cost of training programs to be conducted with OWNER's personnel shall be included in the Contract price. The training and instruction, insofar as practicable, shall be directly related to the System being supplied.
- B. The SYSTEM SUPPLIER shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- C. The SYSTEM SUPPLIER shall make use of teaching aids, manuals, slide/video presentations, etc. After the training services, such materials shall be delivered to OWNER.
- D. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.
- E. All training schedules shall be coordinated with, and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER's working schedule.
- F. Specific details of the nature and duration of training to be provided are defined in the individual specification sections.

3.07. Testing – General

- A. All elements of the SCADA, both hardware and software, shall be tested to demonstrate that the total system satisfies all of the requirements of the Contract Documents
- B. As a minimum, the testing shall include shop tests, operational check-out tests, and Demonstration Tests.

- C. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system producing the correct result (effect), the specific test requirements will have been satisfied.
- D. All tests shall be conducted in accordance with, and documented on, prior approved procedures, forms, and checklists. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.
- E. Provide all special testing materials and equipment. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide suitable means of simulation. Define these simulation techniques in the test procedures.
- F. The SYSTEM SUPPLIER shall coordinate all of their testing with the CONTRACTOR, the ENGINEER, all affected suppliers, and the OWNER.
- G. The ENGINEER reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.

3.08. Operational Readiness Test (ORT)

- A. Prior to startup and demonstration testing, certify that the entire installed SCADA (inspected, tested and documented) is ready for operation. These inspections and tests shall include Loop/Component inspections and tests. The SYSTEM SUPPLIER shall fully debug problems in the system as a whole. Final approval of control software will not be based on written descriptions of software functions alone, but on actual performance in the field.
- B. Check the entire SCADA for proper installation, calibration and adjustment on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and the SCADA Specifications.
- C. The Loop/Component Inspections and Tests shall be implemented using approved forms and checklists. Example sheets are provided at the end of this Specification Section. These shall be developed by the SYSTEM SUPPLIER and submitted for approval.
- D. Maintain the Loop Status Reports and Component Calibration Sheets at the jobsite and make them available to the ENGINEER at any time.
- E. Witnessing: These inspections and tests do not require witnessing. However, the ENGINEER will review the Loop Status Sheets and Component Calibration Sheets and spot-check their entries periodically and upon completion of the Operational Check-out Tests. Correct any deficiencies found.

- F. Final Documentation: The completed reports and sheets shall be assembled in one document and submitted together with a completed Manufacturer's Check-Out Certification.

3.09. Field Acceptance Test (FAT)

- A. Once the SCADA has passed the ORT, the SYSTEM SUPPLIER shall perform a witnessed Field Acceptance Test (FAT) on the complete SCADA. The FAT shall demonstrate that the SCADA is operating and in compliance with the Contract requirements. Each specified function shall be demonstrated on a paragraph-by-paragraph, and site-by-site basis.
- B. Prior to the FAT, the entire installed SCADA shall be certified in writing by the CONTRACTOR that it is ready for operation.
- C. The system shall operate for a continuous 100 hours without failure before this test will be considered successful.
- D. The FAT shall cover the entire SCADA, including control functions, alarms, and status monitoring. Test procedures used for factory tests may be adopted for these tests if modified as required.

Loop Check-out Sheet

Project Name:	Owner's Project No. (if applicable):	Page of
Project Owner:	Regulatory Agency Project No. (if applicable):	
HDR Project No.:	Date:	

LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD					CONTROL CAB		
	LEAK CHECK ₍₁₎			TERM/CONT CHECK ₍₂₎		TERM/CONT CHECK ₍₂₎		
	Device No.	Tag	Process Conn.	Signal Tube	Device No.	Tag	Termination Ident.	Termination Ident.

1. Leak check for pneumatic signal tubing to be per ISA-PR7.1.
2. Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT

MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR						
EQUIP STATUS						
ALARM POINT						

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

AS LEFT SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: _____

Date: _____

Instrument Calibration Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.:	Date:
Control Loop No.:	

Instrument Tag No.	Transmitter/gauge span:
Manufacturer:	Switch set-point:
Model No.	Switch dead band:
Serial No.	Switch range:

TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Contract Documents): _____

Remarks: _____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: _____

Date Certified: _____

END OF SECTION