CONTROL NARRATIVE

PRO Series Premium RO

NPI

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1 RO System Overview

This GE water purification system produces reverse osmosis water.

The following unit processes may be included in this design:

- Feed Pump
- Pre-Treatment Filter
- Acid/Caustic Injection
- Antiscalant Injection
- Bisulfite Injection
- Reverse Osmosis Machine
- Clean-In-Place (CIP) System
- Permeate Storage Tank with Transfer Pump

2 General Information

The reader should refer to the Piping and Instrumentation Diagrams (P&ID's), Operations Sequence Chart (OSC) and the Control Logic Chart (CLC) for a complete understanding of the control scheme as described below.

The PLC follows specific steps to automatically control valves, pumps, etc., during the operating states for the system. These steps are listed and described in the OSC.

Details of the control logic, setpoints, etc., that are required to operate the RO system are given in the CLC.

States are a series of steps a unit or process area follows to perform various operations, such as RUNNING. A specific state discussed in this document is shown in full capital letters, and a specific step is shown with the first letter capitalized. For example, Production is a step that occurs in the RUNNING state. Equipment modes, such as AUTO and OFF, are also shown in full capital letters.

2.1 PLC Platform

In the documentation the Programmable Logic Controller is referred to as the PLC. The PLC provides automated control of the RO equipment. All the programming for the control of the system is stored in the PLC.

Automatic control functions associated with equipment operation are achieved with a GE Fanuc Versamax PLC or an Allen-Bradley CompactLogix PLC.

Development softwares for PLC ladder logic:

Description	Manufacturer	Version
Proficy Machine Edition	GE Fanuc	5.9
RSLogix 5000	Rockwell/Allen-Bradley	16.00.00

PLC hardware for GE Fanuc Versamax PLC option:

Rack Location	Description	Manufacturer	Model Number
Slot 0:	PLC, Processor, Versamax	GE Fanuc	IC200CPUE05
Slot 1:	Discrete Input Module	GE Fanuc	IC200MDL640
Slot 2:	Discrete Input Module	GE Fanuc	IC200MDL640
Slot 3:	Discrete Output Module	GE Fanuc	IC200MDL940
Slot 4:	Discrete Output Module	GE Fanuc	IC200MDL940
Slot 5:	Analog Input Module	GE Fanuc	IC200ALG262
Slot 6:	Analog Input Module	GE Fanuc	IC200ALG264
Slot 7:	Analog Output Module	GE Fanuc	IC200ALG320

PLC hardware for Allen-Bradley CompactLogix PLC option:

Rack Location	Description	Manufacturer	Model Number
Slot 0:	PLC, Processor, CompactLogix	Allen Bradley	1769-L32E
Slot 1:	Discrete Input Module	Allen Bradley	1769-IQ16
Slot 2:	Discrete Input Module	Allen Bradley	1769-IQ16
Slot 3:	Discrete Output Module	Allen Bradley	1769-OW16
Slot 4:	Discrete Output Module	Allen Bradley	1769-OW16
Slot 5:	Analog Input Module	Allen Bradley	1769-IF8
Slot 6:	Analog Input Module	Allen Bradley	1769-IF8
Slot 7:	Analog Output Module	Allen Bradley	1769-OF8C

Discrete input listing:

Description	Type	GE Address	A-B Address
RO Low Inlet Pressure Switch	DI	%I00001	I:1/0
RO High Concentrate Pressure Switch	DI	%I00002	I:1/1
RO High Permeate Pressure Switch	DI	%I00003	I:1/2
Panel Control Power	DI	%I00004	I:1/3
RO High Pressure Pump #1 Aux Ct/Drive Run Ct	DI	%I00005	I:1/4
RO High Pressure Pump #2 Aux Ct (With Pro-450)	DI	%I00006	I:1/5
CIP Pump Aux Ct	DI	%I00007	I:1/6
Permeate Transfer Pump Aux Ct	DI	%I00008	I:1/7
Feed Pump Aux Ct	DI	%I00009	I:1/8
Sulfite Pump Fault Relay Ct	DI	%I00010	I:1/9
Acid/Caustic Pump Fault Relay Ct	DI	%I00011	I:1/10
Antiscalant Pump Fault Relay Ct	DI	%I00012	I:1/11
Spare Chemical Pump Fault Relay Ct	DI	%I00013	I:1/12
Spare	DI	%I00014	I:1/13
Spare	DI	%I00015	I:1/14
Discrete Start/Stop Signal Dry Contact (By Customer)	DI	%I00016	I:1/15
Pretreatment Filter #1 Backwash Relay Ct	DI	%I00017	I:2/0
Pretreatment Filter #2 Backwash Relay Ct	DI	%I00018	I:2/1
CIP Heater Aux Ct	DI	%I00019	I:2/2
CIP Heater High Temperature Ct	DI	%I00020	I:2/3
Spare	DI	%I00021	I:2/4
Spare	DI	%I00022	I:2/5
Spare	DI	%I00023	I:2/6
Spare	DI	%I00024	I:2/7
Spare	DI	%I00025	I:2/8
Spare	DI	%I00026	I:2/9
Spare	DI	%I00027	I:2/10
Spare	DI	%I00028	I:2/11
Spare	DI	%I00029	I:2/12
Spare	DI	%I00030	I:2/13
Spare	DI	%I00031	I:2/14
Spare	DI	%I00032	I:2/15

Discrete output listing:

Description	Type	GE Address	A-B Address
RO High Pressure Pump #1 Run Control Relay	DO	%Q00001	O:3/0
RO High Pressure Pump #2 Run Control Relay	DO	%Q00002	O:3/1
CIP Pump Run Control Relay	DO	%Q00003	O:3/2
Permeate Transfer Pump Run Control Relay	DO	%Q00004	O:3/3
Feed Pump Run Control Relay	DO	%Q00005	O:3/4
Sulfite Pump Run Control Relay	DO	%Q00006	O:3/5
Acid/Caustic Pump Run Control Relay	DO	%Q00007	O:3/6
Antiscalant Pump Run Control Relay	DO	%Q00008	O:3/7
Spare Chemical Pump Run Control Relay	DO	%Q00009	O:3/8
CIP Heater Run Control Relay	DO	%Q00010	O:3/9
Spare	DO	%Q00011	O:3/10
Spare	DO	%Q00012	O:3/11
Spare	DO	%Q00013	O:3/12
Spare	DO	%Q00014	O:3/13
Spare	DO	%Q00015	O:3/14
Spare	DO	%Q00016	O:3/15
RO Service Inlet Solenoid Valve	DO	%Q00017	O:4/0
RO Permeate Outlet Solenoid Valve	DO	%Q00018	O:4/1
RO Permeate Recycle to Feed Solenoid Valve	DO	%Q00019	O:4/2
Spare	DO	%Q00020	O:4/3
Spare	DO	%Q00021	O:4/4
Spare	DO	%Q00022	O:4/5
Spare	DO	%Q00023	O:4/6
Spare	DO	%Q00024	O:4/7
Alarm Horn	DO	%Q00025	O:4/8
Alarm Strobe Light	DO	%Q00026	O:4/9
Spare	DO	%Q00027	O:4/10
Spare	DO	%Q00028	O:4/11
Spare	DO	%Q00029	O:4/12
Spare	DO	%Q00030	O:4/13
Spare	DO	%Q00031	O:4/14
Spare	DO	%Q00032	O:4/15

Analog input listing:

Description	Type	GE Address	A-B Address	Range
Permeate Flow Transmitter	AI	%AI0009	I:5.0	Dependent on size
Concentrate Flow Transmitter	AI	%AI0010	I:5.1	Dependent on size
Inlet Conductivity Transmitter	AI	%AI0011	I:5.2	(0-2000 uS)
Permeate Conductivity Transmitter	AI	%AI0012	I:5.3	(0-200 uS)
Inlet pH Transmitter	AI	%AI0013	I:5.4	(0-14 pH)
Inlet ORP Transmitter	AI	%AI0014	I:5.5	(-1000 – 2000 mV)
Permeate Temperature Transmitter	AI	%AI0015	I:5.6	(32 – 212 F)
Spare	AI	%AI0016	I:5.7	
Primary Pressure Transmitter	AI	%AI0017	I:6.0	(0-500 psi)
Final Pressure Transmitter	AI	%AI0018	I:6.1	(0-500 psi)
Permeate Tank Level Transmitter	AI	%AI0019	I:6.2	(0-100 %)
Spare	AI	%AI0020	I:6.3	
Spare	AI	%AI0021	I:6.4	
Spare	AI	%AI0022	I:6.5	
Spare	AI	%AI0023	I:6.6	
Spare	AI	N/A	I:6.7	

Analog output listing:

Description	Type	GE Address	A-B Address	Range
Acid/Caustic Pump Analog Run Output	AO	%AQ0001	I:7.0	(0-100 %)
RO High Pressure Pump VFD Analog Run Output	AO	%AQ0002	I:7.1	(0-100 %)
Spare	AO	%AQ0003	I:7.2	
Spare	AO	%AQ0004	I:7.3	

2.2 Operator Interface Platform

To accommodate equipment operation and all other control, display, and monitoring requirements, this system employs a Human Machine Interface (HMI) for access to system controls. The HMI communicates with the PLC, which in turn controls the system.

These requirements are achieved with a GE Fanuc QuickPanel HMI, or an Allen-Bradley PanelView+ HMI.

Development softwares for HMI graphics:

Description	Manufacturer	Version
Proficy Machine Edition	GE Fanuc	5.90
Factory Talk View Studio ME	Rockwell/Allen-Bradley	5.00.00 (CPR 9)

HMI hardware for GE Fanuc QuickPanel HMI option:

Description	Manufacturer	Model Number
QuickPanel	GE Fanuc	IC754VBF12CTD

HMI hardware for Allen-Bradley PanelView+ option:

Description	Manufacturer	Model Number
PanelView+ 700	Allen Bradley	2711-B7C4D1

3 PRO Model Selection

The PRO Series RO Equipment is available in various models for different flow requirements. The applicable model must be selected from list of options at the HMI.

Available options: PRO-50, PRO-100, PRO-150, PRO-200, PRO-300, PRO-450.

Instrument ranges for flow measurements are automatically applied in the PLC, based on the selected model. Process setpoints for flow alarms and flow control loops must be entered at the HMI for the selected model.

The PRO-450 model is equipped with two RO Pumps. Other models are equipped with a single RO Pump. If the PRO-450 model is not selected, PLC and HMI elements associated with the second RO Pump are inhibited.

4 RO Machine Modes & States of Operation

The RO Machine is equipped with mode selections for control. This machine does not require state selections for control. Mode buttons for a unit define how the transitions occur from one operating state to another. States normally include a sequence of steps where devices such as pumps and valves are aligned to complete a particular function. This machine does not require state buttons for an operator to manually initiate a particular state.

4.1 Modes of Operation

The RO Machine is equipped with mode selections. Selectable modes are: AUTO, OFF, HAND, FILL, CIP, and CIP FLUSH. Using the mode buttons on the HMI, the operator can place the RO Machine to the desired mode. The unit is in only one mode at a time and, normally, it is in AUTO mode.

In AUTO mode, the unit changes from one state to another as required by various control functions, such as high level in the Permeate Storage Tank. If there is a demand for the unit to run, the unit proceeds to the RUNNING state. The unit continues in RUNNING, until the demand for product water decreases placing the unit to STANDBY.

In OFF mode, the unit proceeds to the STOP state, where the devices dedicated to the unit are closed or stopped in a controlled manner. The operator may turn a unit OFF at any time.

In HAND mode, the unit proceeds to the RUNNING state. The unit continues in RUNNING, without regard for downstream demand and without regard for a backwash status.

In FILL mode, the unit proceeds to the FILL state. Valves are opened to flood the machine with feed water.

In CIP mode, the unit proceeds to the CIP state. The CIP mode is selected to drive a cleaning solution through the RO membranes.

In CIP FLUSH mode, the unit proceeds to the CIP FLUSH state. The CIP FLUSH mode is selected to rinse the RO membranes after a cleaning procedure.

4.2 States of Operation

The RO Machine is not equipped with state selections. States are derived in the PLC from the selected mode for the machine. Possible states are: RUNNING, STOP, STANDBY, FAULT, FILL, CIP, CIP FLUSH, and PERM FLUSH

The RUNNING state is the normal operating state for a RO Machine. The final step of the RUNNING state is the Production step, where product water is directed downstream.

The RUNNING steps are summarized as follows:

1) Open the inlet and permeate valves and start the Feed Pump;

2) Start the RO Pump.

The STOP state is selected when a RO Machine is not available for normal operation. Pumps are stopped, the RO inlet and RO permeate recycle valves are closed, the RO permeate valve is open when transitioning from either FILL, MANUAL, or AUTO mode to an OFF mode. If transitioning from CIP mode or CIP FLUSH mode to an OFF mode then the RO permeate valve is closed.

The STANDBY state is selected when a RO Machine is available for normal operation, but not required for Production.

The STANDBY steps are summarized as follows:

1) Open the permeate recycle valve, close the permeate valve, and recirculate permeate water to the RO Pump inlet for a set duration, typically 5 minutes;

2) Stop the pumps and close the valves.

Requirement for a Permeate Flush operation on transition to STANDBY is a selectable option at the HMI. If the option is declined, the first step of a transition to STANDBY is skipped.

The FAULT state is selected when a RO Machine has been unexpectedly removed from normal operation by a critical alarm condition. Pumps are stopped and valves are closed, without a sequence of steps.

The FILL state is selected to flood the RO Machine with feed water. The Feed Pump is started and the inlet and permeate valves are opened, without a sequence of steps. After a set duration, typically 10 minutes, the FILL sequence is complete and the machine proceeds to FAULT.

The CIP state provides an opportunity for the application of a cleaning solution.

The CIP steps are summarized as follows:

1) Open the inlet valve and start the CIP Pump;

2) Start the RO Pump.

3) Start the optional CIP Heater.

The CIP FLUSH state provides an opportunity to rinse the RO membranes after a cleaning procedure.

The CIP FLUSH steps are summarized as follows:

1) Open the inlet valve and start the Feed Pump;

2) Start the RO Pump.

5 Feed Pump

The Feed Pump boosts the feed pressure to the RO Machine.

Controls for the Feed Pump are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the Feed Pump are inhibited.

The pump is called to run when the RO Machine is in a RUNNING, FILL, or CIP FLUSH state. The pump is also called to run when the RO Machine is in the Permeate Flush step of a STANDBY state.

Critical alarm conditions will stop the RO Machine, and stop the pump in response to the loss of demand.

6 Pre-Treatment Filter

The Pre-Treatment Filter (or Filters) remove particulate matter from the feed water.

A local controller manages the requirements for filter operation. The PLC does not directly control the operation of the Pre-Treatment Filter.

The PLC monitors a backwash status from a Pre-Treatment Filter through a hardwired discrete input that is energized by the local controller during backwash. A backwash signal will temporarily interrupt the normal automatic operation of the RO Machine.

The supply of a Pre-Treatment Filter is optional, based on feed water quality and product water requirements. If the Pre-Treatment Filter option is not included in the mechanical scope of supply, the hardwired discrete input channel for backwash status is not wired. Programming for a response to a backwash status remains in the PLC, but the programming will never see a change in the input channel to initiate that response. The option for Pre-Treatment Filter controls does not require a selection at the HMI.

7 Acid/Caustic Injection

Acid or caustic are used to correct the pH of the feed water.

Controls for the Acid/Caustic Pump are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the Acid/Caustic Pump are inhibited.

Once selected, the desired chemical is a selectable option. The Acid/Caustic Pump may be selected for Acid or Caustic.

The pump is called to run when the RO Machine is in a RUNNING, FILL, or CIP FLUSH state. The pump is also called to run when the RO Machine is in the Permeate Flush step of a STANDBY state.

Critical alarm conditions will stop the RO Machine, and stop the pump in response to the loss of demand.

7.1 Acid/Caustic Chemical Dosing Control

If the Acid/Caustic Pump is selected to Acid, an increase in pump output will decrease the pH of the feed water. As the pH increases, the pump speed begins to rise and the pH is reduced.

If the Acid/Caustic Pump is selected to Caustic, an increase in pump output will increase the pH of the feed water. As the pH increases, the pump speed begins to drop and the pH is reduced.

8 Antiscalant Injection

Antiscalant is used to increase the solubility of ions in the feed water. This increase in solubility helps to prevent scaling of the RO membranes.

Controls for the Antiscalant Pump are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the Antiscalant Pump are inhibited.

The pump is called to run when the RO Machine is in a RUNNING, FILL, or CIP FLUSH state. The Antiscalant Pump is not called to run when the RO Machine is in the Permeate Flush step of a STANDBY state.

Critical alarm conditions will stop the RO Machine, and stop the pump in response to the loss of demand.

9 Bisulfite Injection

Sodium metabisulfite (bisulfite) is used to convert free chlorine in the feed water to chloride. Free chlorine would otherwise damage the RO membranes.

Controls for the Bisulfite Pump are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the Bisulfite Pump are inhibited.

The pump is called to run when the RO Machine is in a RUNNING, FILL, or CIP FLUSH state. The pump is also called to run when the RO Machine is in the Permeate Flush step of a STANDBY state.

Critical alarm conditions will stop the RO Machine, and stop the pump in response to the loss of demand.

10 RO Machine Controls

The RO membranes remove dissolved solids and ions from the feed water.

Control for the RO Machine is a selectable option at the HMI. If the option is selected for analog control, start and stop triggers are derived from the level in the Permeate Storage Tank to determine when the machine is to be placed into the RUNNING state and when the machine is to be placed into the STANDBY state. If the option is selected for discrete control, start and stop triggers are derived from a discrete demand input that is monitored by the PLC.

If the PLC receives a backwash status from a Pre-Treatment Filter, the RO machine is removed from RUNNING and placed into STANDBY. Any start trigger is disabled until the backwash is complete.

Mode selections other than AUTO will inhibit automatic triggers for normal operation of the machine.

The machine is removed from RUNNING and placed into FAULT by critical alarm conditions. These alarm conditions are: RO Enclosure Emergency Stop Activated, Feed Pump Failure, Acid/Caustic Pump Fault, Antiscalant Pump Fault, Bisulfite Pump Fault, High Inlet pH, Low Inlet pH, Inlet pH Sensor Fault, High Inlet ORP, Inlet ORP Sensor Fault, Low RO Pump Suction Pressure, RO Pump Failure, Low Concentrate Flow, Concentrate Flow Sensor Fault, High Concentrate Pressure, Low Permeate Flow, Permeate Flow Sensor Fault, High Permeate Pressure, High Inlet Temperature, Inlet Temperature Sensor Fault, High Permeate Storage Tank Level, Permeate Storage Tank Level Sensor Fault.

Non-critical alarm conditions are: High Differential Membrane Pressure, Primary Pressure Sensor Fault, Concentrate Pressure Sensor Fault, High Permeate Conductivity, Permeate Conductivity Sensor Fault, Inlet Conductivity Sensor Fault, and Low Permeate Tank Level.

10.1 Permeate Flow Control

Controls for a RO Pump VFD are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the VFD are inhibited.

The process variable for pump speed during RUNNING or CIP FLUSH, or during the Permeate Flush step of STANDBY, is the RO Permeate Flow.

As the flow increases, the pump speed begins to drop and the flow is reduced.

The control loop is inhibited when the pump is called to run during a CIP state. The PLC applies a preset speed during CIP, without automatic adjustments for measured flow.

The preset speed is adjustable at the HMI.

10.2 Production Quality Monitoring & Control

The quality of product or permeate water from the RO Machine is monitored with a conductivity analyzer. Conductivity is monitored for alarms when a unit is in RUNNING or the Permeate Flush step of STANDBY.

High Permeate Conductivity is a critical alarm that puts the unit to FAULT.

The alarm setpoint is adjustable at the HMI.

11 CIP System

The CIP Pump directs a cleaning solution to the RO Machine.

Controls for the CIP Pump are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the CIP Pump are inhibited.

The pump is called to run when the RO Machine is in a CIP state.

Critical alarm conditions will stop the RO Machine, and stop the pump in response to the loss of demand.

The CIP System also includes a CIP Heater to heat the cleaning solution.

Controls for the CIP Heater are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the CIP Heater are inhibited.

The heater is called to run when the CIP Pump is running.

Critical alarm conditions will stop the RO Machine, and stop the heater in response to the loss of demand.

12 Permeate Storage Tank with Transfer Pump

Permeate water from the RO Machine is stored in the Permeate Storage Tank.

The Transfer Pump directs the permeate water to downstream equipment.

Controls for the Transfer Pump are a selectable option at the HMI. If the option is declined, PLC and HMI elements associated with the Transfer Pump are inhibited.

Selection of the RO Machine for analog control is a requirement for pump operation. Selection of the RO Machine for discrete control will inhibit the level signal from the Permeate Storage Tank, and prevent operation of the pump.

Start and stop triggers for pump operation are derived from level in the Permeate Storage Tank.

The pump is stopped by critical alarm conditions. These alarm conditions are: RO Enclosure Emergency Stop Activated, Transfer Pump Fault, Permeate Storage Tank Level Sensor Fault.

13 Shutdowns and Alarms

The purpose of an alarm is to communicate that an operator is expected to take action to rectify or prevent an abnormal situation.

Depending on the nature of the problem, the alarm may be a shutdown alarm or an advisory alarm.

A shutdown alarm will be generated when the PLC has determined that operation is unsafe or undesirable. Shutdown alarms are typically reset by pressing an Alarm Reset button.

If a shutdown alarm occurs on the RO Machine during the RUNNING state, the machine is removed from RUNNING and placed into FAULT. The FAULT state for a RO Machine does not require a sequence of steps. All shutdown alarms for a RO Machine are immediate shutdown alarms, and further classification of shutdown alarms is not required. On reset of all related shutdown alarms, the machine is automatically removed from FAULT and returned to the desired operation.

Advisory alarms are to notify the operator of an abnormal condition. The operator is expected to acknowledge an advisory alarm by pressing the Acknowledge All button and correct the abnormal situation. If the problem is not corrected, production quality and quantity may drop off quickly.

Activation of any alarm will energize a PLC output for an alarm horn. The operator must press the Horn Mute button to silence the horn.

Activation of any alarm will also energize a PLC output for an alarm beacon. The alarm beacon will remain lit until all alarms have been reset.

All alarms are indicated with a message on an alarm banner. All alarms and the time they occurred are recorded on an alarm summary screen.

14 Power Interruption / Power Up

When a loss of power occurs, all pumps are immediately stopped, all fail open valves are opened, and all fail closed valves are closed.

Response when power is restored is a selectable option at the HMI.

If the option is selected to reset, the mode selector for the RO Machine is automatically driven to OFF when power is restored. Mode selectors for the Feed Pump, Acid/Caustic Pump, Antiscalant Pump, Bisulfite Pump, CIP Pump, CIP Heater, and Transfer Pump, are driven to Manual-Stop. An operator must return the mode selectors to the desired position for normal operation to resume.

If the option is selected to hold, the mode selector for the RO Machine is unchanged when power is restored. Normal operation will automatically resume.

15 Emergency Stop / Emergency Stop Reset

An emergency stop button is available on the RO control enclosure. When pressed, power to the PLC outputs is interrupted. All pumps are immediately stopped, all fail open valves are opened, and all fail closed valves are closed. A hardwired reset pushbutton is located near the emergency stop button on the RO control enclosure. To restore power, the emergency stop must be pulled out, and the reset pushbutton must be pressed in.

When the emergency stop button is pressed, an alarm is generated at the HMI, and the RO Machine is immediately transitioned to FAULT.

Response when power is restored is a selectable option at the HMI.

If the option is selected to reset, the mode selector for the RO Machine is automatically driven to OFF when the emergency stop button is pressed. Mode selectors for the Feed Pump, Acid/Caustic Pump, Antiscalant Pump, Bisulfite Pump, CIP Pump, CIP Heater, and Transfer Pump, are driven to Manual-Stop. An operator must restore power with the hardwired pushbutton to reset the alarm, and then return the mode selectors to the desired position for normal operation to resume.

If the option is selected to hold, the mode selector for the RO Machine is unchanged when the emergency stop button is pressed. An operator must restore power with the hardwired pushbutton to reset the alarm, and normal operation will automatically resume.

16 All Stop/All Auto

A Switch All Equipment to Auto button is available at the HMI. Selection will drive all mode selections to Auto, except for the CIP Pump.

A Switch All Equipment to Off button is also available at the HMI. Selection will drive all mode selections to Off or Manual-Stop, excluding the CIP Pump and the CIP Heater.

17 Restore Factory Defaults

A Reset to Factory Defaults button is available at the HMI. Selection will restore all process and alarm setpoints to initial values.

18 Operator Interface

As described below, GE W&PT standards for HMI design are applicable for HMI development.

18.1 Password Access & Privileges

The HMI includes four levels of password protection: Guest, Operator, Supervisor, and Administrator. Passwords and user names are factory set, as defined in the CLC. The Guest user type does not require a password.

The Guest user type shall have the following privileges:

- Navigate through the graphic screens and monitor plant and equipment status

The Operator user type shall have the Guest privileges and also the following privileges:

- Monitor presets and setpoints, and adjust process control setpoints (not process alarm setpoints)
- Access process unit control buttons and reset alarms
- Silence the alarm horn and acknowledge alarms
- Place devices such as pumps and valves in Auto (but not in Manual)

- Access PID controller popup screens, change PID control selections, and adjust PID control parameters (except PID tuning parameters)

The Supervisor user type shall have the Operator privileges and also the following privileges:

- Adjust all presets and setpoints
- Place devices such as pumps and valves in Manual (in addition to Auto)
- Adjust PID tuning parameters

The Administrator user type shall have the Supervisor privileges and also the following privileges:

- Security configuration, including adding users and changing passwords
- All SCADA/HMI application and operating system privileges

The HMI is configured to log out the current user after one hour of inactivity and/or four hours after logging in.

The HMI display is configured to go to a screen-saver after two hours of inactivity.

18.2 Screen Color-Coding

The HMI uses the color-coding shown below.

Table 1: HMI Color Code Devices Chart

Color	Valve	Pump
Green	Open	On
Red	Closed	Off
Yellow	n/a	Failure

18.3 Units Conversion

Engineering unit preference is a selectable option at the HMI. If the imperial option is selected, all flows are displayed in gpm, all temperatures are displayed in ^{o}F, and all pressures are displayed in psi. If the metric option is selected, all flows are displayed in m3/h, all temperatures are displayed in ^{o}C, and all pressures are displayed in bar.

Instrument ranges are automatically adjusted in the PLC, based on the selected model and the engineering unit preference. Process setpoints for alarms and control loops are automatically converted when the engineering unit preference is changed.

19 Communications

The HMI communicates with the PLC via ethernet.

IP addresses for ethernet devices are reserved as follows:

Device	IP Address
Switch	192.168.100.1
PLC	192.168.100.2
HMI	192.168.100.3
Remote Monitoring	192.168.100.4
Subnet	255.255.255.0
Gateway	n/a

Remote Monitoring hardware is not included. The IP address is reserved for customer use.

This design does not include networked communications to field devices.

20 Control Interface

A discrete demand request is monitored by the PLC. This signal may be used to cycle the RO Machine between a RUNNING state and a STANDBY state.

21 Calculations

Formulae for calculations are documented in the CLC.

PRO Series Premium RO Control Logic Chart

CLC_Pro_Prem_AB_GE_1306061_Rev_B.xls

Tag		Tag name for the element. An “X” in the tag’s suffix may be used to represent identical elements, if usage of that “X” is consistent with the P&ID tagging convention.
Description		Description for the element.
Type		Purpose for the element. Predefined types will prompt the use of defined and standardized programming practices. The following predefined types are available:
	Alarm	Notifies an operator with an alarm message at the operator interface.
	Analog In	A reading from a field instrument.
	Comm	A variable or a set of variables that are communicated to or from the PLC via a networked communications architecture.
	Computed	Calculates a numeric value for use in a PLC program and/or display at an operator interface.
	Controller	Calculates a continuous or binary output for regulating a process variable.
	Info	General information for a programmer or any user of the CLC.
	Motor	Sets a command from the PLC to run a motor, or other similar device.
	Selector	An operator or automatic selection, usually with three or more possible values. The output variable is usually an integer word or boolean array in a PLC, with one and only one bit on at a time.
	Sequencer	Directs the automatic operation of pumps, valves, and other control devices through a series of operations.
	Setpoint	A numeric value for use in a PLC program that can be adjusted by a user at an operator interface.
	Switch	A discrete value for use in a PLC program and/or display at an operator interface.
	Totalizer	Calculates a totalized value.
	Valve	Sets a command from the PLC to open a valve.
Sub Type		Further breakdown of the type category.
Loop Tag		A grouping of elements with a common purpose. If W&PT standard tagging has been applied on the P&ID, the element tags are derived from the loop tags. For example, transmitter 34-FIT-211 contributes to flow loop 34-F-211, and motor pushbutton 34-HS-101 contributes to motor loop 34-M-101. If custom tagging has been applied on the P&ID, abbreviated text or an extrapolation of the custom tagging convention may be used for a grouping of elements.
Range **Min & Max**		The range of the numerical value of the produced data, or the entry limits for the setpoint that is used to trigger the produced data. The number of decimal places shown indicates the resolution at the operator interface. For example, 0.0 to 10.0 psig.
Setpoint		The default value for a given setpoint.
Units		The engineering units of the produced data or setpoint.
Set/Derivation		The conditions for setting or calculating the produced data. Used by the programmer to create the produced data.
Reset		The conditions for reset of the produced data.
Action		The action that occurs when the produced data is set. Also used to explain the intent or usage of the produced data..
Operator Interface		A description of programming on the operator interface for monitoring and/or control of the produced data.
Alarm Type		A classification of the alarm generated by the PLC program when the element is true. A = Advisory S = Shutdown Sn = Normal Shutdown Si = Immediate Shutdown blank = no alarm
Severity		To differentiate the urgency for an operator to respond to particular alarms. C = Critical Alarm N = Noncritical Alarm
Log		Flags the element as a data point to be logged by data acquisition software.

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Revision		Flags the element as changed since an earlier revision of the document, with reference to the revision identifier associated with the change.
Notes		Generally used for notes or comments that are not required for programming, including explanation of a recent revision or explanation of a unique customization.

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
Plant Information		00-															
	Controls Documents	00-	Info								The OSC, CLC and Control Narrative with the P&ID's should be reviewed in their entirety to assist in the understanding of plant operations.						
	Setpoints	00-	Info								All setpoints to be verified in the field. Changes may be required for field conditions & requirements.						
	Device Display Colors	00-	Info	Colors							The following color scheme is used for device status: GREEN - indicates a pump is on and a valve is open. RED - indicates a pump is off and a valve is closed. YELLOW - indicates a pump has failed. A device in MANUAL will have a "M" symbol displayed over or beside the device on the process graphic.						
	Trending PID Loops	00-	Info	Trending							SP, PV, and CV parameters for all PID loops are trended. Update time is .01 sec for all items. Minimum storage time is 2 hours.						
	Ethernet IP Address for PLC	00-	Info	Ethernet							IP Address: 192.168.100.2 Sub Net Mask: 255.255.255.0						
	Ethernet IP Address for HMI	00-	Info	Ethernet							IP Address: 192.168.100.3 Sub Net Mask: 255.255.255.0						
	HMI Security Level = Administrator	00-	Info	Security					When the user name and password are entered. Default user name: ADMINISTRATOR1,ADMINISTRATOR2, ADMINISTRATOR3 Password: 9111,9112,9113	After one hour of inactivity and/or four hours after logging in. Also reset by selection of the Logout button on the HMI. Resets to no security.	The Administrator user type shall have the Supervisor privileges and also the following privileges: · Security configuration, including adding users and changing passwords · All SCADA/HMI application and operating system privileges	User name and password entry accessible from any process graphic, by selection of Login button. Current user displayed on user name entry graphic. Includes Logout button, common to all security levels, accessible from all graphics.					
	HMI Security Level = Supervisor	00-	Info	Security					When the user name and password are entered. Default user name: SUPERVISOR1,SUPERVISOR2,SUPERVISOR3 Password: 5111,5112,5113	After one hour of inactivity and/or four hours after logging in. Also reset by selection of the Logout button on the HMI. Resets to no security.	The Supervisor user type shall have the Operator privileges and also the following privileges: · Adjust all presets and setpoints · Place devices such as pumps and valves in Manual (in addition to Auto) · Adjust PID tuning parameters	User name and password entry accessible from any process graphic, by selection of Login button. Current user displayed on user name entry graphic. Includes Logout button, common to all security levels, accessible from all graphics.					
	HMI Security Level = Operator	00-	Info	Security					When the user name and password are entered. Default user name: OPERATOR1,OPERATOR2,OPERATOR3 Password: 1111,1112,1113	After one hour of inactivity and/or four hours after logging in. Also reset by selection of the Logout button on the HMI. Resets to no security.	The Operator user type shall have the Guest privileges and also the following privileges: · Monitor presets and setpoints, and adjust process control setpoints (not process alarm setpoints) · Access process unit control buttons and reset alarms · Silence the alarm horn and acknowledge alarms · Place devices such as pumps and valves in Auto (but not Manual) · Access PID controller popup screens, change PID control selections, and adjust PID control parameters (except PID tuning parameters)	User name and password entry accessible from any process graphic, by selection of Login button. Current user displayed on user name entry graphic. Includes Logout button, common to all security levels, accessible from all graphics.					
	HMI Security Level = Guest	00-	Info	Security					When no user is logged in.	None.	The Guest user type shall have the following privileges: · Navigate through the Overview, RO Machine, RO Data, Alarm, and Alarm Diagnostic screens and monitor plant and equipment status	User name and password entry accessible from any process graphic, by selection of Login button. Current user displayed on user name entry graphic. Includes Logout button, common to all security levels, accessible from all graphics.					
	HMI Screen Saver	00-	Info						After 30 minutes of inactivity.	On any touch.	Activates screen saver.	Marquee banner "GE Water & Process Technologies".					
	HMI Date and Time	00-K-001	Computed						HMI system clock.			Displayed on all process graphics. Date = dd Mmm yyyy Time = 23:59:59					
	PLC Date and Time	00-K-001	Computed						PLC system clock. Set to value of HMI Date and Time when the Time Synchronize button is pressed.			Displayed on any graphic with a schedule setpoint. Includes Time Synchronize button for operator selection, accessible from all graphics that display the PLC Time. Date = dd Mmm yyyy Time = 23:59:59					

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
00-JS-001	PLC Power Restored	00-J-001	Switch						If PLC Power Up Hold Option is in RESET: - when power is restored to the PLC.	Momentary.	If PLC Power Up Hold Option is in RESET: - RO Machine Mode Selector is driven to OFF. - Mode selectors for the Feed Pump, Acid/Caustic Pump, Antiscalant Pump, Bisulfite Pump, CIP Pump, CIP Heater, and Transfer Pump are driven to MANUAL and devices are stopped. If PLC Power Up Hold Option is in HOLD: - No action.	None.					
00-HA-005	RO Enclosure Emergency Stop Activated	00-Y-005	Alarm						ALWAYS: - when E-Stop Button "PBL-1" is pressed.	If RO Enclosure Emergency Stop Activated Hold Option is in RESET: - after the E-Stop Button has been pushed back in. If RO Enclosure Emergency Stop Activated Hold Option is in HOLD: - when the RO Machine Alarm Reset button is pressed, after the E-Stop Button has been pushed back in.	If RO Enclosure Emergency Stop Activated Hold Option is in RESET: - RO Machine Mode Selector is driven to OFF. - Mode selectors for the Feed Pump, Acid/Caustic Pump, Antiscalant Pump, Bisulfite Pump, CIP Pump, CIP Heater, and Transfer Pump are driven to MANUAL and devices are stopped. If RO Enclosure Emergency Stop Activated Hold Option is in HOLD, and if RO Machine is in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine is placed into FAULT.	Alarm message.	Si	C			
00-JAL-002	PLC Battery Low	00-J-002	Alarm	zS_DisAlarm1			discrete		ALWAYS: - when the PLC Battery is low for 300 seconds.	When the battery is normal and the RO System Machine Alarm Reset pushbuton is pressed.	No action.	Alarm message.	A	N			
00-YA-006	PLC Forces Present	00-Y-006	Alarm	zS_DisAlarm1			discrete		ALWAYS: - when PLC forces are present for 5 seconds.	When PLC forces are removed and the RO System Machine Alarm Reset pushbuton is pressed.	No action.	Alarm message.	A	N			
00-YA-007	Not All Devices in Auto	00-Y-007	Alarm	zS_DisAlarm1			discrete		ALWAYS: - when the Ancilliary equipment is in Manual mode.	When the ancillary equipment used is in Auto mode and the RO System Machine Alarm Reset pushbutton is pressed.	No action.	Alarm message.	A	N			
00-YA-004	Alarm Horn	00-Y-004	Switch						When any new alarm is detected.	When the Horn Mute button is pressed.	Energizes PLC discrete output to activate alarm horn	Animates color of Horn Mute button to red. Includes Horn Mute button for operator selection, accessible from all graphics.					
00-YY-004	Alarm Beacon	00-Y-004	Switch						When any new alarm is detected.	When all alarms have been reset.	Energizes PLC discrete output to activate alarm beacon. Not tagged.	None.					
N/A	Switch All Equipment to Auto	N/A	Switch						When the Switch All Equipment to Auto button is pressed.	Momentary.	Used to drive all mode selections to AUTO, except for the CIP Pump and CIP Heater.	Includes button for operator selection, accessible from overview graphic.					
N/A	Switch All Equipment to Off	N/A	Switch						When the Switch All Equipment to Off button is pressed.	Momentary.	Used to drive all mode selections to OFF or MANUAL-STOP, including the CIP Pump.	Includes button for operator selection, accessible from overview graphic.					
N/A	Reset to Factory Defaults	N/A	Selector						When a Reset to Factory Defaults button is pressed.	Momentary.	Available selections: CONFIGURATION, SETPOINTS, ALL. If Configuration is selected: - PLC Power Up Hold Option is set to RESET. - RO Enclosure Emergency Stop Activated Hold Option is set to RESET. - Feed Pump Option is set to DISABLE. - Acid/Caustic Pump Option is set to DISABLE. - Antiscalant Pump Option is set to DISABLE. - Bisulfite Pump Option is set to DISABLE. - CIP Pump Option is set to DISABLE. - CIP Heater Option is set to DISABLE. - Transfer Pump Option is set to DISABLE. If Setpoints is selected: - Restores all process and alarm setpoints to default values. If All is selected: - Performs actions listed above for Configuration. - Performs actions listed above for Setpoints.	Includes Configuration, Setpoints, and All buttons for operator selection, accessible from configuration graphic. Operator selection must be confirmed with a prompt before actions occur.					
N/A	HMI Display Metric Units	N/A	Switch						When the Metric button is pressed.	When the Unit button is pressed.	Available selections: English, Metric. Used to convert flows, temperature, and pressures, including alarm setpoints.	Displayed on configuration graphic. Includes Metric and Imperial buttons for operator selection, accessible from configuration graphic.					

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
Feed Pump		34-0-100															
N/A	Feed Pump Option Enabled	34-M-101	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
N/A	Feed Pump Demand Controller	34-M-101	Controller	Step	0	1		pumps	per OSC			None.					
34-P-101	Feed Pump Run Command	34-M-101	Motor	zS_Motor1					AUTO: - per OSC. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fail 34-YA-101 Set to AUTO by Switch All Equipment to Auto Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off.		Pump called to run. Energizes PLC discrete output to operate motor.	Standard motor symbol with faceplate popup. Motor symbol provides access to motor popup. Invisible when Feed Pump Option is in DISABLE.					
34-YA-101	Feed Pump Fail	34-M-101	Alarm	zS_DisAlarm1					If pump called to run: - when running confirmation is missing for 5 seconds.	When the RO Sysem Machine Alarm Reset pushbutton is pressed.	Disables pump. If RO Machine is in any step of STANDBY, RUNNING, FILL, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	Feed Pump Run Time	34-M-101	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on motor faceplate.					
Pre-Treatment Filter		06-0-100															
N/A	Pre-Treatment Filter Backwash	33-Y-103	Switch						On when 33-YS-101 or 33-YS-102 is on.		If RO Machine is in any step of RUNNING, except when RO Machine Mode Selector is in HAND: - RO Machine proceeds to STANDBY, step 2. If RO Machine is in Permeate Flush step of STANDBY: - Triggers immediate transition to next step.						
33-YS-101	Pre-Treatment Filter 1 Backwash	33-Y-101	switch						Discrete Input from filter backwash control			Display message on overview screen "filter 1 in backwash"					
33-YS-102	Pre-Treatment Filter 1 Backwash	33-Y-102	switch						Discrete Input from filter backwash control			Display message on overview screen "filter 2 in backwash"					
Acid/Caustic Injection		34-0-500															
N/A	Acid/Caustic Pump Option Enabled	34-M-501	Selector						Available selections: ENABLE ACID, ENABLE CAUSTIC, DISABLE NONE.			Displayed and selected on configuration graphic.					
34-P-501	Acid/Caustic Pump Run Command	34-M-501	Motor	zS_Motor1	0	100	pH Controller 34-AIC-201	% speed	AUTO: Per OSC Speed is set to zero when pump is not called to run. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fault 34-YA-501 Set to AUTO by Switch All Equipment to Auto . Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off.		Pump called to run. Energizes PLC discrete output to operate motor. Sets PLC analog output to operate at desired speed.	Standard motor symbol with desired speed indicator and faceplate popup. Motor symbol provides access to drive popup. Desired speed indicator provides access to PID controller faceplate. Invisible when Acid/Caustic Pump Option is in DISABLE.					
34-YA-501	Acid/Caustic Pump Fault	34-M-501	Alarm	zS_DisAlarm1					If pump called to run and pump fault discrete input from pump is on for more than 5 seconds. (Fault contact open on a fault)	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables pump. If RO Machine is in any step of STANDBY, RUNNING, FILL, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	Acid/Caustic Pump Run Time	34-M-501	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on drive faceplate.					

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
Antiscalant Injection		34-0-600															
N/A	Antiscalant Pump Option Enabled	34-M-601	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
N/A	Antiscalant Pump Demand Controller	34-M-601	Controller	Step	0	1		pumps	per OSC			None.					
34-P-601	Antiscalant Pump Run Command	34-M-601	Motor	zS_Motor1					AUTO: - per Demand Controller. MANUAL: - per Demand Controller. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fault 34-YA-601 Set to AUTO by Switch All Equipment to Auto Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off.		Pump called to run. Energizes PLC discrete output to operate motor.	Standard motor symbol with faceplate popup. Motor symbol provides access to motor popup, customized for fault input. Invisible when Antiscalant Pump Option is in DISABLE.					
34-YA-601	Antiscalant Pump Fault	34-M-601	Alarm	zS_DisAlarm1					If pump called to run: - when a fault status is detected for 5 seconds.(Fault contact open on a fault)	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables pump. If RO Machine is in any step of RUNNING, FILL, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	Antiscalant Pump Run Time	34-M-601	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on drive faceplate.					
Bisulfite Injection		34-0-400															
N/A	Bisulfite Pump Option Enabled	34-M-401	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
N/A	Bisulfite Pump Demand Controller	34-M-401	Controller	Step	0	1		pumps	per OSC			None.					
34-P-401	Bisulfite Pump Run Command	34-M-401	Motor	zS_Motor1					AUTO: - per Demand Controller. MANUAL: - per Demand Controller. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fault 34-YA-401 Set to AUTO by Switch All Equipment to Auto Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off		Pump called to run. Energizes PLC discrete output to operate motor.	Standard motor symbol with faceplate popup. Motor symbol provides access to motor popup, customized for fault input. Invisible when Bisulfite Pump Option is in DISABLE.					
34-YA-401	Bisulfite Pump Fault	34-M-401	Alarm	zS_DisAlarm1					If pump called to run: - when a fault status is detected for 5 seconds. (Fault contact open on a fault)	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables pump. If RO Machine is in any step of STANDBY, RUNNING, FILL, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	Bisulfite Pump Run Time	34-M-401	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on drive faceplate.					
Spare Chemical Pump Injection		34-0-700															

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
N/A	Spare Chemical Pump Option Enabled	34-M-701	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
N/A	Spare Chemical Pump Demand Controller	34-M-701	Controller	Step	0	1		pumps	per OSC			None.					
34-P-701	Spare Chemical Pump Run Command	34-M-701	Motor	zS_Motor1					AUTO: - per Demand Controller. MANUAL: - per Demand Controller. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fault 34-YA-701 Set to AUTO by Switch All Equipment to Auto Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off		Pump called to run. Energizes PLC discrete output to operate motor.	Standard motor symbol with faceplate popup. Motor symbol provides access to motor popup, customized for fault input. Invisible when Spare Chemical Pump Option is in DISABLE.					
34-YA-701	Spare Chemical Pump Fault	34-M-701	Alarm	zS_DisAlarm1					If pump called to run: - when a fault status is detected for 5 seconds. (Fault contact open on a fault)	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables pump. If RO Machine is in any step of STANDBY, RUNNING, FILL, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	Spare Chemical Pump Run Time	34-M-701	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on drive faceplate.					
RO Machine		34-0-200															
N/A	RO Machine Model Selector	34-H-200	Selector						Operator sets PRO-50, PRO-100, PRO-150, PRO-200, PRO-300, PRO-450			Displayed on all graphics. operator selection accessible from configuration graphic.					
N/A	RO Machine Mode Selector	34-Y-200	Selector						When a mode button is pressed. Set to AUTO by Switch All Equipment to Auto Set to OFF by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to OFF by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to OFF by Switch All Equipment to Off		Available modes: AUTO, OFF, HAND, FILL, CIP, CIP FLUSH.	Displayed on process graphic and unit control graphic. Includes Auto, Off, Hand, Fill, CIP, and CIP Flush buttons for operator selection, accessible from unit control graphic.					
N/A	RO Machine State	34-Y-200	Sequencer	State					per OSC		Available states: RUNNING, STOP, STANDBY, FAULT, FILL, CIP, CIP FLUSH. Transition to a state triggers the associated step sequencer per OSC.	Displayed on process graphic and unit control graphic. Does not require state request buttons.					
N/A	RO Machine Running Step Sequencer	34-Y-200	Sequencer	Step	1	2		step	per OSC Includes time remaining timer for timed steps, counting downwards to zero for duration of step, as required per OSC.		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button. Does not require display of time remaining.					
N/A	RO Machine Stop Step Sequencer	34-Y-200	Sequencer	Step	1	1		step	per OSC		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button.					
N/A	RO Machine Standby Step Sequencer	34-Y-200	Sequencer	Step	1	2		step	per OSC Includes time remaining timer for timed steps, counting downwards to zero for duration of step, as required per OSC.		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button. Does not require display of time remaining.					

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
N/A	RO Machine Fault Step Sequencer	34-Y-200	Sequencer	Step	1	1		step	per OSC		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button.					
N/A	RO Machine Fill Step Sequencer	34-Y-200	Sequencer	Step	1	1		step	per OSC		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button.					
N/A	RO Machine CIP Step Sequencer	34-Y-200	Sequencer	Step	1	3		step	per OSC Includes time remaining timer for timed steps, counting downwards to zero for duration of step, as required per OSC.		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button. Does not require display of time remaining.					
N/A	RO Machine CIP Flush Step Sequencer	34-Y-200	Sequencer	Step	1	2		step	per OSC Includes time remaining timer for timed steps, counting downwards to zero for duration of step, as required per OSC.		Activation of a step aligns devices (such as valves and pumps) per OSC.	Displayed on process graphic and unit control graphic. Does not require Goto Next Step button. Does not require display of time remaining.					
N/A	RO Machine Permeate Flush Option Enabled	34-Y-200	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
N/A	RO Machine Standby Permeate Flush Step Duration Timer Setpoint	34-Y-200	Setpoint		1	15	per OSC	min			Operator entered setpoint for duration of Standby Step 1.	Adjustable on configuration graphic.					
34-KAH-200F_1	RO Machine Fill Time Complete	34-Y-200	Alarm	zS_DisAlarm1	0	10	10	min	In FILL: - when the elapsed time in a Fill step is at or above this setpoint.	When the unit Alarm Reset pushbutton is pressed.	If in any step of FILL: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on configuration graphic.	Si	C			
N/A	RO Machine Alarm Reset Pushbutton	34-H-201	Switch						When the Alarm Reset button is pressed.	Momentary.	Resets alarm conditions to restore normal operation of the RO Machine. If in FAULT with mode selector in AUTO: - RO Machine proceeds to STANDBY, step 1. If in FAULT with mode selector in HAND: - RO Machine proceeds to RUNNING, step 1. If in FAULT with mode selector in FILL: - RO Machine proceeds to FILL, step 1. If in FAULT with mode selector in CIP: - RO Machine proceeds to CIP, step 1. If in FAULT with mode selector in CIP FLUSH: - RO Machine proceeds to CIP FLUSH, step 1.	accessible from the alarm screen.					
34-AI-201	RO Machine Inlet pH	34-A-201	Analog In	zS_Analog1	0.0	14.0		pH	Scaled analog input value from transmitter 34-AIT-201.			Displayed on process graphic. Provides access to setpoint popup.					
34-AAT-201	RO Machine Inlet pH Sensor Fault	34-A-201	Alarm						- when the signal from the transmitter is above 20.5 mA or below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message.	Si	C			
34-AAH-201	RO Machine Inlet pH High	34-A-201	Alarm	zS_AlgAlarm1	2.0	10.0	8.0	pH	In any step of RUNNING, FILL, or CIP FLUSH, and during Permeate Flush step of STANDBY: - when the pH is at or above this setpoint for 60 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of pH.	Si	C			
34-AAL-201	RO Machine Inlet pH Low	34-A-201	Alarm	zS_AlgAlarm1	2.0	10.0	4.0	pH	In any step of RUNNING, FILL, or CIP FLUSH, and during Permeate Flush step of STANDBY: - when the pH is at or below this setpoint for 60 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of pH.	Si	C			
N/A	RO Machine Inlet pH Controller Setpoint	34-A-201	Setpoint		2.0	10.0	7.0	pH			Operator entered setpoint used in pH Controller 34-AIC-201.	Adjustable on controller faceplate.					
N/A	RO Machine Inlet pH Controller	34-A-201	Controller	PID	0	100		%	PID AUTO: - CV driven to zero if Acid/Caustic Pump not called to run (Acid/Caustic Pump Demand Controller at zero). - CV restored to last value on pump restart. PV = Inlet pH 34-AI-201 SP = HMI Set Point E=SP-PV if Acid/Caustic pH Correct selected to enable CAUSTIC E=PV-SP if Acid/Caustic pH Correct selected to enable ACID		CV = used to set speed for Acid/Caustic Pump 34-P-501	Standard PID controller faceplate.					

PRO Series Premium RO Control Logic Chart

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
34-AI-202	RO Machine Inlet ORP	34-A-202	Analog In	zS_Analog1	0	1000		mV	Scaled value from transmitter 34-AIT-202.			Displayed on process graphic. Provides access to setpoint popup.					
34-AAT-202	RO Machine Inlet ORP Sensor Fault	34-A-202	Alarm						ALWAYS: - when the signal from the ORP channel is above 20.5 mA for 2 seconds. - when the signal from the ORP channel is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	C			
34-AAH-202	RO Machine Inlet ORP High	34-A-202	Alarm	zS_AlgAlarm1	-1000	2000	200	mV	In any step of RUNNING, FILL, or CIP FLUSH, and during Permeate Flush step of STANDBY: - when the ORP is at or above this setpoint for 60 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of ORP.	Si	C			
34-FV-201	RO Machine Inlet Valve	34-V-201	Valve	zS_Valve1					AUTO: - per OSC. MANUAL: - per OSC.		Valve called to open. Energizes PLC discrete output to open valve.	Standard valve symbol with faceplate popup. Valve symbol provides access to valve popup.					
34-FI-203	RO Inlet Flow	34-F-203	Computed		0.0	Refer to Perm/Conc flows		gpm m3/h	RO Permeate Flow 34-FI-201 plus RO Concentrate Flow 34-FI-202			Displayed on process graphic.					
34-AI-204	RO Machine Inlet Conductivity	34-A-204	Analog In	zS_Analog1	0	2000		uS	Scaled value from transmitter 34-AIT-204.			Displayed on process graphic. Does not require a setpoint popup.					
34-AAT-204	RO Machine Inlet Conductivity Sensor Fault	34-A-204	Alarm						ALWAYS: - when the signal from the conductivity channel is above 20.5 mA for 2 seconds. - when the signal from the conductivity channel is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	N			
34-PAL-201	RO Pump Suction Pressure Low	34-P-201	Alarm	zS_DisAlarm1			discrete		In steps of RUNNING, CIP, or CIP FLUSH, and during Permeate Flush step of STANDBY: - when the pressure is low for 15 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message.	Si	C			
	RO Pump VFD Option Enabled	34-M-201	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
34-P-201 34-P-202	RO Pump Run Command	34-M-201	Motor	zS_Motor1	0	100	Permeate Flow Controller 34-FIC-201	% speed	AUTO: - per OSC. MANUAL: - not available. Speed is set to zero when pump is not called to run. Speed is set to zero if RO Pump VFD Option is set to DISABLE. Speed for pump 2 is set to zero if RO Machine Model is not set to PRO-450. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fail 34-YA-201, 34-YA-202		Pump called to run. Energizes PLC discrete output to operate motor. Sets PLC analog output to operate at desired speed.	Standard motor symbol with desired speed indicator and faceplate popup. Motor symbol provides access to drive popup, if RO Pump VFD Option is in ENABLE, or motor popup, if RO Pump VFD Option is in DISABLE. Desired speed indicator provides access to PID controller faceplate. Desired speed indicator is invisible when RO Pump VFD Option is in DISABLE. Pump 2 is invisible when RO Machine Model is not set to PRO-450.					
34-YA-201 34-YA-202	RO Pump Fail	34-M-201	Alarm	zS_DisAlarm1					If pump called to run: - when running confirmation is missing for 5 seconds.	When the unit Alarm Reset pushbutton is pressed, or when the pump Alarm Reset pushbutton is pressed.	Disables pump. If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	RO Pump Run Time	34-M-201	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on motor faceplate or drive faceplate.					
34-PI-202	RO Primary Pressure	34-P-202	Analog In	zS_Analog1	0.0 0.0	500.0 34.5		psi bar	Scaled value from transmitter 34-PT-202.			Displayed on process graphic. Does not require a setpoint popup.					
34-PAT-202	RO Primary Pressure Sensor Fault	34-P-202	Alarm						ALWAYS: - when the signal from the pressure transmitter is above 20.5 mA for 2 seconds. - when the signal from the pressure transmitter is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	N			
34-PDI-202	RO Differential Pressure	34-P-202	Computed		0.0	500.0		psi bar	RO Primary Pressure 34-PI-202 minus RO Concentrate Pressure 34-PI-205			Displayed on process graphic. Provides access to setpoint popup.					

PRO Series Premium RO Control Logic Chart

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
34-PDAH-202	RO Differential Pressure High	34-P-202	Alarm	zS_AlgAlarm1	0	200.0 13.8	0.0	psi bar	ALWAYS: - when the differential pressure is at or above this setpoint for 60 seconds.	When the differential pressure is normal.	No action.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of differential pressure.	A	N			
34-PI-205	RO Final Concentrate Pressure	34-P-205	Analog In	zS_Analog1	0.0 0.0	500.0 34.5		psi bar	Scaled value from transmitter 34-PT-205.			Displayed on process graphic. Does not require a setpoint popup.					
34-PAT-205	RO Final Concentrate Pressure Sensor Fault	34-P-205	Alarm						ALWAYS: - when the signal from the pressure transmitter is above 20.5 mA for 2 seconds. - when the signal from the pressure transmitter is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	N			
34-PAH-207	RO Concentrate Pressure High	34-P-207	Alarm	zS_DisAlarm1		80	discrete	psi bar	ALWAYS: - when the pressure is high for 0.2 seconds.	When the unit Alarm Reset pushbutton is pressed.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message.	Si	C			
34-FI-202	RO Concentrate Flow	34-F-202	Analog In	zS_Analog1	0.0 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450	per model 50.0 100.0 100.0 150.0 150.0 200.0 11.4 22.7 22.7 34.1 34.1 45.4		 gpm gpm gpm gpm gpm gpm m3/h m3/h m3/h m3/h m3/h m3/h	Scaled value from transmitter 34-FIT-202.			Displayed on process graphic. Provides access to setpoint popup.					
34-FAT-202	RO Concentrate Flow Sensor Fault	34-F-202	Alarm						ALWAYS: - when the signal from the flow channel is above 20.5 mA for 2 seconds. - when the signal from the flow channel is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	C			
34-FAL-202	RO Concentrate Flow Low	34-F-202	Alarm	zS_AlgAlarm1	0.0	See RO Concentrate Flow Low Set Point for the Upper Range		gpm	In any step that calls for RO Pump operation. - when the flow is at or below this setpoint for 60 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of flow.	Si	C			
N/A	RO Concentrate Flow Low Set Point Range Upper Limit	34-F-202	Setpoint		0.0 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450	per model 25 50 50 75 75 100 5.7 11.4 11.4 17 17 27.7		 gpm gpm gpm gpm gpm gpm m3/h m3/h m3/h m3/h m3/h m3/h	Value is based on US/Metric Configuration Switch								
34-AAT-203	RO Permeate Conductivity Sensor Fault	34-A-203	Alarm						ALWAYS: - when the signal from the conductivity channel is above 20.5 mA for 2 seconds. - when the signal from the conductivity channel is below 3.5 mA for 2 seconds.	When the unit Alarm Reset pushbutton is pressed.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	N			
34-AAH-203	RO Permeate Conductivity High	34-A-203	Alarm	zS_AlgAlarm1	0	200	150	uS	In Production step of RUNNING: - when the conductivity is at or above this setpoint for 60 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of conductivity.	Si	N			
N/A	RO Rejection	34-A-203	Computed		0.0	100.0		%	Equals: (1 - [PERM / FEED]) * 100 where PERM = RO Permeate Conductivity 34-AI-203 FEED = RO Machine Inlet Conductivity 34-AI-204			Displayed on process graphic.					

PRO Series Premium RO Control Logic Chart

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
34-TI-201	RO Inlet Temperature	34-T-201	Analog In	zS_Analog1	32.0 0	212.0 100.0		deg F deg C	Scaled value from transmitter 34-TIT-201.			Displayed on process graphic. Provides access to setpoint popup.					
34-TAT-201	RO Permeate Temperature Sensor Fault	34-T-201	Alarm						ALWAYS: - when the signal from the temperature channel is above 20.5 mA for 2 seconds. - when the signal from the temperature channel is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	C			
34-TAH-201	RO Permeate Temperature High	34-T-201	Alarm	zS_AlgAlarm1	32.0 0	120.0 50	104.0 40.0	deg F deg C	In any step of RUNNING, FILL, CIP, or CIP FLUSH, and during Permeate Flush step of STANDBY: - when the temperature is at or above this setpoint for 15 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of temperature.	Si	C			
34-FI-201	RO Permeate Flow	34-F-201	Analog In	zS_Analog1	0.0 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450	per model 100.0 200.0 200.0 400.0 400.0 600.0 22.7 45.5 45.5 90.8 90.8 136.3		 gpm gpm gpm gpm gpm gpm m3/h m3/h m3/h m3/h m3/h m3/h	Scaled value from transmitter 34-FIT-201.			Displayed on process graphic. Provides access to setpoint popup.					
34-FAT-201	RO Permeate Flow Sensor Fault	34-F-201	Alarm						ALWAYS: - when the signal from the flow channel is above 20.5 mA for 2 seconds. - when the signal from the flow channel is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	C			
34-FAL-201	RO Permeate Flow Low	34-F-201	Alarm	zS_AlgAlarm1	0.0 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450 PRO-50 PRO-100 PRO-150 PRO-200 PRO-300 PRO-450	per model 50.0 100.0 150.0 200.0 300.0 450.0 11.4 22.8 34.2 45.6 68.4 102.2		 gpm gpm gpm gpm gpm gpm m3/h m3/h m3/h m3/h m3/h m3/h	In any step that calls for RO Pump operation except CIP. - when the flow is at or below this setpoint for 60 seconds.	When the unit Alarm Reset pushbutton is pressed.	RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of flow.	Si	C			
N/A	RO Permeate Flow Controller Setpoint	34-F-201	Setpoint		0	See RO Permeate Flow Low Set Point for the Upper Range		 gpm gpm gpm gpm gpm gpm m3/h m3/h m3/h m3/h m3/h m3/h	Value is based on US/Metric Configuration Switch								
	RO Permeate Flow Controller Preset for CIP	34-F-201	Setpoint		0	100	field	%			Operator entered setpoint used in Flow Controller 34-FIC-201 for CIP operation.	Adjustable on controller faceplate.					
N/A	RO Permeate Flow Controller	34-F-201	Controller	PID	0	100		%	PID AUTO: - CV driven to zero if RO Pump 34-P-201 not called to run. - CV restored to last value on pump restart. - CV driven to Preset for CIP and loop inhibited, when pump called to run during CIP. PV = Permeate Flow 34-FI-201 SP = HMI Set Point E=SP-PV		CV = used to set speed for RO Pump 34-P-20X.	Standard PID controller faceplate, customized to include Preset for CIP.					
N/A	RO Recovery	34-F-201	Computed		0	100		%	Equals: (PERM / FEED) * 100 where PERM = RO Permeate Flow 34-FI-201 FEED = RO Inlet Flow 34-FI-203			Displayed on process graphic.					

PRO Series Premium RO Control Logic Chart

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
34-PAH-206	RO Permeate Pressure High	34-P-206	Alarm	zS_DisAlarm1			discrete		ALWAYS: - when the pressure is high for 0.2 seconds.	When the unit Alarm Reset pushbutton is pressed.	If in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message.	Si	C			
34-FV-203	RO Machine Permeate Valve	34-V-203	Valve	zS_Valve1					AUTO: - per OSC. MANUAL: - per OSC.		Valve called to close. De-energizes PLC discrete output to open valve.	Standard valve symbol with faceplate popup. Valve symbol provides access to valve popup.					
34-FV-205	RO Machine Permeate Recycle Valve	34-V-205	Valve	zS_Valve1					AUTO: - per OSC. MANUAL: - per OSC..		Valve called to open. Energizes PLC discrete output to open valve.	Standard valve symbol with faceplate popup. Valve symbol provides access to valve popup.					
CIP System		35-0-100															
N/A	CIP Pump Option Enabled	35-M-101	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
35-P-101	CIP Pump Run Command	35-M-101	Motor	zS_Motor1					AUTO: - per OSC. MANUAL: - per OSC.. DISABLED (in AUTO or MANUAL): - when any of the following are true: Pump Fail 35-YA-101 Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off.		Pump called to run. Energizes PLC discrete output to operate motor.	Standard motor symbol with faceplate popup. Motor symbol provides access to motor popup. Invisible when CIP Pump Option is in DISABLE.					
35-YA-101	CIP Pump Fail	35-M-101	Alarm	zS_DisAlarm1					If pump called to run: - when running confirmation is missing for 5 seconds.	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables pump. If RO Machine is in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	CIP Pump Run Time	35-M-101	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on motor faceplate.					
N/A	CIP Heater Option Enabled	35-H-101	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
35-H-101	CIP Heater Run Command	35-H-101	Motor	zS_Motor1					AUTO: - per OSC. MANUAL: - per OSC. DISABLED (in AUTO or MANUAL): - when any of the following are true: Heater Fail 35-YA-101A Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off.		Heater called to run. Energizes PLC discrete output to operate heater.	Standard heater symbol with faceplate popup. Heater symbol provides access to heater popup. Invisible when CIP Heater Option is in DISABLE.					

PRO Series Premium RO Control Logic Chart

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Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
35-YA-101A	CIP Heater Fail	35-H-101	Alarm	zS_DisAlarm1					If heater called to run: - when running confirmation is missing for 5 seconds.	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables heater. If RO Machine is in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of heater symbol on process graphic.	Si	C			
35-TAH-101A	CIP Heater Fail	35-H-101	Alarm	zS_DisAlarm1					If heater called to run: - when temperature ok confirmation is missing for 5 seconds.	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables heater. If RO Machine is in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Changes colour of heater symbol on process graphic.	Si	C			
N/A	CIP Heater Run Time	35-H-101	Totalizer	Timer	0	1,000,000		hours	Accumulates when heater is running.	Rolls over automatically at 1,000,000 hours.		Displayed on heater faceplate.					
Permeate Storage Tank		38-0-100															
N/A	Permeate Analog Control Option Enabled	38-L-101	Switch						When the Analog button is pressed.	When the Discrete button is pressed.	Available selections: ANALOG, DISCRETE.	Displayed on configuration graphic. Includes Analog and Discrete buttons for operator selection, accessible from configuration graphic.					
N/A	Permeate Discrete Demand	38-L-101	Switch						When Permeate Analog Control Option is in DISCRETE:		When on, if RO Machine is in any step of RUNNING with RO Machine Mode Selector in AUTO: - RO Machine proceeds to STANDBY, step 1. When off, if RO Machine is in any step of STANDBY with RO Machine Mode Selector in AUTO, except if Pre-Treatment Filter Backwash 06-YS1-101 is on: - RO Machine proceeds to RUNNING, step 1.	Displayed on process graphic.					
38-LI-101	Permeate Storage Tank Level	38-L-101	Analog In	zS_Analog1	0	100		%	Scaled value from transmitter 38-LIT-101.			Displayed on process graphic. Animates tank fill indication. Provides access to setpoint popup. Invisible when Permeate Analog Control Option is in DISCRETE.					
38-LAT-101	Permeate Storage Tank Level Sensor Fault	38-L-101	Alarm						When Permeate Analog Control Option is in ANALOG: - when the signal from the level transmitter is above 20.5 mA for 2 seconds. - when the signal from the level transmitter is below 3.5 mA for 2 seconds.	Sensor outputs signal in the 4-20 mA range.	If RO Machine is in any step of STANDBY, RUNNING, FILL, CIP, or CIP FLUSH: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoints not adjustable from operator interface.	Si	C			
38-LAH-101	Permeate Storage Tank Level High	38-L-101	Alarm	zS_AlgAlarm1	0	100	95	%	When Permeate Analog Control Option is in ANALOG:: - when the level is at or above this setpoint for 5 seconds.	When the RO Machine Alarm Reset pushbutton is pressed or the Analog level control RO Stop level has been reached.	If RO Machine is in any step of RUNNING: - RO Machine proceeds to FAULT, step 1.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of level.	Si	C			
38-LSH-101	Permeate Storage Tank Level to Stop RO	38-L-101	Switch		0	100	90	%	When Permeate Analog Control Option is in ANALOG: - when the level is at or above this setpoint for 5 seconds.		If RO Machine is in any step of RUNNING with RO Machine Mode Selector in AUTO: - RO Machine proceeds to STANDBY, step 1.	Setpoint adjustment on popup accessible from process graphic indication of level.					
38-LSL-101	Permeate Storage Tank Level to Start RO	38-L-101	Switch		0	100	30	%	When Permeate Analog Control Option is in ANALOG: - when the level is at or below this setpoint for 5 seconds.		If RO Machine is in any step of STANDBY with RO Machine Mode Selector in AUTO, except if Pre-Treatment Filter Backwash 06-YS1-101 is on: - RO Machine proceeds to RUNNING, step 1.	Setpoint adjustment on popup accessible from process graphic indication of level.					
38-LSH2-101	Permeate Storage Tank Level to Start Transfer Pump	38-L-101	Switch		0	100	20	%	When Permeate Analog Control Option is in ANALOG: - when the level is at or above this setpoint for 5 seconds.		Starts Transfer Pump.	Setpoint adjustment on popup accessible from process graphic indication of level.					
38-LAL-101	Permeate Storage Tank Level Low	38-L-101	Alarm	zS_AlgAlarm1	0	100	5	%	When Permeate Analog Control Option is in ANALOG:: - when the level is at or below this setpoint for 5 seconds.	When the RO Machine Alarm Reset pushbutton is pressed or the Analog level control RO Start level has been reached.	No action.	Alarm message. Setpoint adjustment on popup accessible from process graphic indication of level.	A	N			
N/A	Permeate Storage Tank Level to Stop Transfer Pump	38-L-101	Switch		0	100	10	%	When Permeate Analog Control Option is in ANALOG: - when the level is at or below this setpoint for 5 seconds.		Stops Transfer Pump.	Setpoint adjustment on popup accessible from process graphic indication of level.					
N/A	Transfer Pump Option Enabled	38-M-101	Switch						When the Enable button is pressed.	When the Disable button is pressed.	Available selections: ENABLE, DISABLE.	Displayed on configuration graphic. Includes Enable and Disable buttons for operator selection, accessible from configuration graphic.					
N/A	Transfer Pump Demand Controller	38-M-101	Controller	Step	0	1		pumps	Set to 1: - Permeate Storage Tank Level to Start Transfer Pump Set to 0: - Permeate Storage Tank Level to Stop Transfer Pump			None.					

PRO Series Premium RO Control Logic Chart

CLC_Pro_Prem_AB_GE_1306061_Rev_B.xls

Tag	Description	Loop Tag	Type	Sub Type	Range Min	Range Max	Setpoint	Units	Set/Derivation	Reset	Action	Operator Interface	Alarm Type	Severity	Log	Revision	Notes
38-P-101	Transfer Pump Run Command	38-M-101	Motor	zS_Motor1					AUTO: - per Demand Controller. MANUAL: - per Demand Controller. DISABLED (in AUTO or MANUAL): - when any of the following are true: RO Enclosure Emergency Stop Activated 00-HA-005 Permeate Analog Control Option in DISABLE Permeate Storage Tank Level Sensor Fault 38-LAT-101 Transfer Pump Option in DISABLE Pump Fail 38-YA-101 Set to AUTO by Switch All Equipment to Auto. Set to MANUAL, and stopped, by PLC Power Restored 00-JS-001 if PLC Power Up Hold Option is in RESET. Set to MANUAL, and stopped, by RO Enclosure Emergency Stop Activated 00-HA-005 if RO Enclosure Emergency Stop Activated Hold Option is in RESET. Set to MANUAL, and stopped, by Switch All Equipment to Off.		Pump called to run. Energizes PLC discrete output to operate motor.	Standard motor symbol with faceplate popup. Motor symbol provides access to motor popup. Invisible when Transfer Pump Option is in DISABLE.					
38-YA-101	Transfer Pump Fail	38-M-101	Alarm	zS_DisAlarm1					If pump called to run: - when running confirmation is missing for 5 seconds.	When the RO System Machine Alarm Reset pushbutton is pressed.	Disables pump.	Alarm message. Changes colour of pump symbol on process graphic.	Si	C			
N/A	Transfer Pump Run Time	38-M-101	Totalizer	Timer	0	1,000,000		hours	Accumulates when pump is running.	Rolls over automatically at 1,000,000 hours.		Displayed on motor faceplate.					

PRO Series Premium RO Operations Sequence Chart

OSC_Pro_Prem_AB_GE_1306061_Rev_B.xls

OPERATING STATE / Step Description	Step #	Feed Pump Demand Controller	Acid/Caustic Demand Controller	Antiscalant Demand Controller	Bisulfite Demand Controller	Inlet Valve	RO Pump	Permeate Valve	Permeate Recycle Valve	CIP Pump	CIP Heater	Permeate Transfer Pump	Duration (if timed,minutes unless noted)	Step	Legend T - Indicates that the valve or pump is throttling in Auto to control a process variable. 0 - Indicates that the valve/motor is closed/off in Auto. 1 - Indicates that the valve/motor is open/on in Auto.
Tag Numbers		**Dedicated Devices**													**The Operations Sequence Chart (OSC), Control Logic Chart (CLC) and the Control Narrative (CN) should all be read to assist in the understanding of system operations.**
		34-YC-101	34-YC-501	34-YC-601	34-YC-401	34-FV-201	34-P-201 N1	34-FV-203	34-FV-205	35-P-101	35-H-101	38-P-101			**Comments & Sequencing Logic**
STOP															Triggered by operator selection of OFF mode from RUNNING, STANDBY, or FILL timing state.
Stopped	Step 1	**0**	**0**	**0**	**0**	**0**	**0**	**1** N6	**0**	**0**	**0**	**0** N4	--	1	Sequence complete.
FAULT															Triggered from states of RUNNING, STANDBY, FILL, CIP, or by shutdown alarms with the RO selector switch in MANUAL, AUTO, or FILL mode.
Stopped	Step 1	**0**	**0**	**0**	**0**	**0**	**0**	**1** N6	**0**	**0**	**0**	**0** N4	--	1	Sequence complete.
STANDBY															Triggered by operator selection of AUTO mode from STOP, FILL, CIP or CIP FLUSH. Triggered in AUTO mode from FAULT by reset of all shutdown alarms. Triggered in AUTO mode from RUNNING by high level in Permeate Storage Tank 38-LT-101, or by loss of discrete demand 38-YS-102. Triggered in AUTO mode from RUNNING by Pre-Treatment Filter backwash status 06-YS1-101.
Permeate Flush	Step 1	**1**	**T**	**0**	**1**	**1**	**T** N2	**0** N3	**1** N5	**0**	**0**	**0** N4	5	1	Waits for step duration, then proceeds to next step. Skipped if not triggered from last step of RUNNING. Skipped if Pre-Treatment Filter backwash status 06-YS1-101. Skipped if Permeate Flush option is declined at the HMI.
Ready	Step 2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0** N4	--	2	Sequence complete.
RUNNING															Triggered by operator selection of HAND mode from any state. Triggered in HAND mode from FAULT by reset of all shutdown alarms. Triggered in AUTO mode from STANDBY by low level in Permate Storage Tank 38-LT-101, or by discrete demand 38-YS-102. Triggers in AUTO mode are inhibited by Pre-Treatment Filter backwash status 06-YS1-101.
Flood	Step 1	**1**	**T**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0** N4	5s	1	Waits for step duration, then proceeds to next step.
Production	Step 2	**1**	**T**	**1**	**1**	**1**	**T** N2	**1**	**0**	**0**	**0**	**0** N4	--	2	Sequence complete.
FILL															Triggered by operator selection of FILL mode from any state. Triggered in FILL mode from FAULT by reset of all shutdown alarms.
Fill	Step 1	**1**	**T**	**1**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0** N4	10	1	Sequence complete.
CIP															Triggered by operator selection of CIP mode from any state. Triggered in CIP mode from FAULT by reset of all shutdown alarms.
Flood	Step 1	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0** N4	5s	1	Waits for step duration, then proceeds to next step.
Starting Pump	Step 2	**0**	**0**	**0**	**0**	**1**	**T** N2	**0**	**0**	**1**	**0**	**0** N4	--	2	Waits for step duration, then proceeds to next step.
Starting Heater	Step 3	**0**	**0**	**0**	**0**	**1**	**T** N2	**0**	**0**	**0**	**1**	**0** N4	30s	3	Waits for step duration, then proceeds to next step.
Cleaning	Step 4	**0**	**0**	**0**	**0**	**1**	**T** N2	**0**	**0**	**1**	**1**	**0** N4	--	4	Sequence complete.
CIP FLUSH															Triggered by operator selection of CIP FLUSH mode from any state. Triggered in CIP FLUSH mode from FAULT by reset of all shutdown alarms.
Flood	Step 1	**1**	**T**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0** N4	5s	1	Waits for step duration, then proceeds to next step.
CIP Flush	Step 2	**1**	**T**	**1**	**1**	**1**	**T** N2	**0**	**0**	**0**	**0**	**0** N4	--	2	Sequence complete.

DEVICE SPECIFIC NOTES:

N1 The PRO-450 model includes a second RO Pump, 34-P-202. If the second pump is included, 34-P-202 is simultaneously called to run with 34-P-201.
N2 The process variable for pump speed during RUNNING, Permeate Flush step of STANDBY, and CIP FLUSH, is permeate 34-FIT-201. Throttling is disabled, and an adjustable preset is applied for pump speed, during CIP.
N3 The Permeate valve is held open for two seconds on transition to the Permeate Flush step of STANDBY.
N4 The Permeate Transfer pump runs from the analog control selection and start/stop set points on the hmi and is independent of the RO.
N5 The Permeate recycle valve is held open for two seconds on transition from Permeate Flush step of STANDBY to RUNNING.
N6 The Permeate valve is held closed when the RO selector switch is in CIP mode or CIP FLUSH mode and if the RO selector switch is then moved to OFF mode. The valve will remain closed in any alarm condition in either CIP and CIP FLUSH mode.