SECTION 13450

PLANT CONTROL AND SCADA SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. This section specifies the supply, installation, programming, and integration of a Programmable Logic Controller (PLC)-based plant control system that shall communicate with all automated devices and field instruments located at the Plant, disposal facilities, lift stations, and shall automate the control of waste water treatment as an integrated system.

B. This section also specifies the supply, installation, programming, and integration of a supervisory control and data acquisition (SCADA) system that shall provide a Human/Machine Interface (HMI) into the PLC-based plant control system. The SCADA system shall allow process data to be monitored, displayed, and stored. It shall also allow the control of automated equipment in accordance with operational state and user-authorization requirements.

C. The PLC-based plant control system shall be capable of fully operating all automatic equipment with or without the SCADA system being in operation.

D. Work includes all required programming of programmable logic controllers (PLCs), master and slave network devices, network interfaces, a SCADA workstation, human-machine interface / supervisory control and data acquisition (HMI/SCADA) software, printer, and other required hardware and software components to yield a complete and operational system.

E. The control logic descriptions contained in this Section describe key operational features and requirements. These descriptions do not, however, describe all logical relationships and constraints, time delay criteria, sequences of operation, and other program features that will be required to yield a functional, real-time system.

1.2 RELATED SECTIONS

A. Section 13420   Process Control Instruments

B. Section 16400   Motor Control Centers and Controls

C. Section 16260   AC Variable Frequency Drives

1.3   SUBMITTALS

A.   Qualifications statement of system integrator, including the number of years experience in work similar to this Project and a list of at least five similar projects that have been performed recently. The project list should give preference to projects that reflect similar conditions and circumstances, and state the human-machine interface (HMI) software package and version used.

B.   Make submittals for all materials, hardware, and software to be provided under this Section, whether as specified or substitutions, in accordance with these Specifications.

C.   Submit a preliminary description of the SCADA workstation display screens to be provided, including a preliminary description or listing of the contents of each. Include a diagram or map that depicts the hierarchical relationship between the display screens, and an indication of how the operator may navigate from one screen to the next. Submit a hardcopy printout of two representative graphical display screens.

1.4   CLOSE-OUT SUBMITTALS

A.   A User's Guide or Operator's Manual describing the intended use of the site-specific programming specified herein.

B.   Documentation and electronic program backup copies of all site-specific programming provided under this Section for all PLCs and SCADA systems, including "as-built" control logic descriptions, annotated program listings, and ladder-logic diagrams.

C.   A system configuration diagram showing all PLCs and their identification tags, local and remote I/O and the logical addresses associated with each physical device, network devices and interfaces, and the description of all interconnecting cables including connectors and pin-outs.

D.   A piping & instrumentation diagram (P&ID) showing the functional relationships and piping between all controlled equipment, instrumentation, and other devices, and the I/O communicated to each device.

E.   A site plan showing the general physical location and identification of all pumps, valves, flow meters, instrumentation, and equipment, with each device labeled with the identifiers used in I/O and software documentation. The site plan need not be to scale.

F.   I/O schematics depicting the signal and control connections of all controlled devices and instruments.

G.   Equipment controlled by PLCs not programmed under this Section may represented by blocks, provided that all physical I/O and data variables communicated between devices is represented.

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H. Upon request, the Engineer will provide electronic media copies of contract documents to facilitate the preparation of these closeout submittals.

1.5 QUALITY ASSURANCE

A. SCADA programming and integration performed under this Section shall be by an integrator who has been regularly engaged in control integration of waste water treatment plants.

B. All equipment furnished or modified under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment.

C. The integrator's trained field representative shall have the following experience requirements:

1. Have overseen the integration of control systems for not less than five filtration water treatment plants.

2. Have overseen the programming of at least five control systems using the same human-machine interface (HMI) software supplied for this Project, in the same or earlier versions of the software.

1.6 SCHEDULING

A. Scheduling and coordination of Work under this section shall as required to maintain treatment plant availability.

1.7 WARRANTY

A. The manufacturer shall provide a one-year labor and parts warranty on the system. Warranties shall start on the date of filing of the "Notice of Completion."

1.8 MAINTENANCE

A. Contractor shall provide twenty (20) hours of telephone-based and eight (8) hours of on-site support and maintenance during the first year of service after the "Notice of Completion." Additional support and maintenance required shall be available at the Contractor's standard rates.

1.9 GENERAL CONTROL LOGIC REQUIREMENTS

A. Alarms

1. Operational alarms generated during operation of the wastewater system shall be classified as follows:

a. Level 1 Alarm—Dialer Notification. Plant operator shall be notified via the alarm dialer. Processes and systems associated with the alarm condition shall be allowed to continue. HMI software shall display an alarm notice that will remain until cleared by the operator.

      b.   Level 2 Alarm—Screen Notification. HMI software shall display an alarm notice that will remain until cleared by the operator.

      c.   Level 3 Alarm—Alarm Log Only.

   2.   Alarm log.

      a.   All alarm events shall be logged. Alarm log entries shall include as a minimum: date-time stamp, status (triggered or cleared), description of alarm, and identification of device generating the alarm.

B.   Security

   1.   The commercial HMI/SCADA software and site-specific control programs shall provide a minimum of four levels of security, as follows. Except as noted, all security levels require a username and password in order to log onto and access the system.

      a.   Level 1 Security—Programmer. Provides full access to all control programs, control objects, databases, and all other development resources in addition to the privileges of Level 2.

      b.   Level 2 Security—Supervisor. In addition to the privileges of Level 3, Supervisor access allows modification of allowable set point ranges, and can establish equipment and operational state locks that cannot be modified at less secure levels. Supervisor access is required to create new or modify existing reports.

      c.   Level 3 Security—Operator. This security level represents the level of operational and data control routinely used in day-to-day operation. All data can be reviewed, equipment operational states changed, set points redefined within allowable ranges, and reports and be requested and printed.

      d.   Level 4 Security—Observer. This is the default security level, and requires no username or password. Provides view- and read-only access to displays and operational state data. No changes in operational state of equipment, set points, or other operational or software properties are allowed.

1.10   *SCADA WORKSTATION DISPLAY SCREENS*

A.   General

   1.   As used in this topic, the term "display screen" refers to graphical and alphanumeric displays of data presented on the SCADA workstation monitor. Display screens are generated and controlled by the human-machine interface software.

2. As used in this topic, the term "interactive display screen" refers to a display screen that includes controls, on-screen function keys, icons, or other features that allow the operator to interact with the data and change the operational status of displayed information, equipment, and controlled devices.

3. Interactive display screens shall be provided to communicate and control the status of all equipment, systems, and devices controlled by or in communication with the plant SCADA system. Display screens shall also be provided for all alarms, alarm logs, and operator set points. Data trend displays shall be available for time series data.

4. Interactive display screens that report operational status information about physical equipment or systems shall be graphical in nature. Each item of equipment, including pumps, valves, tanks, etc., shall be shown in a symbolic manner. Piping that is significant to the function of the device or system shall also be shown. The operational state of each device (open, closed, on, auto, hand, off, alarm condition, malfunction, etc.) shall be displayed through use of color, differences in the symbol used, annotation, or other visual manner. Analog data such as tank levels shall be shown Numeric readouts of analog data shall also be provided where appropriate.

5. Status logs, alarm logs, time series data, and other tabular data may be presented in alphanumeric displays. Such displays may be provided to present greater quantities of information than can conveniently be displayed in a schematic graphical representation, or to permit the information to be sorted or filtered according to operator established criteria.

6. Information shall be presented in a hierarchical manner, with initial screens displaying broad, summary information, and more detailed and more closely focused information displayed in subsequent screens. The operator shall be able to navigate between screens using Forward and Back controls, querying display objects visible on the screen, accessing a display screen index, or some combination of these methods. Navigation between screens shall be fully managed within the HMI software environment, requiring no operating-system level commands or actions.

B. System Overview Display.

1. A system overview screen shall be interactive and shall show:

   a. System information including water levels, treatment information, and discharge rates.

   b. Treatment plant information including waste water inflow rate, operational status, and individual flow rates.

   c. Blower operation status

   d. Screen operation status

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e.   Clarifier operation status

f.   Dissolved Oxygen

1.11 MONITORING AND CONTROL FUNCTIONS

CARUTHERS WWTP OPERATION SUMMARY

The control panel shall indicate each motor or item of equipment that is operating.
The control panel shall log the total run time of each drive and allow the operator to review the total run times. The operator will have the ability to reset the start date of the log.

Influent Pumps 1, 2, 3 (SEW-P-001, 002, 003)
Ability for manual operation at the Lift Station
Automatic operation:

Set points on LS for:	LE-001
Low level alarm	217.8
Stop pumps	217.5
Start lead pump	220.5
Start 1st lag pump	221.0
Start 2nd lag pump	222.0
High level alarm	LSHH 001

Automatic triplex alternation with manual override
Automatic transfer to next pump on pump failure
Alarms for pump failure
Monitoring report of hours that each pump runs.
Backflow preventer and valve for each pump (004,005,006) (007,008,009)
There is the potential for additional requirements to be determined in the field.

Influent Flowmeter (FE-020)
Automatic operation:
Automatic signal from flowmeter to control panel on flowrates – instantaneous and totalized.
Monthly totals, maximum day, and average day will be required.
Valves for bypass of flowmeter (021,022,023)
Alarm for power failure
There is the potential for additional requirements to be determined in the field.

Headworks Self Cleaning Screen (SEW-SCR- 050)
Ability for manual operation at the Headworks
Automatic operation:
Set points for:

> Screen to start every 45 seconds. This is adjustable between 30 and 60 seconds
> Screen Start override at the high level elevation of (TBD)
> High level alarm at elevation of (TBD)

Alarms for screen failure
Slide gates in self cleaning screen channel (050,052)
Manual clean bar screen (101)
Slide gates in the manual bar screen channel (051,053)
Slide gate in channel to the pond distribution box (054)
Slide gate at the distribution box to the aeration pond (071)
Potable water to the headworks
Backflow preventer (540)
Gate valves (541,542)
Overflow to drain to the sewer then to the lift station

There is the potential for additional requirements to be determined in the field.

Biolac (400,401)
Automatic operation:
    Dissolved Oxygen sensor will send dissolved oxygen levels in the pond
        If oxygen level is too low, actions may include adjustments to the Blower VFD and/or the valve actuator for each air line
        If oxygen level is too high, actions may include adjustments to the Blower VFD and/or the valve actuator for each air line
        Dissolved Oxygen target is (TBD) mg/l
    NH3 monitor at the effluent (future)
        The settings are adjustable
Alarm for blower failure
Alarm for dissolved oxygen of 0 mg/l.
Receive a signal for dissolved oxygen, each five minutes.
Air Valve at each Biolac train with electric actuator to control air flow based on oxygen levels in the pond (501,502,503,504,505,506)
There is the potential for additional requirements to be determined in the field.

RAS/WAS Air Lift from Clarifier (350,351)
Ability for manual operation at the Clarifiers
Automatic operation:
    Run the RAS/WAS air lift continuously initially, however, the run time is adjustable for a specified amount of time per day. The time of day is also adjustable.
Alarms for air lift failure.
Parshall Flume in RAS flow channel (361)
Ultrasonic level sensor (360)
RAS flowmeter flow records
There is the potential for additional requirements to be determined in the field.

WAS Valve from Clarifier (364)
Manual operation:
    The Valve is always closed.
    The Valve will be opened manually at a various times to direct a portion of the flow to the digester or sludge drying beds. The Digester is an additive alternate and may be a future item.
There is the potential for additional requirements to be determined in the field.

Clarifier Rake Drives (WSE-SLL-380, 381)
Ability for manual operation at the Clarifiers
Automatic operation:
    The rake drive will run continuously if set to run or on automatic.
Alarms for drive failure, excess torque.
Alarm for the cable falling off of the drive
There is the potential for additional requirements to be determined in the field.

Scum collector
Manual operation at the Clarifiers
Drain to the sewer then to the lift station
There is the potential for additional requirements to be determined in the field.

Polymer Pump (SLG-P-670, SLG-T-670) (FUTURE)

Ability for manual operation at the Blower Building
Automatic operation:
> The pump will operate only when the sludge pump is wasted to the drying beds.

Alarms for pump failure.
Backflow preventer (672)
Gate valves (674,676)
Potable water
Backflow preventer (678)
Gate Valve (677)
There is the potential for additional requirements to be determined in the field.

Composite Sampler (570)

Automatic operation:
> The composite sampler is placed near the effluent collection box for influent to the evaporation and percolation ponds

Alarm for pump failure
Alarm for low water level.
Alarm for sampler being full
Rinse line to drain to the disposal ponds
There is the potential for additional requirements to be determined in the field.

Ammonium Sensor (800) (FUTURE)

Automatic operation
> The ammonium sensor is placed near the effluent collection box for influent to the evaporation and percolation ponds
>
> The ammonium sensor will record levels of ammonium in the influent to the evaporation and percolation ponds

Alarm for ammonium over the predetermined limit
Alarm for sensor failure
Slide gate at effluent collection box (810)
Alarm for low water level
There is the potential for additional requirements to be determined in the field.

Blowers (SLG-B-600,601,602)

Ability for manual operation at the Blower Building
Automatic operation:
> If a blower is on manual or automatic, it should be on continuously

PLC to control Blower VFD. There will be links to the D.O. probe information.
Alarms for motor failure.
Alarms for high pressure
Record hours of motor operation
Blowers to be cycled
Backflow preventer for each blower (610,611,612)
Air Valve at each blower with electric actuator to control air flow (620,621,622)
There is the potential for additional requirements to be determined in the field.

Digester (FUTURE)

Air valve for aeration (630)
Slide gate for discharge to the sludge drying beds (650)
Overflow to drain to the sewer then to the lift station
There is the potential for additional requirements to be determined in the field.

Sludge Drying Beds

Effluent gate valves (900,901,902,903,904,905,906)

Slide gate for decant to the lift station (920,921)
There is the potential for additional requirements to be determined in the field.

Dialer parameters
Alarm 1, listed as failure of equipment (blowers, lift station pumps, screen, etc.) or power outage
These alarms shall trigger a call to:
Caruthers CSD office   559-864-8189
David McIntyre cell phone   559-355-0558
Fresno County Sheriff   559-_____
Other alarms to be compiled in an Alarm report at the control panel for viewing by the operators.
All alarms will be equipped with adjustable time delays, setpoints, and enable/disable features.
Other alarms:
Generator Fault
Generator Pre-alarm
Generator running
Raw CP Power Failure

The SCADA system will be used to monitor equipment installed at the plant, and shall generate alarms or corrective signals when necessary.   The device with monitor the following equipment:

Equipment, device, or installation	Monitor/ Control Function (See footnotes)
Sewage pumping stations	2. Accept and record alarm signals. Accept liquid level monitoring, accept Operational status.
Headworks screen	2. Accept and record screen alarms, accept liquid level monitoring.
Headworks flow measurement	2. Accept signal continuously. Record flows and totalize.
Aeration PLC control	2, accept and record signal from the PLC each five minutes for the following parameters: Dissolved oxygen, power draw, and operational status.
Clarifier drives	2. Accept and record operational status.
Blowers	1. Accept and record operation.
Miscellaneous manual input parameters	MLSS, Influent and effluent BOD, Suspended solids, settable solids, EC, pH, and total nitrogen levels, plus six separate registers for additional parameters to be added later

Monitor and reporting- footnotes:
1. Monitor equipment status, local failure alarm

2. Monitor equipment status, local failure alarm, initiate dialer failure alarm

A. Treatment Plant Displays.

1. Provide the operational status of all controlled devices and systems at the treatment plant in one or more interactive display screens.

2. Provide levels, flow rates, and other field instrument readings.

3. Provide displays or interactive displays for all alarms, alarm logs, time sequence trends, and other tabular data acquired in the control and operation of the Plant.

1.12 OPERATOR INTERFACE DEVICE DISPLAYS

A. General.

1. Operator interface devices shall be provided and programmed to provide data access to and control of each of the devices, systems, processes, and set points under automated control at the site where it is located.

2. Each operator interface shall be able to operate autonomously, communicating with and controlling the associated PLC without benefit of the SCADA workstation located in the Office Building or modem communications between the treatment plant and other sites.

3. Information shall be presented in a hierarchical manner, with initial displays providing summary data and subsequent displays providing more detailed and more closely focused data. The operator shall be able to navigate between displays using function keys or other means.

1.13 REQUIRED REPORTS

A. General.

1. The information management portion of the plant control software shall provide the capability to generate predefined and ad hoc reports based on accumulated operational data. The software shall provide the capability to query and filter the data on multiple criteria, including filtering for the sampling frequency of data.

2. Software shall include the necessary tools for creation of new reports, and documentation on the use of these tools by the owner.

B. Monthly Treatment Plant Report

1. Two reports of similar scope and complexity shall be provided at the direction of the Engineer.

REPORT GENERATION

The SCADA system shall collect data from the various flowmeters and monitoring equipment, and shall allow manual input of data received from testing laboratories , plant staff, and similar. Using the collected information, the SCADA system shall be programmed to provide, at a minimum, the following reports:

Report	Notes
Operations trend chart generation	Using data collected and stored, generate a trend chart for each of the following parameters: plant flow; influent and effluent BOD, influent and effluent Suspended solids, influent and effluent nitrogen, MLSS and dissolved Oxygen
Weekly and monthly alarms summary	

PART 2 PRODUCTS

2.1 *PROGRAMMABLE LOGIC CONTROLLERS (PLCs)*

A.   The programmable controllers shall consist of a central processor, process controller, memory, input/output, interconnecting cables, and optional items as required for a complete and operable system and as specified. The system shall be modular in design, with the central processor, communications, and I/O contained in modules that insert into a common chassis. The system shall be capable of supporting additional local expansion chassis. PLC shall have direct communication interface to the variable speed drives. The PLC will control the blower VFD based on the basin D.O. level.

B.   Manufacturer shall be Allen- Bradley in order to maintain consistency throughout the process. Any exception shall be system wide and subject to owner approval.

2.2 *SCADA WORKSTATION*

A.   Provide a new desktop PC computer and printer to serve as the SCADA workstation. All required hardware and software shall be preinstalled, configured, and tested at Contractor's site before delivery to the Project site. All documentation routinely supplied by computer manufacturer shall be included.

B.   Features: The following represents minimum requirements. Upgrades or additional features shall be provided at no additional cost to Owner where required to meet recommendations of the HMI/SCADA software manufacturer.

1.   Intel Xeon Quad Core or equal

2.   Memory: 4 GB

3.   1 TB hard drive

4.   Integrated 10/100 Ethernet

5.   16X DVD drive

6.   Display: 20" flat panel, Color LCD and Intel HD Nvidia Quadro graphics controller

7.   Voice modem card

8.   Keyboard, mouse,

9.   30 minute UPS with surge suppressor

10.   Network Color LED Laser Class Printer

C.   Software

1.   Operating System: Microsoft Windows 7 with XP mode with most recent service packs, as required by HMI/SCADA software.

2.   General Purpose: Microsoft Office XP Professional.

3.   Remote Operation Software: Software as required to permit remote operation and maintenance of the SCADA system software as discussed at paragraph 2.3E below. Office software: Microsoft Office 2010.

4.   All new software shall include original documentation and media (CD-ROMs).

D.   Warranty: 3 years.

E.   Manufacturer Dell or equal.

1.01   TELEPHONE ALARM DIALING SYSTEM

A. General

a.   Provide a cellular alarm dialer per Specification 16721.

2.   Software

a.   Tag/Alarm database: Easily configurable tag database integral to the system. Database links alarm tags in the SCADA system to tags in the system. The system shall have a test button to generator test alarms.

b.   Dial-in and dial-out Verbal Data Acquisition: System shall allow operators to obtain information from the SCADA system via any

touch-tone telephone. Operators shall be able to manipulate user input values with a telephone keypad.

1. Hardware:

    c. The system shall include a voice-modem capable of playing and recording sound files, as well as supporting dial-out and dial-in modem functions.

    Specifications:

Device type:	Voice/FAX-modem
Device format:	Internal or external
Highest data rate:	33.6Kbps

    a. The hardware shall be easily installed on any IBM compatible computer and shall not require a computer sound card to play or record files. All dialer hardware shall be non-proprietary and shall be the same design for all versions of Windows.

2.3 HUMAN-MACHINE INTERFACE / SUPERVISORY CONTROL AND DATA ACQUISITION (HMI/SCADA) SOFTWARE

A. The software shall be Wonderware or Allen Bradley Rockwell FactoryTalk View SE 25 screens package with Historian capable of running on Microsoft Windows XP, and shall be the latest software release version available from the supplier.

B. The software shall enable applications development in Windows, and include all necessary software tools to modify or extend any of the site-specific programming provided under this Specification.

    1. The software shall have a minimum of 1500 tags and shall be expandable in the total number of tags (object names). Object names shall support at least 32 alphanumeric characters.

C. The software shall not require a unique environment or program for designing graphic window displays. The software shall be equipped with a comprehensive symbol library. It shall support bitmap (.bmp), and Windows metafiles (.wmf) symbol files. It shall be able to import and use AutoCAD drawings, photographs, maps, and other images.

D. Software Data Exchange.

    1. The software shall support software data exchange using non-proprietary, publicly documented DDE protocol supplied with Microsoft windows. The software shall be able to act as both DDE client and DDE server.

    2.   The software shall provide read-write access to all real-time data and read-only access to historical data through ODBC-compliant SQL.

E.   Software shall be capable of being supported remotely, either through features inherent in the HMI/SCADA software or through the use of other remote operation software.

F.   Human-Machine Interface / Supervisory Control and Data Acquisition software shall be Wonderware or Allen Bradley RSVIEW.

2.4   SOFTWARE OWNERSHIP

A.   SCADA Source Code shall be provided to and owned by the Caruthers CSD in an electronic backup media format.

B.   PLC Logic code and program listings shall be provided to and owned by the Caruthers CSD in an electronic backup media format.

C.   All software licenses for SCADA programming, PLC programming shall be provided to and owned by the Caruthers CSD.

PART 3 EXECUTION

3.1   INSTALLATION

A.   Installation of programmable logic controllers, I/O components, network devices, and other hardware specified in this section shall be installed in accordance with manufacturer's instructions.

B.   Contractor shall provide all equipment, connections, and appurtenances for a complete and operational system.

3.2   FIELD QUALITY CONTROL

A.   Contractor's field service.

    1.   The Contractor shall provide the service of a qualified representative to provide instructions on the proper installation of the equipment, inspect the completed installation, participate in the startup of equipment controlled by the PLC-based control system, participate in the field testing of the plant control and SCADA systems and make any necessary adjustments and program changes, conduct training of the Owner's personnel as described below, and place the plant control and SCADA systems in trouble-free operation. The contract price paid for the plant control and SCADA systems shall include the cost of these services.

B.   Installation supervision shall include forty (40) hours of inspection and field adjustments.

C.   Training shall include ten (10) hours of instruction.

END OF SECTION