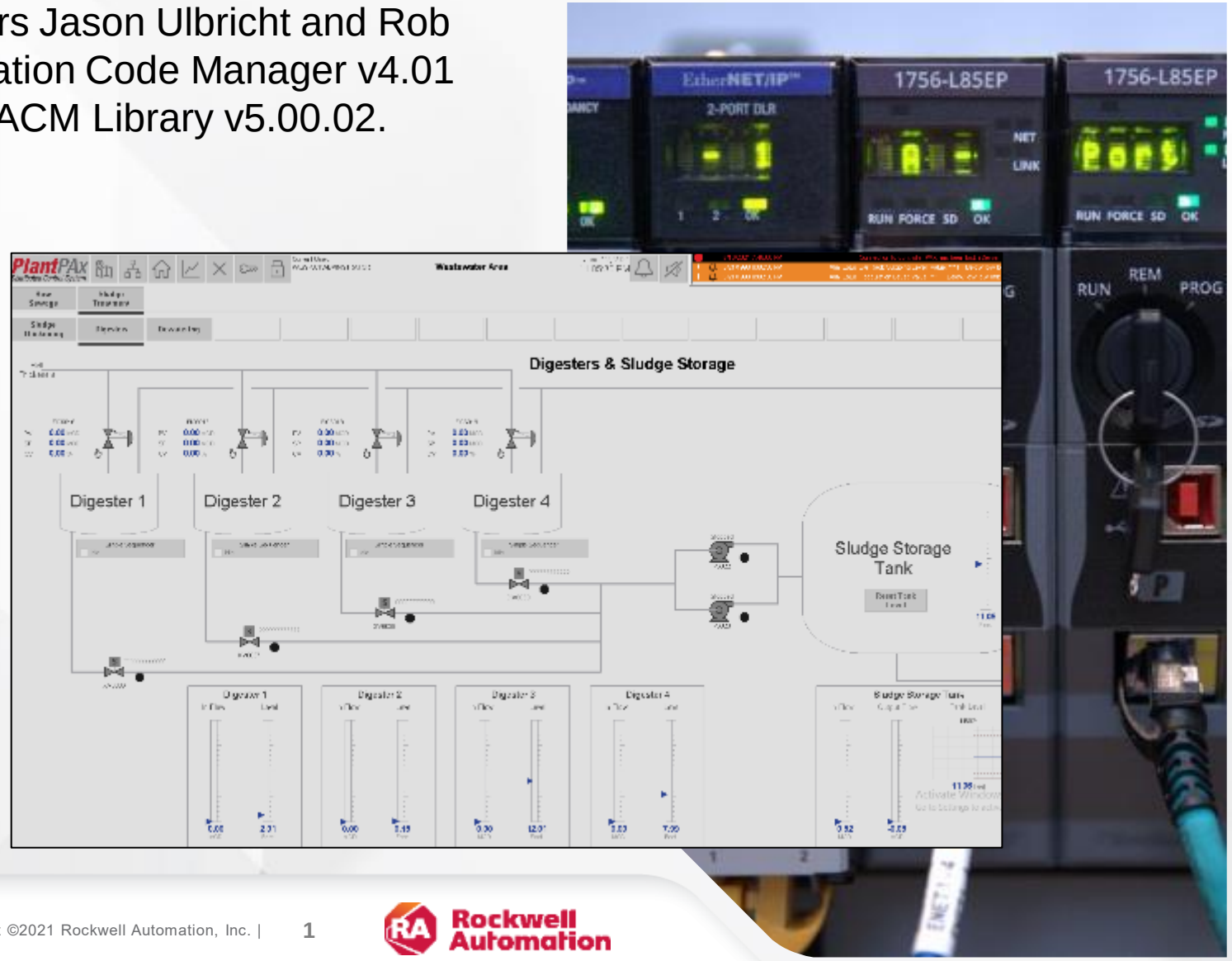
GTC Webinar

Using ACM with PlantPAx 5.0 and the New 5.0 Equipment Module (EM) Object

Thank you for joining Commercial Engineers Jason Ulbricht and Rob Munk for a webinar showcasing the Application Code Manager v4.01 (ACM) software tool and the PlantPAx 5.0 ACM Library v5.00.02.

Follow along as ACM is used to build WasteWater digester application code, including basic device Control Strategies, and new for PlantPAx 5.0 Equipment Module (EM).

See how configuration is used by selecting library objects (process strategies, equipment modules, etc.) and providing configuration data, such as object name and descriptions, equipment set points, control interlocks, I/O mapping, etc. Once all the configuration, not programming, is complete the project is downloaded to a controller.



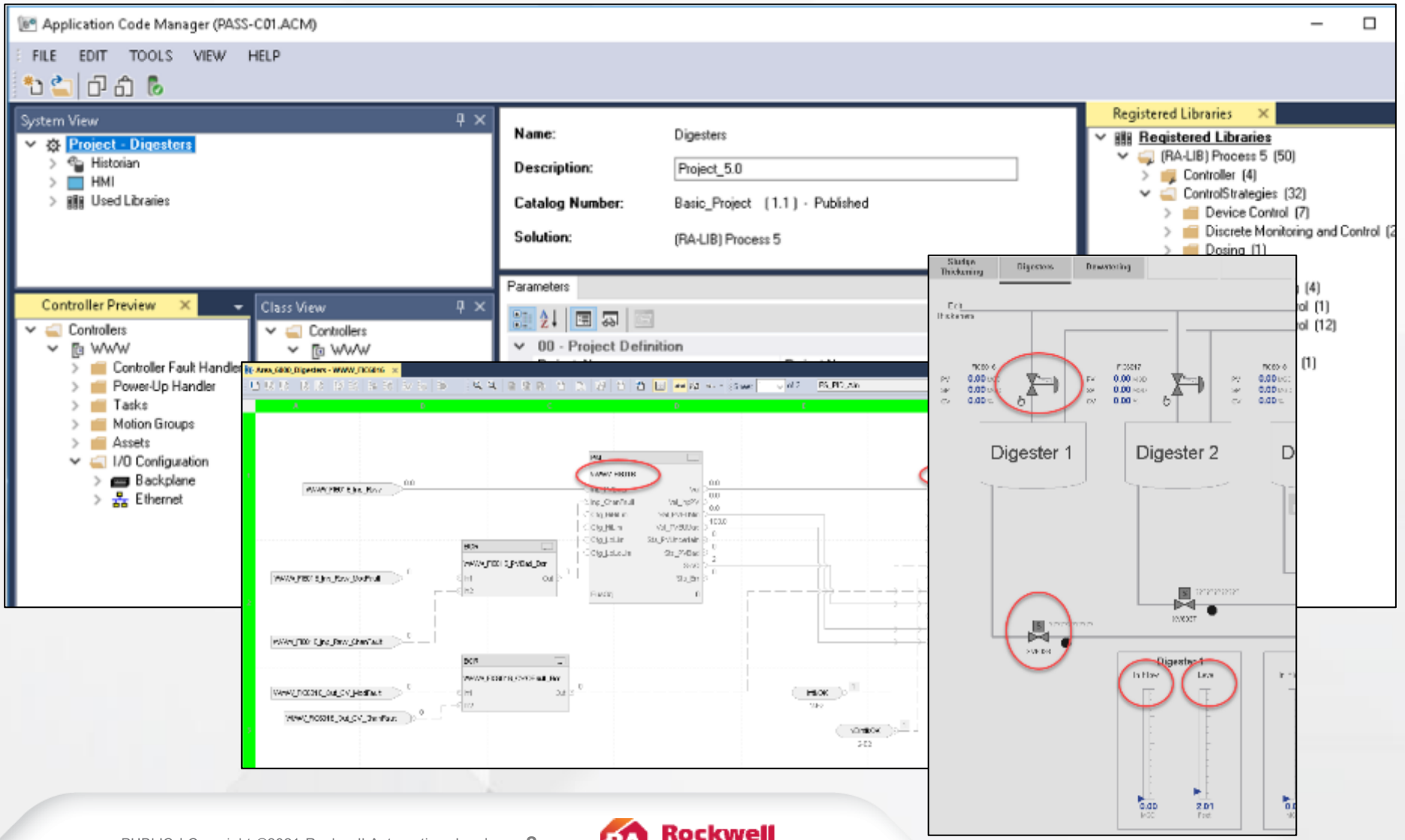
Rockwell Automation

Studio5000 Application Code Manager (ACM)

Application Code Manager is an engineering tool that enables more efficient project development by leveraging reusable libraries.

You can create your own libraries using Library Designer or use provided ones, like the PlantPAx library.

Application Code Manager not only creates the Logix code but also associated FactoryTalk ViewSE/ME displays, FactoryTalk Historian tags and FactoryTalk Alarm and Events (FTAE) content.



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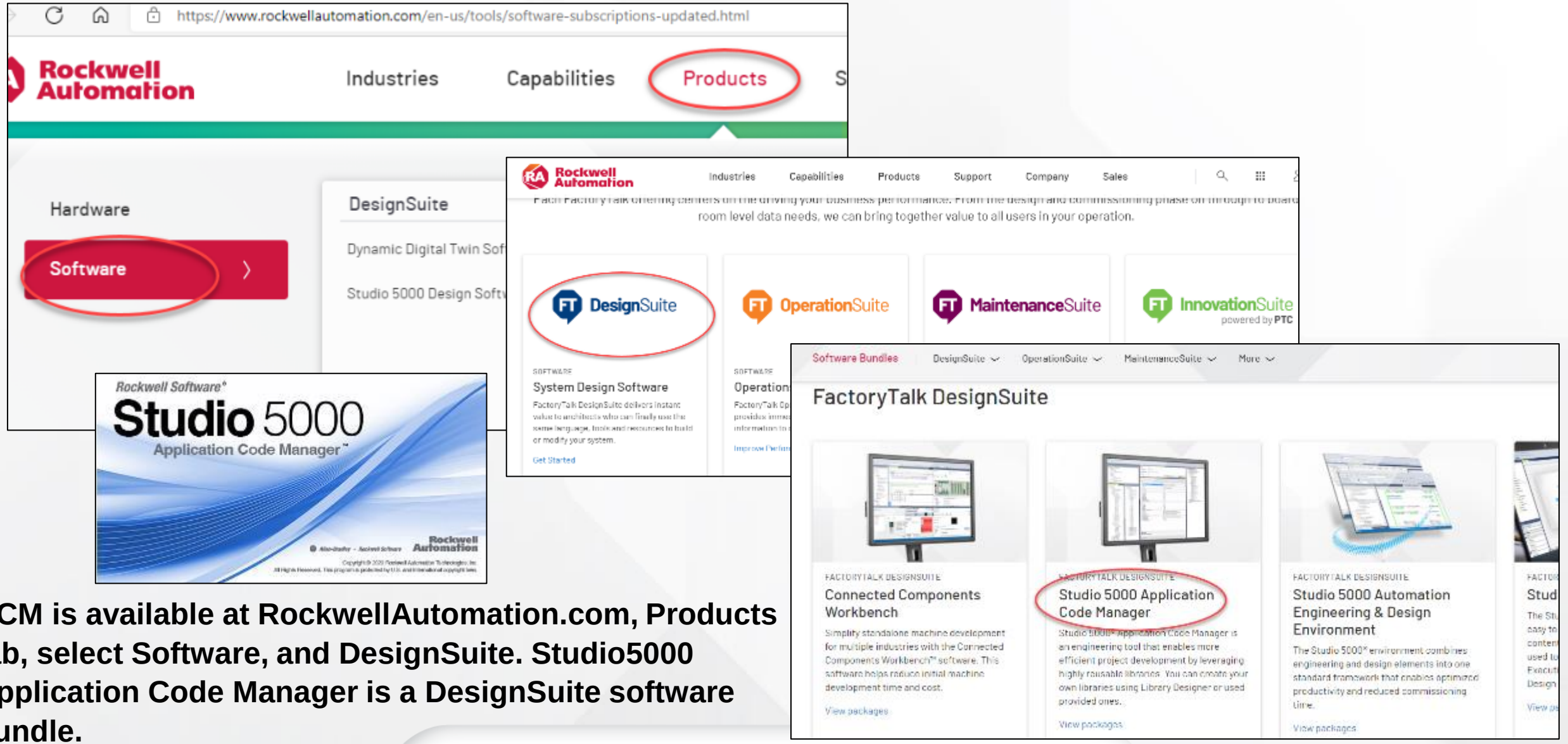
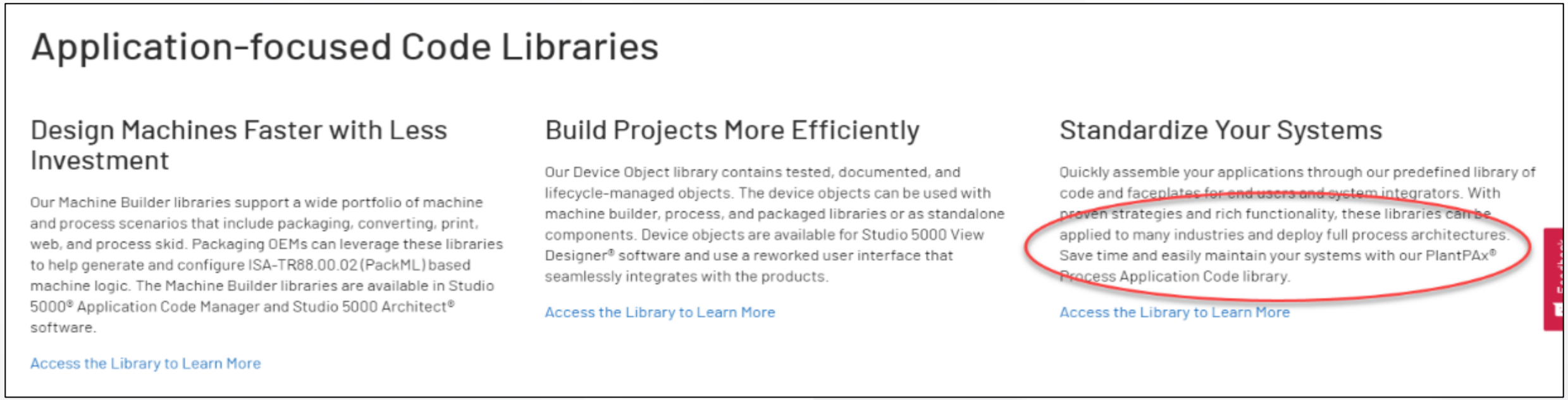
Where to get Studio5000 Application Code Manager



ACM is available at RockwellAutomation.com, Products tab, select Software, and DesignSuite. Studio5000 Application Code Manager is a DesignSuite software bundle.

Application Focused Libraries

Rockwell has ACM libraries for process, motion, and drives applications.



Application-focused Code Libraries

Design Machines Faster with Less Investment

Our Machine Builder libraries support a wide portfolio of machine and process scenarios that include packaging, converting, print, web, and process skid. Packaging OEMs can leverage these libraries to help generate and configure ISA-TR88.00.02 (PackML) based machine logic. The Machine Builder libraries are available in Studio 5000® Application Code Manager and Studio 5000 Architect® software.

Access the Library to Learn More

Build Projects More Efficiently

Our Device Object library contains tested, documented, and lifecycle-managed objects. The device objects can be used with machine builder, process, and packaged libraries or as standalone components. Device objects are available for Studio 5000 View Designer® software and use a reworked user interface that seamlessly integrates with the products.

Access the Library to Learn More

Standardize Your Systems

Quickly assemble your applications through our predefined library of code and faceplates for end users and system integrators. With proven strategies and rich functionality, these libraries can be applied to many industries and deploy full process architectures. Save time and easily maintain your systems with our PlantPAx® Process Application Code library.

Access the Library to Learn More

Rockwell has libraries of standard application content to help easily integrate automation products into systems. Our application content helps engineers create automation projects from standardized, lifecycle-managed, application-focused libraries in an efficient way. This content includes code libraries for process, motion, and drives applications.

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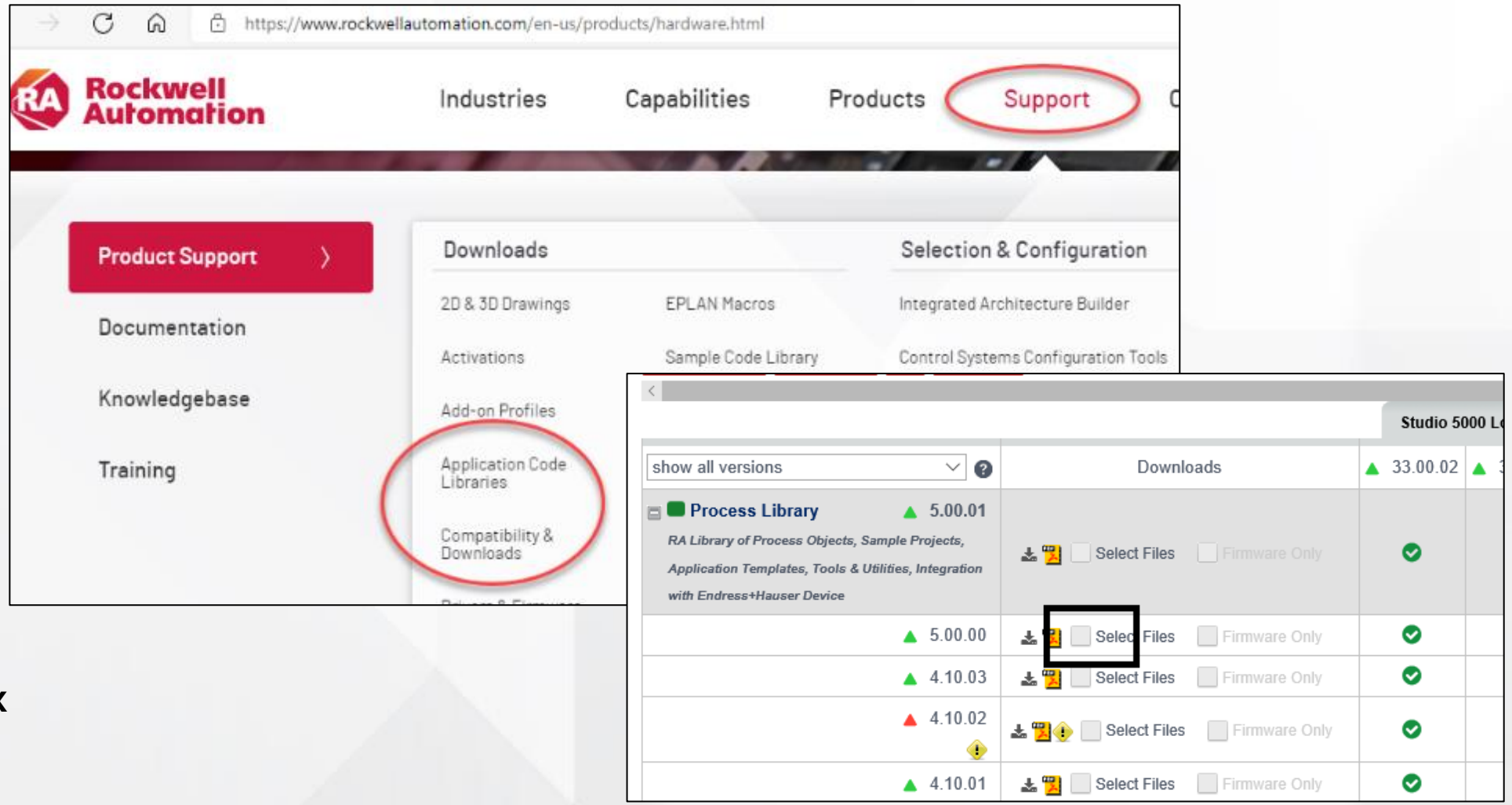
Getting the PlantPAx 5.0 Process Library for ACM

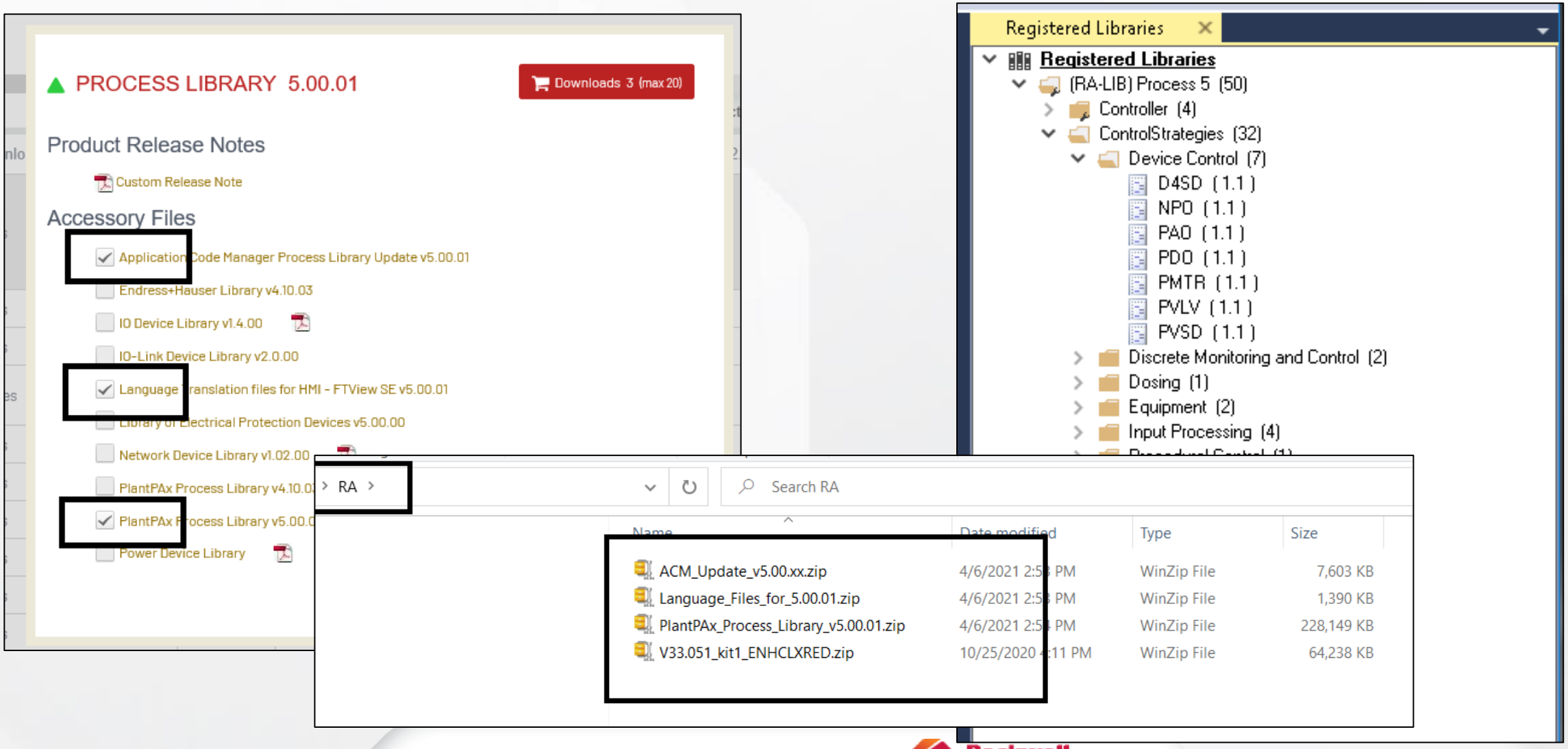
Available at RockwellAutomation.com, Support tab, select Compatibility and Download center, and search for PlantPAx Process.



Managed library objects and faceplates for use with Studio 5000 Application Code Manager (ACM) available in PlantPAx 5.0 and 4.1 Libraries.

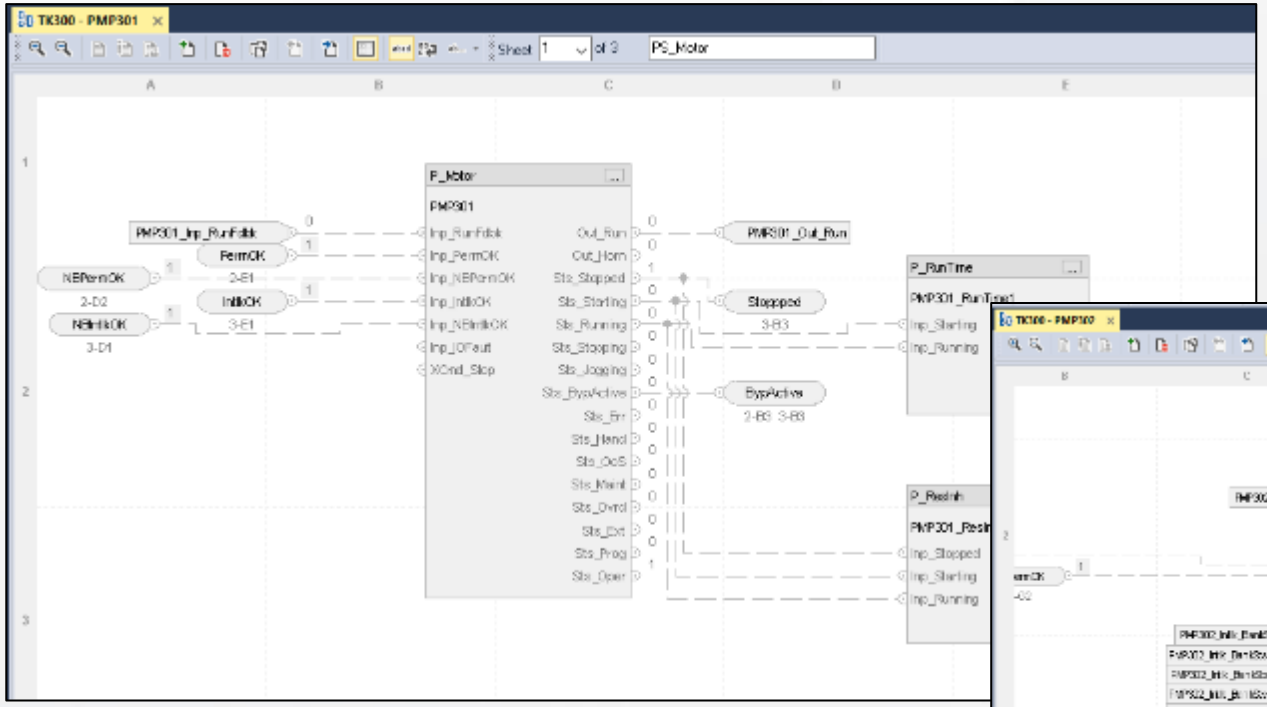
Getting the PlantPAx Library for ACM

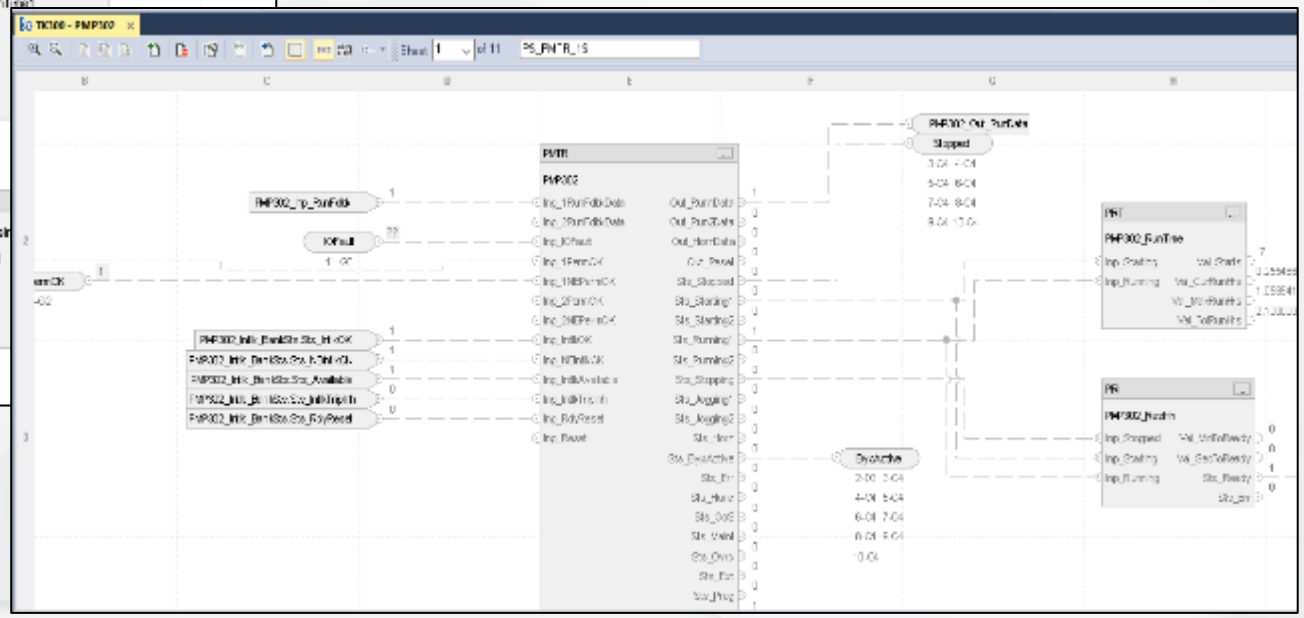
Tested, documented and life-cycle managed library for use with Studio 5000 Application Code Manager (**ACM**)



PlantPAx Process Library includes Process Strategies

PlantPAx Process Library 4.x
Add-On-Instruction (AOI) based
P_Motor block



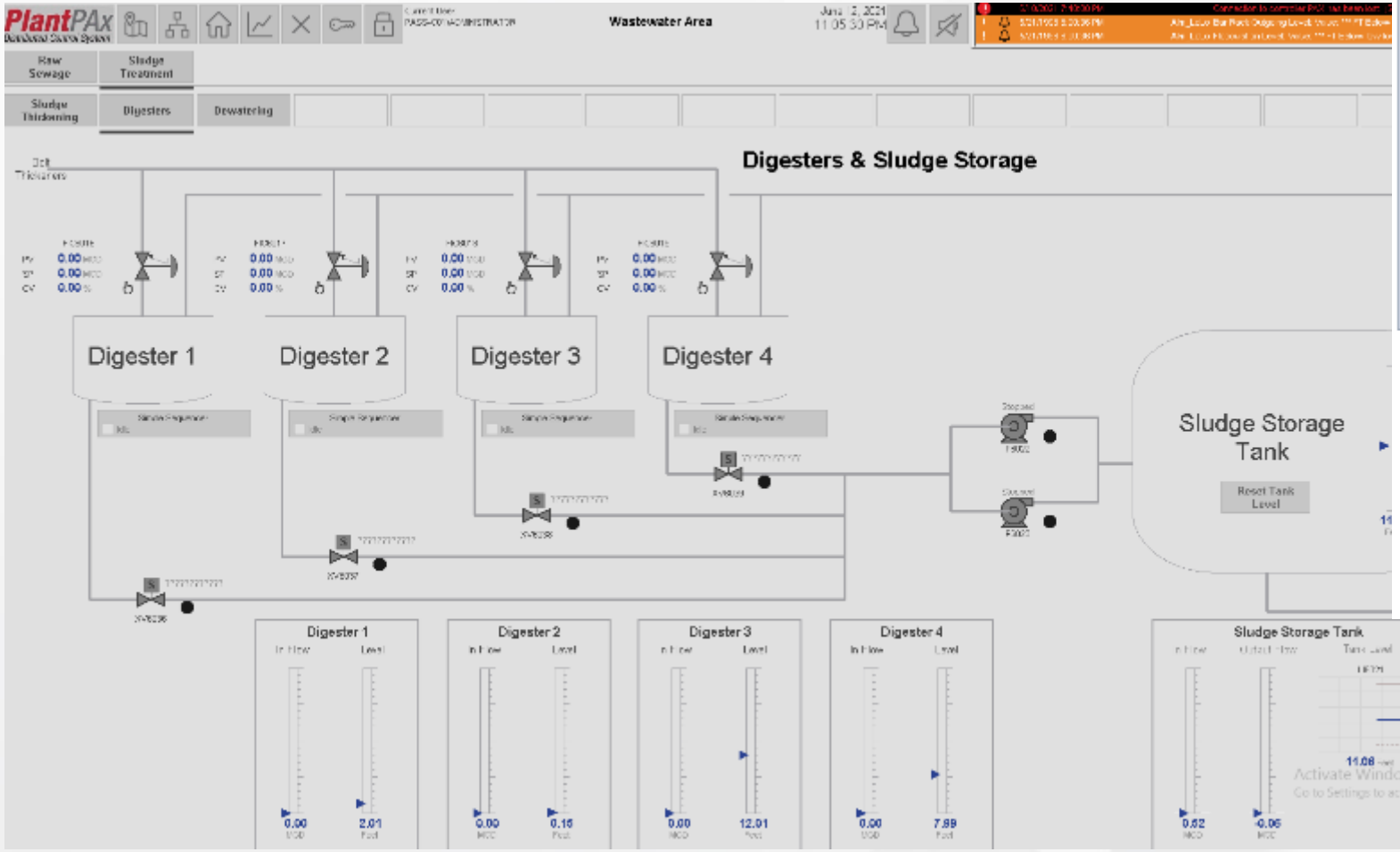


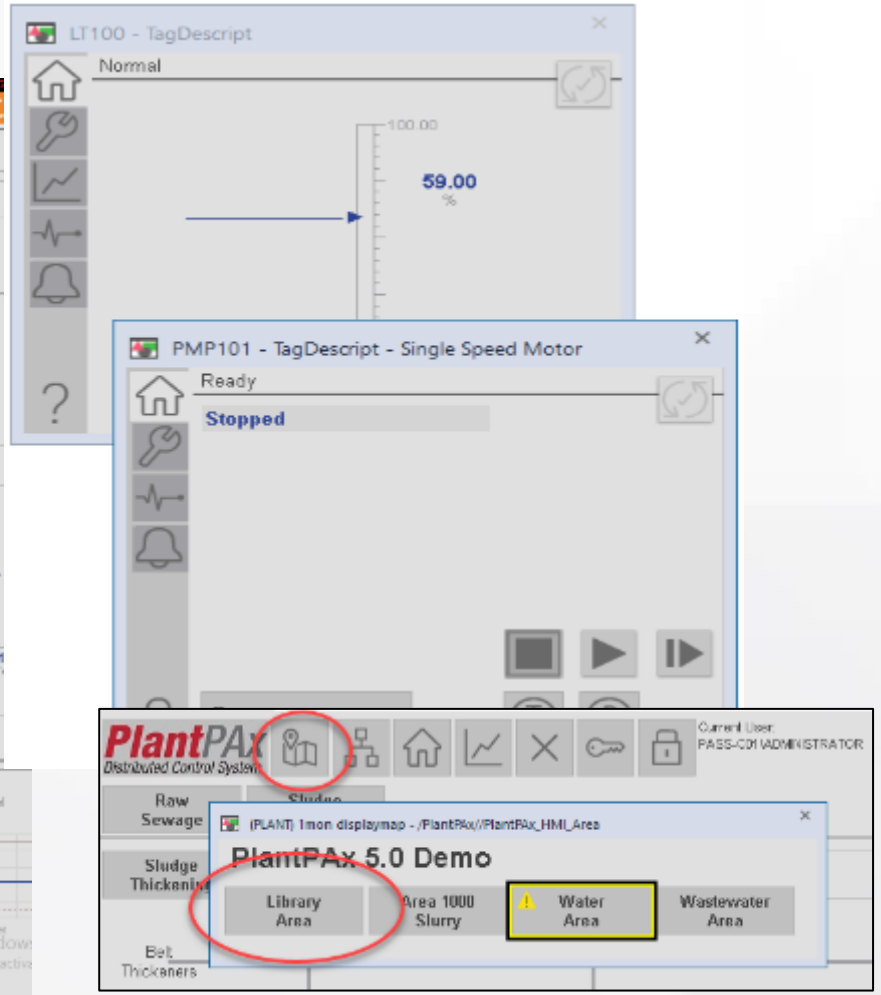
The library is free from the Product Compatibility and Download Center (PCDC).

PlantPAx Process Library 5.0
Firmware based
PMTR Motor block
And new PlantPAx 5.0 Dialog Boxes

PlantPAx Process Library includes Device Objects and Faceplates

The library also contains all the HMI objects for a PlantPAx project.





To see the complete library, download the PlantPAx 5.0 Process Demo Image.

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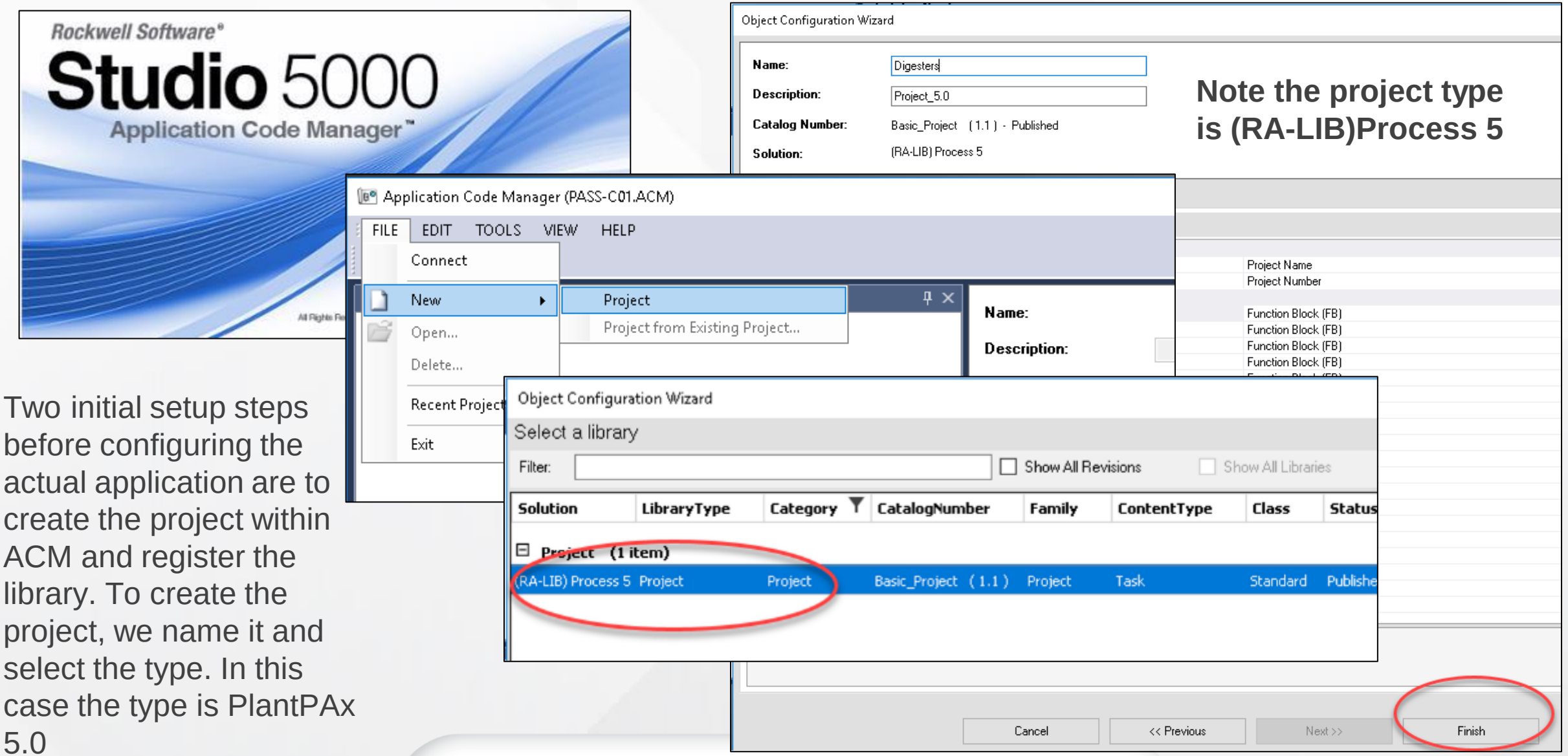
The first step in ACM is to Create a Project

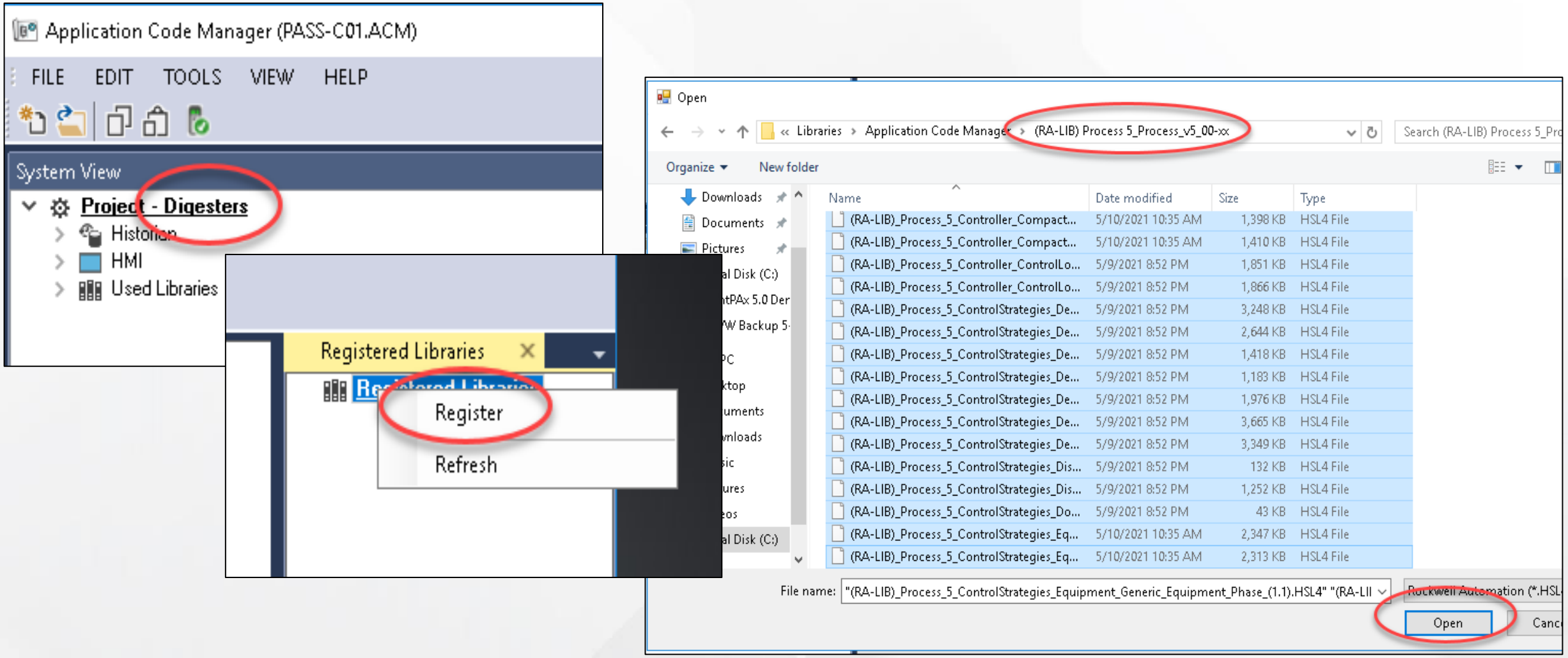


Note the project type is (RA-LIB)Process 5

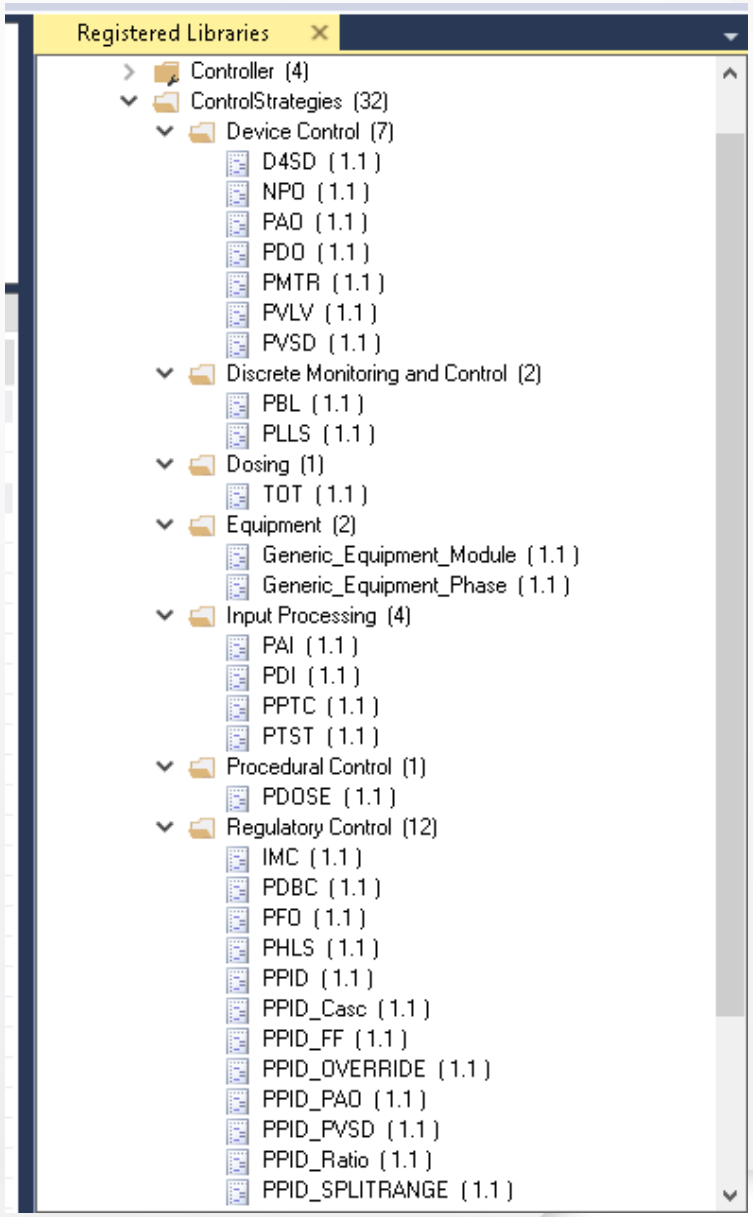
Two initial setup steps before configuring the actual application are to create the project within ACM and register the library. To create the project, we name it and select the type. In this case the type is PlantPAx 5.0

Register the Library

The next step is to register the PlantPAx Process library within ACM.



Process Library 5.0 Instructions and Process Strategies.



Library Resources

LIBRARY OBJECT	LIBRARY OBJECT	LIBRARY OBJECT
I/O PROCESSING	PowerFlex 755 Drive (P_PF755)	**CROSS FUNCTIONAL**
Basic Analog Input (P_AIn)	SMC™-50 Smart Motor Controller (P_SMC50)	Condition Gate Delay (P_Gate)
Analog Input Channel (P_AIChan)	SMC™ Flex Smart Motor Controller	Interlocks with First Out and Bypass (P_Intlk)
Advanced Analog Input (P_AInA		
Dual Sensor Analog Input (P_AI		
Multiple Analog Input (P_AInMu		
Discrete Input Object (P_DIn)		
Discrete Input Object Advanced		
Discrete Output (P_DOut)		
Analog Output (P_AOut)		
Pressure/Temperature Compens (P_PTComp)		
Tank Strapping Table (P_StrapTb		
HART Analog Input (P_AInHART		
HART Analog Output (P_AOutH		
REGULATORY CONTROL		
Proportional + Integral + Deriva Enhanced (P_PIDE)		
Analog Fanout (P_Fanout)		
High or Low Selector (P_HiLoSel		
Deadband Controller (P_DBC)		

REGULATORY CONTROL		
Proportional + Integral + Derivative Enhanced (P_PIDE)	Hand-operated Valve (P_ValveHO)	Logix Change Detector (L_ChangeDet)
Analog Fanout (P_Fanout)	Motor-operated Valve (P_ValveMO)	Logix Controller CPU Utilization (L_CPU)
High or Low Selector (P_HiLoSel)	Mix-proof Valve (P_ValveMP)	Logix Redundant Controller Monitor (L_Redun)
Deadband Controller (P_DBC)	Solenoid-operated Valve (P_ValveSO)	Logix Task Monitor (L_TaskMon)
	2-state Valve Statistics (P_ValveStats)	Logix Module Status (L_ModuleSts)
	n-Position Device (P_nPos)	
PROCEDURAL CONTROL	**STEAM TABLE**	**DISPLAY ELEMENTS AND FACEPLATES FOR BUILT-IN INSTRUCTIONS**
Sequencer Object (P_Seq)	Saturated Steam Pressure (P_PSat)	Built-in Autotuner
Dosing (Weight Scale or Flowmeter) (P_Dose)	Saturated Steam Temperature (P_TSat)	Coordinated Control (CC)
Lead/Lag/Standby Motor Group (P_LLS)	General Steam Table (P_Steam)	Internal Model Control (IMC)
MOTORS	Entropy (P_Steam_hs)	Modular Multivariable Control (MMC)
Single-speed Motor (P_Motor)	Steam Properties Given Pressure and Enthalpy (P_Steam_ph)	Ramp Soak (RMPS)
Two-speed Motor (P_Motor2Spd)	Steam Properties Given Pressure and Entropy (P_Steam_ps)	Totalizer (TOT)
Reversing Motor (P_MotorRev)	Hand-operated Motor (P_MotorHO)	P_DInAdv (speed switch)
Hand-operated Motor (P_MotorHO)	Modular Multivariable Control (MMC)	P_IntlkAdv (interlocks)
Discrete 2-, 3-, or 4-state Device (P_D4SD) (also used for valves)	Proportional + Integral + Derivative Enhanced (PIDE)	
PowerFlex® 523/525 VF Drives (P_PF52x)	Ramp Soak (RMPS)	
PowerFlex 753 Drive (P_PF753)	Totalizer (TOT)	

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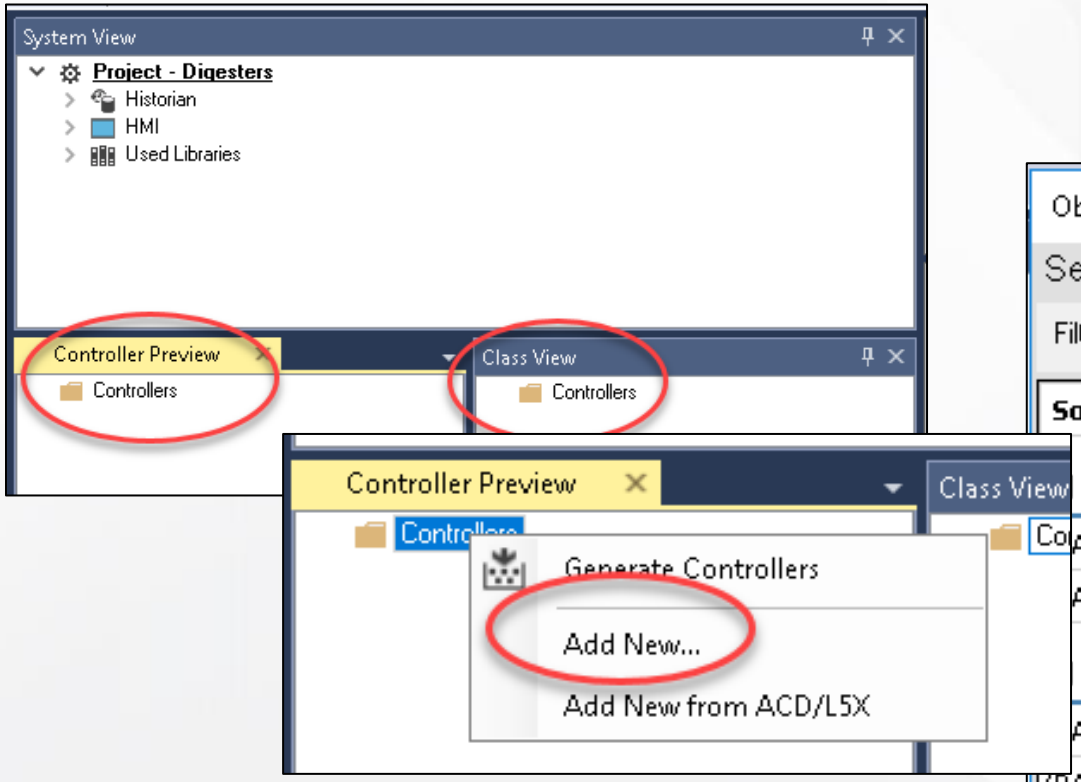
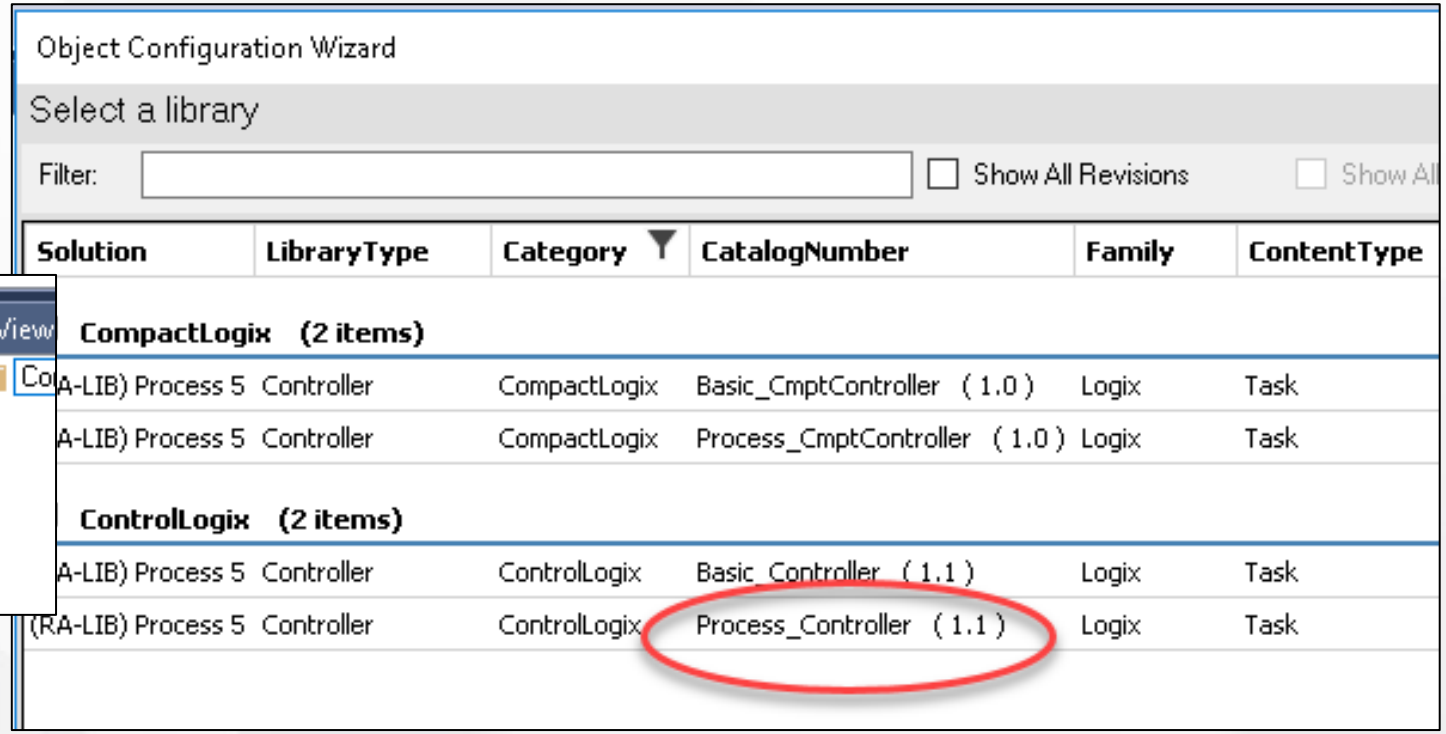
Add a Controller to the Project

Note no controllers exist in the project yet. Add a Process Controller 1756- L85EP for PlantPAx 5.0.





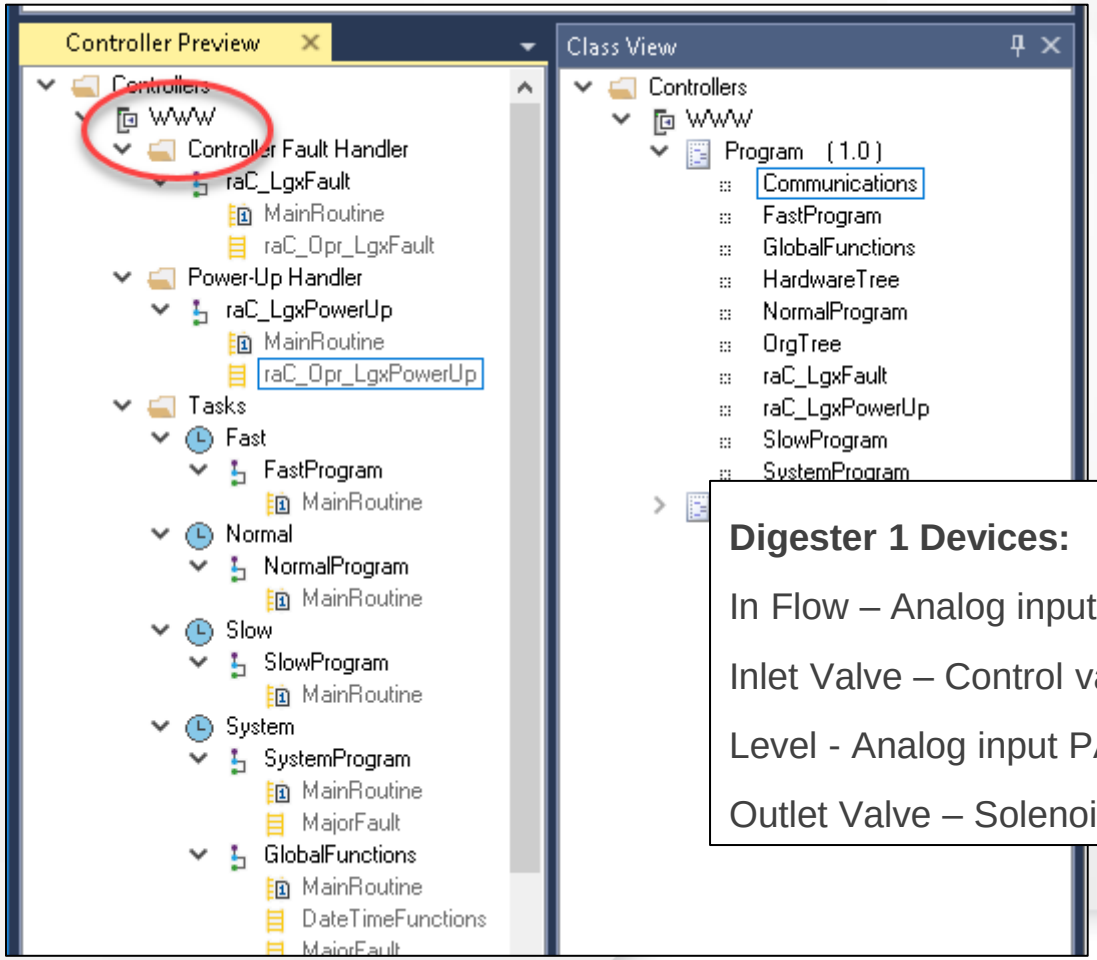
Controller Preview shows what content will be generated in the final ACD from the configured Class View library objects.

Class View shows all the configured library objects as well as all the instances.

PlantPAx Task Model

The PlantPAx Task Model includes Slow, Normal and fast tasks.

The WasteWater Digester application – inlet flow, level and outlet valve is added to the normal task running at 250ms.



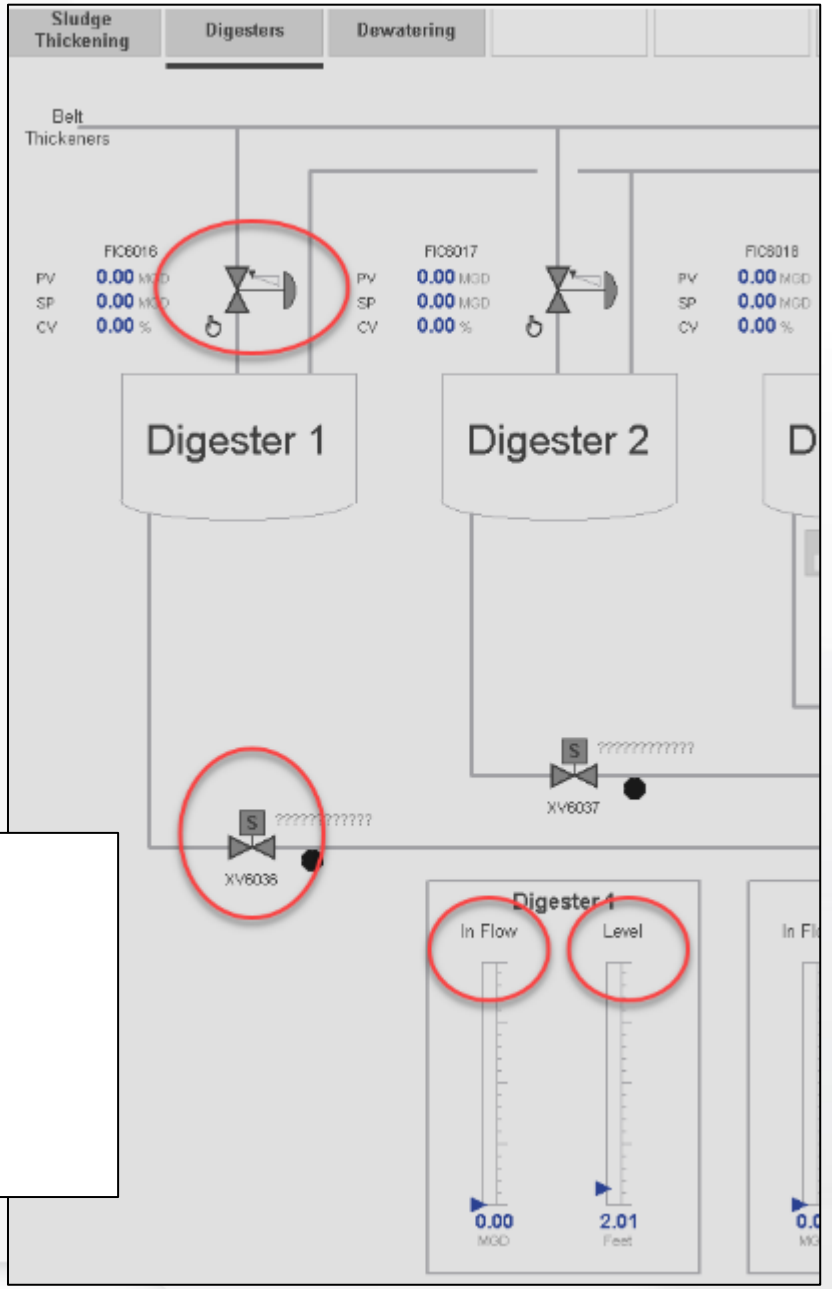
Digester 1 Devices:

In Flow – Analog input PAI - WWW_FI6016

Inlet Valve – Control valve PPID - WWW_FIC6016

Level - Analog input PAI - WWW_LI6011

Outlet Valve – Solenoid valve PVLV - WWW_XV6036



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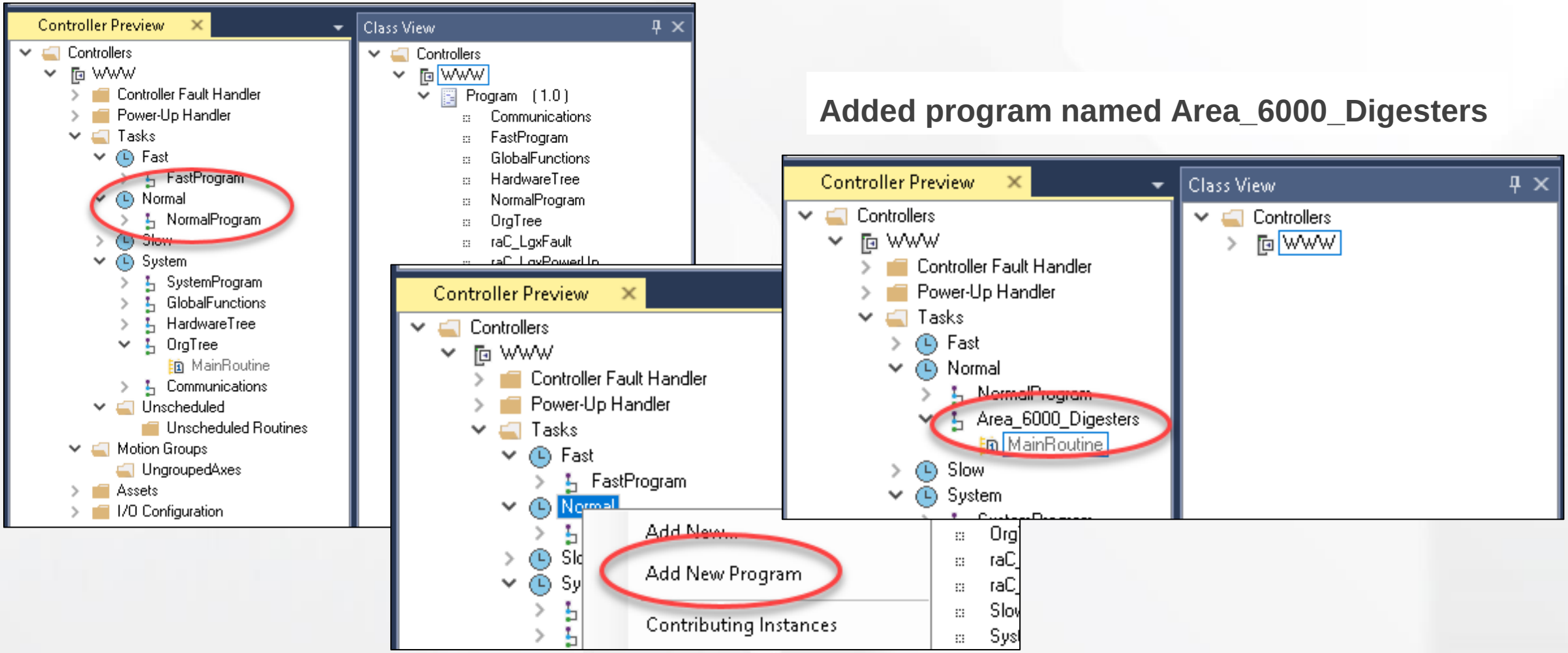
Configuring the Normal Task – adding a Program

Add new program to the Normal Task.



Added program named Area_6000_Digesters

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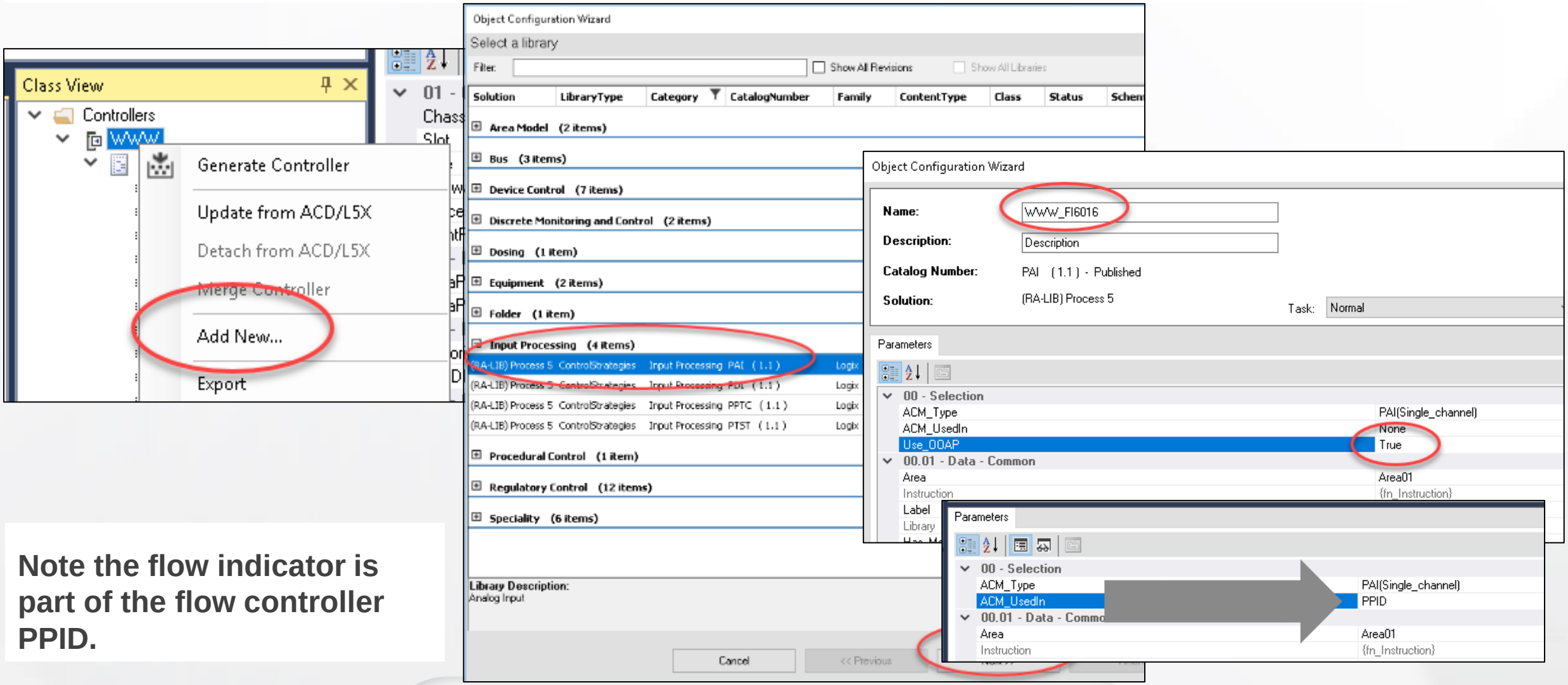
Add Process Strategies to the Controller

Add flow indicating control strategy (PAI) named WWW_FI6016 to the digester program.



Note the flow indicator is part of the flow controller PPID.

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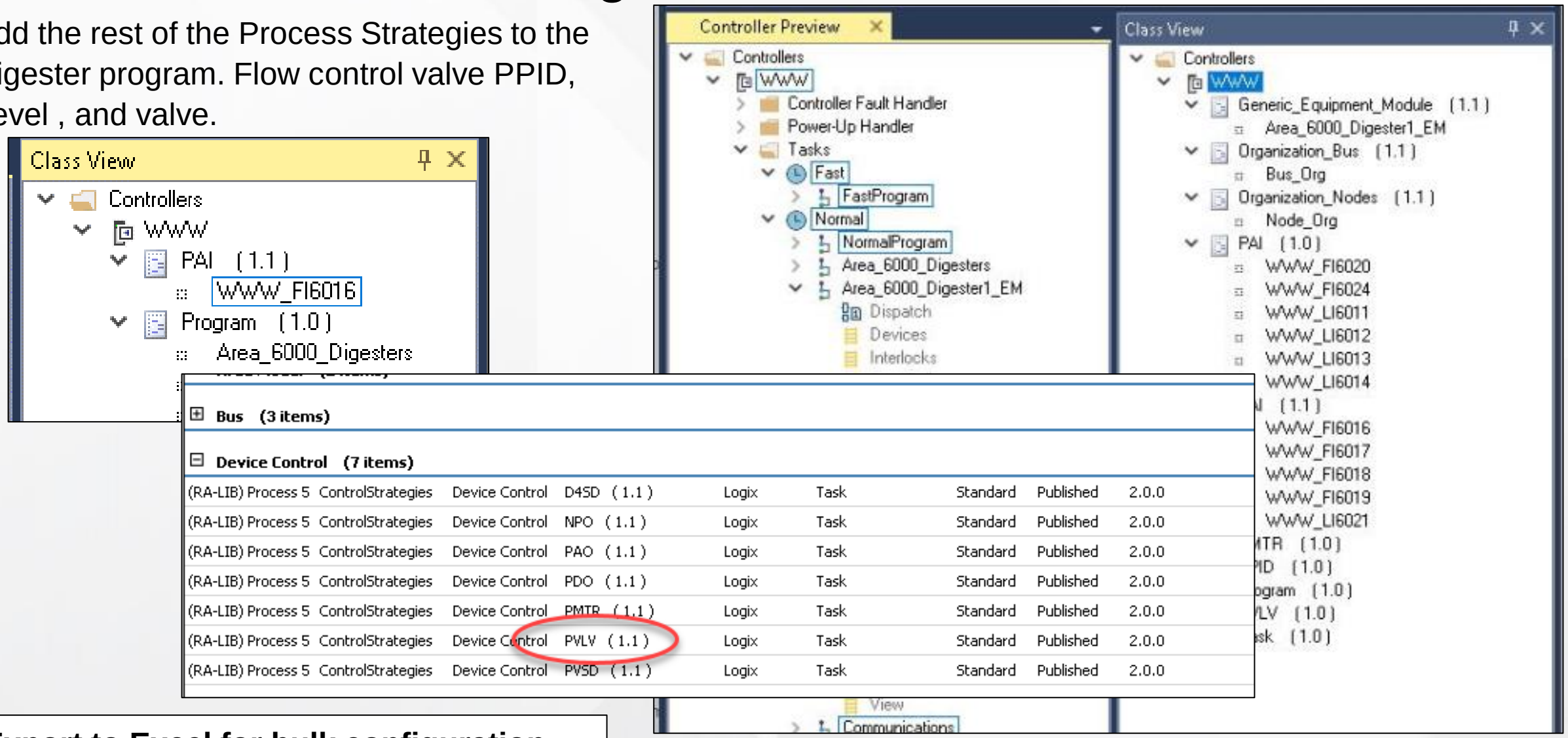
Add More Process Strategies to the Controller

Add the rest of the Process Strategies to the Digester program. Flow control valve PPID, Level , and valve.



Export to Excel for bulk configuration

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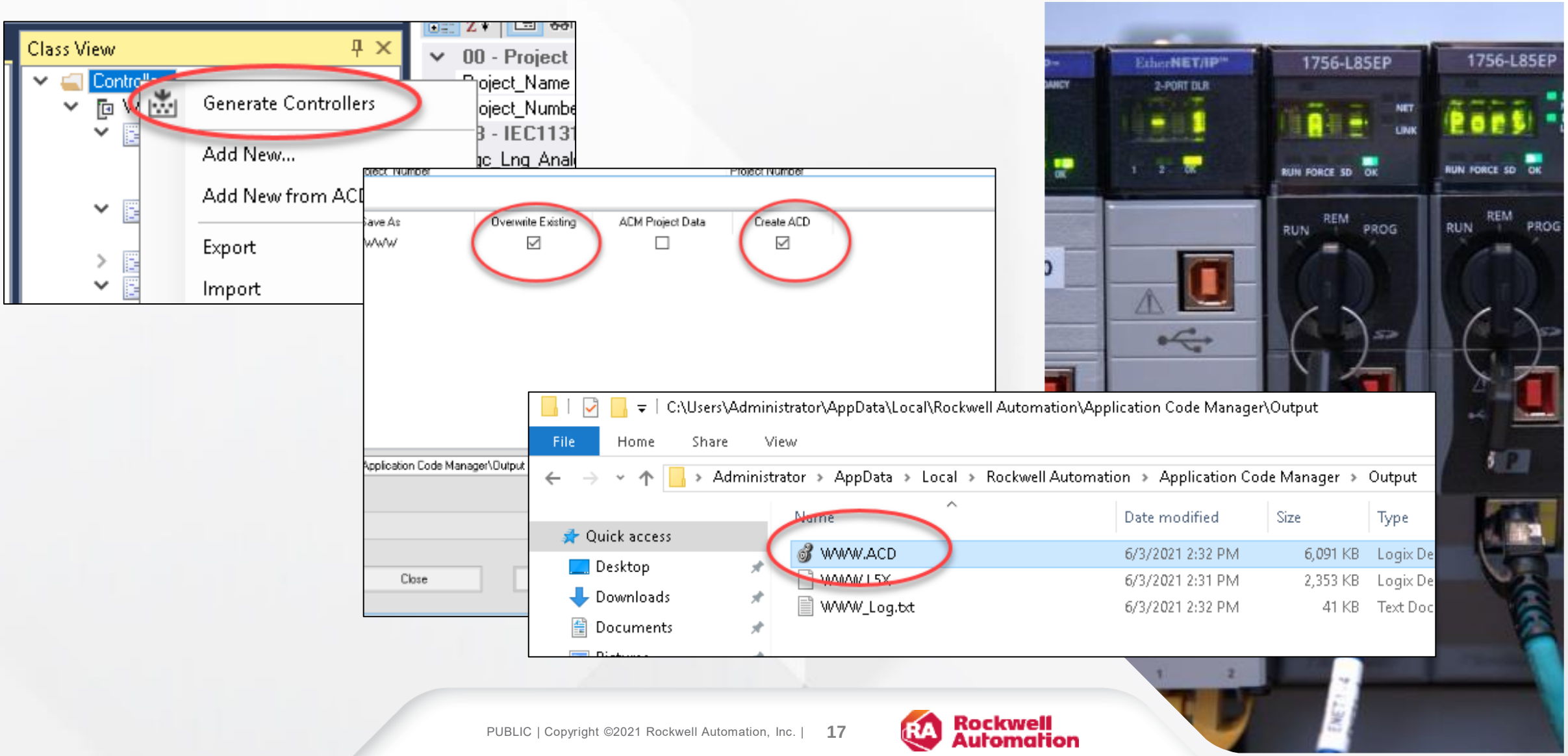
Generate the Controller Code

Once all the Control Strategies are added we can generate the controller ACD file.



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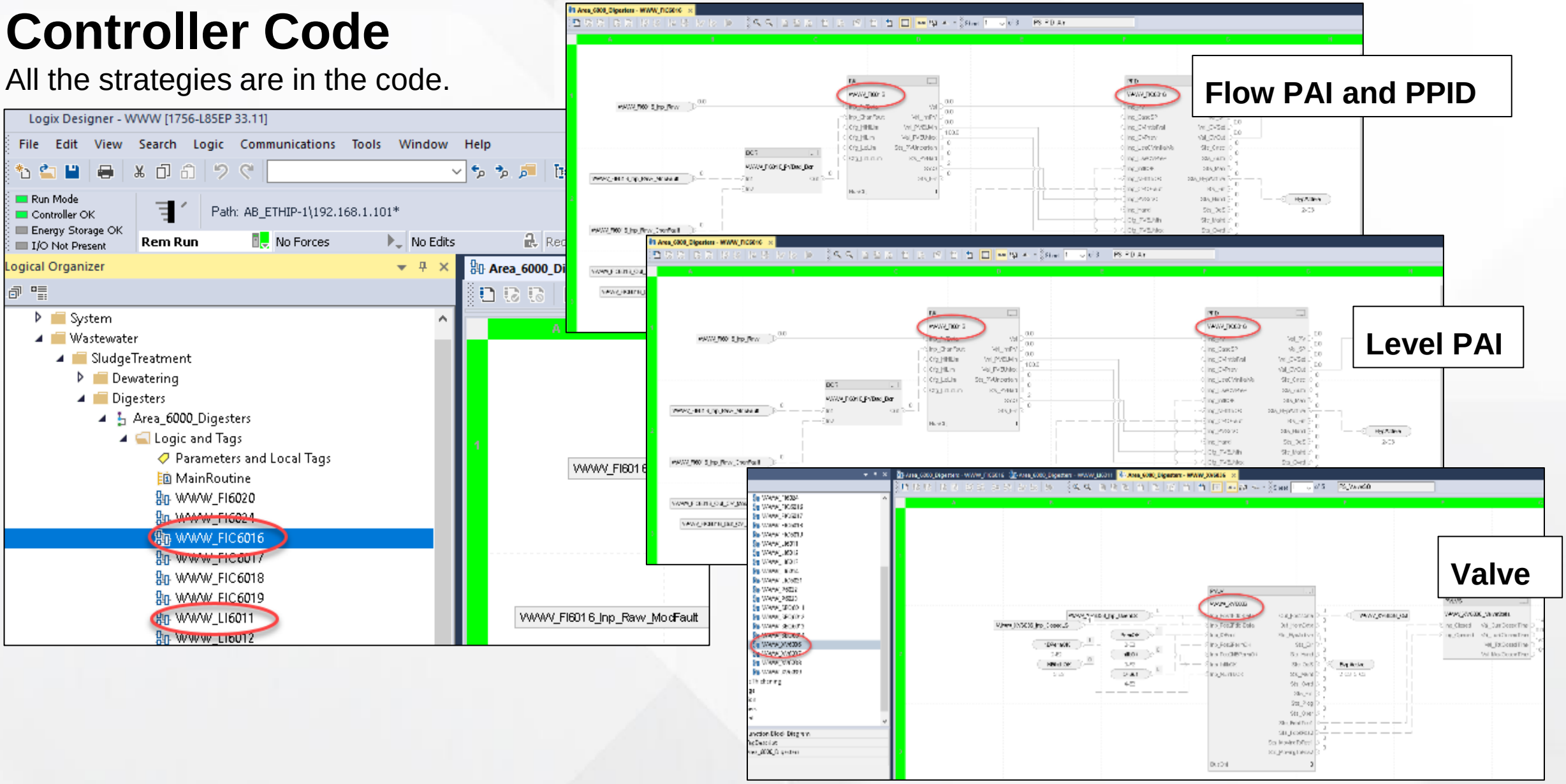
Controller Code

All the strategies are in the code.



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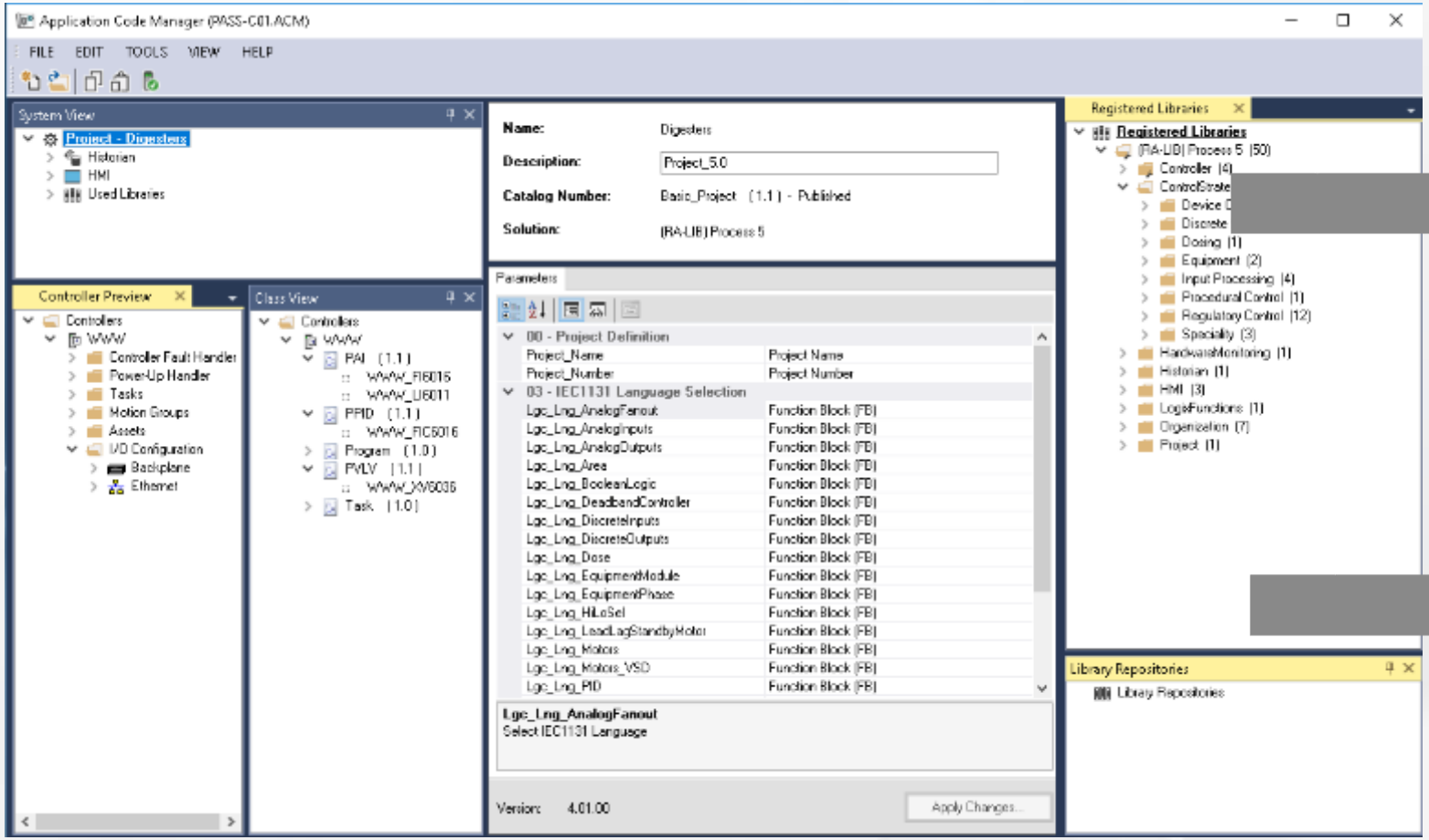
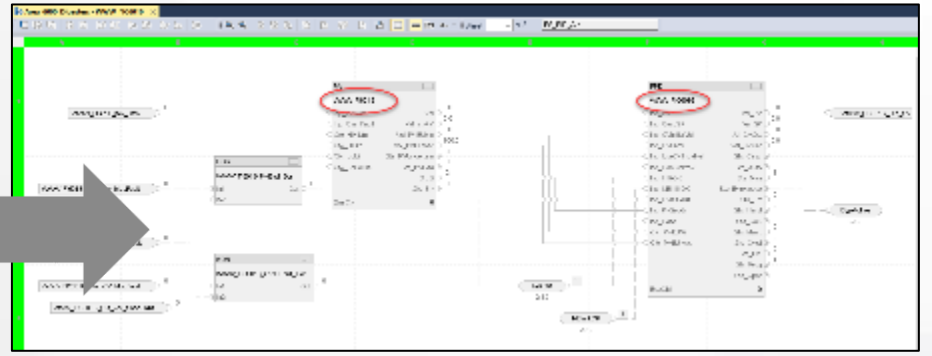
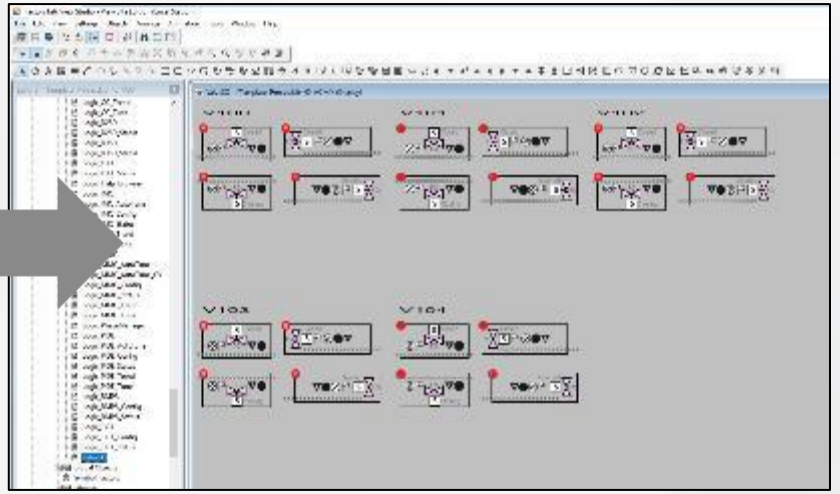
ACM can also create the HMI objects

ACM and the Library of Process Objects can also be used to quickly configure the HMI FactoryTalk View Studio application that comprise a PlantPAx System. This can help reduce the engineering time to assemble a new integrated architecture process HMI application.







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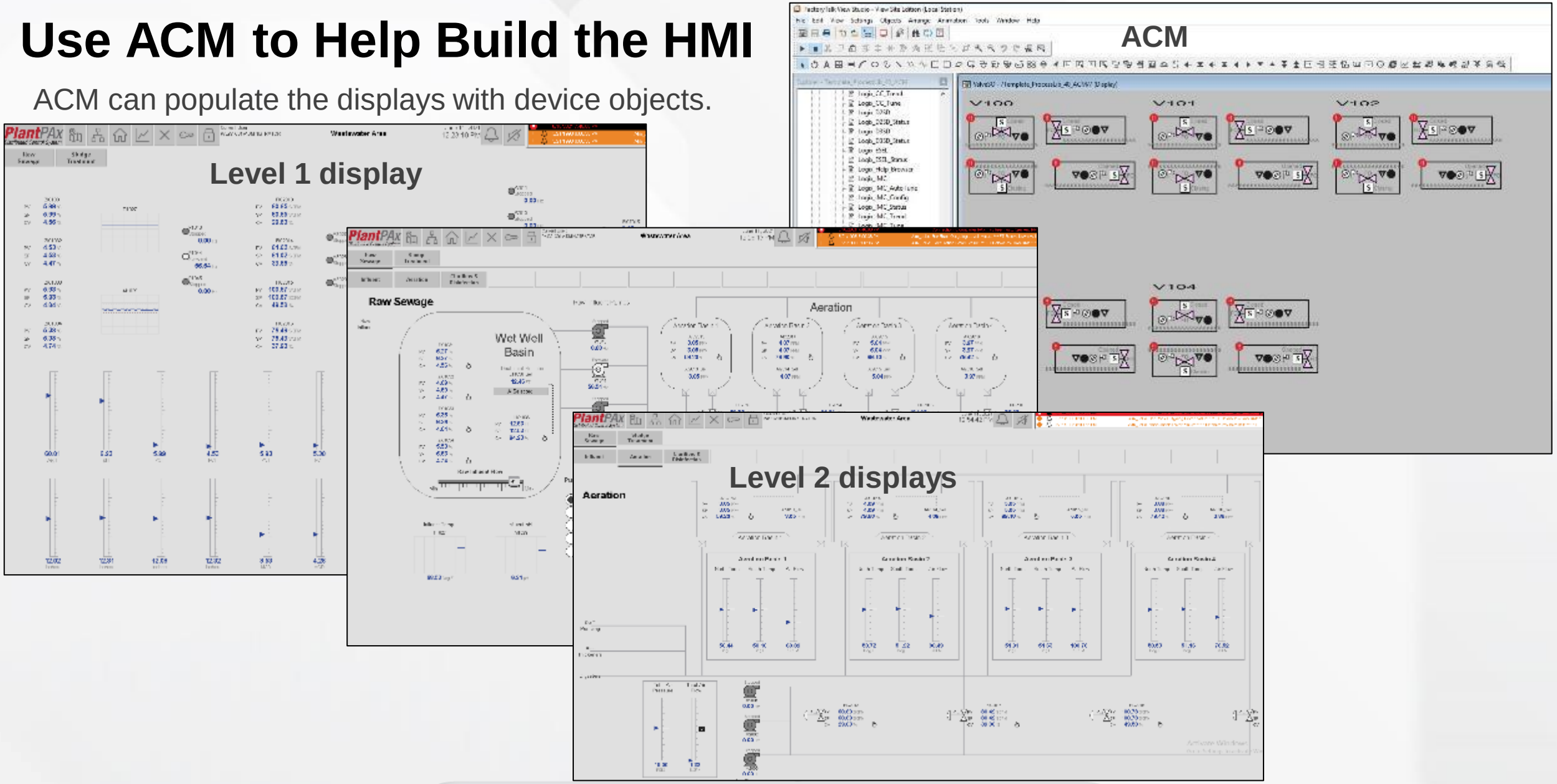
Use ACM to Help Build the HMI

ACM can populate the displays with device objects.



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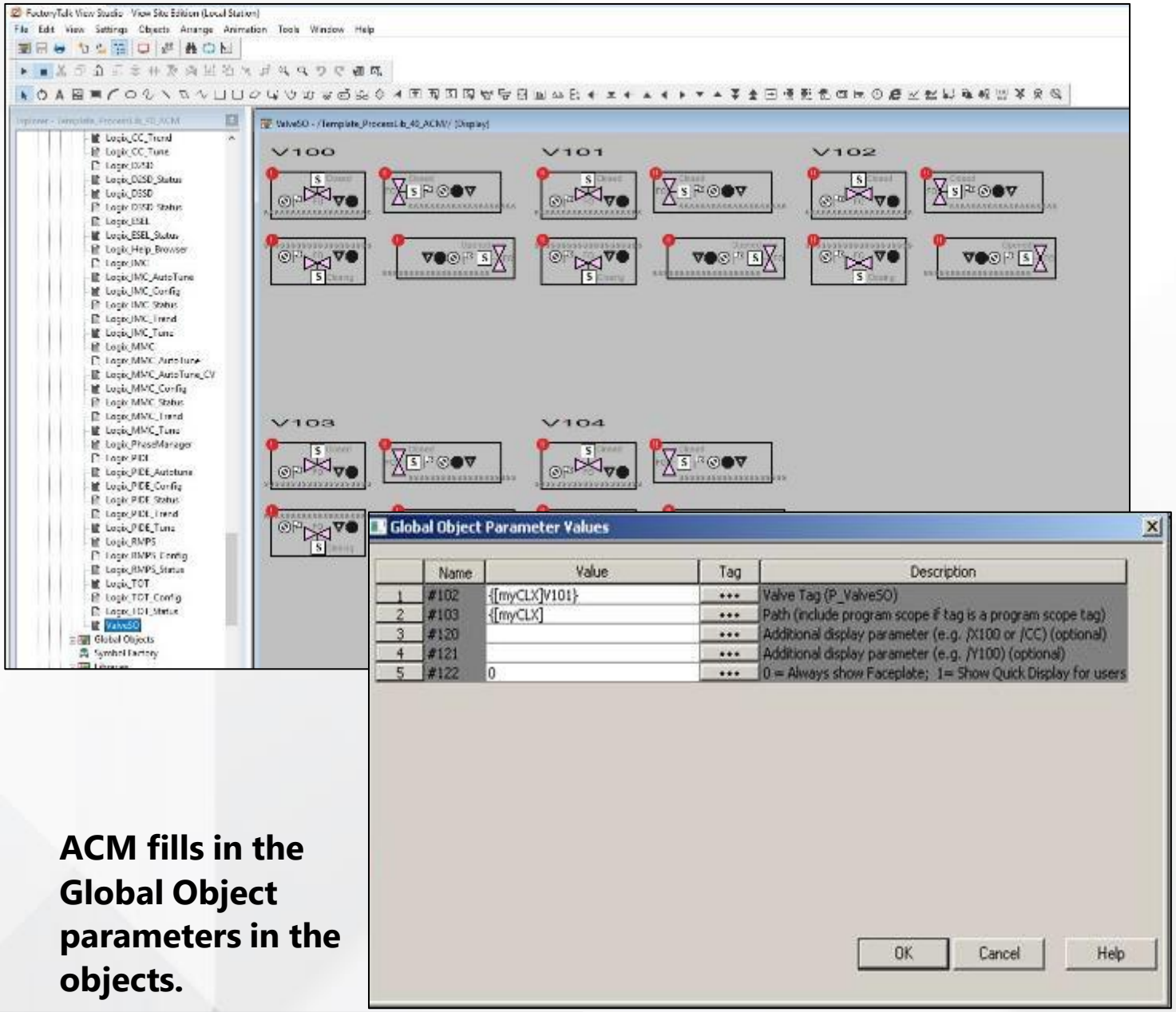
ACM HMI

ACM creates PlantPAx Library based graphics with the Global Object Parameter Values already correct.

To configure ACM using the PlantPAx HMI Library, you use View Studio to see which orientation of the global object you want, and ACM creates PlantPAx Library based graphics with the Global Object Parameter Values already correct.

Also:

ACM also generates FactoryTalk Alarms and Events Content for 4.x libraries (AOI based) and Historian tags.



ACM fills in the Global Object parameters in the objects.

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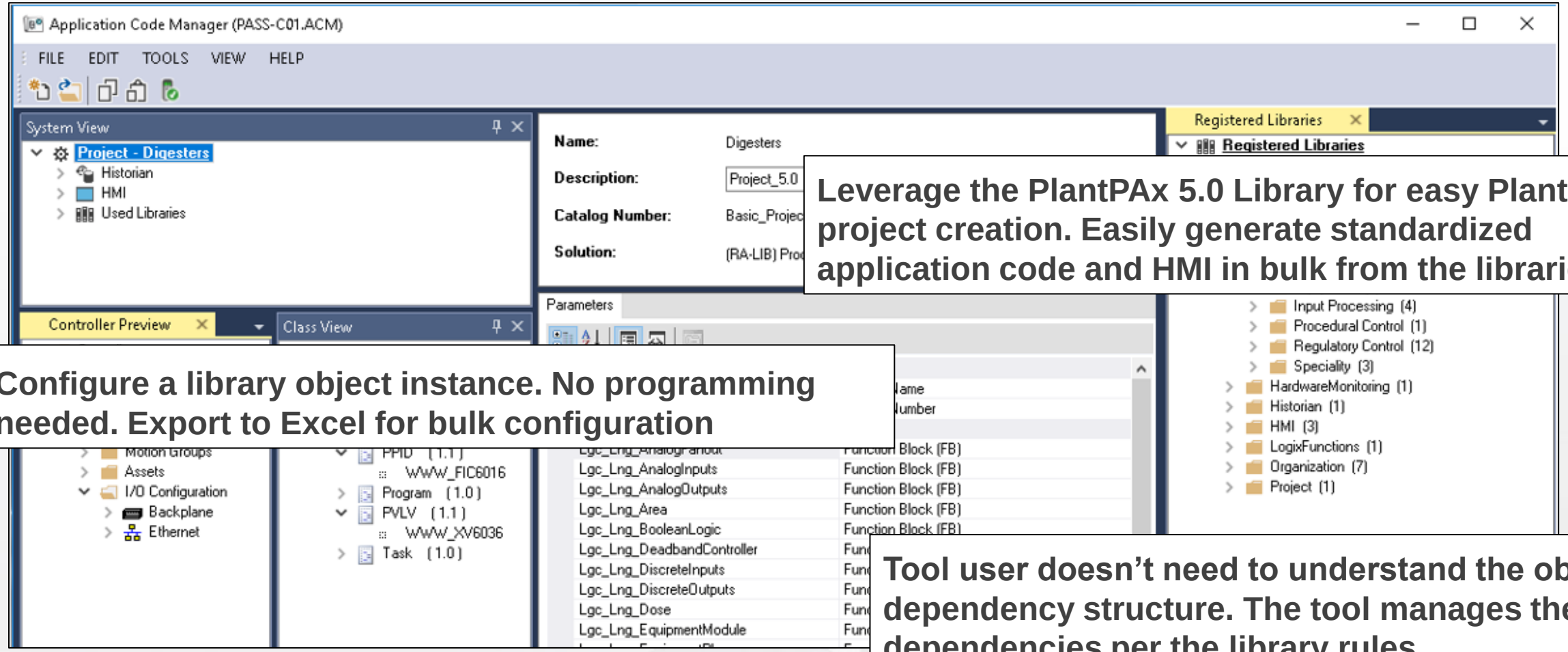
Summary

ACM has a free and paid version. The free version of Application Code Manager can only connect to a local database instance and only support a single controller per project. Projects with multiple controllers will need a license. The PlantPAx Process Library is free.



Leverage the PlantPAx 5.0 Library for easy PlantPAx project creation. Easily generate standardized application code and HMI in bulk from the libraries.

Configure a library object instance. No programming needed. Export to Excel for bulk configuration

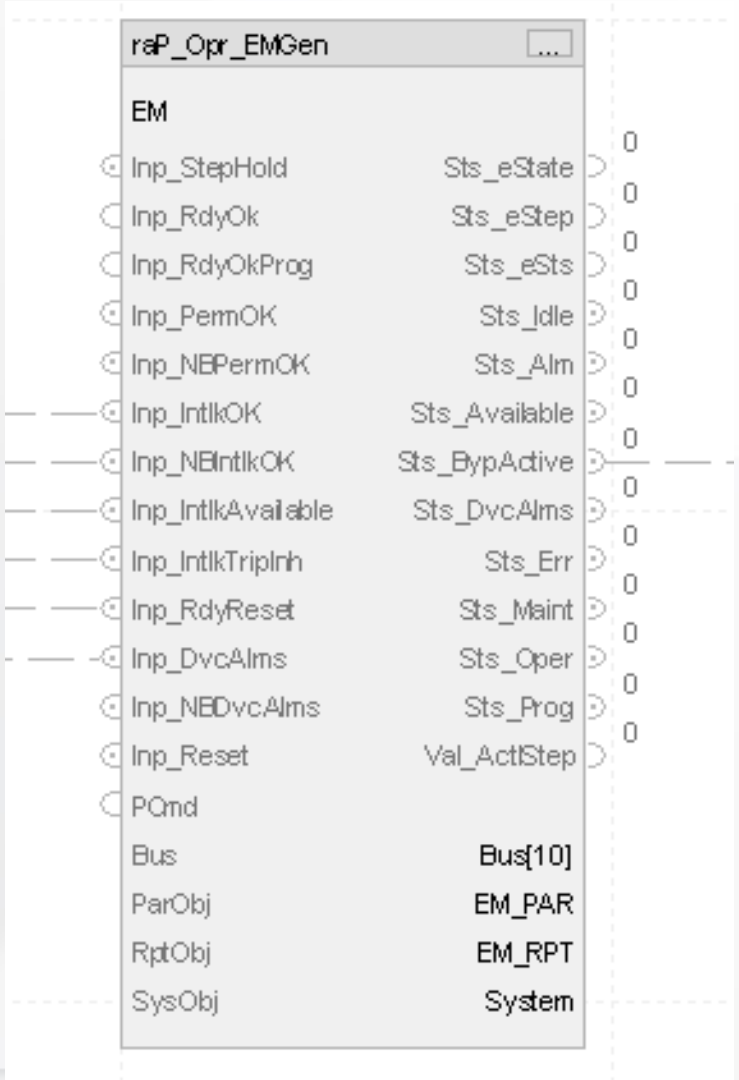
Tool user doesn't need to understand the object dependency structure. The tool manages the dependencies per the library rules.

Thank you,
Now Jason will present an overview on the new Equipment Module (EM) and use ACM to add an EM to the process strategies created above. He will then give an overview of the Organization Bus and review the final state logic in the controller file (ACD) that ACM generated.

PlantPAx 5.0 Equipment Module (EM)

Using ACM to create and configure the PlantPAx Equipment Module

- The raP_Opr_EMGen (Generic Equipment Module) object controls an Equipment Module in a variety of command sources and monitors for fault conditions. The PlantPAx EM allows users to configure up to 32 equipment states.
- An equipment module can be configured to operate independently, or one or several EMs can be moved to specific states by an Equipment Phase according to a product recipe.
- For this webinar we will be focusing on configuring and using a single equipment module to control the states of a Wastewater Digester.



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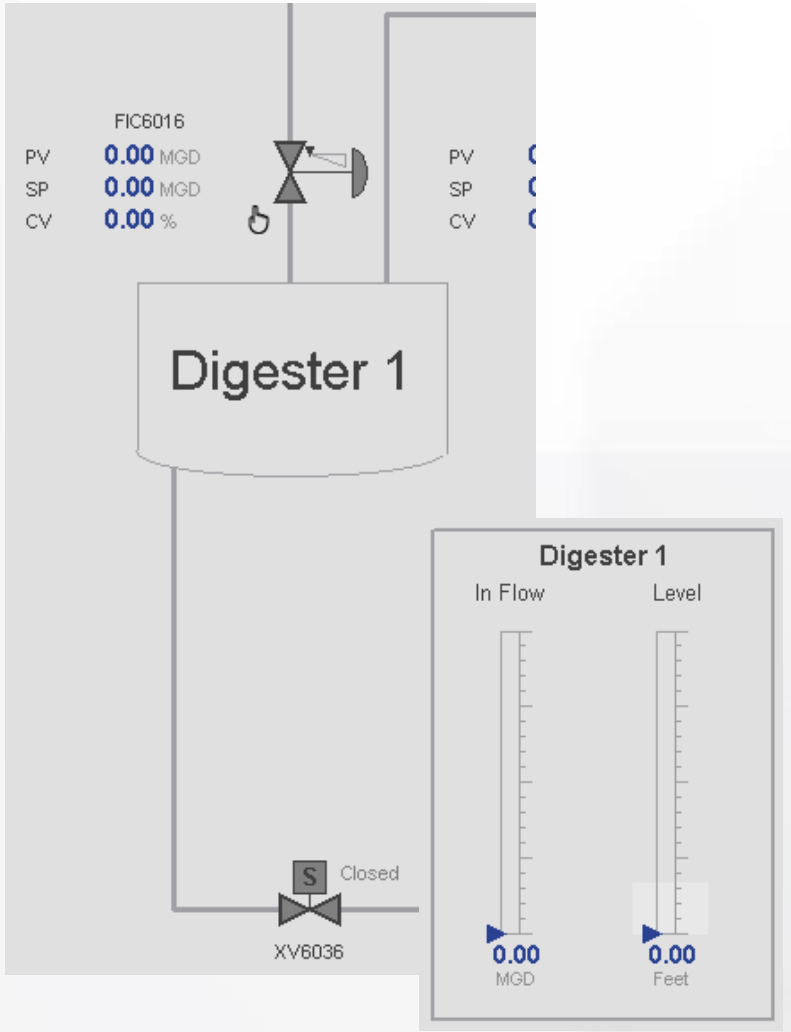
Wastewater Digester

This section of the presentation will build upon the Control Strategies that we just created.

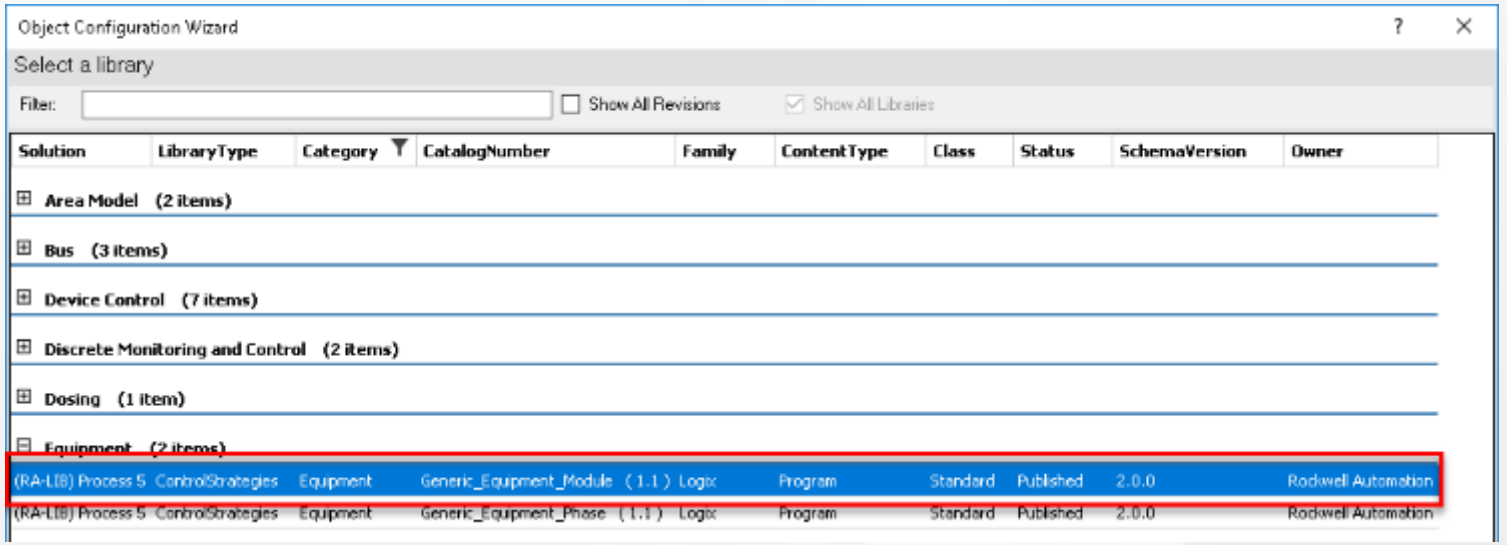
- The Digester EM will manipulate the PPID Control Valve FIC6016 and Discharge Valve XV6036 to either Drain or Fill the digester tank.
- The user will enter two parameters – Tank Level Setpoint and Flow Rate of the liquid entering the tank.

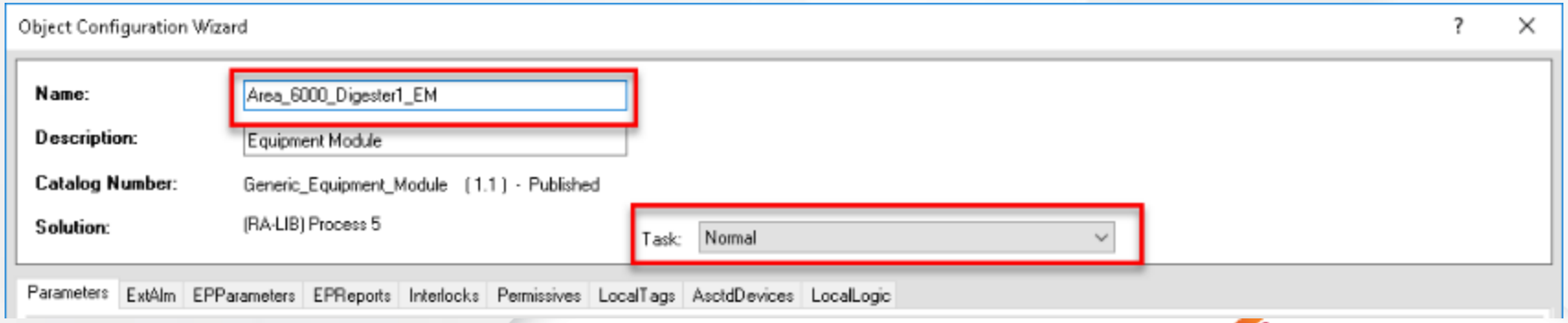


	Off	Drain	Fill
FIC6016	Off	Off	PV following SP from Parameter
XV6036	Closed	Opened	Closed
LI6011	At Setpoint	Draining to SP	Filling to SP

Using ACM to create the EM Program

- ACM can be used to easily create and configure an Equipment Module. It gives the user the ability to associate devices, create EM state routines, and configure parameters, interlocks, permissives, and alarms.
- Begin by right clicking the controller in ACM and selecting Add New, then select the Generic_Equipment_Module Control Strategy. Name the EM and select the Task.



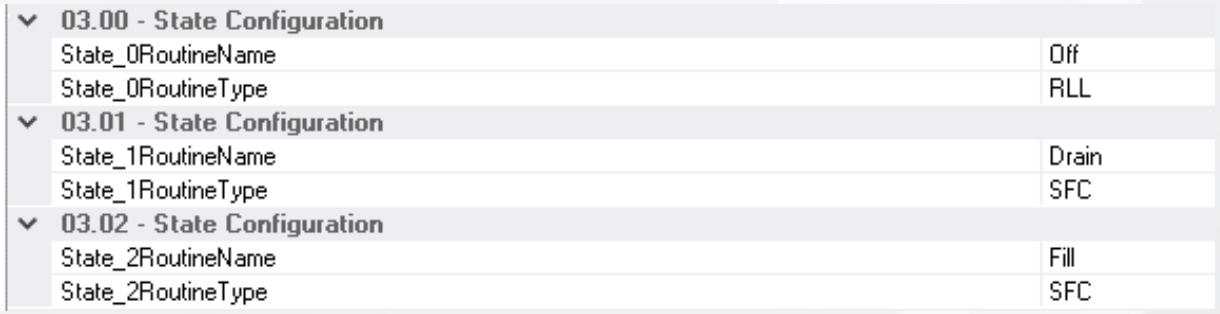


Using ACM to create the EM Program

- Set the number of states in Cfg_NumStates. This EM will have 3 states – Off, Drain, and Fill.

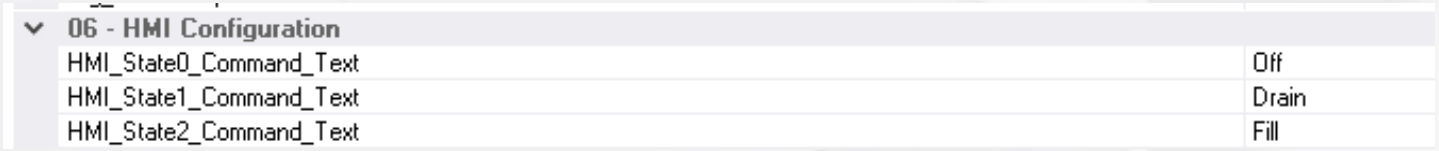
02 - Device Configuration	
Cfg_NumStates	3
Cfg_PermAllowCmd	0
Cfg_HasParCmds	False
Cfg_HasRptCmds	False
Cfg_WaitRptData	False
Cfg_AllowShelve	True
Cfg_AllowDisable	True
Cfg_HasMoreObj	False
Cfg_ShedOnExtddAlms	True
Cfg_ShedOnIntlk	
Cfg_IdleState	0

- Configure the Routine Name and Routine Type for each state.



03.00 - State Configuration	
State_0RoutineName	Off
State_0RoutineType	RLL
03.01 - State Configuration	
State_1RoutineName	Drain
State_1RoutineType	SFC
03.02 - State Configuration	
State_2RoutineName	Fill
State_2RoutineType	SFC

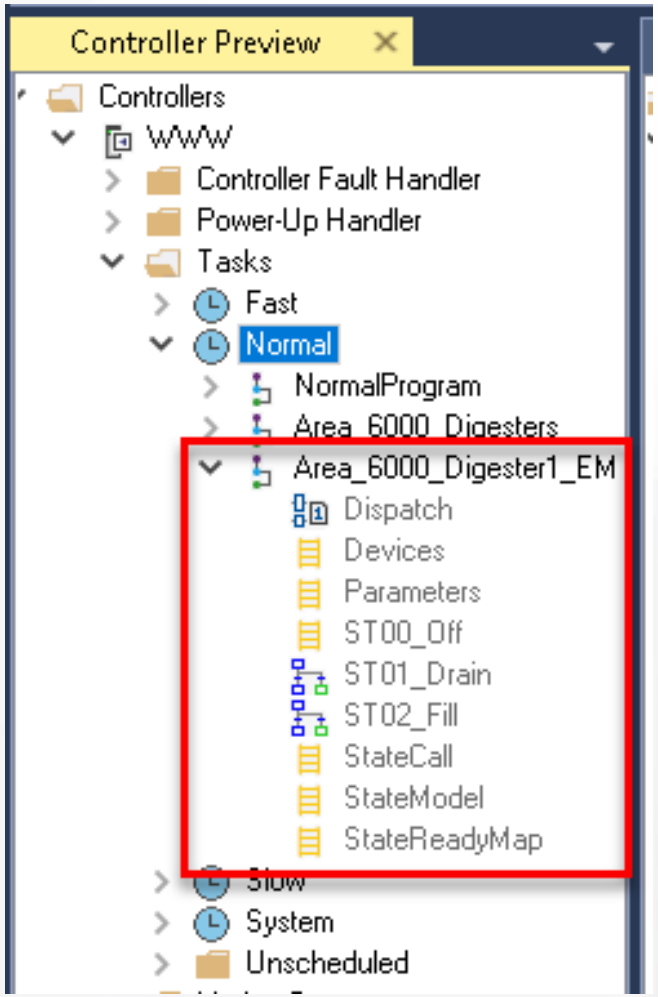
- Configure the HMI State Button Text.



06 - HMI Configuration	
HMI_State0_Command_Text	Off
HMI_State1_Command_Text	Drain
HMI_State2_Command_Text	Fill

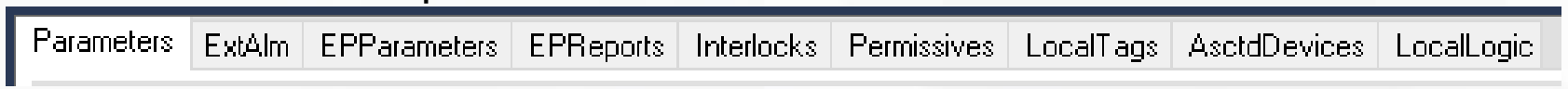
Using ACM to create the EM Program

- Click Finish to create the EM Program. The Digester EM should now be created under the Normal task with the Off, Drain, and Fill routines.
- If you intend on using Interlocks or Permissives, be sure to set Cfg_HasIntlkObj and Cfg_HasPermObj parameters in the 01 – Programming and Execution section to true.

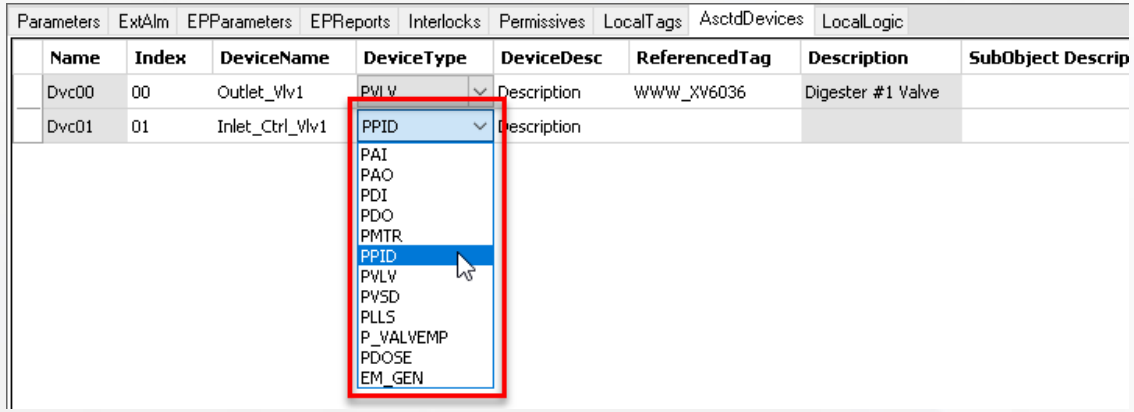


Configure Associated Devices

- Once we have the EM Program created, we can assign things like associated devices, parameters, alarms, interlocks, and permissives.



- To configure the associated devices, navigate to the AsctdDevices tab in the EM configuration. Right click in the blank area and select Add New. The DeviceName field is the name of the Alias Tag that will be created, while the ReferencedTag field is where we will select the Control Strategies we created earlier in this presentation. Select the appropriate Device Type in the drop-down menu for each device.

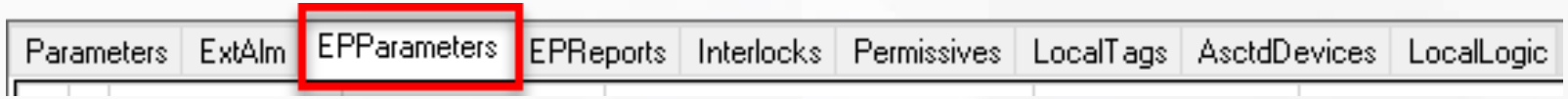


- The four Associated Devices for this Digester EM are configured as follows:

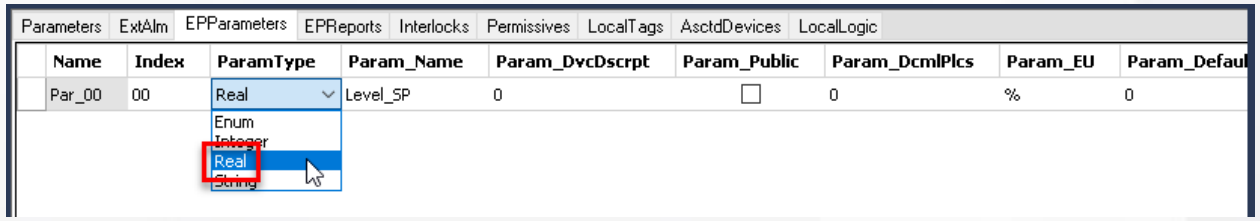
Name	Index	DeviceName	DeviceType	DeviceDesc	ReferencedTag	Description	SubObject Description
Dvc00	00	Outlet_Vlv1	PVLV	Description	WWW_XV6036	Digester #1 Valve	
Dvc01	01	Inlet_Ctrl_Vlv1	PPID	Description	WWW_FIC6016	PID Control Loop	
Dvc02	02	Inlet_Flow1	PAI	Description	WWW_FI6016	Flow In Digester #1	
Dvc03	03	Tank_Level1	PAI	Description	WWW_LI6011	Digester #1 Level	

Configure Parameters

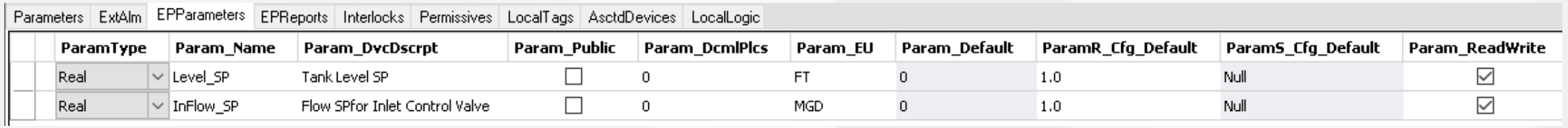
- The last step necessary to configure the Digester EM is to configure the Level Setpoint and Flow parameters. These can be created in the EPParameters tab.



- Right click in the parameter area and click Add New. Select the Parameter Type, Give the Parameter a name, and set the appropriate EU.

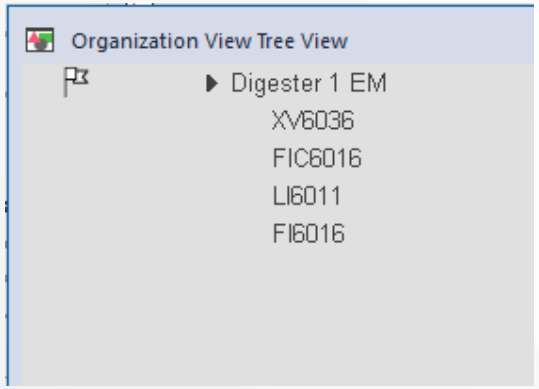


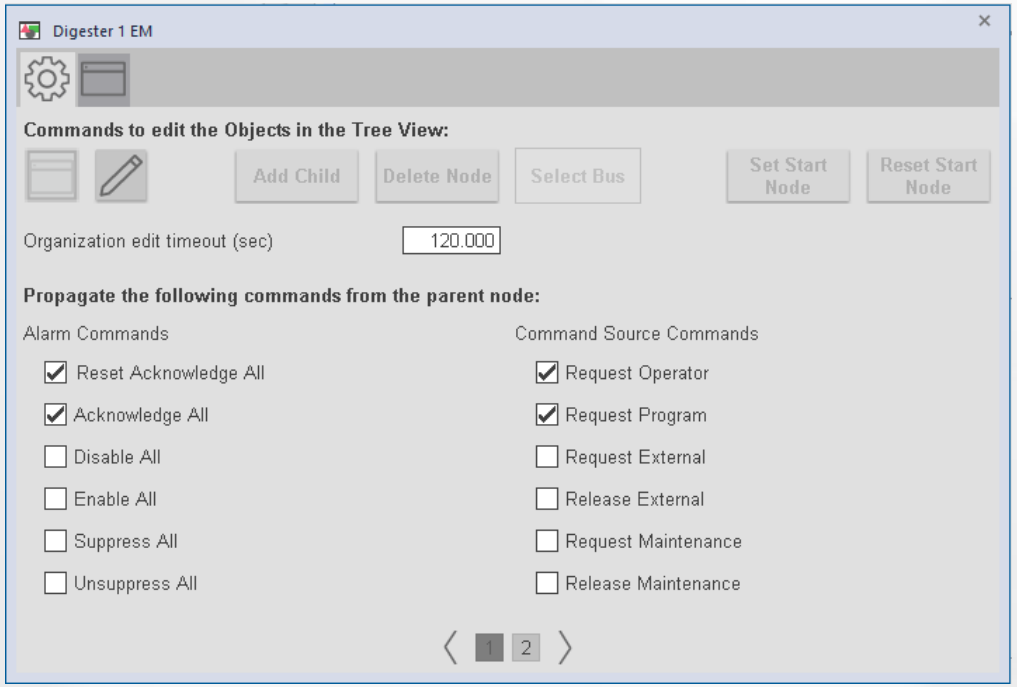
- The completed parameters for the Digester EM are shown below:



PlantPAx 5.0 Organization Bus

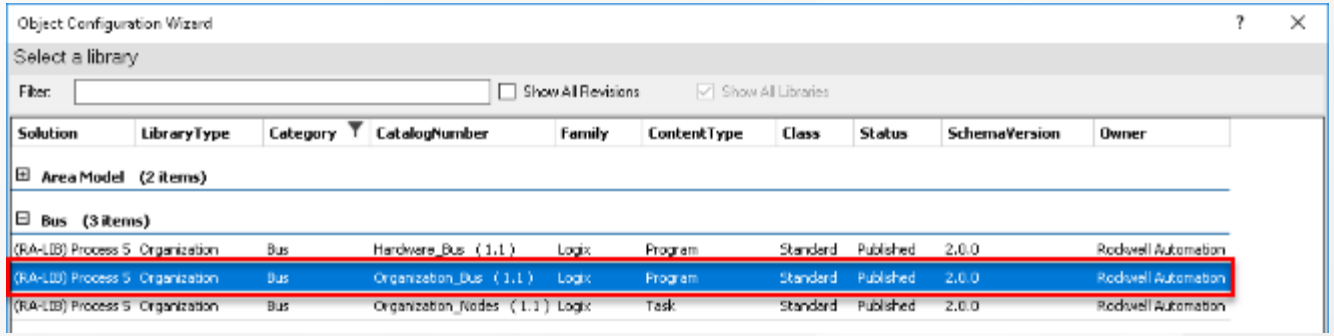
- Organization is a method by which parent / child relationships can be created and modified among control objects. Organization provides a method to propagate a selected subset of commands from the parent down to its children or propagate the aggregate of a selected subset of status (related to command source, alarms, etc.) from the children up to the parent(s).
- Organizational views can be many nodes deep and wide, and numerous organizational views can reference the same devices to suit the needs of the user. The structure and view of these organizational trees can be modified online from the HMI. This provides the ability to coordinate commands of related equipment and view their related status (equipment modules or phase modules), or alternatively to monitor specific equipment or equipment types as a maintenance function.



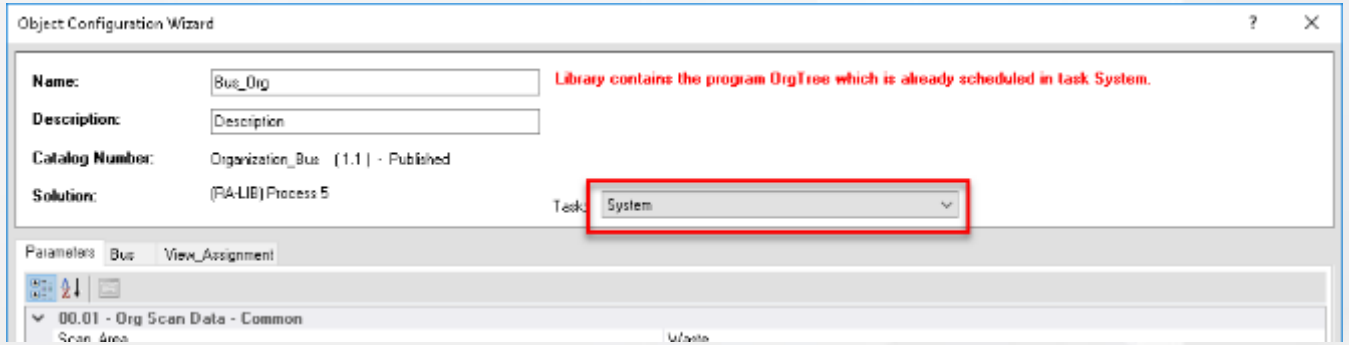


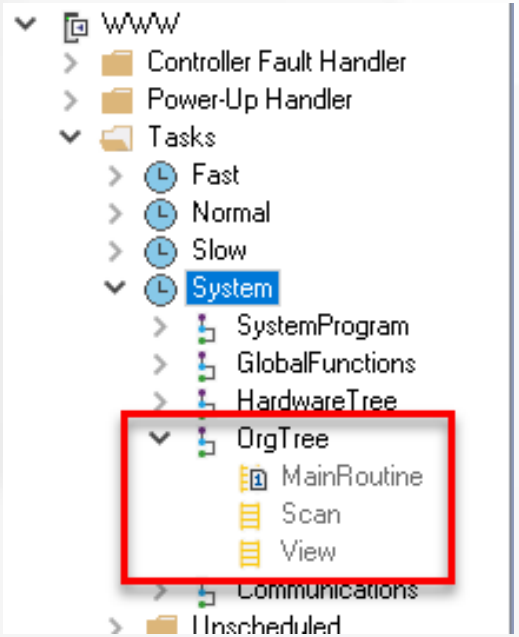
Using ACM to create the Organization Bus

- ACM can be used to easily create and configure the Organization Bus object and add devices as Bus Nodes.
- In ACM, right click the controller and select Add New. Select the Organization_Bus object.



- Select the System task and click Finish. The OrgTree program will now be populated in the System task.

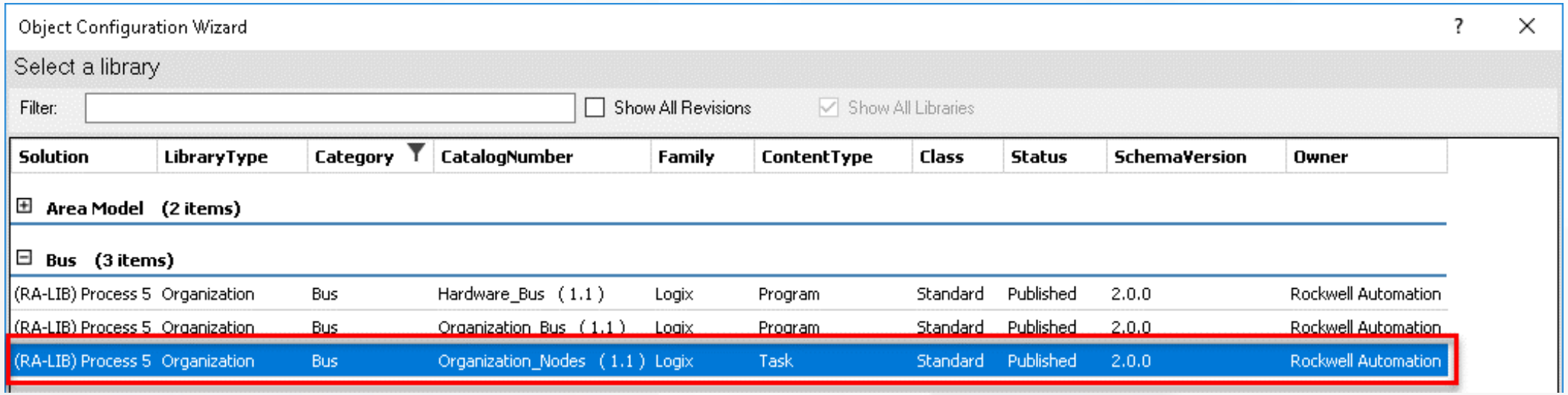




Using ACM to create the Organization Bus

- Next, an Organization Node object needs to be added to the project.

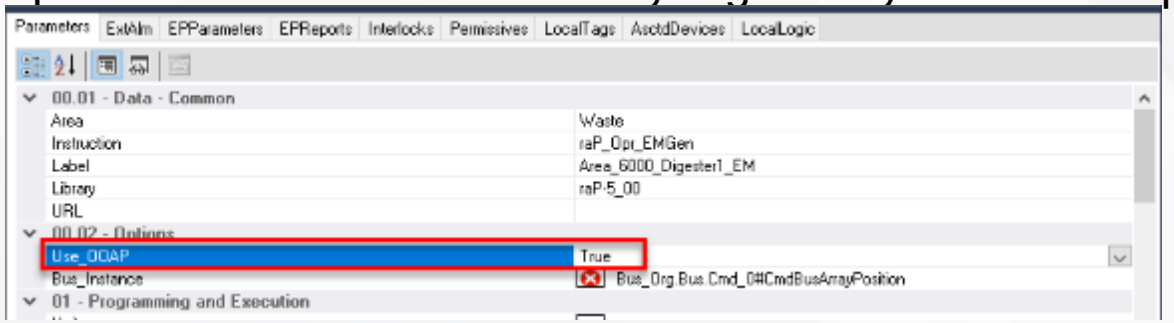
This creates an array of nodes where devices can be assigned and organized.



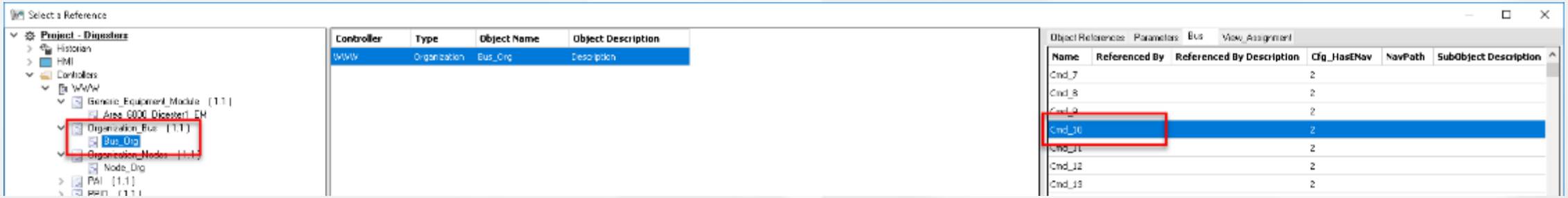
- Click Next and select the number of nodes (length of the array) that you would like to create. For this example, the default of 500 was used.

Assigning Devices to the Organization Bus

- Now that the Organization Bus and Organization Node have been created, we can assign each of the device objects we've created to a bus node.
- For each device, we need to set the parameter Use_OOAP to True, then click the ellipsis in the Bus_Instance Field to select the correct Node for the device. It's helpful to use a spreadsheet or table to visually organize your devices prior to this step.

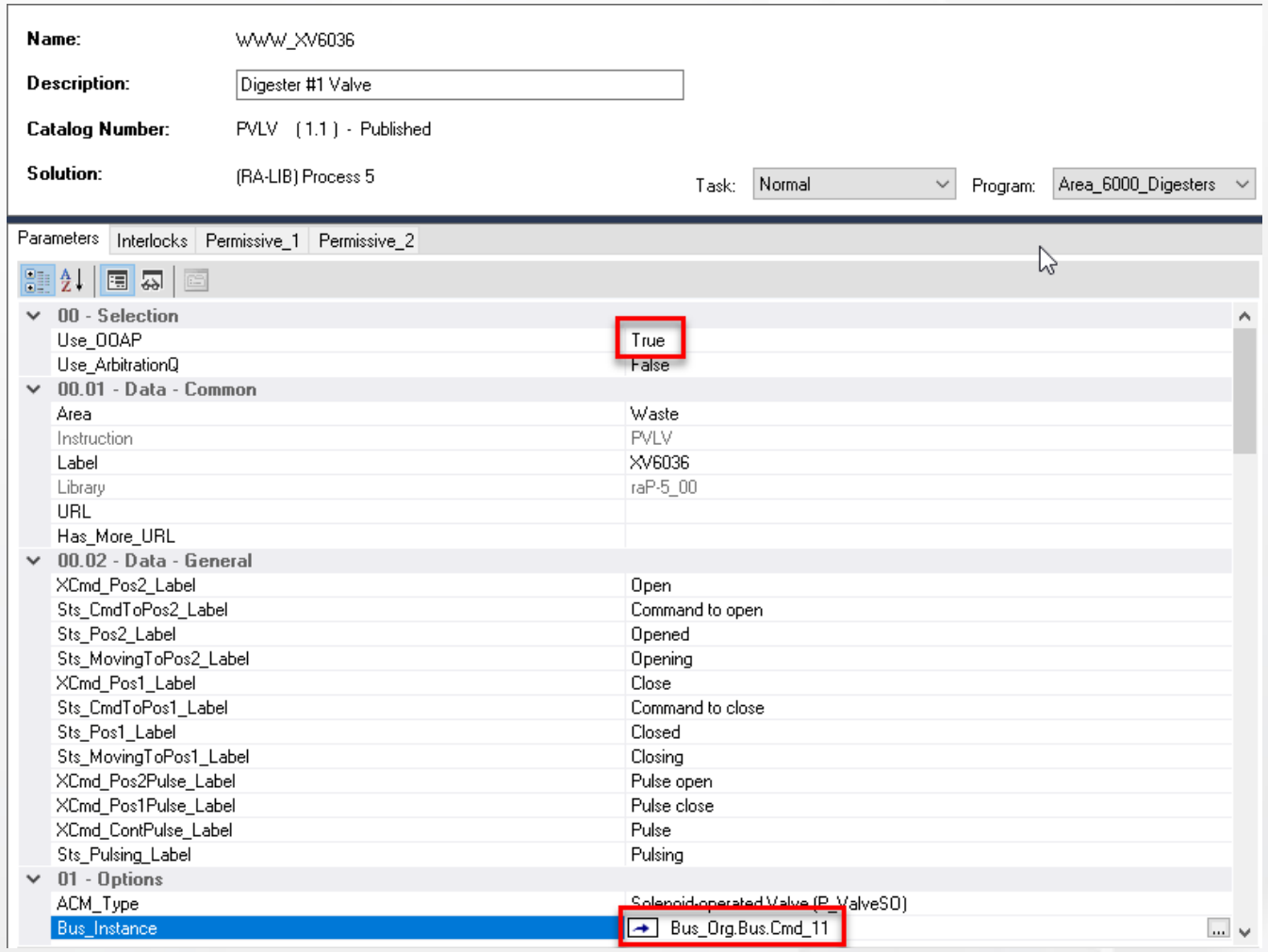


- Select the Bus Node instance that you would like to be associated with each device. The EM has been assigned to Node 10.



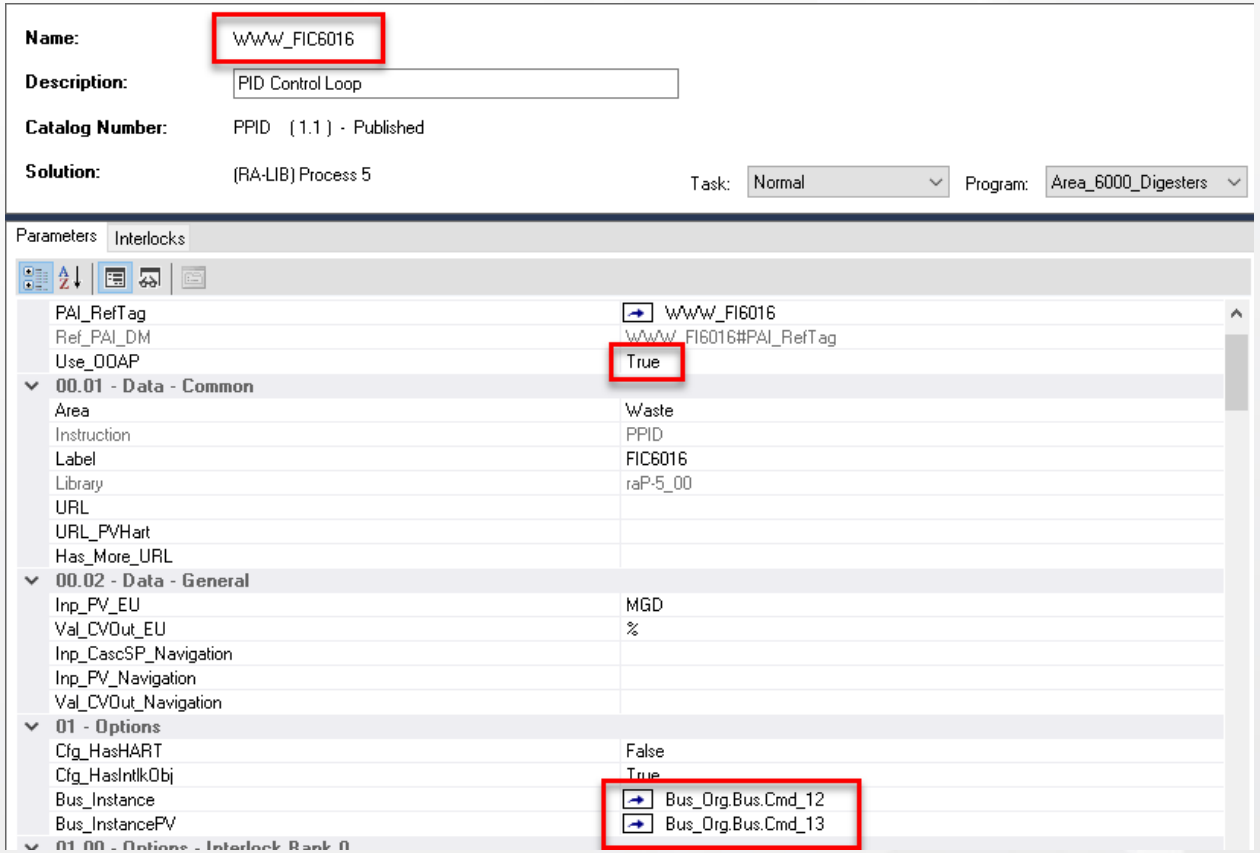
Assigning Devices to the Organization Bus

- The Discharge Valve is assigned to Bus Node 11.



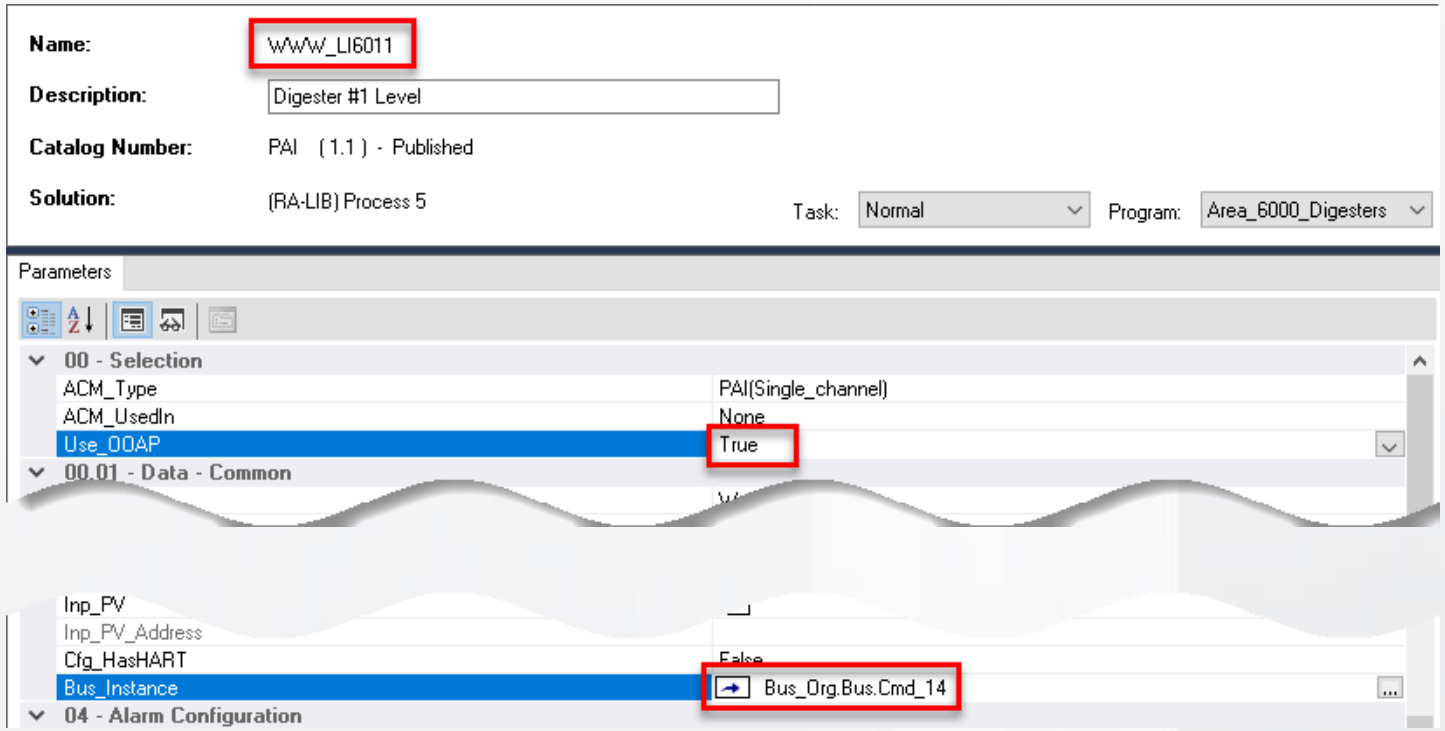
Assigning Devices to the Organization Bus

- The Control Valve PPID and associated PAI are assigned to Bus Node 12 and 13 respectively.
- You do not need to change any configuration to the PAI strategy for the associated FI6016 Analog Input. This configuration is done within the PPID CS configuration parameters.



Assigning Devices to the Organization Bus

- The Tank Level PAI is assigned to Bus Node 14.



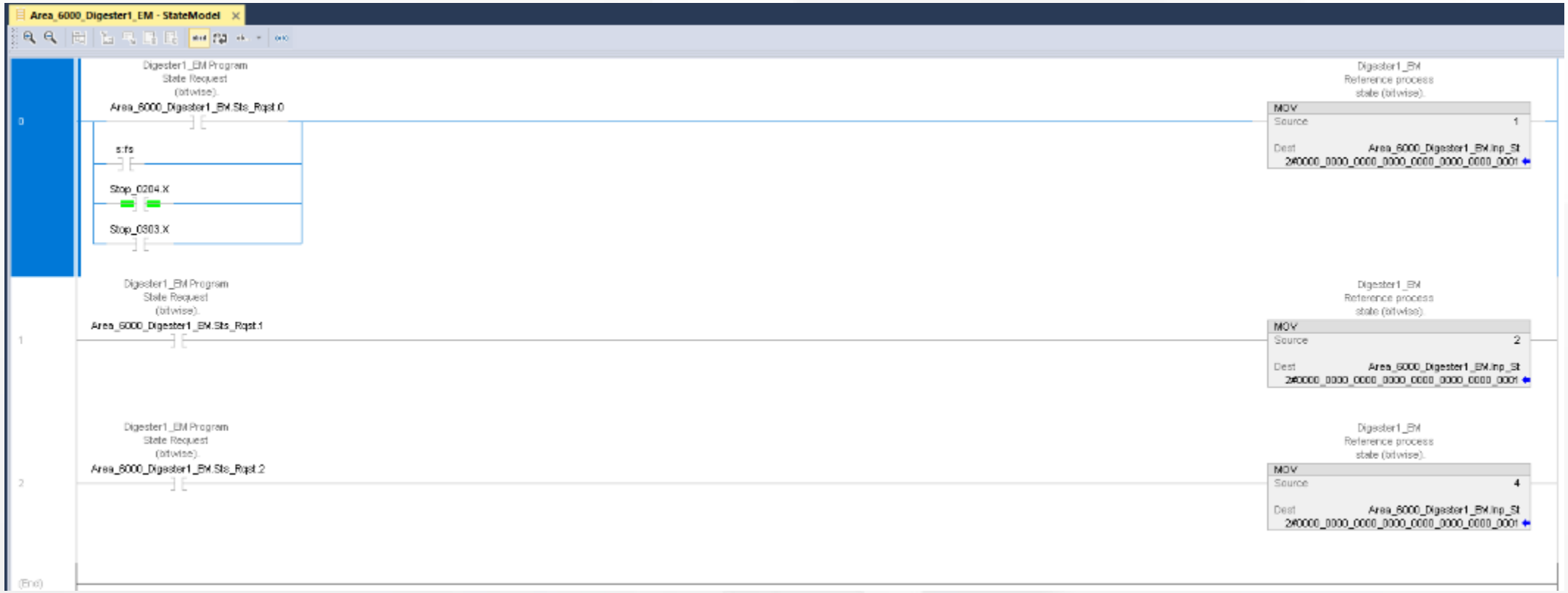
- Once the Bus Nodes have been assigned, we can generate the controller and begin to create the state logic.

Finalizing the Logic for the Equipment Module

- Once the ACD file is generated, we need to complete the logic for the EM.
  - The **Dispatch** routine contains the EM that was created as well as JSRs to each of the other routines. This routine does not need to be modified.
  - **Devices** contains device alarm logic. Some basic alarms have been created, but additional alarm conditions can be added if desired.
  - **Interlocks** is an empty routine since we did not configure any interlocks in the ACM project.
  - **Parameters** contains the EM_PAR objects for the two parameters that we created.
  - **St00_Off**, **ST01_Drain**, and **ST02_Fill** contain the logic for each of the three EM states.
  - **StateCall** is used to call the correct EM state when an operator clicks the related HMI button.
  - **StateModel** contains your state model (if state model is implemented external to raP_Opr_EMGen.
  - **StateReadyMap** contains the logic that controls visibility on the different state buttons.

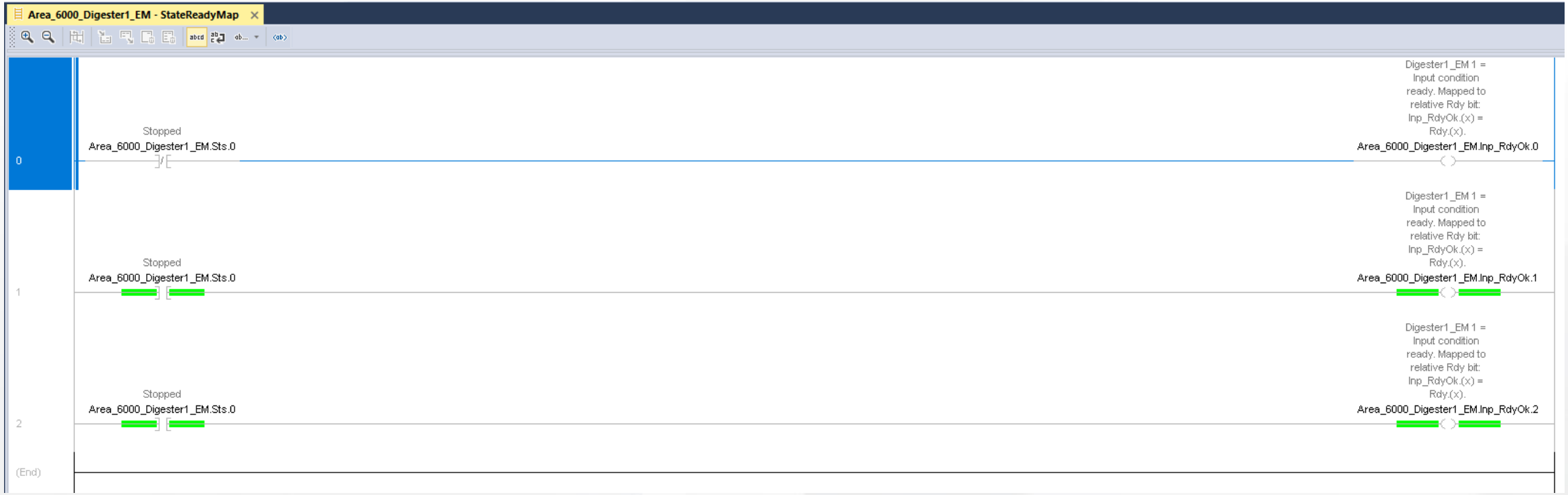
State Model Routine

- The State Model routine can be modified to implement logic to handle the EM state logic.
- For the Digester EM, we've just added two rungs to return the EM to the Off state upon completion of the Drain or Fill sequences.



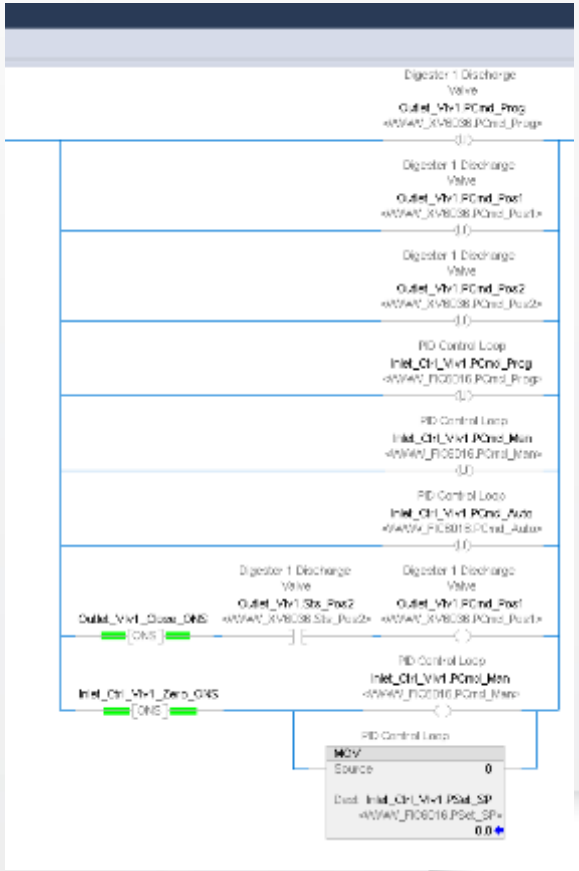
State Ready Map

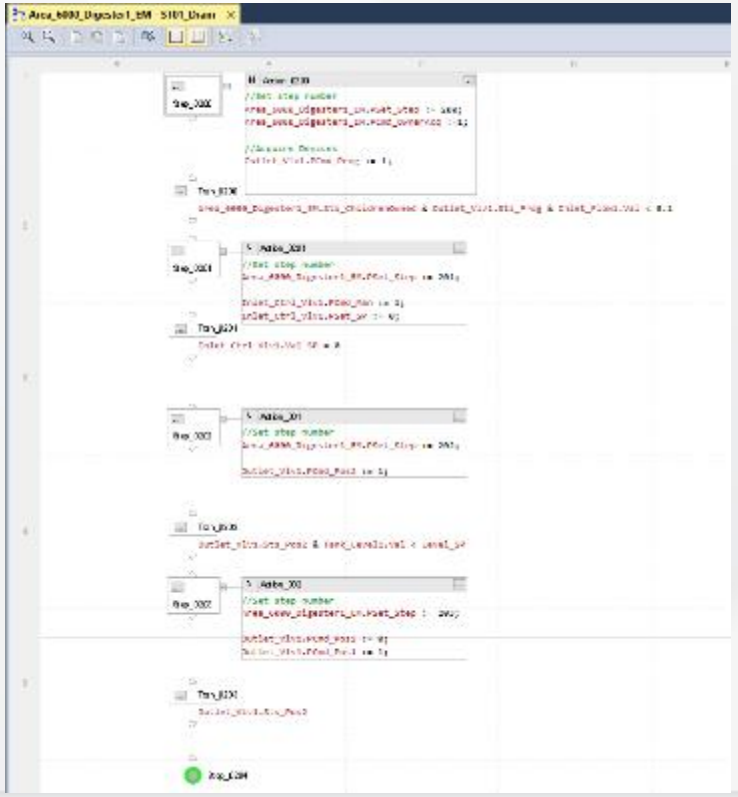
- The State Ready Map was modified for the Digester EM so that the Drain and Fill buttons were only available when the Digester is in the Off state.

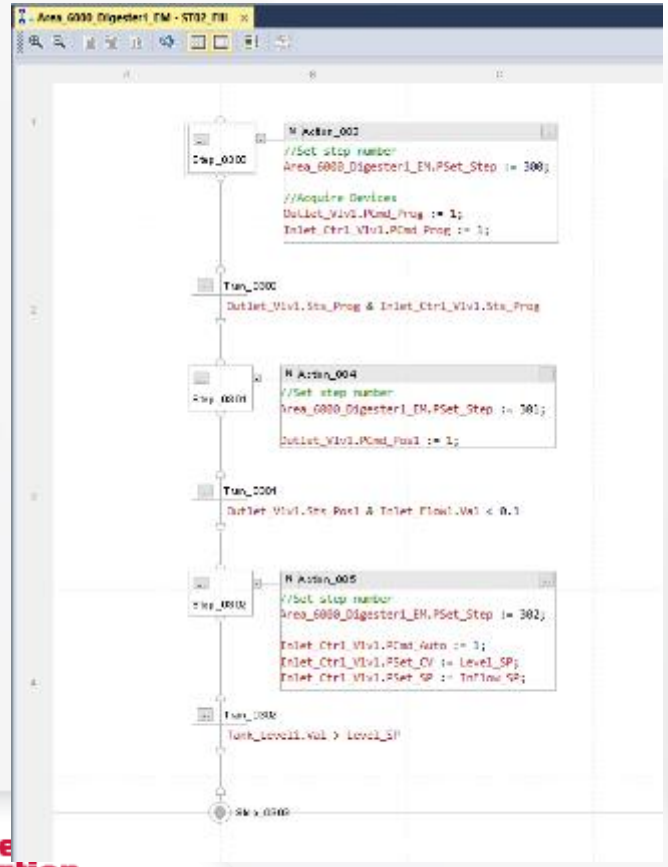


State Logic

- The ST00_Off, ST01_Drain, and ST02_Fill routines need to have logic added. For this EM, the Off routine will return the devices to their normal state and relinquish control, Drain will open the discharge valve until the tank drains to the entered level setpoint, and Fill will close the discharge valve, then manipulate the PPID Control Valve to fill the tank using the level setpoint and flow parameters.

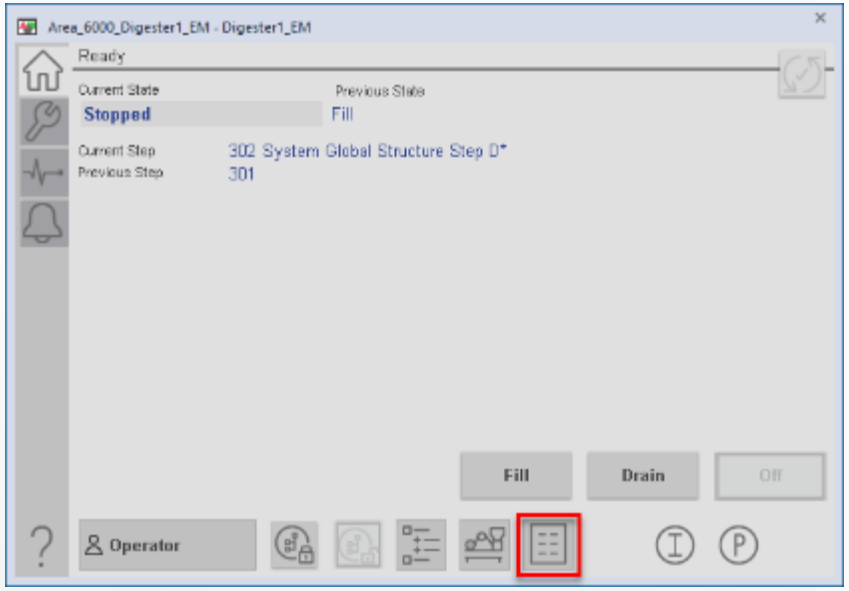




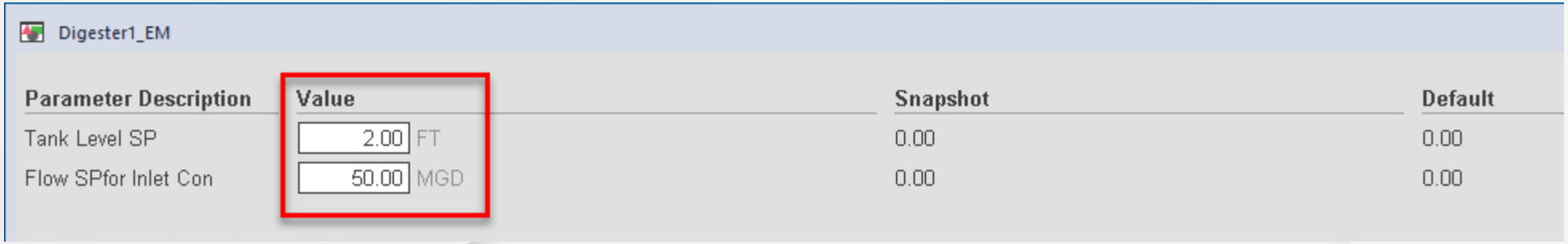


Running the EM

- With the Digester in the Off state, click to launch the Parameters faceplate.

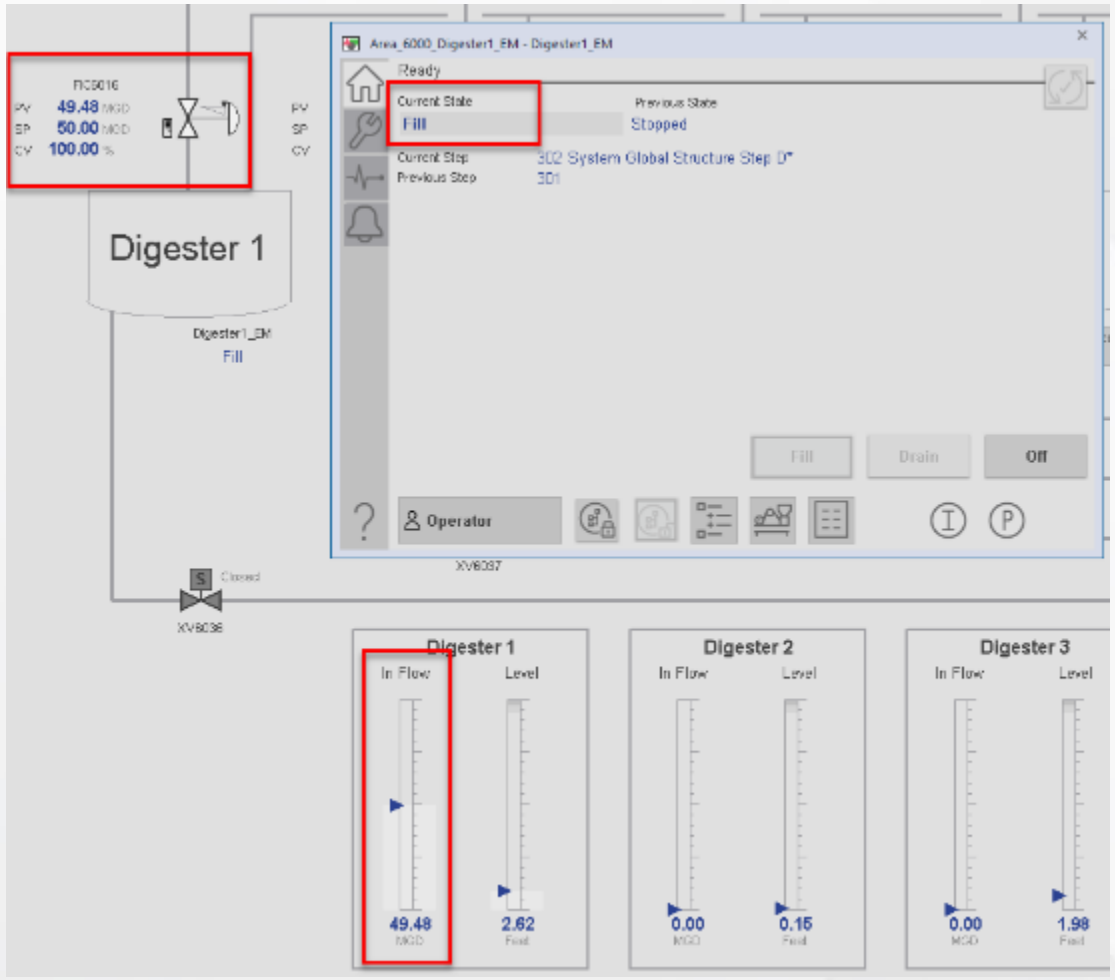


- Enter values for each parameter. Only the Tank Level SP parameter will be used for the Drain state.



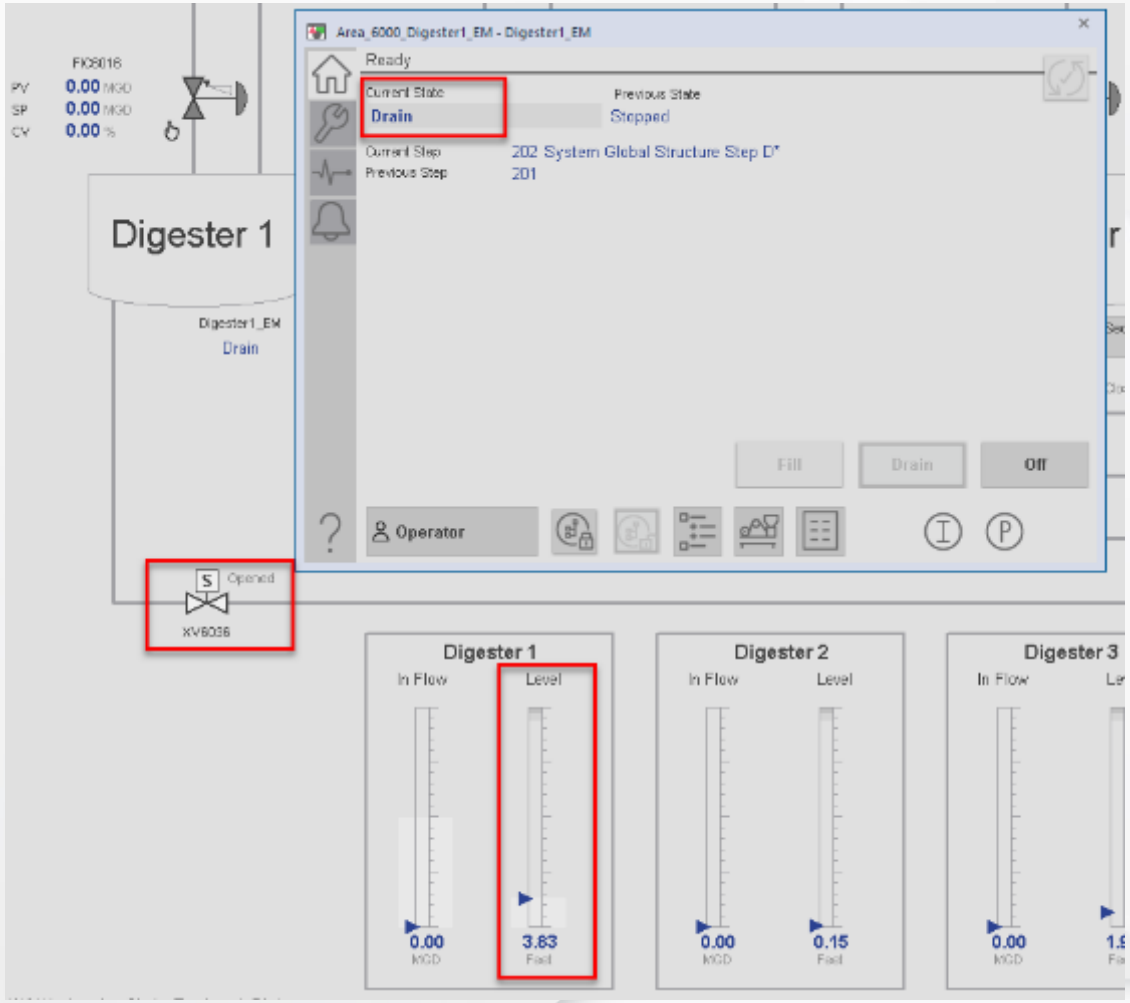
Fill State

- In the Fill state, the PPID SP is set to the EM parameter, and the tank is filled until the Digester Level PAI reaches the Tank Level SP parameter.



Drain State

- In the Drain state, the outlet valve is opened and the tank is drained until the Digester Level PAI reaches the setpoint entered into the parameters.



Thank You

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