SECTION 405000 PROCESS CONTROL AND INSTRUMENTATION SYSTEM (PCIS) GENERAL REQUIREMENTS

PART 1 - GENERAL

A. Description

1. This section of the specifications includes materials, testing, and installation of process control and instrumentation system as specified herein and indicated on the drawings.

2. These specifications shall not be interpreted as permission or direction to violate any governing code or ordinance. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:

a. Instrumentation: ISA - The International Society of Automation.

b. Wiring: National Electrical Code (NEC), ISA S5.3 and S5.4.

c. Control Panels: NEMA Standards Publication 250-2003.

d. Control Logic: NFPA 79.

e. Piping: ANSI B31.3 (instrumentation piping).

B. Related Work Specified Elsewhere

1. N/A

C. Scope of Work

1. The work involves furnishing all hardware and software, programming, installation, labor, material, equipment, and engineering in strict compliance with the contract documents for the Waterline Intertie Project BP3, including support to the City of Santa Maria for interfacing with their existing SCADA system.

D. Submittals

1. Detailed System Drawings and Data:

a. The submittal shall consist of six sets of detailed drawings and data prepared and organized by the Contractor. All drawings, schematics, layouts, and diagrams shall be done on 11" x 17" sheets utilizing AutoCAD.

b. Drawings shall contain only relevant simplified details using symbol approach. Photographic images of components depicting irrelevant details (screws, holes, logos, etc.) are not allowed.

c. Drawings prints shall not contain details and texts smaller than 3/64”.

2. Two sets of submittals will be returned to the Contractor.

3. Submit these drawings and data as a complete package at the same time.

4. Submittals shall be in three-ring hardcover binders and arranged for convenient use including tab sheets, all indexed, and cross referenced with a separate index for each item.

5. Provide manufacturers cut sheets and manuals for all hardware to be provided.

6. Provide ISA type instrumentation data sheets for each component, together with a technical product brochure or bulletin. The data sheets, as a minimum, shall show:

   a. Instrument tag designation.

   b. Component name.

   c. Manufacturer's model number.

   d. Calibrated range.

   e. Instrument location.

   f. Input and output characteristics.

   g. Scale range and units (if any) and multiplier (if any).

   h. Requirements for electric supply.

7. Group the data sheets together in the submittal by type. Provide individual data sheets for each instrument with one brochure or bulletin to cover all identical uses of that component.

8. The detailed construction drawing submittal shall include, as a minimum, the following types of drawings and diagrams required for the construction of this project:

   a. Legend, Symbols, and Index.

   b. System Block Diagrams.

c. Power Distribution Diagrams.

d. Instrument Control Panel Layouts/Construction Drawings/Details. The drawings shall include the following:

(1) Dimensions

(2) Location of all components

(3) Identification of all components

(4) Bill of Materials

(5) Conduit entry area.

e. PLC/RTU Rack Elevation Drawing for each PLC/RTU.

f. Internal Panel Wiring Diagrams.

g. Digital I/O Module Wiring Diagrams.

h. Analog I/O Module Wiring Diagrams.

i. Detailed NFPA 79-style Ladder Diagrams (for discrete wiring) to meet the following minimum requirements:

(1) Each subassembly shall be shown as a rectangle in the diagram with all external terminals identified. Terminals unknown at the time of the submittal shall be left blank, to be filled later. Single contacts internal to the subassemblies shall be shown in the rectangle connected to their terminal points.

(2) Where the internal wiring diagrams of subassemblies are furnished on separate sheets, they shall be shown as a rectangle in the schematic diagram with all external points identified and cross-referenced to the separate sheets of the control circuit. Coils and contacts internal to the subassemblies shall be shown in the rectangle connected to their terminal points.

(3) Show unique rung numbers on left side of each rung. A cross-referencing system shall be used in conjunction with each relay coil so that associated contacts may be readily located on the diagram. The contacts shall be referenced to coils as well, so that associated coils may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, the purpose of the

contact shall be described on the same sheet. Spare contacts shall be shown.

(4) Limit, pressure, float, flow, temperature sensitive, and similar switch symbols shall be shown on the schematic (ladder) diagram with all utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position. If the equipment is shown in a specific position, the position shall be identified.

(5) Contacts of multiple contact devices, e.g., selector switches, shall be shown on the line of the schematic diagram where they are connected in a circuit. A mechanical connection between the multiple contacts shall be indicated by a dotted line or arrow. This does not apply to control relays, starters, or contactors. Additional charts or diagrams may be used to indicate the position of multiple contact devices such as drum, cam, and selector switches.

(6) The purpose or function of all switches shall be shown adjacent to the symbols. The purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram shall be shown adjacent to their respective symbols. The number of positions of the solenoid valve shall be shown adjacent to the valve solenoid symbol.

j. Detailed Loop Interconnection Wiring Diagrams (per ISA S5.3 and S5.4) for the entire system showing all control equipment, instrumentation, electrical equipment, components, wiring, routing, boxes (pull, junction, and terminal junction), terminations, wire tags, and wire colors. The diagrams shall show the detailed interconnection of all electrical equipment, instrumentation, panels, enclosures, components and the like provided under this contract.

k. Arrangement and construction drawings for consoles, control panels, and for other special panels for field installation. These drawings shall include dimensions, location of all components, identification of all components, bill of materials, detailed schematics of all internal wiring, preparation and finish data, nameplates, and the like. These drawings also shall include enough other details to define the style and overall appearance of the assembly; include a finish sample for all panel surfaces.

l. Installation, mounting, and anchoring details for all field instruments and panel mounted components.

m. An instrument list including all instruments provided under this project.

n. An I/O List for each PLC/RTU in the project.

9. Detailed System Software Submittal: The submittal shall consist of six sets of the software system descriptions and diagrams. Two sets of submittals will be returned to the contractor. The software submittal can be made as a separate package to be inserted in the original submittal. The following items must be submitted at least eight weeks prior to the factory witness test orientation:

   a. Detailed PLC/RTU software logic diagram printouts for each PLC/RTU. Logic diagrams shall be fully annotated such that an individual unfamiliar with the diagram format can fully understand the process control logic presented.

   b. An updated I/O List for each PLC/RTU in the project.

   c. Narrative control descriptions for each analog and discrete control loop. Loop descriptions shall describe how each control loop will operate, the PLC control logic, SCS control and monitoring capabilities and in general a job specific description of each control loop in the system.

   d. Sample color printouts of each CRT display, sample printouts of each Operator Interface display, report, and log for the supervisory control system (SCS) software.

10. Complete detailed bills of material: Detailed bill of material for all components shall be provided including complete manufacturers name and model number, quantity to be provided, and cross references to data sheet sections.

11. Operation, Maintenance, and Repair Manuals (OMM):

   a. The organization of the initial submittal required above shall be compatible to eventual inclusion as one volume of the operation, maintenance, and repair manuals.

   b. Operation manuals shall be prepared and submitted to the Owner's Representative for preliminary review in six copies. When the Owner's Representative is satisfied that these are complete and properly prepared, six final sets shall be delivered to the Owner's Representative.

   c. The complete OMM shall contain the following:

      (1) All the information included in the preliminary equipment submittal, the detailed installation submittal, and the additional information required herein, all bound in hard-cover binders

and arranged for convenient use including tab sheets, all indexed and cross referenced with a separate index for each item.

(2) All final “as-built” drawings with the AutoCAD electronic files.

(3) Electronic files for all PLCs, Operator Interfaces, and SCADA programming.

(4) Calibration and maintenance instructions.

(5) Trouble-shooting instructions.

(6) Instructions for ordering replacement parts.

E. Qualifications and Responsibility of Contractor

1. The Contractor shall furnish and install all proposed hardware as shown on the drawings and as specified herein. The PLC system installation and wiring connections to peripheral equipment and instruments shall be the responsibility of the system supplier using qualified personnel possessing the necessary equipment and having experience in making similar installations. Evidence of such qualification, as well as notification of the system supplier assuming unit responsibility, shall be furnished to the Owner in writing prior to commencement of the work.

2. Qualification Evidence: The qualification evidence shall include the following:

   a. Verification that the system supplier shall have had a minimum of five years' experience with the installation and programming of industrial control systems similar in type to those to be installed in this project.

   b. A list of completed similar installations including name, address, and telephone number of the owner, name of project, and date of completion.

   c. The name and qualifications of supervisory personnel to be directly responsible for the programming and installation of the control system.

   d. Software Training Verifications: The supplier shall employ a minimum of two (2) individuals who have been formally trained in the application of the latest revisions releases of existing SCADA software modules.

   e. The names of programming individuals and the certificates of successful course completion shall be provided upon request.

3. Under this section, the Contractor shall furnish the following:

a. Instrumentation equipment (Section 405020).

b. PLC, HMI, and UPS (Section 405040).

c. Control cabinets (Section 405080).

d. Spare parts per Sections 405020, 405040, and 405080.

e. Special tools and test equipment required by the supplier.

f. Installation, integration and testing.

g. Documentation.

h. Operator training.

i. Warranty (one year).

j. Shipping and receiving.

4. All calibration and final checkout of the process control and instrumentation system shall be witnessed by the Owner's Representative to determine if the system complies with the contract documents.

5. The Contractor shall be responsible for coordinating and interfacing with equipment supplied under these contract documents, which are an integral part of the system. Interfacing shall be incorporated in the detailed systems drawings and data section of the contract documents.

6. The system supplier shall be experienced in the design, programming, and service of this type of equipment. In the event of a dispute as to the acceptability of the system supplier, the Owner's Representative shall make the final determination.

F. Guarantee

1. The Contractor shall repair or replace defective components, rectify malfunctions, correct faulty workmanship, all at no additional cost to the Owner during the guarantee.

2. To fulfill this obligation, he shall utilize technical service personnel designated by the Contractor who was originally assigned project responsibility. Services shall be performed within five calendar days after notification by the Owner's Representative.

G. Measurement and Payment

1. Payment for the work in this section shall be included as part of the lump-sum bid amount stated in the Proposal.

## PART 2 - MATERIALS

A. Designations of Components

1. In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

B. Instrument Tagging

1. Attach a stainless-steel tag to the instrument at the factory. Permanently mark the stainless-steel tag with the instrument tag number and the instrument calibration range. The manufacturer's standard metal nameplate as a minimum shall denote model number, serial number, operating electrical voltage and amperage (when applicable), and date of manufacture.

C. Instrument System Power

1. Power provided for the instrument system at the facility shall be 120-volt a-c, single phase, 60 Hz.

2. Where d-c power supplies are not furnished integral with any one instrument system loop, then provide separate solid-state power supplies.

D. Matching Style, Appearance, and Type

1. All display instruments of each type shall represent the same outward appearance, having the same physical size and shape and the same size and style of numbers and pointers.

## PART 3 - EXECUTION

A. Uniformity of Components

1. Components, which perform the same or similar functions, shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and the same appearance.

B. Mounting of Equipment and Accessories

1. Mount equipment in accordance with the installation detail drawings as prepared by the Contractor and reviewed by the Owner's Representative. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Do not install consoles, cabinets, and panels until heavy construction work adjacent to computer and telemetry equipment has been completed to the extent that there shall be no damage to the equipment.

2. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.

3. Mount local equipment in cabinets or existing panels as specified. Mount associated I/O terminals on a common panel or rack; mounting panels and rack shall be baked enamel.

4. Coordinate the installation of the electrical service to components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation supervised by the Contractor.

5. Test the completed system after installation to assure that all components are operating with the specified range and all interlocks are functioning properly.

6. Tubing Valves, and Fittings: All instrument tubing manifolds shall be Type 316 stainless steel, unless otherwise specified elsewhere in these specifications. Tubing runs to transmitters shall be installed with a positive slope in one direction. Fittings and valves shall be Type 316 stainless steel. Block/bleed valves shall be as manufactured by Hex Valve Series HB59, or equal.

C. Calibration

1. Each instrument requiring factory calibration shall be furnished with calibration data. The calibration data shall be factory certified.

2. Calibrate systems after installation in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements, which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. Accomplish this calibration work by a technical field representative of the single instrument supplier. He shall certify in writing to

the Owner's Representative that all calibrations have been made and that all systems are ready to operate.

D. Factory Testing

1. The fully configured SCADA system shall be successfully submitted to a factory acceptance test before shipment to the jobsite. Instrument Control Panel(s) shall be fully assembled and wired.

2. Factory testing shall take place at a Contractor's facility

3. Prior to factory system testing, submit a written detailed test procedure for review by the Owner. Notify the Owner in writing four weeks in advance of the scheduled testing.

4. Factory witness tests shall demonstrate that the system will perform each operation required for all specified conditions, including both normal and emergency operations and conditions. Provide a certification and log of all tests to the Owner for review and comment.

5. Check panel wiring against approved submittal drawings. Record any changes made during testing of the equipment on the record drawings.

6. The system shall be exercised through operational tests, under factory-simulated conditions to demonstrate that the system is fully configured to perform all control, logic, monitoring, reporting, logging, archiving and communications functions as specified and that the system is ready for field installation. All test equipment required to simulate actual field conditions shall be provided by the control system contractor.

7. The factory witness test shall take as long as necessary to demonstrate to the Owner and the Owner's Representative that the system performs each operation.

8. A return visit to the Contractor's facility for re-testing will be at the total expense of the Contractor.

E. Field Testing

1. Exercise systems through field tests in the presence of the Owner in order to demonstrate achievement of the specified performance.

2. Coordinate field tests dependent upon completion of work specified elsewhere. Schedule tests among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

F. 5-day acceptance test

1. When systems are assessed to have been successfully carried through a complete operational test and the Owner concurs in this assessment, a date to start the system acceptance test involving the Owner's operating personnel will be agreed upon.

2. Recheck the systems at this time to verify proper operation, and make final adjustments. The system testing shall consist of five (5) consecutive days (Monday – Friday) of continuous testing utilizing the Owner's day shift working hours. The Contractor shall be on call ready to respond to the site within two hours after day shift working hours and on weekends. The Owner’s representative will determine the severity of the problem to the best of his ability and contact the Contractor for disposition. This arrangement will in no way relieve the system supplier of responding within 2 hours and resolving the problem in a mutually agreed upon time frame not greater than 48 hours.

3. The acceptance tests shall have a success factor of 95% system uptime. If the system should fail below the 95% factor, correct the system problems. System start-up shall start over again from day one. This will continue until the system functions for five consecutive days with a 95% uptime success factor.

G. Operator Training

1. Provide the Owner's operating personnel and/or the Owner’s Representative with three (3) days of formal instruction in the functions and operations of each system provided under this contract. The training shall cover overall system theory, hardware architecture, the operating system, programming instruction in the applicable languages, utility, programs, system generation, and diagnostics. The programming instruction shall include program development, coding, sample programs, and debugging at every programming level. Actual programming exercises and hands-on experience shall be emphasized. Emphasis shall also be placed on safety features and features, which may require readjustment, resetting or checking, and recalibration by them from time to time.

2. Provide the training sessions at the Owner's facilities and on the equipment furnished under this contract. The education and instruction of operating personnel shall be by a qualified instructor familiar with the requirements for this project. Each training session shall be for eight hours of formal instruction. Session dates shall be directed by the Owner. There will be three (3) one-day training sessions, which shall not coincide with any system testing or start-up activities.

END OF SECTION