

SECTION 13326
SUPERVISORY CONTROL AND DATA ACQUISITION
(SCADA) PROGRAMMING

PART 1 - GENERAL

1.01. Scope of Work

- A. This Specification Section defines the requirements for SCADA system programming.
- B. The Work defined herein shall be performed by the SYSTEM SUPPLIER defined in Specification Section 13300.

1.02. Related Work

- A. Specification Section 13300. SCADA - General Requirements.
- B. Specification Section 13325: SCADA Hardware.

1.03. Submittals

- A. Provide a SCADA system software submittal including the following:
 - 1. A listing of all process graphic screens to be provided.
 - 2. A written description of how the operator will interface with the process graphic screens. Support the description with samples of the graphics or pop-up windows to be used.
 - 3. An example screen illustrating the proposed operator interface with the historical database.
 - 4. An example screen illustrating the proposed operator interface with the alarm/event database.
 - 5. An example screen illustrating the proposed trending displays.
 - 6. A list of proposed trends and associated parameters.
 - 7. Examples of proposed reports and associated parameters.

PART 2 - PRODUCTS

THIS PART NOT USED

PART 3 - EXECUTION

3.01. RTU Programming – General Monitoring

- A. Provide the following general monitoring functions for analog inputs:
 - 1. For all analog inputs (pseudo and real):
 - a. Provide out of range alarms if the input signal goes outside the instrument's range
 - b. Provide individually operator adjustable emergency high and low alarms when the value goes outside the allowable process range.
 - c. Provide individually operator adjustable high and low alarms when the value goes outside the normal process operating range.
 - d. Provide a dead-band on all alarm settings.
 - e. Issue Return-to Normal alarms whenever the signal returns to within limits.
 - 2. For all flow related analog inputs:
 - a. Monitor for and record minimum and maximum daily 5-minute average values. Record the date and time of occurrence for each.
 - b. Accumulate a running daily total flow. At midnight, transfer the total to yesterday's total and restart from zero.
 - c. Calculate a running daily average flow. At midnight, transfer the value to yesterday's average and restart the averaging.
 - 3. For all level and pressure related analog inputs:
 - a. Monitor for and record minimum and maximum daily values. Record the date and time of occurrence for each.
- B. Provide the following general monitoring functions for discrete inputs:
 - 1. For all discrete inputs:
 - a. Indicate but do not alarm when a discrete signal changes, as expected, as a result of a control command.
 - b. Alarm whenever an un-commanded change of state occurs

- c. For all local control switch position feedback discrete inputs, issue an advisory alarm to the operator whenever a position change is detected
 - d. Exclude from any control strategy any equipment whose local switch position precludes control. If an operator attempts to control the device through the system, issue a message indicating that the control cannot be accomplished together with the reason.
- 2. For all motorized equipment:
 - a. Accumulate equipment run times based on the running status feedback discrete input.
 - b. Reset the run time value to zero only on operator command via the HMI.
- 3. For all device failure discrete inputs:
 - a. Issue an alarm when the input indicates a device fault
 - b. Set a software fault for the controlled device that can only be reset by operator action after the fail signal has been removed.

3.02. RTU Programming – General Control

- A. General Requirements applicable to the control strategies are:
 - 1. All software fault conditions that are set can only be cleared by operator acknowledgement.
 - 2. Wherever in the descriptions the control strategy refers to the operator, it is intended to mean via the Operator Interface Terminal (OIT) or HMI process graphics.
 - 3. All control strategies shall run within the RTU. Data manipulation (calculated analog values, elapsed time functions, event determination) shall be performed by the RTU for the associated equipment it is monitoring. Any resulting values from these manipulations shall be reported as individual registers. The intent is to avoid utilizing the OIT software for this purpose.
 - 4. The control functions described herein are not intended to be complete comprehensive programming logic descriptions. They describe only the general intended control operation required. Provide complete program logic to completely fulfill the functional requirements indicated.
 - 5. Provide all programming necessary to support the functional requirements of the operator graphic screens.

6. Provide complete debugging services to address issues identified by the OWNER or ENGINEER during and after startup until final acceptance.
- B. Common Constant Speed Motor Operator Control. For all constant speed equipment, provide an operator controllable software HAND/OFF/AUTO switch and proceed as follows:
1. While the switch is in HAND run the equipment.
 2. While the switch is in OFF, stop the equipment and prevent any start commands.
 3. While the switch is in AUTO, take start and stop signals from the appropriate automatic control strategy defined herein.
- C. Common Variable Speed Motor Operator Control. For all variable speed equipment, provide an operator controllable software HAND/OFF/AUTO switch and SPEED potentiometer and proceed as follows:
1. While the switch is in HAND run the equipment at the speed set by the potentiometer.
 2. While the switch is in OFF, stop the equipment and prevent any start commands.
 3. While the switch is in AUTO, take start, stop, and speed signals from the appropriate automatic control strategy defined herein.

3.03. RTU Automatic Controls

- A. Establish a LEAD/LAG sequence for the pumps. Automatically rotate the sequence whenever all pumping stops or every 24 hours at midnight, whichever occurs first. Allow the operator to override this and manually assign the pumps.
- B. Variable Speed Pump Control. At the Main and Hispanola Pump Stations, the pumps shall be controlled to maintain an operator adjustable wet well level. Proceed as follows:
1. Provide the following operator adjustable values:
 - a. LSH – Upper operating wet well level. Limit this value to a maximum of 3” below the Call Lead backup float switch setting.
 - b. LS – Target wet well level.
 - c. LSL – Lower operating wet well level.
 2. Call for the LEAD pump if the level reaches LSH for an operator adjustable time.

3. Use a single PID control loop to adjust the pump's speed to maintain a level of LS.
 4. Call for the LAG pump in sequence if the LEAD pump fails to start or fails while running.
 5. When the level reaches LS, freeze the PID and keep pump speed constant.
 6. If the level rises to LSH or falls to LSL, restart the PID until the level begins to fall or rise, respectively then freeze the PID once more.
 7. Call for the next pump in sequence if pump speed is at an operator adjustable maximum value and the level reaches LSH for an operator adjustable time. Temporarily suspend the PID and ramp down the speed to an operator adjustable value until both starting and running pumps' speeds are equal then resume the PID. Once the level reaches LS, freeze the PID once more.
 8. Stop the longest running pump if the level falls to LSL for an operator adjustable time and pump speed is at an operator adjustable minimum.
- C. Constant Speed Pump Control. At the Village Hall and South Treasure Drive Pump Stations shall be controlled as a standard duplex station based on operator adjustable levels. Proceed as follows:
1. Provide the following operator adjustable values:
 - a. LSHH – Call Lag Pump wet well level. Limit this value to a maximum of 3" below the Call Lead backup float switch setting.
 - b. LSH – Call Lead Pump wet well level..
 - c. LSL – Pumps Off wet well level.
 2. If the level reaches LSH for an operator adjustable time, start the LEAD pump.
 3. If the level reaches LSHH for an operator adjustable time, start the LAG pump.
 4. If the level falls to LSL for an operator adjustable time, stop all pumping.
- D. Alarm Callouts. Provide automatic cellular phone callouts for up to 12 alarms to up to 6 OWNER selected phone numbers.

3.04. Graphics

- A. Provide OIT graphics at Variable Speed pump sites that include the following:

1. Individual pump status (speed, running, stopped, fault, local and OIT H/O/A status, LEAD or LAG assignment). Provide operators the ability to change H/O/A position and LEAD/LAG assignment.
 2. Current wet well level and set points. Provide operators the ability to change wet well level set points.
 3. Current Backup status (normal, in backup) and operator controllable Backup Force and Reset pushbuttons.
 4. Calculated discharge flow.
 5. Current power status (primary or UPS).
- B. Provide OIT graphics at Constant Speed pump sites that include the following:
1. Individual pump status (running, stopped, fault, local and OIT H/O/A status, LEAD or LAG assignment). Provide operators the ability to change H/O/A position and LEAD/LAG assignment.
 2. Current wet well level and set points. Provide operators the ability to change wet well level set points.
 3. Current Backup status (normal, in backup) and operator controllable Backup Force and Reset pushbuttons.
 4. Calculated discharge flow.
 5. Current power status (primary or UPS).
- C. Replicate all OIT graphics, including operator functions, on the HMI screens

3.05. Other HMI Programming

- A. Alarm Log. Provide a log of all alarms issued by the system. The log shall include the date and time of detection. Provide the operator with the ability to sort the displayed log by any combination of the following:
1. Specific equipment.
 2. Alarm description
 3. Date and time.
- B. Event Log. Provide a log of all events issued by the system. The log shall include all alarms, operator control commands and set point changes, alarm acknowledgements and return to normal occurrences following an alarm condition. The date and time of occurrences shall be included together with, where applicable, the identity of the operator. Provide the operator with the ability to sort the displayed log by any combination of the following:
1. Operator.

2. Specific equipment.
 3. Event description.
 4. Date and time.
- C. Historical Database. Provide a historical database that includes, as a minimum, the following information:
1. For all flows:
 - a. Maximum daily value with time of occurrence.
 - b. Daily accumulated value.
 - c. Average daily value.
 - d. Monthly maximum daily value, date and time of occurrence, updated each time the previous value is exceeded.
 - e. Monthly average updated daily.
 2. For all pressures:
 - a. Maximum and minimum daily values with time of occurrences.
 - b. Monthly maximum and minimum daily value, date and time of occurrence, updated each time the previous value is replaced.
 3. For all analysis parameters:
 - a. Maximum and minimum daily values with time of occurrences.
 - b. Average daily value.
 - c. Monthly maximum and minimum daily value, date and time of occurrence, updated each time the previous value is replaced.
- D. Trends. Provide up to four, six-parameter trends as selected by OWNER.
- E. Reports. Provide the following reports:
1. Monthly Operations Report updated daily after midnight.
 2. Monthly Maintenance Report containing accumulated pump run times for all equipment and date and time of last reset. Update this report daily after midnight.
 3. Up to three additional reports as selected by OWNER.

3.06. Programming Acceptance

- A. Regardless of any submittal approvals, final acceptance of the system programming will occur during the final Demonstration Test.
- B. The ENGINEER/OWNER reserves the right to require minor changes in the graphics and programming during the test.

3.07. Training

- A. The cost of training programs to be conducted with OWNER's personnel shall be included in the Contract price.
- B. All training schedules shall be coordinated with, and at the convenience of the OWNER. Shift training may be required to correspond to the OWNER's working schedule.
- C. Provide a minimum of one day training for the OWNER's personnel in the use of the HMI graphics.

3.08. Testing

- A. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and, upon the system producing the correct result (effect), the specific test requirements will have been satisfied.
- B. All tests shall be conducted in accordance with, and documented on, prior approved procedures, forms, and checklists. Each specific test to be performed shall be described and a space provided after it for signoff by the appropriate party after its satisfactory completion. Copies of these signoff test procedures, forms, and checklists will constitute the required test documentation.
- C. Provide all special testing materials and equipment.
- D. The SYSTEM SUPPLIER shall coordinate all of their testing with the CONTRACTOR, the ENGINEER, all affected suppliers, and the OWNER.
- E. The ENGINEER reserves the right to test or retest any and all specified functions whether or not explicitly stated in the approved test procedures. The ENGINEER's decision shall be final regarding the acceptability and completeness of all testing.
- F. Prior to Substantial Completion, the SYSTEM SUPPLIER shall demonstrate the fully operating system. This test will be witnessed by the OWNER and/or the ENGINEER.
- G. The responsible test witness may require modification of the operator graphics displays, etc. during this test before it is considered successful.

END OF SECTION