

SECTION 17341

DATA ACQUISITION AND CONTROL SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

- A. Provide all labor, materials, equipment and incidentals required, and install complete, ready for operation, and test the Data Acquisition and Control System, hereinafter termed SCADA as shown on the Drawings and/or specified herein. The work shall include but not be limited to the following:
 - 1. Providing Programmable Logic Controller (PLC) and associated control panel.
 - 2. Providing PLC Ladder Logic Programming.
 - 3. Providing Computer and communication hardware indicated and specified herein.
 - 4. Providing Wonderware Operator Interface Software, programmed to link all components of the SCADA system specified herein.
 - 5. Integrate existing Water SCADA system with new Wastewater SCADA system
 - 6. Providing testing, training, documentation and other requirements specified herein.
- B. Related Work Specified Elsewhere:
 - 1. Section 17010: Instrumentation and Controls, General Requirements
 - 2. Section 17330: Programmable Logic Controller
 - 3. Section 17510: Panels
- C. Provide all configuration services necessary to provide a fully debugged and operating SCADA system including PLCs. The configuration services required shall consist of the programming and loading of all PLC ladder logic and/or program statements required to implement the data acquisition requirements as detailed on the electrical diagrams or referenced herein and as required to implement the specialized reports, process graphic displays, and other data acquisition/display functions specified.
- D. Provide all cables to interconnect all items shown or described on the SCADA block diagrams.
- F. Provide complete system documentation as specified herein.

1.02 QUALIFICATIONS

- A. It is the intent of these Specifications that the SCADA system be supplied by an I&C subcontractor. The subcontractor must show proof of experience in selecting, furnishing, programming, customizing, debugging, supervising, installing, and placing into operation all hardware and software specified within this Section.
- B. The I&C subcontractor shall be either a manufacturer or a "system house," with service facilities, regularly engaged in the design and the installation of digital

system and their associated subsystems as they are applied to the municipal water or wastewater industry. The I&C subcontractor shall satisfy the following criteria:

1. Employs an experienced professional Control Systems Engineer or Electrical Engineer to supervise or perform the work required by this specification section.
 2. Has performed work of similar or greater complexity on at least three previous projects.
 3. Has been actively engaged in the type of work specified in this specification section for a minimum of five years.
 4. Has specific and current configuration experience with the hardware including Programmable Logic Controllers (see Section 17330) selected for the project.
 5. Refer to Section 17010 for additional qualification submittal requirements.
- C. Actual installation of the system need not be performed by the I&C subcontractor's employees; however, the I&C subcontractor, as a minimum, shall be responsible for the technical supervision of the installation.
- D. The I&C subcontractor shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.
- E. Submit with the Specification Compliance List required in Paragraph 1.09 below, the following information, neatly arranged in a binder with index and sectional dividers:
1. A detailed technical proposal including a description of the hardware and software to be supplied, including an overall block diagram.
 2. Include information on at least one computer system of the same type the I&C subcontractor is proposing for this bid. This system is to be completed and fully functional and accepted. Also include information on the type of equipment furnished, date of startup, and name, address and phone number of user personnel responsible for operation of the system.
 3. Resumes of personnel available to be assigned as Project Manager, Systems Engineer, and Control Engineer for this project.
 4. The location nearest I&C subcontractor's facility to the plant site with permanently assigned service personnel who have been trained in the operation and maintenance of the equipment specified.

1.03 SYSTEM DESCRIPTION

- A. The SCADA hardware configuration shall be as shown on the Drawings.
- B. The following description is not intended to be a comprehensive list of the system's features, but will help summarize the major functions of the system. The SCADA system specified here shall be designed to perform the following generalized functions:
1. Collect and store accurate, reliable operating information of each process system and pump station for present and future uses.
 2. Assist plant operating personnel by recording and displaying off-normal operating conditions and equipment failures.
 3. Perform calculations based on automatically acquired sensor data and manually entered data.
 4. Accumulate and store equipment running times.

5. Provide color process graphic displays and summary reports for use by the plant operating and supervisory personnel.
 6. Provide system configuration tools including database, display and report generators.
 7. Flexibility for adding workstations and PLCs without replacing existing software.
 8. Provide process graphics and overall SCADA functions at the workstations indicated on the Drawings and specified herein.
 9. HMI Software: Invensys Wonderware InTouch no equal to match existing City's Water System SCADA.
- C. The PLCs shall be connected to the SCADA system via Ethernet (with cable modems) and serial (with dial-up modems) communications. The SCADA system shall include a workstation which shall perform multi-tasking processing, real-time data transfer, and serve as the human-machine interface (HMI) indicated on the Drawings.
- D. System Capacity: The SCADA system shall have the I/O (tag) capacity as shown on the Drawings plus an additional 200% I/O capacity for future expansion.

1.04 QUALITY CONTROL

- A. The I&C subcontractor shall allow the Owner and Engineer to inspect and witness the testing of the hardware and software at the factory acceptance test. Suitable notice shall be provided to allow this inspection before any shipments are made.

1.05 QUALITY ASSURANCE

- A. All material shall be new, of current manufacture, free from defects, and of the quality specified or shown. Each type of material shall be of the same manufacturer throughout the work. All material shall be the product of established, reputable manufacturers normally engaged in the production of the particular item being furnished.
- B. Equipment shall be suitably packaged by the manufacturer to protect it during shipment, storage and after installation.

1.06 PROGRESS REPORTS

- A. Significant milestones for all key tasks relating to engineering, software development, procurement, fabrication, assembly, test and installation shall be incorporated in the Critical Path Method (CPM) schedule specified in Division 1. Submittals and deliverable documentation shall be among the milestones charted. Each progress report specified for the CPM schedule shall show actual performance against projected performance.

1.07 CODES AND STANDARDS

- A. Codes: All SCADA equipment and materials, including their installation, shall conform to the following applicable codes and requirements:
1. National Electrical Code, (Title 8 of the California Electrical Code).
 2. National Electrical Safety Code.

3. Occupational Safety and Health Act standards.
 4. Federal Communications Commission regulations Title 47, Part 90 of the Code of Federal Regulations.
 5. Any applicable local electrical and/or safety codes.
- B. Variances: In instances where two codes conflict, the more restrictive requirements shall apply.
- C. Standards: Equipment shall conform to the applicable EIA, IEEE, ISA, NEMA, and SAMA Standards. The revisions of these standards, in effect on the date of issuance of the Contract Documents, shall apply unless a specific edition is referenced.
- D. Underwriters Laboratories listing shall be required for all equipment and materials where such listings are offered by the Underwriters Laboratories.

1.09 SUBMITTALS

- A. The I&C subcontractor shall furnish within six weeks of the Contractor's Notice to Proceed and before Shop Drawing submittals, a Specification Section (17330 and 17341) Compliance List consisting of a sequential list of each numbered paragraph within this specification section followed by the words "Compliance", "Deviation", or "Noncompliance". Accompanying the list shall be all backup documentation the I&C subcontractor desires to submit as substantiation of his request for either a Deviation or Noncompliance. The terms "Compliance", "Deviation", and "Noncompliance" shall have the following meanings:
1. Compliance: Furnish the hardware or software function specified without exception.
 2. Deviation: A hardware item or software function that is different from what is specified is proposed. Deviations shall be fully described.
 3. Noncompliance: The hardware or software item specified is not provided. Noncompliance items shall be fully described.
- B. Submittals shall include those items set forth in Section 17010 and the following additional requirements. Each submittal shall be bound in three-ring binders(s) and shall contain an index and sectional dividers. All drawings or sketches shall be folded or reduced for inclusion within the binder. The submittal shall be divided into the following four sections:
1. Project Overview
 2. System Hardware
 3. System Software
 4. Specified System Applications
- C. Project Overview: This submittal shall provide an overview of the proposed system including system configuration (block) diagrams, the approach to the work, the proposed work schedule including milestone dates for proposed meetings between Contractor's project personnel, the Engineer, Owner and I&C subcontractor, details of factory testing and field acceptance testing, and details of training programs.
- D. System Hardware:

1. This submittal shall provide complete documentation of the hardware proposed including:
 - a. ISA S20 Specification Forms for each major hardware component listing all model numbers, optional, auxiliary and ancillary devices that are being provided.
 - b. Descriptive literature for each hardware component, which fully describes the unit being provided.
 - c. Complete block diagram showing the interconnections between major hardware components and a complete input signal listing.
 - d. Complete to-scale drawings of all cabinets, panels and consoles including internal and external layouts.
 - e. A list of all hardware to be furnished and its electrical, environmental, and performance characteristics.
 2. The System Hardware submittal shall also contain all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts in order to enable the I&C subcontractor to proceed with the detailed site preparation for all equipment.
- E. System Software:
1. This submittal shall provide manufacturer's standard product sheets and a listing of all software modules supplied to meet these requirements.
 2. This software submittal shall not cover the detailed plant reports or process graphic displays. These shall be included in a subsequent submittal after the Contractor has met with the Engineer, Owner and I&C subcontractor and developed the specifics of these for the plant.
- F. Specific System Applications:
1. This submittal shall cover the specific details of the plant reports and process graphic displays that the I&C subcontractor has previously developed through meetings with the Engineer, Owner and I&C subcontractor.
 2. The specifics of the logs, reports, and process graphic displays shall be developed by the I&C subcontractor in conjunction with the Engineer and Owner.

1.10 COORDINATION MEETINGS

- A. The Contractor shall schedule a minimum of two mandatory coordination meetings during the Shop Drawing submittal phase of the project. The meetings shall include as a minimum, attendance by the Engineer, Owner and I&C subcontractor.
1. The first meeting shall be held after the first Shop Drawing submittal. The purpose of the meeting shall be for the I&C subcontractor to summarize their understanding of the project, discuss any proposed substitutions or alternatives; schedule testing and delivery milestone dates; and request any additional information.
 2. The second meeting shall be held in advance of the Factory Test. The meeting is to discuss any related issues regarding screen development, control descriptions or reports prior to scheduling of the SCADA System Factory Test.

1.11 FINAL DOCUMENTATION

- A. The I&C subcontractor shall submit the following final documentation prior to final acceptance of the system:
 - 1. As-built documentation of the system.
 - 2. Hardware Maintenance Documentation and Software Maintenance Documentation.
 - 3. Operator's manual.
- B. The I&C subcontractor final documentation shall be new documentation written specifically for this project, but may include standard and modified standard documentation. Modifications to existing hardware or software manuals shall be made on the respective pages or inserted adjacent to the modified pages. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- C. The manuals shall contain all illustrations, detailed drawings, wiring diagrams, and instructions necessary for installing, operating, and maintaining the equipment. The illustration parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such illustrations shall be incorporated within the printing of the page to form a durable and permanent reference book.
- D. If the I&C subcontractor transmits any documentation or other technical information, which he considers proprietary, such information shall be designated. Documentation or technical information that is designated as being proprietary will be used only for the design, construction, operation, or maintenance of the SCADA System and, to the extent permitted by law, will not be published or otherwise disclosed.
- E. The requirements for the Contractor's final documentation are as follows:
 - 1. As-built documentation shall include all previous submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the SCADA resulting from the factory and/or field acceptance tests shall be incorporated in this documentation.
 - 2. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the SCADA in proper operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:
 - a. Operation information: This information shall include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - b. Preventative maintenance instructions: These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines, and the adjustments necessary for periodic preventive maintenance of the SCADA system.

- c. Corrective maintenance instructions: These instructions shall include guides for locating malfunctions down to the card replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause, and instructions for remedying the malfunction.
 - d. Parts information: This information shall include the identification of each replaceable or field repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross references between System Supplier's part number and manufacturer's part numbers shall be provided.
- 3. The Software Maintenance Documentation shall provide a detailed description of the entire software system. This documentation shall be sufficient for software maintenance and modification of the entire software system. The following items shall be included with the Software Maintenance Documentation.
 - a. Computer manufacturer's user manuals: All computer manufacturer's manuals applicable to the system being provided.
 - b. User manuals: All applicable software manuals developed by the I&C subcontractor for the application software shall be provided.
 - c. Software listings: Two (2) sets of well-annotated program listings of all software provided shall be furnished for all software items. These shall include, but not be limited to, the following:
 - 1) All listings associated with the system generation and software configuration of the specific system.
 - 2) Listings of all databases configured for and associated with the system.
 - 3) Listing of all custom or modified software developed specifically for the system.
 - d. Machine readable documentation: The I&C subcontractor shall provide two (2) sets of the following as-built documentation in machine readable format:
 - 1) CD with the entire software system to allow restoration of the entire system should a major reboot be required.
 - e. Retrofit documentation: The Engineer recognizes that not all possible problems related to real-time events, software interlocks, flags, active tasks, and hardware utilization can be discovered during the Acceptance Tests. Therefore, the I&C subcontractor shall investigate, diagnose, repair, update, and distribute all pertinent documentation of the deficiencies, which become evident during the warranty period. All such documentation shall be submitted to the Engineer within 30 days of solving the problem.
- 4. The Contractor shall provide Operator's Manuals for the system operators. These manuals shall be separately bound and shall contain all information necessary for the operator to operate the system. The manuals shall be written in nontechnical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
 - a. An overview of the entire system indicating the function and purpose of each piece of equipment.

- b. A detailed description of the operation of each workstation including all HMI displays.
- c. Complete step-by-step procedures for starting up and shutting down the entire system.
- d. Complete step-by-step procedures for starting up or shutting down an individual subsystem.
- e. A complete description for operating all computer system equipment (i.e., CPU, disk drive, etc.).
- f. Procedures for changing paper, tape, etc.
- g. A complete description of the operation of each workstation functions.
- h. A listing of all data base point names with their respective point descriptions.
- i. A complete glossary of terms.

1.12 SPARE PARTS AND TEST EQUIPMENT

- A. Provide a list of recommended spare parts and test equipment including prices for favorable review for the systems specified herein and in Section 17330.
- B. The type and quantity of spare parts and test equipment will be determined by the Owner after reviewing the Contractor submittal of recommended spares and test equipment with published list pricing data.
- C. All spare parts and test equipment shall be furnished in moisture-proof boxes designed to protect their contents. All boxes shall be labeled to clearly identify contents and purpose.

1.13 GROUNDING

- A. Grounding of the SCADA shall be done in accordance with the NEC, as described in these specifications and as shown on the Drawings.
- B. Cable shields must be grounded at one end only. Shields shall be grounded in the rack where signal power is supplied. The data highway shield shall be grounded at the isolated bus bar associated with the workstations.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The workstation shall be installed in environmentally controlled air-conditioned areas shown on the Drawings. It shall be designed to operate satisfactorily between 60°F and 90°F and up to 90% humidity assuming no condensation will occur.
- B. All equipment furnished shall be suitable for operation on electrical power as shown on the Electrical Drawings.
- C. The operator workstation shall be powered by a UPS.

2.02 OPERATOR STATION HARDWARE

- A. The operator workstation shall consist of a personal computer, hard disk, DVD-ROM (R/RW), color monitor, and interface hardware to peripheral devices and data highway. Hardware shall be described herein and configured as shown on the Drawings.
- B. Computer:
 - 1. Computer shall be purchased no earlier than 3 months before the factory test. Computers shall use the latest technology at the time.
 - 2. The computer shall have the following features:
 - a. Intel Xeon 2.40 GHz Dual Core Processor W3503, or better
 - b. dual 500 GB minimum SATA 3.0Gb/s hard drives, configured with hardware RAID 1, 70 GB boot/system partition, and the remaining space for the data partition
 - c. 4 GB Dual Channel DDR3 SDRAM at 1066 MHz
 - d. Video card with at least 256 MB of video RAM. Video card shall be ATI FireMV, NVIDIA Quadro, or equal
 - e. One 16x DVD-ROM Drive + 48x CD-RW Drive .
 - f. 4 USB 2.0 ports, 1 parallel port, 1 serial port
 - g. Microsoft Windows: either Windows XP Professional or Windows 7 Professional, depending on which is the latest version supported by Wonderware at the time of submittals.
 - h. 56k v.92 data/fax external modem, compatible with SCADAAlarm
 - i. Gb Ethernet network interface
 - j. 3 year Parts and Labor Warranty, Onsite Service, and Tech support
- C. Workstation Hardware System:
 - 1. Mouse: Each mouse shall meet the following minimum requirements:
 - a. 300 DPI resolution, minimum
 - b. A 4-foot cord
 - c. Mouse pad
 - d. Microsoft USB Optical operation compatible
 - 2. Keyboards: Each keyboard shall meet the following minimum requirements:
 - a. 101 key tactile feedback, membrane surface with numeric keypad, cursor control keys, and 12 function keys.
 - b. A 6-foot coiled cable and plug.
- D. Manufacturer: Dell Computer; Hewlett Packard; or equal.

2.03 COLOR MONITOR

- A. Color LCD Flat Panel Monitor: Color monitor shall meet the following minimum requirements:
 - 1. 24-inch minimum diagonal screen size
 - 2. Resolution: 1920 x 1080 pixels minimum.
 - 3. Front panel controls.
 - 4. Sync rate: 75 Hz. x 82 Hz. maximum.
 - 5. 3 year Parts and Labor Warranty

- B. Manufacturer: Dell; ViewSonic; NEC or equal.

2.04 DATA HIGHWAY

- A. The data highway system shall link the PLC with SCADA as shown on the Drawings. The data highway use TCP/IP protocol for Ethernet communications and Modbus for serial communications.
- B. The failure, disconnection or connection of a PLC shall have a backup communication system consisting of a dialup telephone modem will be provided and will only be used if the cable system fails
 - 1. If the Ethernet SCADA communications between the SCADA computer and any pump station PLC fails. The computer would dial up each pump station PLC experiencing a cable system outage. Once finished, the computer would dial the next PLC experiencing an outage. The cycle would be repeated until cable system communications is restored. not affect the operation of other highway stations.

2.05 SOFTWARE - GENERAL

- A. General Requirements:
 - 1. The following specification describes the capabilities of the complete software system as a whole, without being definitive as to where particular functions are resident or implemented. The bulk of this section is directed to describing the details of the workstation resident software.
 - 2. Furnish all programming necessary to provide a fully debugged and operating system. The software required shall consist of those programs necessary for the SCADA system to efficiently perform the functions specified herein, plus enable convenient and efficient preparation of new programs. Assume complete responsibility for the successful operation of all software and application programs provided as part of the SCADA system. All programs shall be completely debugged and operable prior to delivery of the SCADA system.
 - 3. Configuration programming standards shall establish the conventions to follow when the process control database is defined, graphic displays are built, and reports are configured. They shall also apply to other table or file building procedures. The specifics of these standards depend largely upon the features of the configuration tools. Establish standards for:
 - a. Formatting of data base entries to keep documentation and listings of data base readable and easy to interpret.
 - b. Graphic screen layout to allow ease of understanding when paging from one display to another.
 - c. Report generator statement usage to enhance readability and maintainability.
 - 4. Design all software such that specified process system growth can be accomplished without the need for additional computer hardware. Allocate sufficient space in the software to allow for 50% spare input/output points, for future sequence control and regulatory control programs and for at least five additional HMI.
 - 5. Design all software such that anticipated system growth can be accomplished without the need for system regeneration. In general, the design shall be such

that the process control and process information databases may be modified without taking the control system off line. Scan points may be added, deleted and/or changed at any time, as may be HMI displays, log formats and all other online modifications. Future control strategies may be modified, added to or deleted from the system as necessary without system regeneration.

6. All software shall be standard products that are fully developed, tested, and supported. The software shall be compatible with the system hardware and shall meet the functional and performance requirements specified. The application software shall permit onsite configuration and generation of all application related programs including, but not limited to, input/output points, control strategies, displays, and reports.
7. All application software shall operate with a common graphical user interface that supports both mouse and keyboard interaction.
8. The application operator interfaces software shall be operable with minimal use of keyboard except for data entry. This includes graphic development.

2.06 OPERATOR INTERFACE SOFTWARE

- A. General: Software shall be multitasking window type software. All operator actions except for data entry shall be by pointing and clicking with the mouse. Windows for viewing process graphics shall be resizable and scrollable. Software shall permit operator call-up of multiple pre-defined screens of the same process or other process including trends, alarms. There shall be no restriction on the combination of types of screens simultaneously viewable from one HMI.

- B. Software: Provide Wonderware software to match existing City facilities including the following applications:

1. HMI visualization component: Wonderware InTouch Runtime license
2. SCADAAlarm

Provide Wonderware comprehensive support which shall run throughout construction and the warranty periods.

- C. Software Functions: The major software, which shall be resident in the Operator workstation, includes:

1. Data Gathering
2. Graphic Displays of Process
3. Alarm Processing
4. Report Generator
5. Historical Data Management
6. SCADALARM dialing
7. Remote Access

- D. Screen:

1. A minimum of twenty (20) process graphic displays shall be designed and generated. The process graphic displays shall include a single master plant schematic and multiple sublevels that provide increasingly detailed information about unit processes, processes equipment and auxiliary systems such as electrical power distribution.
2. The color conventions for process graphic displays will be established during the first design review meeting. Various combinations of symbol, value and units color change, together with blinking and color intensities changes, shall

be used to specify current process operating condition. Color scheme shall match existing Water system SCADA .

E. Software Graphics Capabilities:

1. The graphics package must provide a means of creating and displaying color graphic displays that will be used by the operator to monitor and control the process. Real-time values being read from the field devices will be displayed periodically in a variety of user-configurable formats. The graphics package must support multi-document applications (several displays may be open at the same time).

F. Device Communications:

1. Driver Configuration
2. Display-only Communications
3. Error Detection
4. Diagnostics
5. I/O Driver Toolkit

G. Archiving and Reporting:

1. Archive Configuration
2. Displaying Archived Data
3. Display Output

H. Report Generator and Required Reports:

1. Provide customized report generator for at least five (5) reports, which shall be formatted as required by the Owner.
2. The final formats and variables (including process variables and laboratory data) to be printed shall be developed after consulting with the Owner. Each report page shall have the name of the plant, type of report, time and date the report was prepared and the page number. All logs and summary reports shall be allowed to be manually initiated and canceled.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Refer to Section 17010, Part 3.

3.02 SYSTEM CONFIGURATION AND APPLICATIONS PROGRAMMING

- A. System Configuration: The wastewater remote sites shall communicate over the cable network using Ethernet TCP/IP protocol. Configure the two existing Water computers to function as a redundant I/O server for both Water and Wastewater SCADA systems. For the new Wastewater computer, configure the computer to communicate over telephone modem if the cable system fails. Provide any scripting and necessary time delays in Wonderware to accomplish this task.
- B. Communication: The new Water system SCADA workstation shall communicate with existing Water SCADA workstation over the cable network. Provide required IP

addressing to accomplish this communication. Telephone modem communication shall only be enabled when cable communication fails. See Item A above.

C. Security Management:

1. Provide login security using Wonderware login for Water and Wastewater groups so that Water SCADA operators can only control the Water system and Wastewater control the wastewater SCADA. Viewing and alarms shall be available to all operators. Modify existing 2 computers on the Water SCADA system to comply with this requirement.
2. The city of San Bruno will provide Citrix security software to enable secure access though the Internet. Coordinate wit the City and configure this software for the new computer using the same procedure currently used on the Water SCADA system.

- D. Provide the following HMI screens as a minimum. Design screens so that all operator actions, including setpoint charges, can be accomplished with the mouse without using the keyboard. Design screens for screen resolution and text to match existing Water SCADA. Provide buttons on every screen.

Screen Number	Description	Features and References
1	Site Map	Update existing site map to show Wastewater sites and access to each site display
2	Menu Screen	Add to existing Water SCADA screens to show Wastewater system
3	Lomita Pump Station	
4	Crestmoor Pump Station	
5	Crestwood Pump Station	
6	Olympic Pump Station	
7	Spyglass Pump Station	
8	Sharp Park (Pacific Heights) Pump Station	
9 and 10	Miscellaneous Systems	
11 and 12	Trends	
13	Alarms	
14 – 20	Owner selected screens	

- E. Display: The use of displays that convey three-dimensional look, such as pumps, piping, tanks, valves and others shall be used. Third party symbols or icons can be used. The I&C subcontractor shall review available symbols or icons with the Engineer and District's representative to select those for use on this Project. The symbols and icons shall utilize the following as a minimum. This is not intended to be a complete list.

1. Pump and valves: Change in color and/or flash in the "Run," "Ready," and "Fail" modes. Colors will be selected by the Owner.

2. Pipe segments: These shall change color when related valves are open or where pumps are running. Colors for "Flow" or "No Flow" will be selected by the Owner.
3. Tank levels: Animated with digital or bar graph indicating units.
4. Pressures: Digital or bar graph indication as selected by the Owner.
5. Analysis measurement: Same as Item 4 above.
6. Menus: Provide display menus of operation, etc. The layouts of such menus shall be selected by the Owner.
7. Switches and buttons: For pumps, valves, etc., these can be preformatted icons to be selected by the Owner.
8. Alarms: An alarm window at the bottom of each screen shall appear to indicate the recent three alarm. All other alarms will be displayed on alarm summary screen. Alarms shall also appear on screens where alarms are related, such as tanks, pumps, etc.
9. Trends: Real time trends and historical trends shall be provided. Grouping of trends shall be selected by the Owner.
10. Reports: Formats and data shall be selected by the Owner.
11. Main Menu: Provide an overall "Main Menu" to allow selection of screens. Format and content shall be selected by the Owner.

F. SCADALARM: The existing Water SCADA workstations include two SCADALARM software packages. Add the new Wastewater SCADA alarms to existing system and reconfigure the 2 software packages so that the SCADALARM calls out one group of operators upon an alarm on the Water SCADA and another group on alarms on the Wastewater SCADA system

3.03 FACTORY TEST PLAN

- A. A factory test plan shall be submitted after all hardware and software submittals have been favorably reviewed by the Engineer and at least six weeks in advance of the test date. The test plan shall have sign-off and date blocks for the Engineer.
- B. The complete test plan shall include descriptions for the following as a minimum.
 1. System hardware and software summary.
 2. A schedule for the testing describing the specific tasks to be performed and the time allotted for each.
 3. Hardware simulation of all process inputs from the PLCs to the workstation displays.
 4. Demonstration of required control strategies.
 5. Demonstration of reports produced by the system.
 6. Demonstration of graphic screens developed.
 7. PLC Input/Outputs.
 8. Communication by serial cable.

3.04 FACTORY TEST

- A. A formal system test shall be performed by the I&C subcontractor and witnessed by the Owner or his designated representative at the I&C subcontractor's factory, prior to shipment. The purpose of the test shall be to verify the functionality, performance, and stability of the hardware and software. The system must operate continually for 40 hours without failure before the test shall be judged successful.

Successful completion of this test shall be the basis for approval of the system to be shipped to the site.

- B. The I&C subcontractor shall determine through his own tests and quality assurance programs that the equipment is ready for shipment. The I&C subcontractor's internal test procedures for hardware shall be equal to or exceed the requirements set forth in ANSI Standard RP55.1, "Recommended Practice - Hardware Testing of Digital Process Computer," in so far as they apply.
- C. Where hardware items are of standard manufacture, and in current production, the manufacturer shall certify that applicable tests have been performed, and met in accordance with said standard, and be prepared to supply copies of data to Engineer upon request. Any assemblage of devices together with operating programs shall be tested together as provided herein.
- D. The various tests performed during the witnessed factory test shall be designed to demonstrate that hardware and software fulfill all the requirements of the Specifications, including control strategies and PLC functions. The test conditions shall resemble, as closely as possible, the actual installed conditions. Any additional hardware or software that may be required to successfully verify system operation shall be supplied at no additional cost.
- E. Tests to be performed shall include, but not be limited to the following.
 - 1. Building and loading the system database.
 - 2. Conduct online modifications to the database.
 - 3. Demonstrate operability of the interfaces (hardware and software).
 - 4. Demonstrate operability of the data communication network.
 - 5. Demonstrate all system software functions specified.
 - 6. Conduct PLC ladder logic tests.
 - 7. Simulate all PLC process input points using a simulator panel and verify that the points are correctly mapped on associated displays and reports.
 - 8. Simulate selected operating condition to verify the response time performance of the SCADA system.
 - 9. Generate reports using test data.
- F. During the test, the Engineer shall have unrestricted access to the system, and all faults identified during this period shall be corrected and retested prior to completion of factory test. All test data and procedures followed during testing shall be logged, and certified copies of logs shall be provided to the Engineer.
- G. Notify the Engineer in writing a minimum of 30 days in advance of this proposed starting date for the witnessed factory test. At the time of notification, submit any revisions to the detailed test procedure previously approved by the Engineer in the factory test plan.

3.05 FIELD TEST

- A. General: Perform field testing to verify the operation of the SCADA system. Sequence and organized field testing by plant area. Provide area testing and include loop checkout and maintenance/support demonstrations. Test all functions

and equipment at the server/work station level. Perform an integrated system test to verify the operation of the entire SCADA system.

B. Subsystem Testing:

1. Loops:
 - a. Check each loop from the primary element to the respective PLC and workstation displays.
 - b. Document and submit all loop checks to the Engineer. Documentation shall include loop number and description, termination information, loop drawing reference, type of test(s) performed, signature of tester, signature of Engineer and date, and problem description, if any.
2. Workstations:
 - a. Fully check out all workstation displays and data base linkages, user entry functions and all other specified functions.
 - b. Demonstrate configuration capability, system backup and reloading, system status displays and use, diagnostics and power fail/restart.
 - c. Document and submit all demonstrations to the Engineer, including description of function, signature of tester and date, signature of Engineer and date, and problem description, if any.
 - d. Test all data handling and access functions. Use live data from the plant and include the plant-wide database, workstation displays, and user entry functions.

C. Integrated System Testing:

1. Perform integrated system testing to verify the operation of the complete SCADA system. Integrated system testing shall not begin until all subsystem testing has been completed. Testing shall include, but not be limited to, data communication, both normal and failure modes; system response times with all hardware operational and its respective application and configuration software running; impact of component failures on system operation; report generation, and any other test reruns the Engineer may elect to perform.
2. Provide full time, onsite assistance for the test duration. Run the test for five days and witnessed by the Engineer. Promptly correct any deficiencies found whenever possible. If deficiencies remain uncorrected at the end of the test period, the test period will be extended on a day-to-day basis until proper operation can be demonstrated.
3. Upon successful completion of the integrated system test and subsequent review and approval of complete system final documentation, the system shall be considered substantially complete and the one-year warranty period shall commence.

3.06 SERVICES TO BE PROVIDED DURING WARRANTY PERIOD

- A. For a period of one year following substantial completion, the I&C subcontractor shall repair, replace, adjust and/or service all defective work in accordance with the General Conditions of this Contract. In addition, for this same one-year period, the I&C subcontractor shall provide the following maintenance of the work of this specification section only.
1. Provide onsite response to emergency calls within 24 hours after receipt.
 2. Provide a minimum of 12 monthly preventive maintenance visits by a qualified service man of the I&C subcontractor's permanent employees who is familiar

with the type of equipment and software provided for this project. Each preventive maintenance visit shall include routing adjustment, calibration, cleaning, and lubrication of system equipment and verification of correct software operation. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit; however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Contractor shall have full responsibility for the system hardware and software preventive corrective maintenance. The Contractor shall provide all necessary maintenance parts, supplies, and/or tolls during the one-year warranty period.

3. Observe and instruct Owner's designated maintenance personnel (maximum of five at any one time) in the details of the maintenance work being performed on each and every preventive maintenance visit.

B. The costs for the above services shall be included in the Contract Price.

3.07 MAINTENANCE CONTRACT

- A. The Contractor or I&C subcontractor shall submit to the Owner, prior to final payment and acceptance as a closeout submittal, a signed and executable maintenance contract for Owner's consideration. The maintenance contract shall include all labor, parts (including major pieces and/or components of the system), and emergency calls necessary to provide complete system maintenance for a period of two years commencing exactly one year after the date of substantial completion or at the end of the one-year warranty period previously mentioned.
- B. The maintenance services to be provided under the maintenance contract shall be identical to those provided under Paragraph 3.05 above.
- C. The costs for this two-year maintenance contract, including delayed commencement, shall not be included in the Contract Price.

3.08 TRAINING

- A. The cost of training shall be included in the Contract Price, to be conducted with designated Owner's personnel, covering configuration, operation, and maintenance of the system as specifically set forth hereinafter. The training and instruction shall be directly related to the system being supplied hereunder.
- B. Training for the PLC shall be provided as described in Section 17330.

END OF SECTION