SECTION 17330A

CONTROL STRATEGIES

CONTROL STRATEGY 0.1

TITLE: System Configuration

A.   General: This strategy describes the configuration of the Programmable Logic Controller (PLC) and associated operator interface (HMI) at the existing SCADA system.

B.   Programmable Logic Controller: The Instrumentation and Control (I&C) subcontractor shall provide a new PLC for control and monitoring of the Sodium Hypochlorite System (PLC-FP42) and for monitoring of the 4W water strainer system.   The I&C subcontractor shall also modify the existing PLC in Digester Control Building No. 2 (PLC-FP38) for control and monitoring of the new Sludge Withdrawal Pump.
1.   PLC-FP42 (New, at the Sodium Hypochlorite System): Control and monitoring of the Sodium Hypochlorite Feed System. The PLC panel shall be provided with switches and indicating lights for local monitoring and controls of process variables associated with the hypochlorite feed system. The plant's existing Modbus Plus communication network shall be extended to the new PLC for communications to the SCADA system. Existing signals for plant Effluent flow shall be wired to this PLC for flow pacing of the new hypochlorite pumps.
2.   PLC-FP38 (Existing, at Old Heater Building): This PLC shall be modified for control and monitoring of the new Digester No. 3 Sludge Withdrawal Pump and for monitoring of level of new temperature and level instruments.

C.   Field instruments and devices are connected as PLC Inputs. While some signals are not processed by the PLC for control, they shall be programmed for monitoring at the HMI.

D.   Operator Interface: The HMI at the plant SCADA system shall be modified for the addition of screens to monitor and control the hypochlorite system and the new sludge withdrawal pump as described in these Control Strategies. The HMI shall also include, but not be limited to, the functions as listed below.   Coordinate with the Owner for requirements for new process screens, alarm annunciation and display, trends and reports. Print outs of new HMI screens shall be submitted to the District Project Manager for review.
1.   Indication of equipment status and total running hours.
2.   Indication and logging of alarms.
3.   Indication and totalization of flows.
4.   Indication of process variables such as level and flows.
5.   Adjustment of control settings such as time delay and levels setpoints.
6.   Display of alarms.
7.   Display of real time and historical trends for flows, tank level and turbidity.
8.   Control of equipment in "Hand" mode at the HMI.

E.   Alarms: The existing alarm notification system shall be modified to include new alarm signals as required by the owner. The existing alarm notification software is Wonderware SCADAlarm.

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CONTROL STRATEGY 0.2

TITLE: General Equipment Interface

AREA: All

RELATED CONTROL STRATEGIES: All

A.   General: This strategy describes typical interface logic of the PLC with final control elements such as pumps and other equipment. This applies to all control strategies in this section of the Specifications. The HMI as referenced in these control strategies are those in the SCADA system.

B.   Description: The PLC shall monitor or determine the equipment's related inputs/outputs as follows:

1.   Monitor whether equipment is in "Ready" mode before initiating or queuing equipment for control.

2.   If equipment is ready, the PLC shall activate a normally open discrete output "DO" to start the equipment.

3.   The PLC shall interrogate the circuit and monitor the input "RUN" discrete input.

4.   If the "RUN" input is not activated within an adjustable time period of $t = 0 - 10$ seconds, the PLC shall annunciate an equipment "Fail" condition on the operator interface panel.

5.   The PLC shall also annunciate an equipment "Fail" on the operator interface panel if a separate discrete input signal is detected.

6.   The "RUN" signal shall activate on elapsed time register in the operator interface to monitor the total run time of equipment.

C.   Equipment Alternation: For two or more pieces of equipment of the same function, the PLC shall alternate their operation in one of the following manners. The selection shall be made manually from the HMI.

1.   Manual: The "lead" piece of equipment is assigned and will continue to run unless it fails or process conditions require the "standby" equipment to run. In the next cycle of operation, the same equipment continues the same assignment unless manually reassigned.

2.   Automatic (Run Time): The equipment alternates from "lead" or "standby" based on manually set run time. When the actual run time exceeds the set point, the PLC places the current "lead" time last in the sequence and starts the next "Ready" equipment in the sequence.

D.   Lead-Lag (Standby) Operation (typical for tandem pump arrangements):
1.   The Lag or Standby pump starts if a lead pump fails.

2. A pump failure shall occur if a pump fails to run after a call to run following a 0-60 second delay,

   <u>or</u>   while called-to-run but fails to continue running,

   <u>or</u>   the Lag or Standby pump has been selected but the Lead pump is OFF.

3. A failed pump shall be locked OFF and prevented to restart until <u>reset</u> by the operator. A pump is reset from failed condition when both HOA selectors are placed in OFF.

E. Runtime:
   1. Log the runtime of all pumps.
   2. To determine Runtime, the PLC monitors a start or run contact such as from a MCC motor starter.
   3. Monitor for and determine Runtimes even if the "Ready" signal is not activated.

F. Loss of Normal Power:

   1. The PLC cabinet shall be provided with a relay and contact to indicate loss of "normal" power (120V) to the PLC. This shall be monitored upstream of the UPS.
   2. After loss of normal power, the PLC shall restart PLC controlled loads in steps. Stagger start loads in 5 second increments.

CONTROL STRATEGY 0.3

TITLE: Alarm System

RELATED EQUIPMENT AND CONTROL STRATEGIES: All

A.   General: This strategy describes the monitoring and display of alarm conditions. The alarm conditions can be 1) Discrete input and 2) Derived.

B.   Description:

1.   Discrete Input: Whenever a discrete input alarm is detected, the PLC shall annunciate an alarm after an adjustable delay of 0 - 5 seconds.

2.   Derived Alarms: A derived alarm consists of monitoring of analog inputs and/or logic derivation within control strategies. The PLC monitors these events and produce alarms after an adjustable delay of 0 - 5 seconds.

3.   Setting of alarm setpoint shall be available on the operator interface.

C.   Alarm Sequence: The PLC programs shall execute alarms as follows, unless otherwise required by the Owner to match the existing operation:

1.   Upon the activation of an alarm, a flashing indication and alarm text message shall be displayed on the operator interface.

2.   An "Alarm Acknowledge" button at the operator interface shall acknowledge the alarm and the alarm message shall stay steady,

3.   An "Alarm Reset" button shall remove the alarm message.

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CONTROL STRATEGY 1

TITLE: Sodium Hypochlorite Feed Control

AREA: Sodium Hypochlorite Feed System   SHEET: I3.1

PLC: PLC-FP42

RELATED EQUIPMENT: Sodium Hypochlorite Metering Pumps

A.   General: Sodium Hypochlorite is used for disinfection chlorination and for RAS chlorination.
     Three new hypochlorite pumps shall replace four existing pumps. Each pump shall be
     provided with a new variable frequency drive (VFD). A new PLC shall be provided for
     automatic pump controls. Under normal conditions, Pump No. 1 and No. 2 operate in
     lead/lag operation in Disinfection Chlorination Mode. Pump No. 3 operates in RAS
     Chlorination Mode, but also acts as a standby pump to be used for disinfection if Pump No.
     1 or No. 2 fails. Pump Nos. 1 and 2 can also serve as a back-up for RAS chlorination if
     Pump No. 3 fails.

B.   Monitoring and Alarms
     1. Monitoring:
         Metering Pumps: Ready, Run
         Plant Effluent: Flow (used for flow pacing in Disinfection Mode)
         Effluent Hypo: Flow (monitoring only)
         RAS Hypo: Flow (monitoring only)
         Effluent Chlorine Residual (used for flow pacing in Disinfection Mode)

     2. Alarms:
         Pump Fail (Derived)

C.   Feed Control:
     1. Hand (Local at the pump control panel): Hand-Off-Auto (HOA) Selector Switch at the
         pump control panel is in HAND.
         a.   Feed rate is controlled manually via a speed controller at the pump VFD.
     2. Hand (Remote at the SCADA HMI): HOA switch at the pump control panel is in AUTO.
         a.   Pump starts when the pump HOA switch on the HMI display is placed in the
                HAND position and the pump is not failed.
         b.   Feed rate is manually entered at the HMI to adjust pump speed.
     3. Automatic: HOA switch at the pump control panel is in AUTO.
         a.   Pump starts when the pump HOA switch on the HMI display is placed in the
                AUTO position and the pump is not failed.
         b.   Feed rate is controlled automatically via a speed controller and paced according
                to the chlorination mode selected. At the pump control panel, selector switches
                are provided for each pump to assign a chlorination mode for each pump.
                i. Disinfection Chlorination Mode: (Pump No. 1 and No. 2 Lead/Lag, Pump
                    No. 3 Standby). The PLC shall use a compound loop consisting of PID
                    loop control to compare an operator input setpoint (entered at the HMI or
                    at the pump control panel) to actual Cl_2 residual. The output of the loop
                    controller shall be multiplied by the plant effluent flow signal to determine
                    the required chemical volume. The output signal is proportional to the
                    speed of the pump. Flow and residual are measured by existing

instruments. Effluent flow is measured by an ultrasonic level transmitter at effluent weir that is monitored by the PLC (signals shall be rewired to the new PLC). The chlorine residual is monitored by a existing analyzers (signals shall be rewired to the new PLC).

    ii. RAS Chlorination Mode: (Pump No. 3 Lead, Pump No. 1 and No. 2 Standby). The PLC shall use a ratio control to send an output signal to the pump that is proportional to the RAS flow. The Operator shall enter the flow setpoints (at the HMI or at the pump control panel) to adjust the speed of the pumps. The output signal is proportional to the speed of the pump. RAS flow is measured by an existing instrument and monitored by a separate PLC. The signal shall be communicated to the new PLC through the Modbus network.

c. Chlorination mode selection: Chlorination mode for each pump shall be manually set using selector switches at the pump control panel. The Operators shall manually adjust valves for proper feed assignments.

d. Pump alternation: Lead/lag assignments of the pumps shall be set at the HMI.

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CONTROL STRATEGY 2

TITLE: Sludge Withdrawal Pump Control

AREA: Digester No. 3

PLC: PLC-FP38

RELATED EQUIPMENT: Sludge Withdrawal Pump
Digester No 3 Pressure Transmitter (Digester Level Measurement)
Digester No 3 Sludge Withdrawal Flow Meter

A.   General: A new withdrawal pump shall be installed at Digester No. 3 for sludge removal.

B.   Monitoring and Alarms
1.   Monitoring:
Pumps: Ready, Run Fail
Digester No. 3 Sludge Level
Digester No. 3 Sludge Withdrawal Flow

2.   Alarms:
Digester Low Level (Derived)
Digester High Level (Derived)
Sludge Withdrawal Pump Fail (Derived)

C.   Pump Control:
1.   Hand (Local at the pump control panel): Hand-Off-Auto (HOA) Selector Switch at the pump control panel is in HAND. Speed is controlled manually via a speed controller at the pump VFD.
2.   Hand (Remote at the SCADA HMI): HOA switch at the pump control panel is in AUTO. Pump starts when the pump HOA switch on the HMI display is placed in the HAND position and the pump is not failed. Speed is manually entered at the HMI to adjust pump speed.
3.   Automatic: HOA switch at the pump control panel is in AUTO.
a. Pump starts when the pump HOA switch on the HMI display is placed in the AUTO position and the pump is not failed.
b. Pump is cycled on and off, and the speed is varied as needed, to pump the target volume of sludge fed to the digester per day. The target volume is an automatic calculation by SCADA to match the daily totalized volume of sludge fed to Digester No. 3. A new magnetic flowmeter shall be installed to monitor sludge withdrawal flow. Once the daily target volume is pumped, the pump shall not operate until the next 24 hour monitoring period starts. If the pump is unable to pump the daily target volume, then the volume not pumped shall be added to the target volume for the next 24 hour period.
c. The volume of sludge pumped is determined by totalizing flow using the new sludge withdrawal flow meter.
d. The sludge withdrawal pump shall not be allowed to operate under the following conditions
a. When either of the existing elutriation pumps are operating
b. When the Digester No. 3 feed valve is open.
c. When the Digester No. 3 sludge level is below a low level setpoint.

CONTROL STRATEGY 3

TITLE: Digester Cover Level Monitoring

AREA: Digester No. 3, 4, 5

PLC: PLC-FP38

RELATED EQUIPMENT: Digester No. 3 Cover Level Transmitter
Digester No. 4 Cover Level Transmitter
Digester No. 5 Cover Level Transmitter

A.   General: New digester cover level measurement instruments will be installed on Digester Numbers 3, 4, and 5.

B.   Monitoring and Alarms
1.   Monitoring:
Digester No. 3 Cover Level
Digester No. 4 Cover Level
Digester No. 5 Cover Level

2.   Alarms:
Digester No. 3 Cover - Low Level (Derived)–
Digester No. 3 Cover - High Level (Derived)–
Digester No. 4 Cover - Low Level (Derived)–
Digester No. 4 Cover - High Level (Derived)–
Digester No. 5 Cover - Low Level (Derived)–
Digester No. 5 Cover - High Level (Derived)–

C.   Control:
1.   None

TITLE: Digester #3 Cover Tilt Monitoring

AREA: Digester No. 3

PLC: PLC-FP38

RELATED EQUIPMENT: Digester No. 3 Cover Tilt Transmitter (Tilt Measurement)

A.   General: A new digester cover instrument will be installed on Digester Number 3 to measure the tilt of the cover.

B.   Monitoring and Alarms
   1.   Monitoring:
       Digester No. 3 Tilt

   2.   Alarms:
       Digester No. 3 Cover – High Tilt (Derived)

C.   Control:
   1.   None

CONTROL STRATEGY 5

TITLE: 4W Strainer Monitoring

AREA: 4W Strainer (Gallery B)

PLC: PLC-FP42

RELATED EQUIPMENT: 4W Strainer No. 1
                                          4W Strainer No. 2

A.   General: New 4W strainers will be installed to remove particulate matter from the 4W water supply.

B.   Monitoring and Alarms
    1.   Monitoring:
        4W Strainer No. 1-Fault
        4W Strainer No. 1-Flush in Progress
        4W Strainer No. 2-Fault
        4W Strainer No. 2-Flush in Progress

    2.   Alarms:
        4W Strainer No. 1-Fault
        4W Strainer No. 2-Fault

C.   Control:
    1.   None

TITLE: Digester 4 and 5 Temperature Monitoring

AREA: Digester 4 and 5

PLC: PLC-FP38

RELATED EQUIPMENT: Digester #4 Temperature Transmitters (sludge to and from Digester)
Digester #5 Temperature Transmitters (sludge to and from Digester)

A.   General: New temperature indicator transmitters will be installed in the recirculation sludge piping for Digester Numbers 4 and 5 to monitor digester temperature.

B.   Monitoring and Alarms
1.   Monitoring:
Sludge Temperature to Digester #4
Sludge Temperature to Digester #5
Sludge Temperature from Digester #4
Sludge Temperature from Digester #5

2.   Alarms:
Digester #4 Temperature-Low (Derived) (sludge to and from Digester)
Digester #5 Temperature-High (Derived) (sludge to and from Digester)
Digester #4 Temperature-Low (Derived) (sludge to and from Digester)
Digester #5 Temperature-High (Derived) (sludge to and from Digester)

C.   Control:
1.   None

END OF CONTROL STRATEGIES