

SECTION 40 96 00
APPLICATIONS SOFTWARE

PART 1 GENERAL

1.01 WORK INCLUDED

- A. The Process Control System Integrator (SI) shall design, develop, and start up the Plant PLC/SCADA Application process control software.
- B. The Work of this section shall include:
 - 1. Project management and revision control.
 - 2. Applications software workshops, if and when required by Contracting Officer.
 - 3. Applications software standards and submittals.
 - 4. Applications software development.
 - 5. Software testing.
 - 6. Software installation.
 - 7. Startup.
- C. The SI shall be responsible for developing standards for the plant PLC and SCADA programming and configuration. New Application Software development shall follow the new High Performance Graphics industry accepted standards. The SI shall also develop alarming and historian to ISA 101 Human Machine Interfaces for Process Automation Systems.
- D. The SI shall provide all loop tuning and software modifications employed throughout the startup and testing period with actual process to provide operation exhibiting stable and controllable response to all process changes, steady state operation, and alteration of control parameters such as set point, with robust and fault tolerant functionality, all in accordance with the requirements of these Specifications.
- E. All Application Software developed by SI for the NPS becomes the property of NPS and may be modified, deleted, copied and reused for other functions or in other plants.

1.02 RELATED SECTIONS

- A. The Work described in the following sections also applies to the Work in this section. Other sections of the Specifications not referenced below shall also apply to the extent required for proper performance of this Work.
 - 1. Division 00, General Conditions.
 - 2. Division 01, General Requirements.

3. Division 26, Electrical.
4. Division 40, Process Interconnections.

1.03 DIVISION OF WORK

- A. The SI shall provide and implement the applications software required to complete the Work.
- B. The SI shall have overall system responsibility and shall provide all work necessary to satisfy all requirements of this and related sections.
- C. The software of this section at a minimum shall include software, programming and configuration of PLC control code, SCADA graphics, trend groups, alarming software, historian points, and reports.
- D. Definition of Software Types:
 1. Standard Software: Software packages that are independent of the project on which they are used. Standard software includes system software and process monitoring and control software.
 - a. System Software: Application independent software developed by Microsoft. Includes, but is not limited to Microsoft operating systems, file management utilities, text editors, debugging aids, and diagnostics.
 - b. PLC Software: Software packages independent of the specific process control project on which they are used. Includes, but is not limited to, providing capability for, data acquisition, monitoring, alarming, SCADA, data collection, data retrieval, trending, report generation, control, and diagnostics.
 2. Application Software:
 - a. Software to provide functions unique to this Work and that are not provided by standard software alone.
 - b. Configuring databases, tables, displays, reports, parameter lists ladder logic, and control strategies required to implement functions unique to this Project.

1.04 WORK SEQUENCE AND SCHEDULE

- A. General: All work provided under this section shall be in accordance with a Milestone Breakdown and System Delivery Plan.
- B. Milestone Breakdown (MB): Summarize the major milestones for work provided along with the major milestones.

C. System Delivery Plan (SDP):

1. The intent of the SDP is to:
 - a. Coordinate and communicate applications software design and testing activities.
 - b. Coordinate interactions with the Contracting Officer regarding workshops, submittal reviews, contractor(s) progress, test witnessing, training, etc.
 - c. Communicate and clarify required work sequences and major milestone.
2. Minimum Content:
 - a. Work sequence and schedule.
 - b. Applications software workshops.
 - c. Applications software submittals.
 - d. Applications software development.
 - e. Software testing.
 - f. Software installation.
 - g. O&M development.
 - h. Government training.
 - i. Startup.

1.05 PREREQUISITES FOR SOFTWARE DEVELOPMENT

- A. Process & Instrumentation Diagrams (P&IDs): SI shall utilize P&IDs on the Drawings. Should the SI determine errors or omissions in the P&IDs that would affect software development schedules, the SI shall immediately notify the Contracting Officer and the Contractor. SI shall keep diligent red-line markups of all P&ID modifications, additions, or clarifications.
- B. Loop Diagrams and Specifications: SI shall utilize Loop Drawings developed by the General Contractor. However, the SI is responsible for providing PLC-level details, e.g., I/O termination identification, software level addresses, etc., to Contracting Officer to allow him to finalize the Project as-constructed Loop Drawings.
- C. Fully attributed I/O Lists and attributed Process Control Narratives (PCN): SI shall annotate and attribute I/O list, and shall annotate PCN with all assumptions, corrections and changes, for each process segment of the Project. The SI shall maintain red-line markups of all changes to facilitate final as-constructed documentation.
- D. Control Strategies: The SI shall review Project Control Strategies for completeness. Should the SI find any errors or omissions, or have questions as to functionality, the SI shall immediately notify the Contracting Officer.

- E. The SI shall develop and document separate programming standards for the PLC programming, SCADA programming, alarming, and historian configuration.
- F. The SI shall develop process graphics descriptions for all graphics programming, for all process segments, as part of the software submittal(s) for that process segment. The SI shall ensure that new graphics development conforms with the SI developed standards.
 - 1. At a minimum, the process graphics descriptions will include:
 - a. Graphic hierarchy.
 - b. Navigation/paging.
 - c. Operator inputs and control templates.
 - d. Action buttons and menus.
 - e. Color coding, alarming, background fills, animation.

1.06 SOFTWARE DESIGN WORKSHOPS

- A. SI shall conduct up to six workshops to develop the PLC and SCADA programming standards and alarming and historian standards prior to commencing any programming work for this Project.
- B. SI may request software design workshops for the work in this section on a process area by process area basis to clarify any questions or confirm compliance with Contract Documents. Should the SI require workshops, they shall submit the request through the General Contractor to be processed through the Contracting Officer.

1.07 PLC SOFTWARE SUBMITTALS

- A. The PLC software submittals shall be 'Action' submittals as defined in Section 40 90 00, Instrumentation and Control for Process Systems.
- B. The PLC Software Submittal shall be singular and all inclusive, submitted in accordance with Section 01 33 23, Submittal Procedures. The PLC Software Submittal shall include, but not be limited to:
 - 1. The SI shall provide all submittals in accordance with Section 01 33 23, Submittal Procedures. SI shall provide six hard copies and one soft copy of all submittals.
 - 2. Logic Diagrams: The SI shall develop and submit logic diagrams for all new PLC code for the Contracting Officer's approval. Diagrams shall be organized and bundled in a way that facilitates optimum review by the Contracting Officer. All PLC codes shall be annotated with comments.
 - 3. Graphic Diagrams: An English narrative of each data acquisition or control loop mission and anticipated action. Narratives shall enumerate the signal point name, signal descriptor, associated PLC number,

- associated system template displays, system functions activated by signal (i.e., interlocks, alarms, logs, etc.).
4. I/O Database: The SI shall develop and submit a fully attributed I/O database. The I/O database shall be organized and bundled in a way that facilitates optimum review by the Contracting Officer. The complete listing of the PLC and SCADA database shall list each data point's relevant parameters such as range, contact orientation, limits, incremental limits, I/O card type, I/O hardware address and assignment as minimum.
 5. Reports: The SI shall document and submit all reports being developed under this Contract.
 6. PLC Software Standards: The SI shall develop PLC software standards based on the Function Blocks listed in this section.
 7. SCADA Standards: The SI shall develop High Performance Graphics SCADA software standards.
 8. Alarming and Historian Standards: The SI shall develop standards for the Alarming procedures. These standards will lay the framework for categorizing the alarms (by criticality and level) and will define how the alarms will be shown on the SCADA displays and be reported out from the SCADA system. The Historian standards will lay the framework for the database points and the frequency for these points to be saved in the Historian database.
 9. A complete set of PLC configuration sheets depicting each loop linkage. Each loop shall be on its own 11-inch by 17-inch sheet.

1.08 SCADA GRAPHIC SUBMITTAL

- A. The SCADA Graphic Submittal shall be singular and all inclusive, submitted in accordance with Section 01 33 23, Submittal Procedures. The SCADA Graphics Submittal shall include, but not be limited to:
 1. One complete set of all displays which are unique to this Project (i.e., process global, system global, process regional, systems regional, process group, process loop, process component, integrated tutorials, integrated process tutorials, integrated documentation, user assistance).
 2. The SI shall ensure that all graphics development, and graphics submittal, conform to the existing graphics layouts, linkages and formats.
 3. The Graphics Submittals shall contain displays in full size color graphic format and replicate the proposed screen contents. All background colors shall be identical to that of the screen content. All displays shall be arranged in a hierarchical order with references to associated SCADA workstations.
 4. A system display linkage diagram which defines the hierarchical order and the linkages via page, down, left, right commands.

5. A definition of each display's data fields by tag numbers, utilizing the developed standard.
6. A definition of each display's dynamic elements which shall blink, change color, rotate or change shape in response to process changes, and conforms to the developed standard.
7. A listing of all "help" text associated with each display screen, arranges in conformance to the developed standard.
8. The Graphics submittals will be closely aligned with the SI developed Alarming and Historian standards.

PART 2 PRODUCTS

2.01 PLC APPLICATION SOFTWARE DESIGN REQUIREMENTS

A. Physical Characteristics: None.

B. Functional Characteristics:

1. PLC Program Design:
 - a. SI shall develop and submit PLC application software in strict accordance with the requirements in the SI developed software standards.
 - b. The PLC shall be used to provide each process segment automatic control, alarm functions, and continuous loop control. Specific PLC functional requirements are described in the control narratives of source code for the current system provided as part of the Contract Document.
 - c. The SI shall organize the PLC application software into:
 - 1) Sections:
 - a) Contains all logic for a specific unit operation.
 - b) Each section consists of a general logic subsections and, followed by unit operation subsections.
 - c) Subsections: Contains logic for specific equipment such as a pump, valve, or loop.
 - 2) Functional Blocks:
 - a) Building block for pumps, valves, loop control, analog processing, and alarm switches.
 - b) Requirements for standard PLC function blocks to be provided are specified herein.
 - d. Program Documentation:
 - 1) Note and describe start of a new program section.
 - 2) Briefly describe control objectives.
 - 3) Identify subsections.
 - 4) Subsection documentation includes brief description of control objective followed by a description and tag of the equipment being controlled.

- e. The SI shall provide an organizational index for PLC applications software that can be used to quickly search and locate a specific process section.
- 2. Program Flow Diagram:
 - a. Develop Program Flow Diagrams (PFDs) showing software sections, subsections and functions blocks, subprograms, and their interrelationships. Provide written description of each section subsection and function block that will be used in the actual program.
 - b. PFD for each analog loop and PID loop configuration to include written descriptions of setpoint ramps, loop initialization, interface with PLC, etc.
 - c. PFD submittals shall follow SAMA Standards.
- 3. Standard User Defined Function Block (UDFB) Development:
 - a. General: The SI shall at a minimum develop function blocks for the following preliminary standard functions listed below. These function blocks will be used to implement the SCADA Application requirements described below. These functions shall be reviewed and modified as necessary during the PLC Software Standards Workshops and SCADA Application Standards Workshop.
 - b. Analog Input Scaling Block:
 - 1) Primary function is to scale the raw analog input value to engineering units. Scaling shall be done using linear relation based on raw minimum/maximum and engineering minimum/maximum.
 - 2) Logic to include test and calibrate functions.
 - 3) When TEST mode is active, the block does not scale the raw input. The block passes a test value to the scaled engineering output value.
 - 4) When CALIBRATE mode is active, the block does not scale the raw input. The block holds the last engineering output value. A calibration time is used to set an allowable time for calibrate mode. If the calibration time is exceeded the logic provides an indication that calibration mode duration has been exceeded. The calibration time exceeded indication does not clear the calibration mode.
 - 5) Calibration time is input in minutes as a “real” number.
 - 6) Utilize separate UDT for HMI specific data and PCM internal data.
 - c. Analog Output Scaling Block: Primary function is to scale an engineering value to raw units for transfer to an analog output card. Scaling shall be done using linear relation based on raw minimum/maximum and engineering minimum/maximum.

- d. Analog Alarm Block:
 - 1) This block is used to generate level alarms and rate of change alarm for an analog value.
 - 2) Input setpoints to be included for each of the four alarm levels (HIGH HIGH, HIGH, LOW, and LOW LOW).
 - a) Input setpoints to be data type “REAL”.
 - b) Level alarms to be data type “BOOL”.
 - c) Alarms are self-resetting based on a settable dead band.
 - d) A dead band value is input as a percentage of the full Engineering scale (0 percent to 100 percent) and is used to provide the reset setpoints for each of the level alarms.
 - e) Code is required to convert the dead band percentage to engineering units based on the minimum and maximum engineering units for the analog value.
 - 3) Input setpoints are to be included for the rate of change (ROC) amount and rate of change time interval.
 - 4) ROC limit is input as a percentage of the full engineering scale (0 percent to 100 percent).
 - 5) Code to use the ROC check time to periodically calculate the current ROC. The code is then required to test if the current ROC (absolute value) is greater than the maximum allowed ROC. If current ROC is greater than Max ROC, ROC alarm is activated.
 - 6) Individual Enable control bits to be provided for each of the four alarm points as well as ROC alarm.
- e. Discrete Alarm Block:
 - 1) This block is used to condition a discrete alarm input.
 - 2) Include the ability to disable the alarm input.
 - 3) Include a de-bounce time function to prevent nuisance alarms.
 - 4) Include the ability to invert the discrete alarm input signal.
 - 5) If the alarm is enabled, and the discrete input is active for more than the de-bounce period of time, activate the alarm output.
 - 6) If the channel fault is active, activate the alarm output.
- f. Chemical Dosage Block:
 - 1) This block is used to generate a speed reference signal for a chemical injection pump based on a flow paced input signal.
 - 2) If flow pace flow rate signal is less than low flow cut off, set pump speed to zero.
 - 3) Include ability to select between flow pace mode and direct chemical flow rate setpoint control.

- g. Repeat Cycle Timer Control Block:
 - 1) This block is used to control the sequencing of a multi-equipment system for up to three pieces of equipment.
 - 2) Include logic to recognize which equipment is available and provide controls accordingly:
 - a) Enable sequence control of equipment available only.
 - b) Include the ability to sequence up to three pieces of equipment.
 - 3) Include OFF time for the sequence.
 - 4) Include separate ON time for each piece of equipment.
 - 5) Include overall AUTO/MANUAL control mode.
 - 6) When in AUTO mode, configure the block such that:
 - a) Block will wait for a period of time equal to the OFF time, then start first piece of equipment.
 - b) When ON time done for first piece of equipment, STOP first piece of equipment and START second piece of equipment.
 - c) When ON time done for second piece of equipment, STOP second piece of equipment and START third piece of equipment.
 - d) When ON time done for third piece of equipment, STOP third piece of equipment and repeat sequence.
 - e) Block to be configured to skip unavailable equipment.
 - 7) When in MANUAL mode configure the block such that:
 - a) Any single piece of equipment can be selected to run continuously.
 - b) No equipment will run automatically.
- h. Fixed Speed Motor Block:
 - 1) This block is used for control of a fixed speed motor.
 - 2) The block can be used for a Reversing or Non-Reversing motor.
 - a) Forward/Reverse selection is not to be visible as a standard block setting. Control function to be selected as visible from the block settings during configuration if required.
 - b) Reverse output is not to be visible as a standard block setting. Control function to be selected as visible from the block settings during configuration if required.
 - 3) Standard Code to Include:
 - a) JOG function for testing.
 - b) AUTO/MANUAL control selection and feedback indication.
 - c) HOA indication.
 - d) Motor runtime hours (total accumulated and hours since last maintenance reset).
 - e) Motor number of starts.

- f) Control interlock input (AUTO and MANUAL mode).
- g) Process interlock input (AUTO mode).
- h) Motor status (ON/OFF, FAIL, AUTO/MANUAL mode, HOA mode, etc.).
- i) Motor fail RESET control.
- 4) Scaling and Presets:
 - a) JOG Mode Default Time Setting: 4 seconds.
 - b) Fail Timer Setting: 8 seconds.
 - c) Total Runtime Hour Automatic Reset: 17,520 hours.
- 5) Motor direction is to be controlled by the direction selection input.
 - a) Default motor direction is forward.
- 6) If the motor is in AUTO mode and direction control is set to FORWARD then FORWARD RUN output will activate if AUTO START active (and permissives allow).
 - a) AUTO START is based on detail code created elsewhere in the PCM program and is based on the APC Operational Procedures.
- 7) If the motor is in AUTO mode and direction control is set to REVERSE then REVERSE RUN output will activate if AUTO START active (and permissives allow).
 - a) AUTO START is based on detail code created elsewhere in the PCM program and is based on the APC Operational Procedures.
- 8) If the motor is in AUTO mode, then both the FORWARD RUN and REVERSE RUN output will deactivate if AUTO START inactive.
- 9) If the motor is in AUTO mode and running, the motor will continue to run when switched to MANUAL mode (bump less transfer).
- 10) If the motor is in MANUAL mode and the appropriate AUTO RUN bit is not active (forward or reverse as required), the motor will not continue to run when switched to AUTO mode.
- 11) If the motor is in MANUAL mode, then one RUN output will activate (forward or reverse as required) if MANUAL START toggles.
- 12) If the motor control is in MANUAL mode, then RUN outputs will deactivate if MANUAL STOP toggles.
- 13) If the motor is set to JOG mode, then the motor will start in the selected direction when the JOG Start is activated.
 - a) Motor will run for the JOG timer preset amount of time, then stop.

- b) This function is intended for short duration bump testing of motors.
 - c) This function bypasses all software interlocks.
- 14) If in AUTO or MANUAL mode, motor will not start (or will stop if running) if:
 - a) Control Interlock input = 0 (fail safe).
 - b) Motor Fail Output = 1.
- 15) If in AUTO mode, motor will not start (or will stop if running) if:
 - a) Process Interlock input = 0 (fail safe).
- 16) Block to be configured such that motor fail will latch.
- 17) Motor FAIL based on “fail to start,” “fail to stop,” or fail indication directly from motor starter.
 - a) Manual fail reset input to be used to clear a motor fault.
- 18) Runtime hours are calculated as a total cumulative as well as maintenance interval.
 - a) Total cumulative hours accumulate to a maximum of 2 year’s continuous operation.
 - b) Maintenance interval hours calculate the time since the last Maintenance Reset.
 - c) Include manual RTH reset inputs for total RTH and maintenance RTH.
- 19) The number of starts is incremented each time the motor starts.
 - a) Include manual NOS reset input.
- i. Lead-Lag Control Block:
 - 1) This block is used to provide run control for a two motor LEAD/LAG configuration.
 - 2) Include logic to recognize which motors are available and provide controls accordingly.
 - a) If only one motor is available, set that motor to lead.
 - 3) Include lead motor start input.
 - 4) Include lag motor start and stop set point inputs.
 - a) When process variable input is greater than lag start level setpoint, and lead motor is running, start the lag motor.
 - b) If both motors are running and process variable is less than the lag motor stop level setpoint, stop the lead motor and toggle the lead/lag assignment.
 - 5) Include ability to manually toggle the LEAD/LAG status.
- j. Duty-Standby Control Block:
 - 1) This block is used to provide run control for a two motor DUTY/STANDBY configuration.

- 2) Include logic to recognize which motors are available and provide controls accordingly.
 - a) If only one motor is available, set that motor to duty mode.
 - 3) Include option to use single discrete run input or use start/stop level inputs.
 - 4) Include duty motor start and stop set point inputs.
 - a) If process variable input is greater than duty start level setpoint, start the duty motor.
 - b) If the process variable is less than the duty motor stop level setpoint, stop the duty motor and toggle the duty/standby assignment.
 - 5) Include ability to manually toggle the DUTY/STANDBY status.
 - 6) Include automatic toggle of DUTY/STANDBY status when duty motor was running, then transitions to stop.
- k. Modulating Valve Control Block:
- 1) This block is used to control a modulating valve utilizing a position reference output (analog signal).
 - 2) Logic to include:
 - a) LOCAL/REMOTE indication.
 - b) AUTO/MANUAL control and feedback indication.
 - c) When in MANUAL mode include ability to input manual position reference signal.
 - 3) When in AUTO mode, configure the block such that the auto position reference signal input is passed to the valve position reference output.
 - a) Auto position reference signal is determined from detail PCM code programmed based on process requirements.
 - 4) When in MANUAL mode configure the block such that the manual position reference signal is passed to the valve position reference output.
 - 5) Include single valve FAULT alarm:
 - a) FAULT alarm to be based on fail signal from valve if available.
 - b) FAULT alarm to be latching in logic. Use RESET input to clear the fault condition.
- l. Open-Close Valve Block:
- 1) This block is used to control a two-position valve utilizing a single command output.
 - 2) Logic to include:
 - a) LOCAL/REMOTE indication.
 - b) AUTO/MANUAL control and feedback indication.
 - c) Adjustable Fail Timer.
 - d) Number of Transitions (NOT).

- 3) Scaling and Presets:
 - a) Fault timer default setting; 15 seconds (adjustable).
 - b) Total Number of Transitions before automatic reset; 10,000 cycles.
- 4) When in AUTO mode configure the block such that:
 - a) OPEN output will activate if AUTO OPEN command bit is active.
 - b) CLOSE output will activate if AUTO CLOSE command bit is active.
 - c) AUTO OPEN and AUTO CLOSE commands are based on detail code created elsewhere in the PCM program.
 - d) Neither control output will enable if both AUTO OPEN command and AUTO CLOSE command are active at the same time.
- 5) When in MANUAL mode configure the block such that:
 - a) OPEN output will activate if MANUAL OPEN is active.
 - b) CLOSE output will activate if MANUAL CLOSE is active.
- 6) When OPEN output active, latch output on until either the OPEN feedback is received or the valve fail is active.
- 7) When CLOSE output active, latch output on until either the CLOSE feedback is received or the valve fail is active.
- 8) Include single valve FAULT alarm:
 - a) FAULT alarm to be time based such that the OPEN/CLOSE feedback must be received within the "Fail Time" of an OPEN/CLOSE command being issued.
 - b) Fail timer will start timing if both OPEN/CLOSE feedback active.
 - c) Fail timer will start timing if neither OPEN/CLOSE feedback active.
 - d) FAULT alarm to be latching in logic. Use reset input to clear the fault condition.
- 9) The number of transitions is incremented each time the valve transition from full open to full close or from full close to full open.
 - a) Include Number of Transitions reset input.
- m. OPEN/STOP/CLOSE Valve Block:
 - 1) This block is used to control a two-position valve using two separate commands for open and close. This block includes the ability to stop a valve part way through a transition.
 - 2) Logic to include:
 - a) LOCAL/REMOTE indication.
 - b) AUTO/MANUAL control and feedback indication.

- c) Adjustable Fail Timer.
- d) Number of Transitions (NOT).
- 3) Scaling and Presets:
 - a) Fault Timer Default Setting: 15 seconds (adjustable).
 - b) Total Number of Transitions Before Automatic Reset: 10,000 cycles.
- 4) When in AUTO mode configure the block such that:
 - a) OPEN output will activate if AUTO OPEN command bit is active.
 - b) CLOSE output will activate if AUTO CLOSE command bit is active.
 - c) OPEN and CLOSE outputs will deactivate if AUTO STOP is active.
 - d) AUTO OPEN and AUTO CLOSE commands are based on detail code created elsewhere in the PCM program.
 - e) Neither control output will enable if both AUTO OPEN command and AUTO CLOSE command are active at the same time.
- 5) When in MANUAL mode configure the block such that:
 - a) OPEN output will activate if MANUAL OPEN is active.
 - b) CLOSE output will activate if MANUAL CLOSE is active.
 - c) OPEN and CLOSE outputs will deactivate if MANUAL STOP is active.
- 6) When OPEN output active, latch output on until either the OPEN feedback is received, the valve fail is active, or MANUAL STOP is active (when in MANUAL mode).
- 7) When CLOSE output active, latch output on until either the CLOSE feedback is received, the valve fail is active, or MANUAL STOP is active (when in MANUAL mode).
- 8) Include single valve FAULT alarm:
 - a) Fault alarm to be time based such that the OPEN/CLOSE feedback must be received within the "Fail Time" of an OPEN/CLOSE command being issued.
 - b) Fail timer will start timing if both OPEN/CLOSE feedback active.
 - c) Fail timer will start timing if neither OPEN/CLOSE feedback active.
 - d) Fault alarm to be latching in logic. Use reset input to clear the fault condition.

- 9) The number of transitions is incremented each time the valve transition from full open to full close or from full close to full open.
 - a) Include Number of Transitions reset input.
- n. Flow Totalizer Block:
 - 1) This block is used to totalize flow rate signals.
 - a) Include flow total today and yesterday.
 - 2) Logic to include selection of input flow units of mgd, gpm, gph, or cfm.
 - 3) Logic to include low flow cut off set point input.
 - 4) Scaling and Presets:
 - a) Default flow totalization time slice equals 5.0 seconds.
 - b) If used in timed interrupt task, set routine update time accordingly.
 - c) If used in continuous task, include internal timers to control flow totalization update.
 - 5) If the flow rate is lower than the low flow cut off value, then the flow is not totalized.
 - 6) The block is to be configured such that at an end of day roll over event, the “today” total is moved to the “yesterday” total. Once moved, the “today” total is reset to 0.0.
 - 7) Block to include manual reset input such that if the manual reset is activated, the “today” flow total is reset.
- o. PID Control Block:
 - 1) This block is used for standard PID control.
 - 2) Include AUTO/MANUAL selection and feedback indication.
 - 3) Include ability to select control action (direct or reverse acting).
 - 4) Include inputs for PID controller scaling configuration.
 - 5) Include ability to tune the PID controller without the need to open an instance of the PID block.
 - 6) Include a process interlock input to be used in conjunction with AUTO CONTROL mode.
 - a) Configure the block such that if the process interlock is not active set the control variable to default position.
 - b) MANUAL mode selection supersedes this function.

- 7) When in AUTO mode configure the block such that:
 - a) PID controller will output a control signal based on selected input process variable.
 - b) Control variable will be limited to the range 0 percent to 100 percent.
- 8) When in MANUAL mode, configure the block such that a manually selected reference output will be transferred to the control variable.
- 9) Provide bumpless transfer when switching from AUTO to MANUAL mode and from MANUAL to AUTO mode.
- p. Compliance Block:
 - 1) This block is used to monitor a process variable input and compare to assigned limits. If outside of the assigned limits, the block calculates how long the PV is above or below the assigned limit.
 - a) The block will be configured to calculate time outside of assigned limits for one day and one month periods.
 - b) The block will retain the daily maximum and minimum values for the process variable.
 - c) When a new day is detected all calculated day times are reset to zero and the daily min/max values are set to the current PV.
 - d) When a new month is detected all calculated month times are reset to zero.
 - 2) Logic Includes Setpoint Inputs for:
 - a) Upper and lower target levels.
 - b) Upper and lower out of compliance levels.
 - c) Upper and lower penalty levels.
 - 3) Scaling and Presets:
 - a) Compliance Test Interval Default: 5.0 seconds.
 - b) Range is equal to the range of the process variable being tested.
 - (1) If the process variable is based on an analog input signal and a signal fail is detected, the compliance block code will skip all comparisons.

C. Performance Characteristics: None.

2.02 SCADA AND ALARMING APPLICATION SOFTWARE DESIGN REQUIREMENTS

A. Physical Characteristics: None.

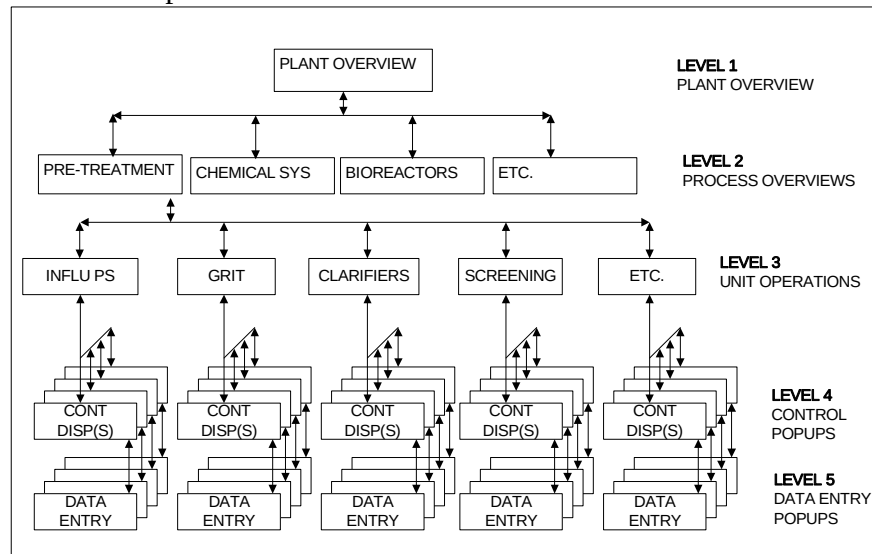
B. Functional Characteristics:

1. General:

- a. SI shall develop and submit SCADA Application software and alarming software in strict accordance with the requirements, and conforming as closely as possible with SI developed standards.
- b. The SI shall develop the SCADA design to convey accurate information to the plant operations staff so they can make informed process control decisions and provide the platform to execute the control decisions.
- c. The following outlines key objectives in designing the HMI graphics displays:
 - 1) Easily navigated menus.
 - 2) Provide no more than three mouse actions to navigate to any Control Popup.
 - 3) Maintain consistency in graphic display and controls design.
 - 4) Maintain consistent and predictable window operations.
 - 5) Provide accurate representation of the plant and its operations.
 - 6) Represent control options in an easily understood fashion.
 - 7) Develop help screens to provide additional information to help the operations staff understand the control options where complex operations are required.
 - 8) Where possible, design overview displays, similar to, the physical layout of the facility.

2. Provide operator access, with security levels as determined in the Application Software Standards, to process and alarm setpoints. General Display Organizational Philosophy: Graphic displays provide the vehicle for Operations to accomplish supervisory control over the entire treatment process. Organization of these graphics displays into a consistent homogeneous hierarchy that permits fast, easy and intuitive navigation between the displays is essential for plant operations. The SI shall use its standard graphic and library together with and the SI developed standards to generate the new displays for the SCADA.

3. Graphics:



- a. Level 1 - Main graphic plant site plan.
- b. Level 2 - Process Overviews:
 - 1) The Process Overview(s) illustrates major processes such as Pre-Treatment, Flocculation, Filtration, Chemical Systems, etc. These overview displays show the most important (essential) process data and major equipment status on a plant wide basis, but provide no equipment or system control.
 - 2) The Process Overview(s) display provide the means to page (i.e., go to) to other Process Overviews or Unit Process overviews, or in some cases directly to Control Popups.
 - 3) As a general rule, the Process Overviews show the most critical status and system data that give the operations staff a good general feel on how the plant, is currently operating. A Process Overview is going to be the opening display whenever the HMI Application is started.
- c. Level 3 - Unit Operations:
 - 1) Unit Process Overviews are full sized screens.
 - 2) The Unit Operations show primary process data on unit processes, unit operations, equipment status, or system status, etc. As a general rule no control strategies are implemented through the Unit Operations Overviews. The unit operations overview provides the means to page to Control Popups.
 - 3) The general rule is to show enough status and system data information that gives operations staff a good general feel on how the individual processes are currently operating. It also provides a launching pad to access control information associated with the individual processes.

- 4) Examples of Unit Operations are Influent Pump Stations, Flocculation/Sedimentation Basins, Filters, and Effluent Pumping. The following illustrate the level of detail on a Unit Process Overview display
- d. Level 4 - Control Pop-ups:
 - 1) Control Popups can be full screen or popup windows.
 - 2) Control Popups provide the means to monitor and provide supervisory control of specific process operations such as pump stations, specific pumps, heat exchangers, flow control, chemical systems, etc. Depending on the complexity of the specific process there may be several levels of displays. For example, some unit operations will have a special display for each phase of a startup sequence. Control of each piece of equipment on individual unit operation Control Popups is possible. The following figure illustrates a typical Control Popup.
 - a) The Level 4 display provides the capability to control specific equipment.
 - 3) Supervisory Control:
 - a) The objective of the HMI application design approach is to implement all supervisory control of the plant and it's process and control strategies from the Control Popups. The control strategies include the following functions:
 - (1) System level control, such as control loops, and sequences, etc.
 - (2) Equipment level control, such as a pump start/stop control.
 - (3) Detailed monitoring of sequence steps and general information messages for status.
 - (4) Important alarm messages.
 - (5) Paging between related displays.
 - (6) Paging between related processes.
 - 4) Pop-Up Windows:
 - a) Pop-up windows provide the capability to control systems and equipment without cluttering the overview or Control Popup. The following illustrates the configuration of a typical pop-up window.
 - b) The typical pop-up window provides the following functions:
 - (1) Status monitoring of equipment being controlled.
 - (2) OPERATING mode.
 - (3) MANUAL mode selection.
 - (4) START/STOP control in MANUAL.
 - (5) Setpoint entry.

- (6) Auto mode selection.
 - (7) Failure Reset.
 - (8) Equipment description.
 - (9) Control for displaying the equipment number.
- e. Level 5 - Data Entry and Trend Displays: Data Entry displays are designed specially for data entry purpose. Operators enter process setpoints, equipment control setpoints (such as lead-lag pump start/stop setpoints), alarm setpoints, etc.
- f. Preliminary Graphics List: The following is a preliminary list of HMI process graphics to be developed. The SI shall prepare actual graphics during Applications Software Submittals based on the Applications Software Standards. The actual final quantity of graphics will be determined as part of Submittals. The SI shall coordinate with existing package systems to develop preliminary and final process graphics.
 - 1) Plant Overview.
- g. Main Navigation Menu Bar: The Main Navigation Menu Bar is series of buttons on the bottom of each display that provides the user with the capability to go to (navigate to) any unit operation.
 - 1) The Main Navigation Menu Bar takes up graphic screen area on each full-size screen but does provide a consistent, fast way to navigate between unit operation screens.
- h. Previous and Next Display Controls:
 - 1) Previous and Next display configurations shall be provided.
 - 2) The previous control shall step the user back through the screens previously viewed in order.
 - 3) The next control will only be functional after the user has used the previous control to step back through displays. The next control will then step the user forward to the most recently viewed display.
- i. System/Control Popups: Each Unit Process Display will have touch animation that call up System/Control Popups. For example, on the Blowers overview a transparent button over a specific blower will call up the respective blower Control Popup.
- 4. Alarm Configuration on the SCADA system and within the Alarming Software:
 - a. Alarm and Events Banner: A graphical object, displaying the five most recent alarms, that can be added to a graphic display. Allows an operator to execute specific commands linked to the alarm, such as suppress or acknowledge an alarm, open up a help menu, or issue a work order to a maintenance management system.
 - b. Alarm and Event Summary: A graphical object displaying up to 2,000 alarms. Commands, similar to the Alarm and Events Banner, can be issued, plus the operator has a full suite of filtering and sorting options available.

- c. Alarm and Events Log Viewer: This graphical object allows the operator to view the history of alarms and events.
- d. Alarm Status Explorer: This graphical object allows an operator to suppress, unsuppress, disable, and enable alarms.
- e. Notification sequence from the Alarming software for the different levels of the alarms. The different levels of alarms will be developed with the Alarming Software standards.

C. Performance Characteristics: None.

2.03 PLC/SCADA I/O DATABASE

A. Physical Characteristics: None.

B. Functional Characteristics:

1. PLC/SCADA I/O Database:

- a. The SI shall provide a Database tool that has the following functions:
 - 1) Coordinate, manage and document all PLC/SCADA points.
 - 2) Access to all database points and attributes (including live data) shall accessible and maintainable thru standard query language.
 - 3) A comprehensive database listing shall be provided that contains the following as minimum:
 - a) Point Tag, English Description, Set/Reset Descriptions, Limits, Engineering Units, Wire Tag Designations to be used on Loop Diagrams and when landing I/O wires in PLC Cabinets, Alarm Priorities, Alarm Limits, Alarm Delays, Alarm Cutout Points, Hardware Addresses, Third-party I/O linkage details including protocols and addressing Packed Group Point usage and descriptions, Point Origination.

C. Performance Characteristics: None.

2.04 TOTALIZATION REQUIREMENTS

A. Physical Characteristics: None.

B. Functional Characteristics:

- 1. SI shall provide diagnostic totalization for all field assets and PLC components. This totalization may include:
 - a. All runtimes and start/stops for rotating equipment greater than 5 hp including, but not limited to pumps, conveyers, augers, fans, blowers and rakes.

- b. All successful open/closes of all motor operated valves, gates and other mission critical valves.
 - c. The runtime for each PLC component and UPS.
 - d. Accumulated analog values of power monitoring for all UPS, switchgear, and motor control centers where said devices are capable of interfacing to PLC.
 - e. Totalization code shall be resident in the PLC in which the I/O is attached.
 - f. A reset of the totalization shall only be initiated by authorized personnel.
 - g. Each totalizer I/O value shall be attributed with the Asset ID associated with the piece of equipment.
2. At a minimum, upon totalization reset, the previous total shall be recorded in the Historian.

C. Performance Characteristics: None.

PART 3 EXECUTION (NOT USED)

END OF SECTION