# Chapter 24 Valve on Wall

#### Water Flow Lab

The Water Flow Lab uses city water in a  $\frac{3}{4}$  in pipe as a source to control flow of the water. The valve was purchased commercially and includes a flow transmitter. Both signals are 4-20 mA. Industrial air is required to power the water valve. The cost of the assembly is about \$1500. Two were installed in the room.

Purpose of the Lab – This lab was designed many years ago to give students in the PLC course(s) first-hand experience in implementing a PID loop. The PLC used has been the A-B compact logix processor. The lab provides experience developing the start-up sequence used to program the PID algorithm and the development of an HMI for use in industry.

Materials - The system includes a flow transmitter and control valve.

Cost – The cost is in the range of \$1500.

Benefit – The benefit of the lab include the training of students in the commissioning of the PID algorithm as well as programming of a single-loop system.

Challenges – This lab has recently been re-built after an accident in the compressed air system. Water was introduced into the air system destroying the I/P (current to pressure) transducer. These units were completely replaced and the systems re-built with the new I/P components.



Flow Valve on Wall

There are two of these systems in the lab. They may be used by two different groups with cabling shared between the groups who share the cable from the valve assembly. The course served is the advanced PLC or Mechatronics II course. A main advantage of this system is that tuning is done manually with stability problems occurring if the valve is not tuned precisely.

Stability/instability problems can be experienced in this lab by slight changes in the tuning variables. Also, the splash guard and catch basin are extremely important in that the flow can reach 90 gpm from this valve. Yes, a lot of water.

Quantity	Item	Description	Unit Price	Amount
1.00	FLO-7104 3/4"	FLOW-TEK BALL VALVE 316SS FULL		
		PORT, NPT ENDS WITH MOUNTING		
		BRACKET AND COUPLING		
1.00	MAX-UT-26-DA	DOUBLE ACTING PNUEMATIC	1,268.00	1,268.00
		ACTUATOR P/N UT26		
1.00	ACC-A51236AT	ACCORD 4-20mA POSTIONER P/N		
		A51236AT SAME AS A51136AT		
		W/BEACON COMPLETELY ASSEMBLED		
		AND TESTED		
1.00	MAR-M1FR2NHFM	0-120 PSI REGULATOR 5 MICRON P/N		
		M1FR2NHFM		
		COMPLETE CONTROL VALVE		
		ASSEMBLY MOUNTED AND TESTED		
		WITH PRESURE GUAGES PER		

The following is a bill of material to construct the flow valve system shown below.





The flow sensor is a paddle wheel placed in the flow of water. There is a calibrated readout for the flow meter that displays the flow in gallons per minute.



# Specifications

General Operating Range: 0.3 to 6 m/s (1 to 20 ft/s) Pipe Size Range: DN15 to DN900 (½ to 36 in.) Linearity: ±1% of max. range @ 25 °C (77 °F) Repeatability: ±0.5% of max. range @ 25 °C (77 °F)

Min. Reynolds Number Required: 4500

## System Overview

Panel Mount	Pipe, Tank, Wall Mount	Integral Mount
Signet 8550 Flow Instrument (Includes mounting bracket and panel gasket)	Signet 8550 Flow Transmitter	Signet 8550 Flow Transmitter
	Signet Universal Adapter Kit (3-8050) (sold separately)	Signet Integral Adapter Kit (3-8051) (sold separately)
Signet Flow Sensor (sold separately) 515 2507 2540 525 2536 2551 2000 2552 2100	Signet Flow Sensor (sold separately) 515 2507 2540 525 2536 2551 2000 2552 2100	Signet Integral Mount Flow Sensor (sold separately) 3-8510-XX 3-8512-XX
Signet Fittings (sold separately)		



### Allen-Bradley Analog Inputs and Outputs

Wiring diagrams for the card as well as the engineering range of the input and output channels are found on the next two pages.







The wiring diagram of the card is shown above. The input and output range of the 4-20 mA engineering units can be found by looking up the accuracy of the signals. Both have a range of 0 mA to 21 mA – 0 to 32640 decimal range. So, 4 mA would be 6217 (32640/21)\*4 and 20 mA would be 31085. Our range for the raw input and output then is 6217 - 31085.

General*	Connection	Input Configuration	Output Configuration
Request	ed Packet Inte	erval (RPI): 80	.0 ms (1.0 - 750.0)
📃 Inhibi	t Module		
🔽 Majo	r Fault On Con	troller If Connection F	ails While in Run Mode
Module	e Fault		
General*	Connection	Input Configuration	Output Configuration
Channe 0 1 2 3	El Enable		
General*	Connection	Input Configuration	Output Configuration
Chann 0 1	el Enable		

#### Using the CompactLogix PID Block with RSView ME

The PID algorithm will be introduced in an application using the CompactLogix hardware and software to provide control of the same valve used in the SLC programming experiences. The graphical operator interface will be upgraded to the newer RSView ME operator interface.

## Configure a PID Instruction

After you enter the PID instruction and specify the PID structure, you use the configuration tabs to specify how the PID instruction should function.



Inclusion of the data tag to create the list shown above. The PID algorithm uses these data tags to calculate and control a PID block. For instance, the PV value for the block is mypid.PV. The SP or setpoint is mypid.SP. The example screens that follow show the newer IF4XOF2F/A card and are used to set up the scaling for the present system in the lab.

Controller Organizer 🗾 👻 🖡 🗙	ổ Controller Pro	operties - Test
🖃 😁 🔁 Controller Test		
Controller Tags	Nonvolatile Men	nory Memory Internet Protocol Port Configuration Network Security Alarm Log
Controller Fault Handler	General	Major Faults Minor Faults Date/Time Advanced SFC Execution Project
Power-Up Handler	Vendor:	Allen-Bradley
🖶 🖶 Tasks		
🚊 🧔 MainTask	Type:	1769-L30ERM CompactLogix™ 5370 Controller Change Controller
👜 🕞 MainProgram	Revision:	23 12
🖶 😽 PID_task		
🚊 🚭 PID_Program	Name:	Test
Program Tags		
<u>1</u> p1	Description:	
Unscheduled Programs / Phases		
🚊 🔄 Motion Groups		Ψ
Ungrouped Axes	Chassis Type:	(none)
Add-On Instructions		
🚊 🗠 🔄 Data Types	Slot:	
i		
🕀 🔤 Predefined		
i International		
Trends		
🚊 🦾 I/O Configuration		
⊡		
📴 [0] 1769-L30ERM Test		
⊡		OK Cancel Apply Help
1769-L30ERM Test		
📇 2097-V31PR0-LM yt		

### Configuration of the L30ERM

The task was set up to execute every 100 msec. This is shown in the figure below:

💰 Task Properties	s - PID_task
General Configu	ration Program / Phase Schedule Monitor
Туре:	Periodic
Period:	100.000 ms
Priority:	10 (Lower Number Yields Higher Priority)
Watchdog:	500.000 ms
Disable Auton	natic Output Processing To Reduce Task Overhead
	OK Cancel Apply Help



Add-On-Defined     Add-On-Defined     Module-Defined     Module-Defined     Module-Defined     If (0) 1769-L30ERM Test     If (0) 1769-L30ERM Test     If (1) 1769-IF4FXOF2F/A AO     If (1) 1769-L30ERM Test     If (1) 1769-L30ERM Test     If (1) 2097-V31PR0-LM yt	Module Properties: Local:1 (1769-IF4FXOF2F1.1)  General Connection Input Configuration Input Alams Output Configuration Output Limits  Type: 1769-IF4FXOF2F 4 Channel Input/2 Channel Output, Fast Analog Vendor: Allen-Bradley Parent: Local Name: AO Slot: 1  Description:  Module Definition Series: A Change Revision: 1.1 Electronic Keying: Compatible Module Connection: Output Data Format: Integer
Add-On-Defined Add-On-Defined Predefined Module-Defined Trends J/O Configuration 1/09 Bus (10) 1769-L30ERM Test (11) 1769-IF4FXOF2F/A AO Ethernet 2097-V31PRO-LM yt	Status: Offline       OK       Cancel       Apply       Help             Module Properties: Local:1 (1769-1F4FXOF2F 1.1)       Image: Connection       Input Configuration       Input Alams       Output Configuration       Output Limits         General       Connection       Input Configuration       Input Alams       Output Configuration       Output Limits         Requested Packet Interval (RPI):       10.0       ms (1.0 - 750.0)       Inhibit Module         Image: Major Fault On Controller If Connection Fails While in Run Mode       Module Fault       Module Fault         Module Fault       OK       Cancel       Apply       Help



Controller Fault Handler	- mypid	{}	
Power-Up Handler	+-mypid.CTL	134217728	
Tasks	-mypid.EN	0	
🖶 🗟 MainTask	-mypid.CT	0	
🗍 🗒 MainProgram	-mypid.CL	0	
⊡ 😽 PID_task	-mypid.PVT	0	
🚊 🕞 PID_Program	-mypid.DOE	1	
🖉 Program Tags	-mypid.SWM	0	
🚹 p1	-mypid.CA	0	
📖 🧰 Unscheduled Programs / Phases	-mypid.MO	0	
🖕 🔄 Motion Groups	mypid.PE	0	
🛄 Ungrouped Axes	mypid.NDF	0	
Add-On Instructions	mypid.NOBC	0	
🚊 🗠 🔄 Data Types	mypid.NOZC	0	
	-mypid.INI	0	
	-mypid.SPOR	0	
Add-On-Defined	-mypid.OLL	0	
	-mypid.OLH	0	
	-mypid.EWD	0	
	mypid.DVNA	0	
in a for configuration	mypid.DVPA	0	
1011769-L30ERM Test	-mypid.PVLA	0	
111769-IF4FXOF2F/A AO	mypid.PVHA	0	
⊟ – 🛣 Ethernet	-mypid.SP	0.0	
🖟 📴 1769-L30ERM Test	-mypid.KP	0.4	
2097-V31PR0-LM yt	-mypid.Kl	1.0	
	-mypid.KD	0.0	
	-mypid.BIAS	0.0	
	-mypid.MAXS	16383.0	
	-mypid.MINS	0.0	
	-mypid.DB	0.0	
	-mypid.SO	0.0	
	-mypid.MAXO	100.0	
	-mypid.MINO	0.0	
		0.1	
	-mypid.PV	0.0	
	-mypid.ERR	0.0	

The Program Tags for the PID mypid are shown with variable contents. These variables are useful as tag references used for communicating with the variables through program control.



The tuning tab shows the variables used to tune the PID block. The Kp, Ki and Kd tuning constants are probably the best variables for the water valve. These constants should not vary too much from the numbers shown or the PID block may become unstable.



#### **PID** Configuration

The configuration tab shows the variables used to set up the type of block used. The variables seen above are the ones used in the download example. There are a number of variables that are not used.

				l r		PID		_	L
0					Proportional	Integral Deriv	ative		⊢
					PID		mypid 🗔	)	L
					Process Var	iable Local:1	:I.Ch1Data		L
					Tieback		0		L
					Control Variable Local:1:0.Ch1Data				L
					PID Master L	оор	0		L
					Inhold Bit		0		L
					Inhold Value		0		L
					Setpoint		0.0 🗲		L
					Process Var	iable	0.0 🗲		L
					Output %		0.0 🗲		L
				L					
				-				~	
PID Setup	- mypid							~	
	<b>.</b>	Alarma C.		_					ן
luning	Configuration	Alarms Sci	aling   I	ag					
			0.0						
Process	Variable (PV) H	ligh:	0.0		•				
			0.0		-				
Process	Variable (PV) L	.ow:	0.0		<b>•</b>				
Process	Variable (PV) [	)eadband:	0.0		-				
Positive	Deviation:		0.0		-				
Negativ	- Deviation :		0.0		-				
Negativ	e Deviation.		0.0						
Deviatio	n Deadband:		0.0		-				
Setpoint (	SP): 0.0				PV Ala	m:	None		
Process \	/ariable: 0.0				Deviati	ion Alarm:	None		
Error:	0.0				Output	Limitina:	None		
Output	0.0	%			Error V	Vithin Deadha	nd No		
Tieback	0.0	2			Setpoir	nt Out of Ran	ne: No		
Mode:	Auto	-			PID Ini	tialized:	No		
	1 210								
		0	к		Cancel	Apply	Help		
					Garroor	. 4440			
			_	_				_	-

PID Alarms

The alarms tab shows the alarm variables used to set up the block. The alarm limits are ignored for now but in a real application will be necessary when setting up a system of alarms.

The scaling tab shows the variables as set up in the block. We need to make a decision whether to scale the engineering units. The unscaled PV and CV are listed at 3200 low to 21000 high. The Engineering Units for the PV may be changed or left as is. For water, the engineered units should be 91 gpm max.

		Tuning	Configuratio	n Alarms	Scaling	Тад		
		Proce	ess Variable (	PV)				
31085		→ Unsc	aled Max.:		*	Engineering Unit Max.:	91.0	*
6217		+ Unsc	aled Min.:		*	Engineering Unit Min.:	0.0	*
		Contr	rol Variable (C	CV)		Tieback		
31085		→ Max.	(at 100 %):		*	Ma <del>x. (at 108</del> %):	0.0	*
6217		→ Min.	(at 0 %):		* *	Min. (at 0 %):	0.0	-
							PID Initialized	d 🗲
	0	-				PID Proportional Integral Derivativ PID Process Variable Local:1:1.0 Tieback Control Variable Local:1:0.0 PID Master Loop Inhold Bit Inhold Value Setpoint Process Variable	ve mypid Ch1Data 0 Ch1Data 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	_
						Output %	0.0 ←	
						Output %	0.0 €	
	PIC	) Setup - I	mypid			Output %	0.0 ¢	1
	PI	) Setup - I Tuning C	mypid	Alarms Sca	ling Tag	Output %	0.0 €	
	PIC	) Setup - I Tuning C Name:	mypid ionfiguration // mypid	Alarms Sca	ling Tag	Output %	0.0 ¢	
	PIC	D Setup - I Tuning C Name: Descriptio	mypid onfiguration / / mypid on:	Alams   Sca	ling Tag	Output %	0.0 €	
	PIL	D Setup - I Tuning C Name: Descriptio Type: Data Type Scope:	mypid onfiguration / mypid on: Base e: PID <b>Base</b>	Alamns Sca	ling Tag	Output %	0.0 €	
	PIC	D Setup - 1 Tuning C Name: Descriptio Type: Data Type Scope: External Access:	mypid onfiguration / mypid on: Base e: PID Read/Wr	Alams Sca	ling Tag	Output %	0.0 ←	
		D Setup - 1 Tuning C Name: Descriptio Type: Data Type Scope: External Access: Setpoint (SF Process Var Error: Dutput: External	mypid onfiguration / mypid on: Base e: PID Base e: PID_ Read/Wr P): 0.0 0.0 0.0 0.0	Alams Sca Program ite	ling Tag	Output %	0.0 ¢	
		D Setup - 1 Tuning C Name: Description Type: Data Type Scope: External Access: Setpoint (SF Process Var Error: Dutput: Reback: Mode:	mypid onfiguration / mypid on: Base e: PID Base e: PID_ Read/Wr P): 0.0 niable: 0.0 0.0 0.0 0.0 Auto	Alams Sca Program ite	ling Tag	Output %	0.0 ¢	

PID Setup

PID Setup - mypid				×
Tuning Configuration	Narms Scaling	Tag		
Setpoint (SP):	þ.o	<b>€</b>	Manual Mode	es F
Set Output:	0.0	<b>▼</b> * %	Software	Manual e
Output Bias:	0.0	▼ %		
Proportional Gain (Kp):	0.4	÷ •	Reset Tuning to the values	Constants
Integral Gain (Ki):	1.0	≑ 🗲 1/s	upon entry in Setup dialog	to the PID
Derivative Time (Kd):	0.0	🛨 🗲 S	Reset	•
Contraction (CD), 0.0			DV Alama	Uish
Process Variable: 0.0111	09076		PV Alam: Deviation Alam:	Low
Error: -0.0111 Output: 0.0	09076 %		Output Limiting: Error Within Deadband	Low
Tieback: 0.0 Mode: Auto	%		Setpoint Out of Range: PID Initialized:	No Yes
	ОК	Cance	el Apply	Help

**Tuning Parameters** 

PID Setup - mypid				×
Tuning Configuration /	Alarms Scaling	Tag		
Setpoint (SP): Set Output:	50.0 41.285263	<ul> <li>★</li> <li>★ %</li> </ul>	Manual Modes ☐ Manual ← ☐ Software Manua	l <del>(</del>
Output Bias:	0.0	<b>≑</b> € %		
Tuning Constants Proportional Gain (Kp):	0.4	*	Reset Tuning Const	ants
Integral Gain (Ki):	1.0	<b>←</b> 1/s	to the values they h upon entry into the l Setup dialog	ad PID
Derivative Time (Kd):	0.0	💼 <del>&lt;</del> s	Reset	
Setpoint (SP):50.0Process Variable:54.578Error:-4.5788Output:41.285Tieback:0.0Mode:Auto	89 1918 263 % %	P D O S S P	V Alamn: High eviation Alarm: Low utput Limiting: None ror Within Deadband: No etpoint Out of Range: No ID Initialized: Yes	
	ОК	Cancel	Apply	Help

PID Setup - mypid				x
Tuning* Configuration	Alarms Scaling	g Tag		
Setpoint (SP):	80.0	<b>♦ €</b> %	Manual Mode	e e Magual e
Output Bias:	0.0	<b>€</b> %	Joitware	
Tuning Constants Proportional Gain (Kp):	0.4	÷	Reset Tuning	g Constants
Integral Gain (Ki):	1.0	<b>€</b> 1/s	to the values upon entry in Setup dialog	they had to the PID
Derivative Time (Kd):	0.0	≑ 🗲 S	Reset	•
Setpoint (SP): 80.0 Process Variable: 50.557 Error: 29.442 Output: 40.0 Tieback: 0.0 Mode: Softwa	407 593 % re Manual		PV Alam: Deviation Alam: Output Limiting: Error Within Deadband: Setpoint Out of Range: PID Initialized:	High High None No No Yes
	ОК	Canc	el Apply	Help

Manual Trial

General States Timing Common Connections	1
Connections	LOOP 2
Appearance	PV SP
Border style: Border width:	100 -
Raised	80
Back style:	
Solid	60
Shape:	40
Rectangle	20
State settings	
Number of states: Next state based on:	PV %
2  Current State	NNNNN
	SP %
Touch margins	NNNNN
Horizontal margin: Vertical margin:	CV %
0 0	
Other	
V Audio	0 100

80	Numeric Input Enable Properties		
60	General Label Numeric Timing Commo	on Connections	
60 40 20 0 	Appearance Border style: Border width: Raised • 4 Back style: Pattern style: Solid • None Shape:	Border uses back color Back color Border color Pattern color Highlight color	
	Rectangle       Touch margins       Horizontal margin:     Vertical margin:       0     0	🔲 Blink	
	Other Audio Key navigation Take focus on press		



#### **Continuing the Allen-Bradley Configuration Pages**

After you enter the PID instruction and specify the PID structure, you use the configuration tabs to specify how the PID instruction should function.

To specify tuning, select the Tuning tab. Changes take effect as soon as you click on another field.

To configure the PID: Specify Setpoint (SP)	Enter a setpoint value (.SP).
Set output %	Enter a set output percentage (.SO) (In software manual mode, this value is used for the output. In auto mode, this value displays the output %.)
Output bias	Enter an output bias percentage (.BIAS).
Proportional gain (Kp)	Enter the proportional gain (.KP).For independent gains, it's the proportional gain (unitless). For dependent gains, it's the controller gain (unitless).
Integral gain (Ki)	Enter the integral gain (.KI). For independent gains, it's the integral gain (1/sec). For dependent gains, it's the reset time (minutes per repeat).
Derivative time (Kd)	Enter the derivative gain (.KD). For independent gains, it's the derivative gain (seconds). For dependent gains, it's the rate time minutes).
Manual mode	Select either manual (.MO) or software manual (.SWM). Manual mode overrides software manual mode if both are selected.
PID equation	Select independent gains or dependent gains (.PE). Use independent when you want the three gains (P, I, and D) to operate independently. Use dependent when you want an overall controller gain that affects all three terms (P, I, and D).
Control action (.CA).	Select either E=PV-SP or E=SP-PV for the control action
Derivative of:	Select PV or error (.DOE). Use the derivative of PV to eliminate output spikes resulting from set-point changes. Use the derivative of error for fast responses to set-point changes when the algorithm can tolerate overshoots.
Loop update time	Enter the update time (.UPD) for the instruction.
CV high limit (.MAXO).	Enter a high limit for the control variable

CV low limit (.MINO).	Enter a low limit for the control variable
Deadband value	Enter a deadband value (.DB)
No derivative smoothing	Enable or disable this selection (.NDF)
No bias calculation	Enable or disable this selection (.NOBC).
No zero crossing in dbnd	Enable or disable this selection (.NOZC).
PV tracking	Enable or disable this selection (.PVT).
Cascade loop	Enable or disable this selection (.CL).
Cascade type (.CT).	If cascade loop is enabled, select either slave or master
<u>Specify Alarms</u> PV high:	Enter a PV high alarm value (.PVH).
PV low:	Enter a PV low alarm value (.PVL).
PV deadband:	Enter a PV alarm deadband value (.PVDB).
Positive deviation	Enter a positive deviation value (.DVP).
Negative deviation	Enter a negative deviation value (.DVN).
Deviation deadband	Enter a deviation alarm deadband value (.DVDB).
PV unscaled maximum	Enter a maximum PV value (.MAXI) that equals the maximum unscaled value received from the analog input channel for the PV value.
PV unscaled minimum	Enter a minimum PV value (.MINI) that equals the minimum unscaled value received from the analog input channel for the PV value.
PV engineering units maxim	num Enter the maximum engineering units corresponding to .MAXI (.MAXS)
PV engineering units minim	um Enter the minimum engineering units corresponding to .MINI (.MINS)
CV maximum (.MAXCV).	Enter a maximum CV value corresponding to 100%
CV minimum (.MINCV).	Enter a minimum CV value corresponding to 0%

Tieback maximum	Enter a maximum tieback value (.MAXTIE) that equals the maximum unscaled value received from the analog input channel for the tieback value.
Tieback minimum	Enter a minimum tieback value (.MINTIE) that equals the minimum unscaled value received from the analog input channel for the tieback value.
PID Initialized	If you change scaling constants during Run mode, turn this off to reinitialize internal descaling values (.INI)

Shifting to the HMI Program, RS Studio is entered and the Libraries choice and then Face Plates choice is entered.

- PID			
🕀 🏧 Libraries	^	MAIN - /PID// (Display)	
[ALARM BANNER]			
- ALARM MULTI-LINE]			
[DIAGNOSTICS]			
[HISTORY] 640x480			
[HISTORY] 800x600			
[INFORMATION]			
[STATUS] 640x480			
[STATUS] 800x600			
- III Arrows			
Bottles			
Buttons - Industrial			
- D Clocks			
CNC Equipment			
Communication - Equipment			
Computer - Printers			
Computer - Workstations			
Conveyor parts			
Data Displays			
DIN 2			
DIN 3			
- Drives AB			
- Ini Face Plates			
- B Gauges			
- 🖬 ISA 1			
- 🖬 ISA 2			
-  Machines			
-  Motors	=		
Motors Relance			
- III Nature - Trees			
Package			
Panel View Plus 1000 - Neypad L	1		
PanelVew Plus 1500 - Keypad L	;		
PanelVew Plus 400 - Keypad La			
PanelViewPlus 600 - Keypad Lay			
Panel/VewPlus 700 - Keypad Lay			
- Pipes 1			
- Pipes 2			
- III Pipes 3			
- <u>II</u> Plo			
- PLC IO Racks			
- Pneumatic			
Pumps	_		
Reciperius_Components     Second			
B) Shaves			
B) Siders			
- D Symbols			
- Ini Tanks			
- III Tanks 2			

With RSStudio, build a screen from scratch using a face plate. There are a number of face plates in the template from which to choose.



HMI Loop Face Plate

The various parts of the face plate are animated. The next screen shows the details:



Animation of the Arrow

🛃 MAIN - /PID// (Display)		
LOOP 2 PV SP 100 80 60 40 20 0 	Properties         Connections         Key Assignments         Arrange         Animation         Convert to Wallpaper         Tag Substitution         Property Panel         Object Explorer	
	Cut Copy Paste Paste without localized strings Delete Duplicate Copy Animation Paste Animation Global Object Defaults Global Object Parameter Values Global Object Parameter Definitions	

Animation of the Numeric Entry



Choose a faceplate and begin modifying it for the application. Several tags are provided with each faceplate. These tags may set a number, allow entry of a number, move an animated arrow or fill a sliding window. Bits may be added for auto/manual and local/remote. Note that alarms may also be included such as the red and yellow tags above.

These faceplates may be modified with additional components. They may also be built from scratch using existing components. At one time, the faceplate could be unbundled. While no longer possible, the individual components may be animated by clicking them and then answering the questions.

