

# **PI World 2019 Lab**

Time-saving Tips for  
Deploying and Expanding AF



OSIsoft, LLC  
1600 Alvarado Street  
San Leandro, CA 94577 USA  
Tel: (01) 510-297-5800  
Web: <http://www.osisoft.com>

© 2019 by OSIsoft, LLC. All rights reserved.

OSIsoft, the OSIsoft logo and logotype, Analytics, PI ProcessBook, PI DataLink, ProcessPoint, Asset Framework (AF), IT Monitor, MCN Health Monitor, PI System, PI ActiveView, PI ACE, PI AlarmView, PI BatchView, PI Vision, PI Data Services, Event Frames, PI Manual Logger, PI ProfileView, PI WebParts, ProTRAQ, RLINK, RtAnalytics, RtBaseline, RtPortal, RtPM, RtReports and RtWebParts are all trademarks of OSIsoft, LLC. All other trademarks or trade names used herein are the property of their respective owners.

#### U.S. GOVERNMENT RIGHTS

Use, duplication or disclosure by the U.S. Government is subject to restrictions set forth in the OSIsoft, LLC license agreement and as provided in DFARS 227.7202, DFARS 252.227-7013, FAR 12.212, FAR 52.227, as applicable. OSIsoft, LLC.

Published: March 25, 2019

## Table of Contents

### Contents

Table of Contents .....	3
Part 1 – Instructor-Led Lab .....	5
Why Create a Hands-on Lab about Deploying AF? .....	5
Section 1. Introduction to Your Enterprise .....	6
Section 2. Using Substitution Parameters and Template Inheritance .....	7
Section 3. Building Your First Element .....	12
Section 4. Building Your First Site .....	19
Section 5. Expanding to a New Site with Different Naming Conventions .....	25
Section 5A. Creating the Site Template .....	25
Section 5B. Building Tag Names.....	27
Section 5C. Configuring a Tag to Reference Another Attribute.....	33
Section 6. PI Vision Part 1: Visualizing our AF Hierarchy .....	36
Part 2: Take-home Bonus Material .....	39
Section 7. Optimizing our AF Templates.....	39
Section 7A. Site Name and Well Name as Attributes .....	39
Section 7B. Using Categories .....	40
Section 7C. Enumeration Sets .....	41
Section 7D. Limits.....	43
Section 8. PI Vision Part 2: Improving Visualization with Optimized Templates .....	45
Limits and Enumeration Sets Exercises.....	46
Section 9. Expanding to a Site with No Tag Naming Conventions .....	47
Section 10. Creating Tags via AF .....	53
Section 11. PI Vision Part 3: Optimizing Asset Swapping.....	66
Section 12. Solutions to Exercises.....	71
Appendix .....	73
Save the Date!.....	75



## Part 1 – Instructor-Led Lab

### Why Create a Hands-on Lab about Deploying AF?

Getting started with Asset Framework can be a daunting task. We wanted to create a walkthrough of building a small AF hierarchy containing a host of tricks you wouldn't normally know existed if you are just using the software. If you are an existing PI user wanting to move your tag-centric world into an asset-centric world, or a brand-new user of PI wanting to design your entire PI Server deployment around AF, this lab will have something for you.

You will start with a (nearly) empty AF Database, and build the AF structure for multiple sites across your enterprise, with each site having increasing complexity. Along the way, we will see the consequences of our design choices on visualization in PI Vision and make improvements to our AF deployment. By the end of the instructor-led portion of the lab (Part 1), you will have had a chance to see how your AF design choices affect your display options in PI Vision. If you continue onto Part 2, you will see a number of best practices in play, improved PI Vision displays, and the fourth and final site will be built by having AF create and configure the tags on the Data Archive for you.

Ideally you would complete sections in order, but Sites #2, #3, and #4 (London, Las Vegas, and San Francisco) can be skipped or completed in any order once you've built Site #1 (Sections 2 and 3). Step-by-step directions are included for nearly every exercise.

## Section 1. Introduction to Your Enterprise

Let's answer a few questions together to see how this lab may be of use to you at your company.

1. Does your company employ any tag naming conventions? For example, I may know that all my drilling equipment tags start with DR and include their location next, and so on.
2. When you started exploring your PI System at your company, was it easy to determine from where your data was originating?
3. Brainstorm a few ways you would want to name your tag data that would improve the learning curve on your systems.

Your enterprise, Drillz R Us, has the following four oil drilling sites, each with numerous wells:

1. Madrid
2. London
3. Las Vegas
4. San Francisco

The Madrid, London and Las Vegas sites are already collecting tag data for your wells. The San Francisco OPC data source is configured and running, but no tags have been created on the PI Data Archive.

The objective is to create a well-defined Asset Framework structure that can be utilized by those unfamiliar with any tag naming conventions at these sites. Those users should also be able to quickly and easily build a display for one well and use it for any of the wells across the four sites.

You currently have an empty AF database with just a few Tables that have been imported by your PI admin, but no AF structure has been defined. You have decided to use the Madrid site as a Base Template since it has the simplest tag naming convention. Other sites will use Derived Templates to override this tag naming convention. All these details will ultimately be transparent to the average user of the data.

Our design will heavily depend on Template Inheritance and Substitution Parameters. Before jumping into building out our AF hierarchy, let's discuss these concepts a bit more.

## Section 2. Using Substitution Parameters and Template Inheritance

### Substitution Parameters:

Substitution parameters are placeholders we use to utilize Templates and other scaling means to build out our AF hierarchy more efficiently. Substitution parameters are denoted by percentage signs as follows: %<parameter>%

A few basic substitution parameters are:

%Element% and %Attribute%

We can use these replacement variables as follows:

If my Element name is **Well01** and an attribute name on that element is **Pressure**, then using the following string of substitution parameters to define the appropriate PI tag for that attribute's data would work as follows:

%Element%.%Attribute%

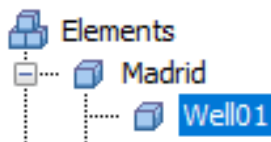
Will resolve to:

Well01.Pressure

Similar to navigating in a Windows File System, using `..\` will navigate up one level in your hierarchy, which in AF is the Parent Element. Therefore, if you want to reference an aspect of your Parent Element such as its name, you can use:

%...\Element%

And if you are on the highlighted Well01 Element shown below:



The substitution parameter would resolve to:

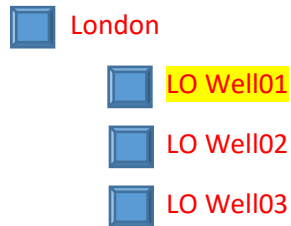
Madrid



Tip

String Builder Data Reference Type Attributes need to have double quotes around Substitution Parameters to populate their Value fields in AF.

Have a look at the following AF structure and determine how we can use substitution parameters to aid in our AF design (the highlighted element corresponds to the screenshot of attributes):



General Child Elements Attributes Ports Analyses Notification Rules Version				
Filter				
	Name	Value	Settings...	
+	Casing pressure	5.82035493850708 psia	\\PISRV01\Lon.749.CP.PV;UOM=psia	
+	Power Consumption	62.881441643872 kW	\\PISRV01\Lon.749.PC.PV;UOM=kW	
	Site Name	London	1	
	Well Name	LO Well01	2	

With just the knowledge of the substitution parameters discussed above, fill in the 2 blank settings parameters with the correct substitution parameters (note these are String Builder type attributes):

1. \_\_\_\_\_

2. \_\_\_\_\_

## Template Inheritance

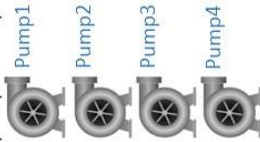
This lab will focus on using Derived Templates to override Attributes of a Base Template, a very useful trick when using Templates. This is just one example of Derived Templates or Template Inheritance. Since Derived Templates include both their own Attributes in addition to their parent(s) or Base Template(s), Template Inheritance can also be used to standardize Attributes of like pieces of equipment in a Base Template, but also provide flexibility for differences in the Derived Templates.

The following two examples are designed to solidify your understanding of these two uses of Derived Templates. The left column describes the Attributes associated with your equipment. The right column shows the desired results for Elements created from your Templates. Fill in the names of the Attributes in each Base Template and Derived Template in the middle column to provide the desired result in Elements created from these Templates.

Template Inheritance Activity 1

Equipment Description

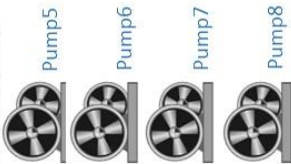
Single Stage Pump  
(4 pumps at site)



Attributes (each pump)

- Power Consumption
- Inlet Pressure
- Stage 1 Compression Ratio
- Outlet Pressure

Two Stage Pump  
(4 pumps at site)



Attributes (each pump)

- Power Consumption
- Inlet Pressure
- Stage 1 Compression Ratio
- Stage 1 Outlet Pressure
- Stage 2 Compression Ratio
- Outlet Pressure

Use templates to easily compare power consumption across all pumps.

Element Template Design

Fill in the 6 red Attribute Template boxes below to produce the desired pump Elements to the right.

Base template

Templates

Element Templates

Pump Base Template

General	Attribute Templates	Ports	Analysis Template
Filter			
Name			
Description			
Template			
Categories			

Derived template

Templates

Element Templates

Pump Base Template

2 Stage Pump Template

General	Attribute Templates	Ports	Analysis Template
Filter			
Name			
Description			
Template			
Categories			

Pump Elements

General	Child Elements	Attributes	Ports	Analysis
Filter				
Name	Pump1			
Description				
Template	Pump Base Template			
Categories				

General	Child Elements	Attributes	Ports	Analysis
Filter				
Name				
Description				
Template				
Categories				

General	Child Elements	Attributes	Ports	Analysis
Filter				
Name	Pump5			
Description				
Template	2 Stage Pump Template			
Categories				

General	Child Elements	Attributes	Ports	Analysis
Filter				
Name				
Description				
Template				
Categories				

Template Inheritance Activity 2

Equipment Description

Wells at Madrid Site      Attributes (each well)  
(3 wells at site)



Site Name  
config: "%.\Element%";  
Well Name  
config: "%Element%";  
Casing pressure  
config: "%Element%.%Attribute%.PV  
Power Consumption  
config: "%Element%.%Attribute%.PV

Wells at London Site      Attributes (each well)  
(4 wells at site)



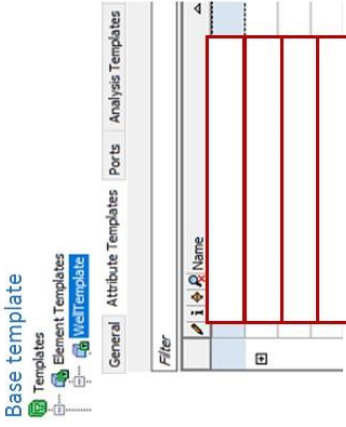
Site Name  
config: "%.\Element%";  
Well Name  
config: "%Element%";  
Casing pressure  
config: "%@.|TagName%  
Power Consumption  
config: "%@.|TagName%

Tags for Casing pressure and Power Consumption at the London Site are named differently than the Madrid Site.

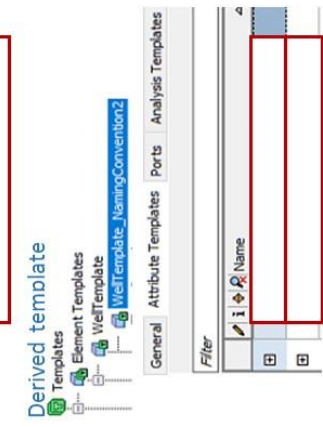
Element Template Design

Fill in the 6 red Attribute Template names below to make tag naming differences between sites transparent to visualization users.

Base template




Derived template



Well Elements

Visualization users will see each well has the same four attributes, but have no idea the Casing pressure and Power Consumption attributes are configured differently for each site.



General    Child Elements    Attributes    Ports    Analysis    Notification Rules    Version

Name: Well01  
Description:  
Template: WellTemplate

Filter	Value
Casing pressure	50.9995 psia
Power Consumption	76.45326457532 kW
Site Name	Madrid
Well Name	Well01

General    Child Elements    Attributes    Ports    Analysis    Notification Rules    Version

Name: LO Well01  
Description:  
Template: WellTemplate\_NamingConvention2

Filter	Value
Casing pressure	5.2035493850709 psia
Power Consumption	62.88144643872 kW
Site Name	London
Well Name	LO Well01

AF will show the resolved tag names

## Section 3. Building Your First Element

In this section we will:

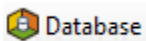
- Create our first well Element
- Create PI Point Data Reference Attributes
- Assign Default Units of Measure for the Attribute, Assign Units of the Measure for the tag used in the PI Point Data Reference
- Convert this well Element to a Template called **WellTemplate** using Substitution Parameters %Element% and %Attribute%

Our basic building block is going to be the well Element. This is the smallest self-contained unit that we would frequently like to compare. Let's start by creating our first well in PI System Explorer.

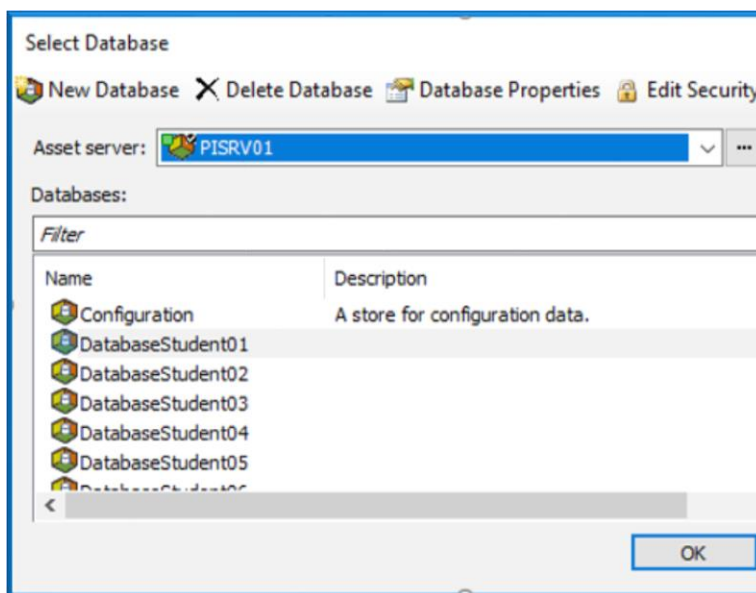
1. Start by logging into the PICLIENTXX machine (your machine will depend on the student number assigned to you) using the provided student username and password.
2. Open PI System Explorer by double-clicking the PSE icon on the desktop. PSE can also be found in the Start Menu under PI System.



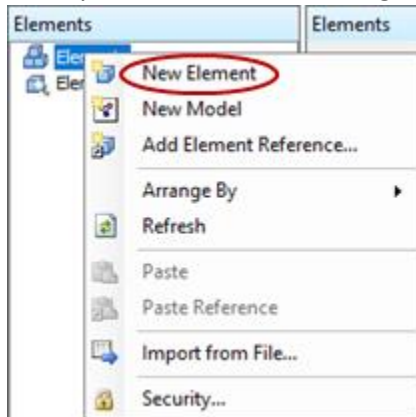
3. Open the **database associated with your student number** by clicking the Database icon at the top left.



4. Select your student user database and Click OK.



- To create your first well Element, right click Elements at the top left and select New Element.




- For “Element Template:” select “<None>”.

### Madrid Tag Naming Convention

Before continuing we need to discuss the tag naming convention at our first site. We have decided to first build well Elements for the Madrid site since it has the simplest tag naming convention. The tags already exist on the PI Data Archive and we do not want to rename any tags. The tag representing **Casing pressure** for **Well01** is called **Well01.Casing pressure.PV**. If we name the element **Well01** and the Attribute **Casing pressure**, we will be able to use these names to build the tag name to be linked to this Attribute. These are known as Substitution Parameters and are denoted by %.

Well Name (%Element%)	Attribute Name (%Attribute%)	Tag Name on PI Data Archive	Tag Naming Convention
Well01	Casing pressure	Well01.Casing pressure.PV	%Element%.%Attribute%.PV
Well01	Power Consumption	Well01.Power Consumption.PV	

A large part of AF is learning how to use Substitution Parameters effectively. This is the simplest example. We will complete many more examples in this lab to build Derived Templates for non-ideal tag naming conventions.

 <b>Tip</b>	<p>Get comfortable using Substitution Parameters. They unlock the power of Templates in AF.</p>
---	---

7. On the General tab, rename your first Element to **Well01**.

General Child Elements Attributes Ports Analyses Notification Rules Version

Name:

Description:

Template:

Categories:

[Extended Properties \(0\)](#) [Annotations \(0\)](#) [Location](#) [Security](#)

Find: [Parents](#) [Children](#) [Event Frames](#)  
[Models](#) [Layers](#) [Connections](#)

8. On the Attributes tab, click “New Attribute” and rename the Attribute to **Casing pressure** on the top right.

General Child Elements Attributes Ports Analyses Notification Rules Version

Filter

Name	Value
Casing pressure	0

Name:

Description:

Properties:

Categories:

Default UOM:

Value Type:

Value:

Data Reference:

9. Set the Default UOM (on the right hand side) for the **Casing pressure** Attribute to **psia** (found under Pressure).

Name:

Description:

Properties:

Categories:

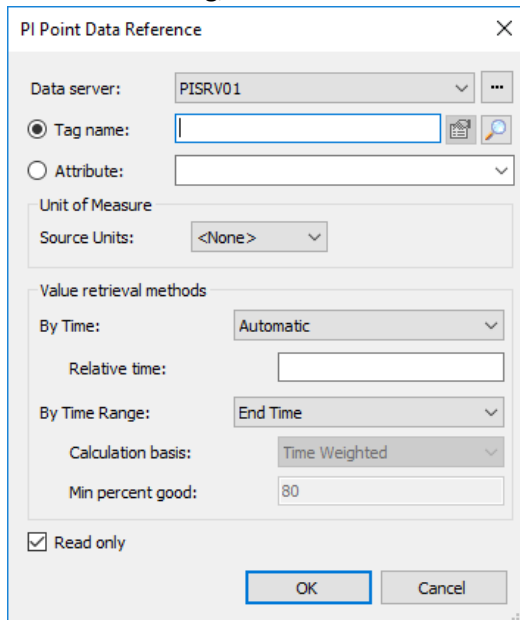
Default UOM:

Value Type:

Value:

Data Reference:

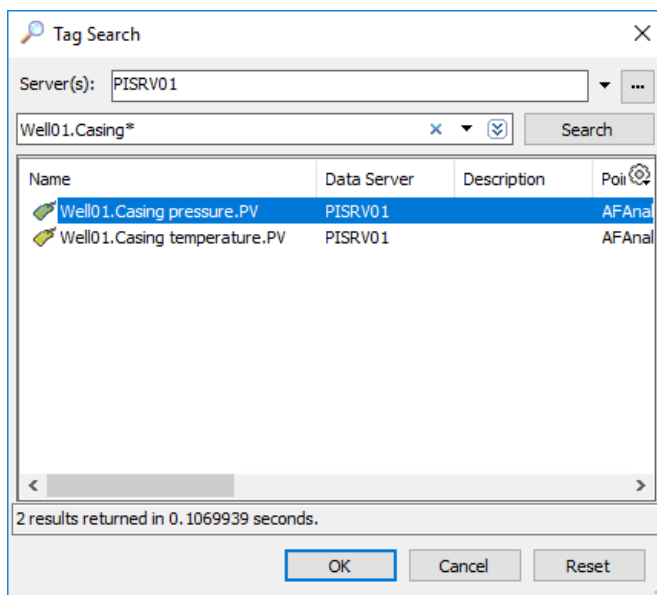
- Click "Settings..." at the right under Data Reference. This will automatically set the Attribute as a PI Point Data Reference. The PI Point Data Reference Configuration Window will appear. (If the right pane above is missing, click the small arrow at the right side of the screen to expand it).



The PI Point Data Reference Configuration Window is shown. It has a title bar with a close button (X). The window contains the following fields and controls:

- Data server:** A dropdown menu showing "PISRV01" with a browse button (three dots).
- Tag name:** A text input field with a magnifying glass icon to its right.
- Attribute:** A dropdown menu.
- Unit of Measure:** A section containing a **Source Units:** dropdown menu showing "<None>".
- Value retrieval methods:** A section containing:
  - By Time:** A dropdown menu showing "Automatic".
  - Relative time:** A text input field.
  - By Time Range:** A dropdown menu showing "End Time".
  - Calculation basis:** A dropdown menu showing "Time Weighted".
  - Min percent good:** A text input field showing "80".
- Read only:** A checked checkbox.
- Buttons:** "OK" and "Cancel" buttons at the bottom right.

- Click the magnifying glass to the right of "Tag name:" to bring up the Tag Search Window. Search for **Well01.Casing\*** and select **Well01.Casing pressure.PV**. Click OK to close the Tag Search window.



The Tag Search Window is shown. It has a title bar with a search icon and a close button (X). The window contains the following fields and controls:

- Server(s):** A dropdown menu showing "PISRV01" with a browse button (three dots).
- Search text:** A text input field containing "Well01.Casing\*" with a clear button (X) and a search button (magnifying glass).
- Search button:** A button labeled "Search".
- Results table:** A table with columns: Name, Data Server, Description, and Poi (with a gear icon).
 

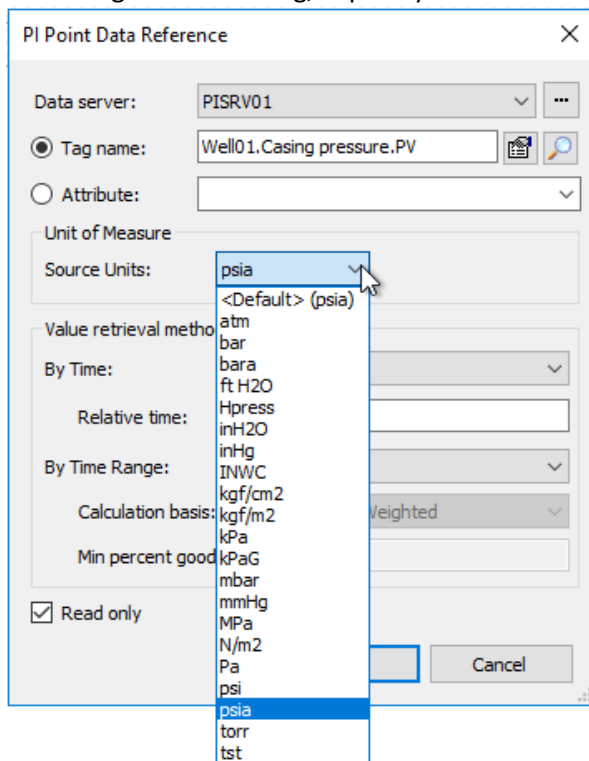
Name	Data Server	Description	Poi
Well01.Casing pressure.PV	PISRV01		AFAnal
Well01.Casing temperature.PV	PISRV01		AFAnal
- Footer:** A status bar showing "2 results returned in 0.1069939 seconds." and buttons for "OK", "Cancel", and "Reset".



Tip

Use wildcards while searching to return more results or fill in gaps that you do not remember  
 \* = any and all characters (multiple characters can be returned)  
 ? = any individual character

12. After selecting the correct tag, explicitly set the PI Point Data Reference Source Units as **psia**.



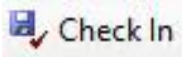
Best Practice

Explicitly define Units of Measure for both the incoming tag in the Default UOM to be displayed by AF (step 9) and in the PI Point Data Reference Configuration Window (step 12)

13. Click OK to close the PI Point Data Reference Window.

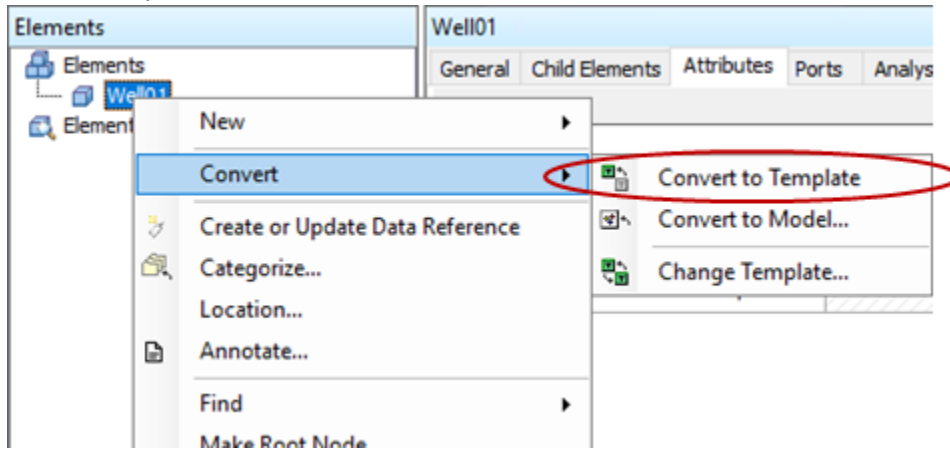
14. Complete steps 8-13 for the **Power Consumption** Attribute. The UOM for the PI tag (Well01.Power Consumption.PV) to be configured in the PI Point Data Reference is **kW**. The default UOM to display in AF is also **kW** (found under Power).


15. Check in your changes by clicking the Check In button at the top of PSE. This commits your changes and edits to the Asset Framework database. Changes you made are now viewable by other users of your database.



*We will not explicitly state to Check In changes in PSE throughout this lab, but you should do so frequently.*

16. We've now created our first Element and would like to convert it to a Template to be reused to build more wells with the same tag naming convention. Right click the **Well01** Element and select Convert to Template.



 <b>Best Practice</b>	<p>All Elements in your AF hierarchy should be made from Templates. In addition to Template Inheritance, Excluded Attributes can help with some use cases. Avoid using Allow Extensions.</p>
---	--

17. We need to assign the desired tag naming convention to the Template which we discussed earlier. In the Convert Attribute to Template dialog box, change "Suggested Point Name:" to **%Element%.%Attribute%.PV** and click Apply. You should notice that the **Casing pressure** and **Power Consumption** rows updated as well. We discussed earlier why this works as our generalized tag naming convention for existing tags at this site. For our other sites this will unfortunately not be the case, but we have many tools in AF to make it work!

Convert Attribute to Template

These attributes have data references to specific PI Points.  
Choose how each data reference should be defined in the template by selecting and/or editing the choices below:

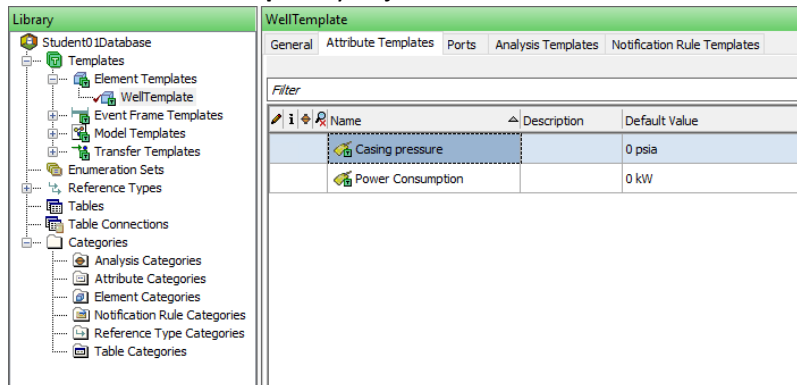
Suggested Point Name:


☐ Include Tag Creation

Attribute	<input type="checkbox"/> Current	<input checked="" type="checkbox"/> Substituted	<input type="checkbox"/> No Data Reference
Casing pressure	<input type="checkbox"/> \PISR\01\Well01.Casing pressure.PV;UOM=psia	<input checked="" type="checkbox"/> \PISR\01\%Element%.%Attribute%.PV;UOM=psia	<input type="checkbox"/>
Power Consumption	<input type="checkbox"/> \PISR\01\Well01.Power Consumption.PV;UOM=kW	<input checked="" type="checkbox"/> \PISR\01\%Element%.%Attribute%.PV;UOM=kW	<input type="checkbox"/>

18. Click OK and Check In your changes.

19. Go to the Library in the lower left, Templates→Element Templates in the top left, and confirm the existence of the **WellTemplate** you just created.

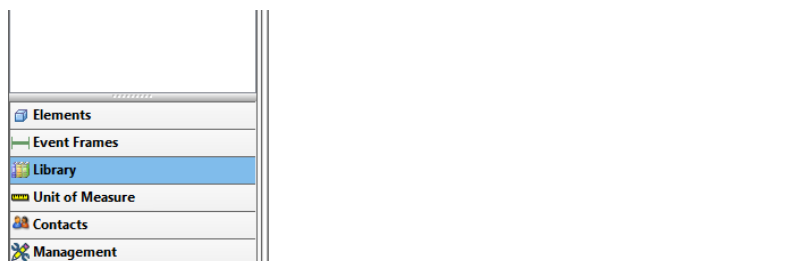





Best Practice

The Library Tab contains all of the Templates, Tables, and Enumeration Sets that we will use in this lab. Once an element is tied to a Template, editing should be done from the Library Tab, and **NOT** from the Elements Tab.

Edits completed directly on the Element in the Elements Tab are overrides to the Template for that Element only and can be undone using Reset to Template.




If we need to add any Attributes to the **WellTemplate** in the future, we can always do that here in the Library. The new Attributes we add will then be propagated to all well Elements created from this Template.



Tip

If you plan on using Template Inheritance, carefully plan which Attributes will be included at each level. You can use multiple levels of Template Inheritance.



Help Tip

There are “catch-up” databases that are already created for you in case you fall behind or get stuck during the lab. Use the catch-up databases as checkpoints to get back on track.

## Section 4. Building Your First Site

In this section we will:

- Create a site Element for Madrid to be reused at each site
- Configure a RollUp Analysis
- Use existing **WellTemplate** to build more wells at Madrid site

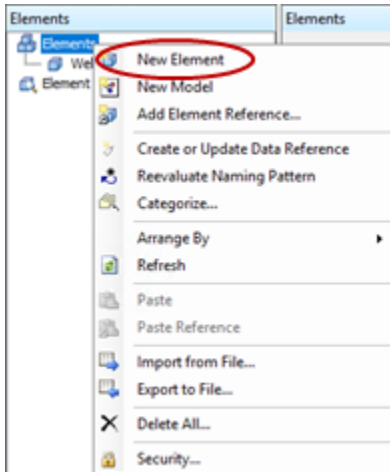
**Well01** is only one of many wells at the Madrid site. We want to create more well Elements using the Template we just created, in addition to a site-wide calculation for the total power being used at the Madrid site at any time. Let's start by building the Madrid site Element, converting that site Element to Template, and then building out the rest of the well Elements at Madrid.


**Brainstorm** (We will discuss as a group):

- 1.
2. Do you already know how to create elements based off a template? Name a way we can easily create these elements.
3. Where in our hierarchy should we perform the site wide calculation?
  - a. What are the benefits of performing the calculation where you specified above?

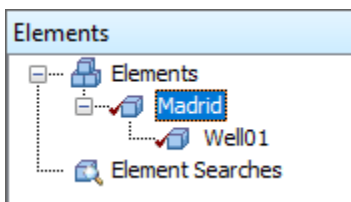
### Step by Step

1. Right click the Parent **Elements** at the top of the AF Hierarchy and Select New Element.



 Best Practice	<p>Each level of your hierarchy should represent a single type of Element. Our first level includes only sites. Our second level includes wells, but it could include other assets with similar significance at our enterprise if they make sense to compare. You would not include sites and equipment at the same level of your hierarchy.</p>
--	--

2. In the Choose Element Template Window, be sure to select <None> for the "Element Template:" and click OK.
3. Rename this Element to **Madrid** on the General tab.
4. The only Attribute for the Madrid site Element will be the total power consumption of all well Elements below it in the hierarchy. Before configuring the Rollup Analysis, let's move the **Well01** Element to be under the Madrid site. Click on **Well01** to highlight it, hold shift while clicking on **Well01** and dragging it to Madrid. A reference type dialog box will pop up. Select Parent-Child. Your hierarchy should now look like the following.



- To configure the Rollup Analysis, click on the **Madrid** Element and go to the Analyses Tab. Select “Create a new analysis”.

Madrid

General Child Elements Attributes Ports Analyses Notification Rules Version

There are no analyses configured for this element.

[Create a new analysis](#)

- Rename the Analysis to **TotalSitePowerConsumption** and configure Analysis Type as Rollup.

Name: TotalSitePowerConsumption

Description:

Categories:

Analysis Type: ☐ Expression ☒ Rollup ☐ Event Frame Generation ☐ SQC

- Well01** should be selected in the dropdown menu for Sample Child Element.
- For “Rollup Attributes from”, “Child elements of Madrid” should be selected.
- Type “Power Consumption” in the “Attribute Name:” box and check Sum as the function.

Rollup attributes from

☒ Child elements of Madrid ☐ This element - Madrid

To select attributes set criteria below

Attribute Name: Power Consumption

Attribute Level: Root Level

Attribute Category:

Element Category:


Element Template:

Select the function(s) to write to an attribute

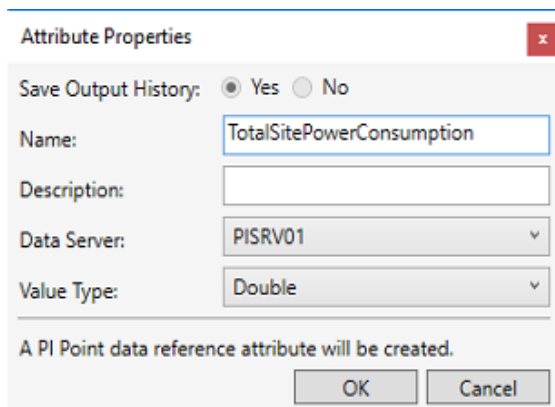
Evaluate

Function	Output(s)	Value At Eval	Value At Last
<input checked="" type="checkbox"/> Sum	Map		
<input type="checkbox"/> Average			
<input type="checkbox"/> Minimum			
<input type="checkbox"/> Maximum			
<input type="checkbox"/> Count			
<input type="checkbox"/> Median			
<input type="checkbox"/> Population standard deviation			
<input type="checkbox"/> Sample standard deviation			

- Click Evaluate and ensure you get a value and not a calculation error.

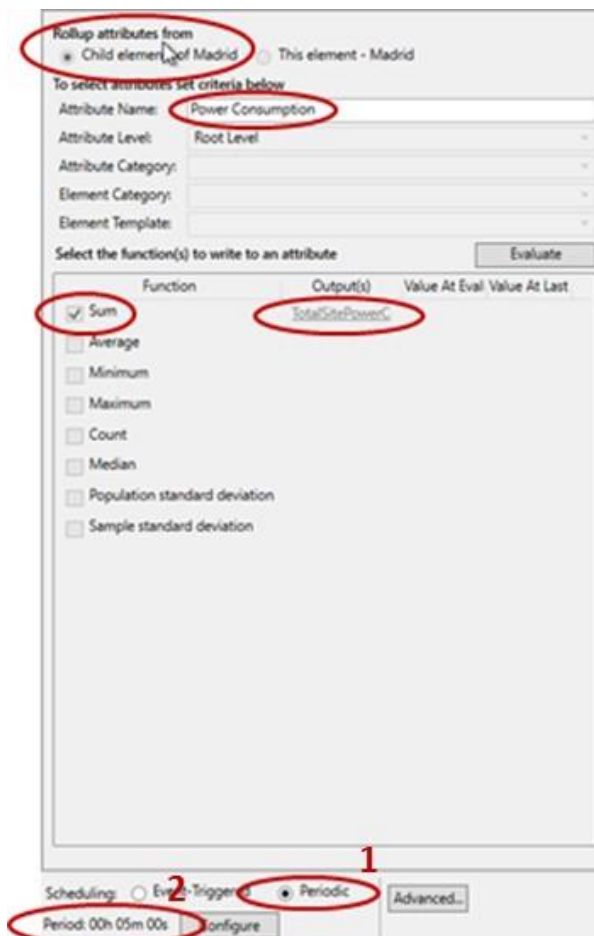
 <b>Best Practice</b>	<p>Use Rollup Analyses when you want calculations to automatically include new assets when they are added to a site.</p>
---	--

11. We now need to output the result of the calculation to an Attribute and set the calculation frequency. To Map the output to a PI tag, select Map→New Attribute. In the Attribute Properties Window, make sure the Attribute Name is set to **TotalSitePowerConsumption** and the Value Type is Double. Click OK.



The 'Attribute Properties' dialog box is shown. It has a title bar with a close button. The 'Save Output History' section has 'Yes' selected. The 'Name' field contains 'TotalSitePowerConsumption'. The 'Description' field is empty. The 'Data Server' dropdown is set to 'PISRV01'. The 'Value Type' dropdown is set to 'Double'. A message at the bottom states 'A PI Point data reference attribute will be created.' There are 'OK' and 'Cancel' buttons at the bottom right.

12. The scheduling at the bottom should be Periodic (1) with a schedule of 5 minutes (2). You may find that Event-triggering may be more appropriate for your own applications. We will not be discussing design consideration for Analysis in this lab. We have used Periodic with 5 minutes to make sure the Analysis triggers frequently so we can see updates during this lab. You can confirm the other items circled below.

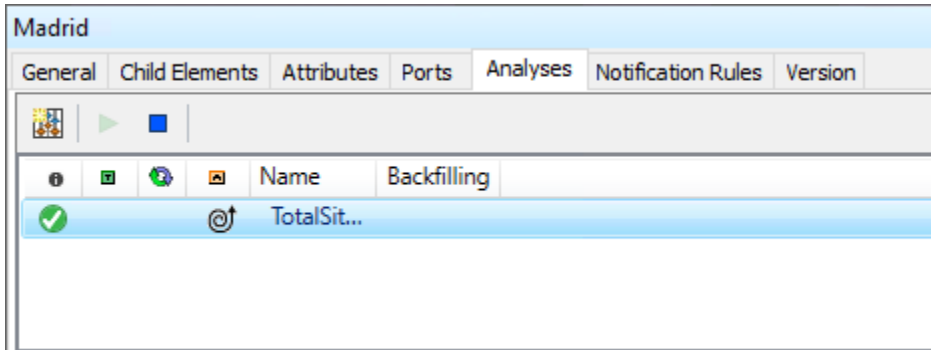


The 'Analysis' configuration dialog box is shown. The 'Rollup attributes from' section has 'Child element of Madrid' selected. The 'Attribute Name' field contains 'Power Consumption'. The 'Attribute Level' is 'Root Level'. The 'Attribute Category' and 'Element Category' are empty. The 'Element Template' is empty. The 'Select the function(s) to write to an attribute' section has a table with the following content:

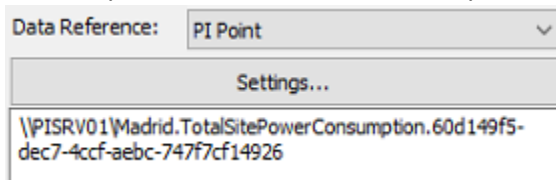
Function	Output(s)	Value At Eval	Value At Last
<input checked="" type="checkbox"/> Sum	TotalSitePowerC...		
<input type="checkbox"/> Average			
<input type="checkbox"/> Minimum			
<input type="checkbox"/> Maximum			
<input type="checkbox"/> Count			
<input type="checkbox"/> Median			
<input type="checkbox"/> Population standard deviation			
<input type="checkbox"/> Sample standard deviation			


The 'Scheduling' section has 'Periodic' selected. The 'Period' field contains '00h 05m 00s'. There are 'Configure' and 'Advanced...' buttons. Red circles and numbers highlight specific elements: a circle around 'Child element of Madrid', a circle around 'Power Consumption', a circle around 'Sum', a circle around 'TotalSitePowerC...', a circle around 'Periodic', and a circle around '00h 05m 00s'. A red '1' is next to the 'Periodic' radio button, and a red '2' is next to the 'Event-Trigger' radio button.

13. Check In the changes and the calculation should automatically start. Hovering over the green check will show Running.

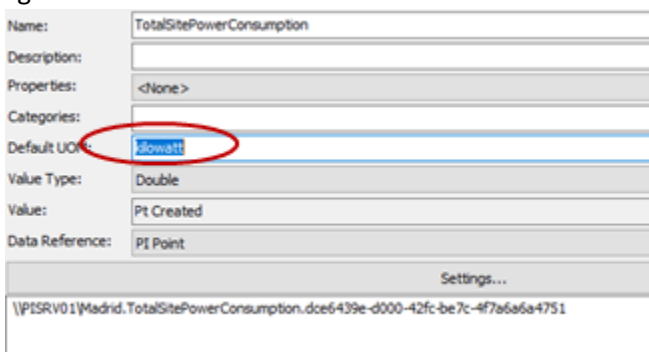


14. However, the tag storing data for **TotalSitePowerConsumption** at **Madrid** has not been updated on the Data Archive. Going back to the Attributes tab, the Value for **TotalSitePowerConsumption** shows as Pt Created. We should see this update once our selected time period has passed.
15. Since we didn't make any changes to the PI Point Data Reference prior to creating the tag, it will automatically include the GUID of the Analysis in the tag name.




 <b>Best Practice</b>	<p>We suggest including the GUID as part of the tag name for Analysis outputs (default behavior). This ensures you don't accidentally configure two Analyses to write to the same output tag.</p>
---	---

16. Change the Default UOM to **kW**.



17. The Attribute value will continue to read "Pt Created" until the periodic trigger calculates a value. You can hit Refresh at the top of the screen to check if the tag has updated.

18. Let's finish building out **Well02**, **Well03**, **Well04** and **Well05** at the **Madrid** site by using the **WellTemplate** Template created earlier. Right click on the **Madrid** Element and Select New→New Child Element.
19. In the Choose Element Template dialog box, select **WellTemplate** under "Element Template:".
20. Rename the well to **Well02** on the General Tab.
21. On the Attributes tab, see if the **Well02.Casing pressure.PV** and **Well02.Power Consumption.PV** tags have been picked up correctly. You may need to hit Refresh at the top, so the Table Lookup portion populates using the updated well name.
22. Follow steps 18-21 to build **Well03**, **Well04**, and **Well05**.
23. Since the Rollup Analysis for the **Madrid** site was generalized to include all wells under it in the hierarchy, it will automatically include all five wells for all future triggers of the power calculation.

 Best Practice	PI Builder can be used if you have many Elements to be created from Templates.
--	--

When you have completed the Section 4 exercise above, start thinking about these group discussion questions below:

1. If you have similar (but non-identical) types of equipment, what are some ways you can design your AF hierarchy?
2. What are the pros and cons of each of these approaches?
3. What can you do if different sites have the same equipment, but different tag naming conventions?

## Section 5. Expanding to a New Site with Different Naming Conventions

In this section we will:

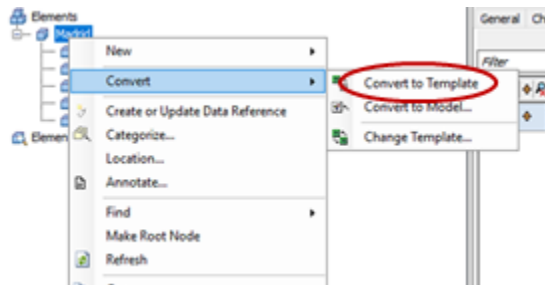
- Convert the **Madrid** Element to a Template called **SiteTemplate**
- Create a **London** site Element using **SiteTemplate**
- Create a Derived Template from the **WellTemplate** to include the London tag naming convention
- Create Attributes in the Derived Template to override those in the Base Template, the Derived Template will allow us to compare wells across sites even though the London site uses a different tag naming convention

**IMPORTANT REMINDER: We will build out our templates on the Library Tab but we may go back to the Elements Tab to verify our work. Remember to always build on our Library Tab!**

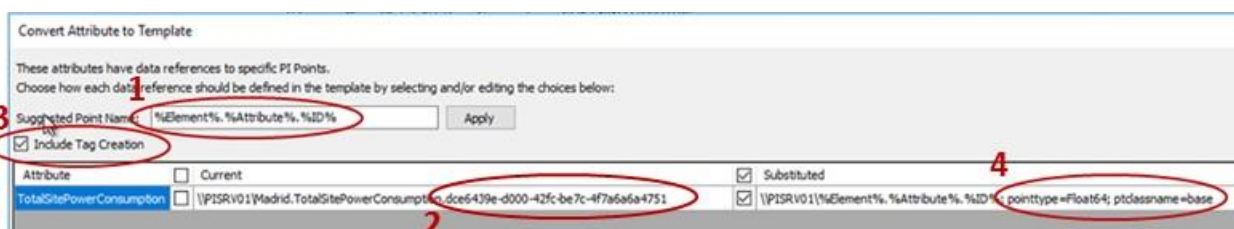
### Section 5A. Creating the Site Template

We want to compare total power consumption at each site, so we should templatize our site Element. Let's start by converting the **Madrid** Element to a Template and then build a new **London** Element.

1. Right click the **Madrid** Element and select Convert to Template.

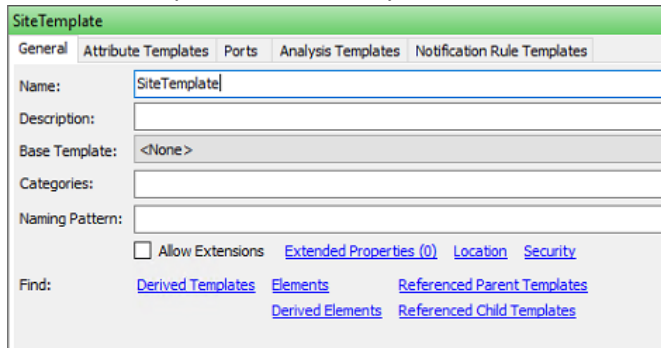


2. We will be letting AF create **TotalSitePowerConsumption** tags for each site. Use a Suggested Point Name of **%Element%.%Attribute%.%ID%** (1). Make sure the TotalPowerConsumption Attribute includes the GUID (2). Since we will be using this template to create new tags, be sure the "Include Tag Creation" box is checked (3). This adds the pointtype and ptclassname to the configuration information of the Attribute to allow tags to be created (4).



3. Click OK.

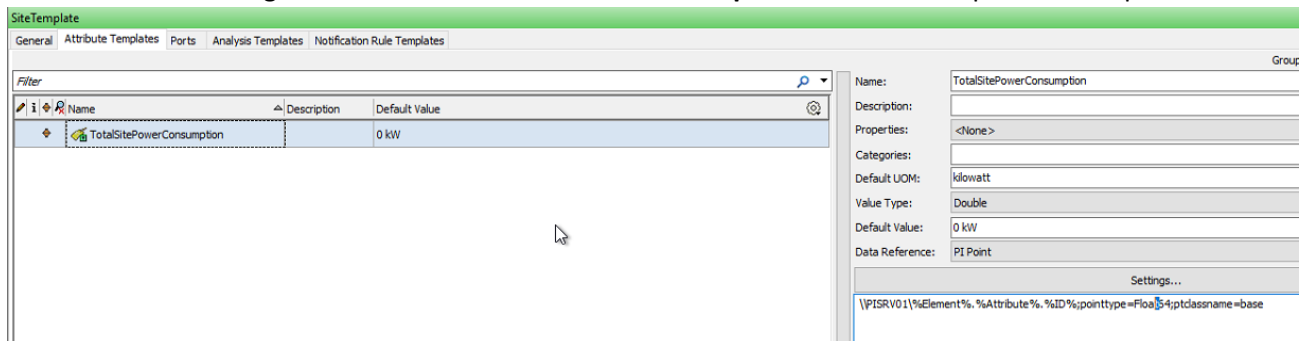
4. Find the new Template in the Library and rename it to **SiteTemplate** on the General Tab.



Best Practice

Our site Element should be templated since we have multiple sites and want to compare the results of the Rollup Analysis.

5. Confirm the configuration of the **TotalSitePowerConsumption** Attribute Template is as expected.



6. Go back to the Element tab in the lower left. Right click on Elements at the top left, right click and create a new Element. Select, **SiteTemplate** since we will be creating the new **London** element.
7. Rename the Element to **London** on the General tab.
8. If the tag is not found, right click on the attribute and click “Create or Update PI Point”.

## Section 5B. Building Tag Names

We would like to make comparisons between wells at our Madrid site and our London site. However, the tag naming conventions are different at these two sets. We will use Derived Templates to make this comparison possible. Let's start by discussing the tag naming convention at the London Site.

### London Tag Naming Convention

If we use the current **WellTemplate** element to create **Well01** at the London Site, AF will be searching for the following tag names on the PI Data Archive: **LO Well01.Casing pressure.PV** and **LO Well01.Power Consumption.PV**. However, these tags do not exist. The tags at the London Site already exist but use a different naming convention as shown below.

Well Name	Attribute Name	Tag Name on PI Data Archive	Tag Naming Convention
LO Well01	Casing pressure	Lon.749.CP.PV	First 3 letters of site name + Control System Number (from Table) + Attribute Abbreviation + PV
LO Well01	Power Consumption	Lon.749.PC.PV	

We will use a Derived Template to override the existing tag naming convention in **WellTemplate**. By using a Derived Template, we can still make comparisons across all wells.

We will use a variety of AF tricks to pull the first three letters of the site name, as well as the Control System Number from a Table based on the well name.

- Let's start by creating a Derived Template from the **WellTemplate**. In the lower left, go to the Library. Find the existing **WellTemplate**, right click, and select New Derived Template.

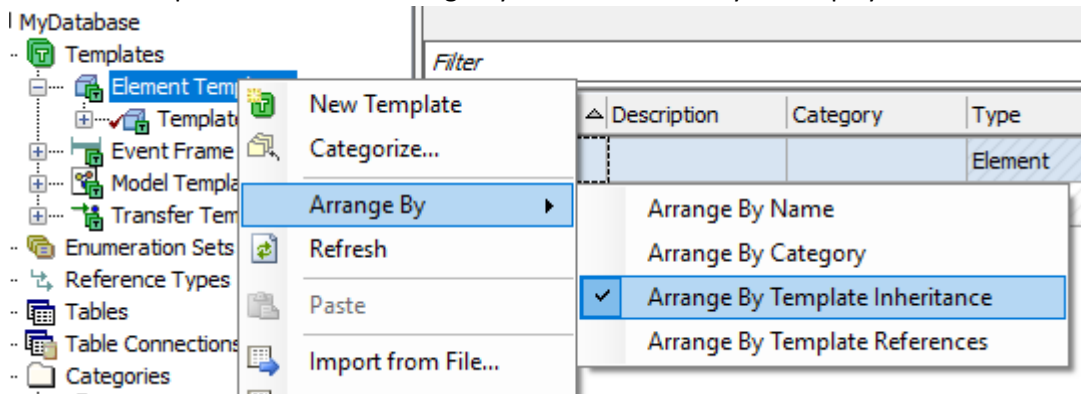


Best Practice

One use of Derived Templates is to override an Attribute of the Base Template. Another common use is to add Attributes that do not exist in the Base Template.

- Rename this Template **WellTemplate\_NamingConvention2** on the General Tab.

3. If the Derived Element Template does not show up under the parent template. Right-click the 'Element Templates' and click 'Arrange-By' to select how they are displayed:



4. On the Attributes Tab, create a New Attribute Template, calling it **Casing pressure**. Be sure to use the exact same name as the Base Template for it to override the Base Template Attribute.
5. Set the Default UOM as **psia**.
6. Create a second Attribute called **Power Consumption**, setting the default UOM as **kW**.

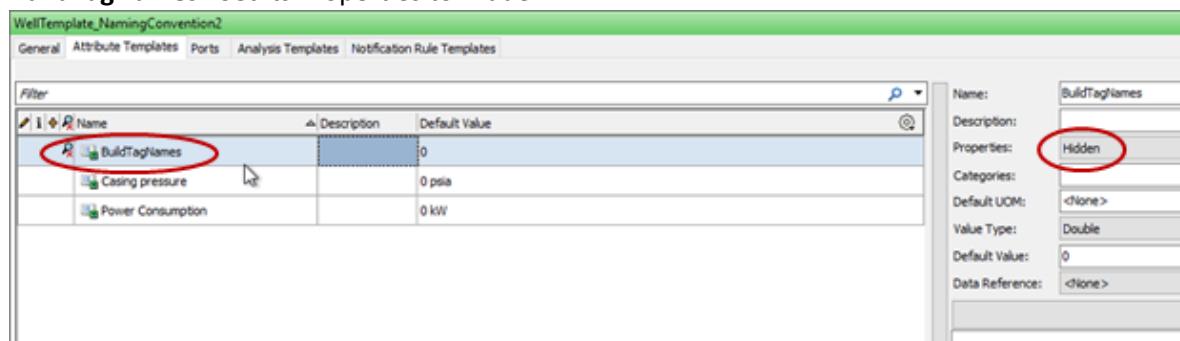
WellTemplate\_NamingConvention2

General Attribute Templates Ports Analysis Templates Notification Rule Templates

Filter

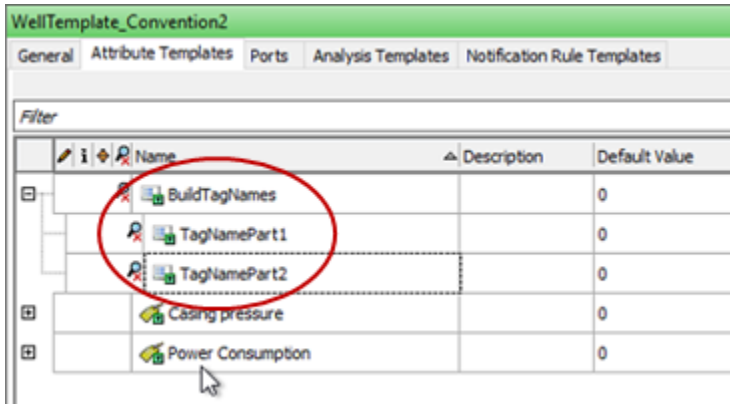
Name	Description	Default Value
Casing pressure		0 psia
Power Consumption		0 kW


7. We need to start building the parts of our tag name that will be used to reference the tag that already exists on the PI Data Archive. Some parts of the tag name will be used across multiple Attributes in our template (e.g. "Lon" and "749") so let's first create those separate from the **Casing pressure** and **Power Consumption** Attributes. Create a New Attribute Template called **BuildTagNames**. Set its Properties to Hidden.



8. Right click on the **BuildTagNames** Attribute and create a new Child Attribute Template, calling it **TagNamePart1**. Notice that the Child Attribute Template is also hidden.

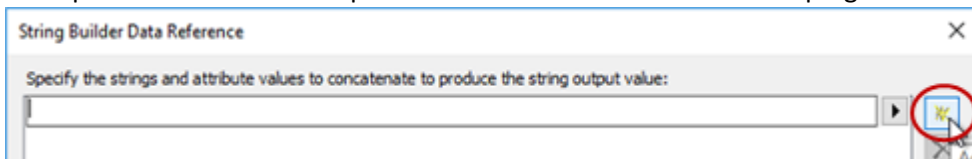
9. Right Click on the **BuildTagNames** Attribute and create a second Child Attribute Template calling it **TagNamePart2**.



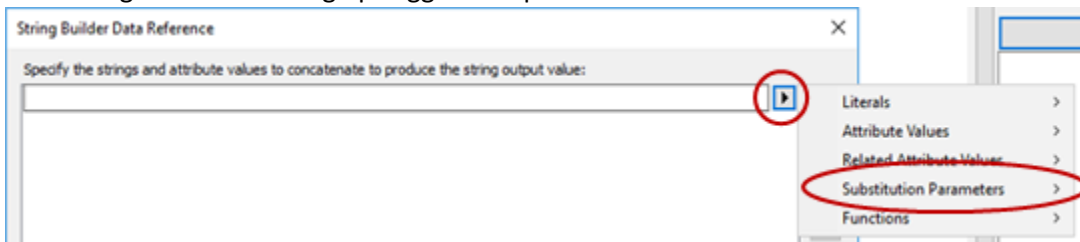
 <b>Best Practice</b>	<p>Hidden Attributes are not visible in many Client Tools. Use them to help build your AF structure without confusing users.</p>
---	--

We are currently building the Derived Template to be used for the London site, or any other site that uses the same tag naming convention. TagNamePart1 will store the first three letters of the site name, while TagNamePart2 will store the Control System Number. We will use a String Builder type data reference combined with Substitution Parameters to build TagNamePart1. We will use a Table Lookup to build TagNamePart2.

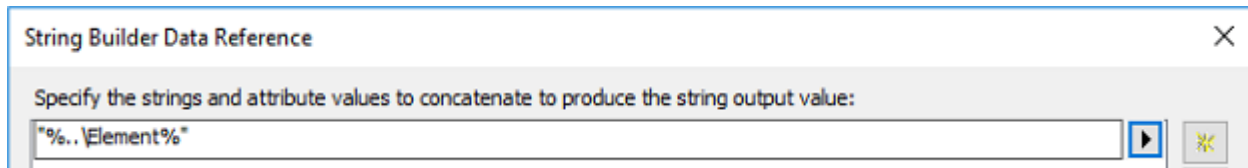
10. Click on **TagNamePart1**. Under Data Reference, select String Builder and click “Settings...”. We will use the String Builder Data Reference window to help us create the reference to the parent elements and truncate (London) it to the first three letters (Lon).
11. First let’s pull in the name of the parent. Click on the star icon in the top right corner of the window.



12. Click on the right arrow to bring up suggested options.

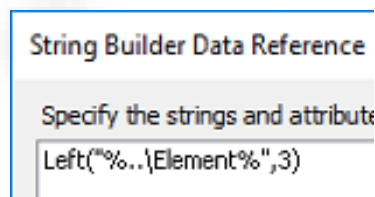


13. Select the Substitution Parameter **%..\Element%** from the list of suggestions items. When a well Element is created under the London site, this will bring in the name London from its Parent Element.

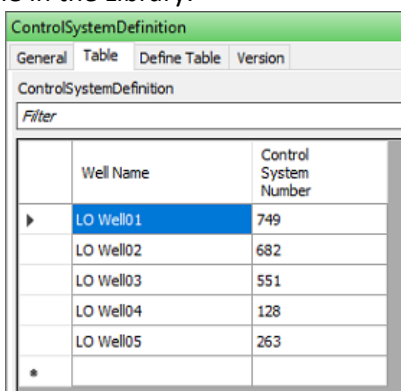


*This is our first use of more complex Substitution Parameters. There is an extension guide to using Substitution Parameters in the Appendix.*

14. We will further edit the **TagNamePart1** Attribute in **WellTemplate\_NamingConvention2** on the Library Tab because we are building onto our template. If you click the right arrow where we found common items, there is a list of common functions, including **Left(string, length)**. This allows us to truncate **London** down to **Lon**. You can click on the line containing **"%..\Element%"** and edit it to **Left("%..\Element%",3)**.



15. Click OK. If you get comfortable with String Builders, you can directly edit the area below "Settings"!
16. The next part is to pull the Control System Number from a Table based on the well name. The Control System Number was used by the PI admin many years ago to create the tags. We received a list of Control System Numbers from the PI admin and created a table that maps our desired well names to those Control System Numbers. To view this table, go to the ControlSystemDefinition Table in the Library.



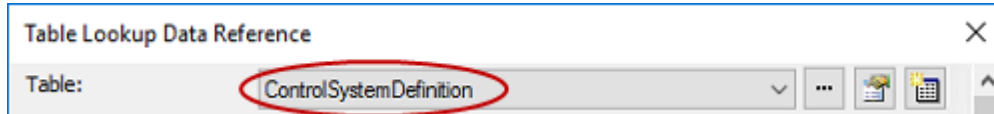
ControlSystemDefinition	
General Table Define Table Version	
ControlSystemDefinition	
Filter	
▶	LO Well01 749
	LO Well02 682
	LO Well03 551
	LO Well04 128
	LO Well05 263
*	



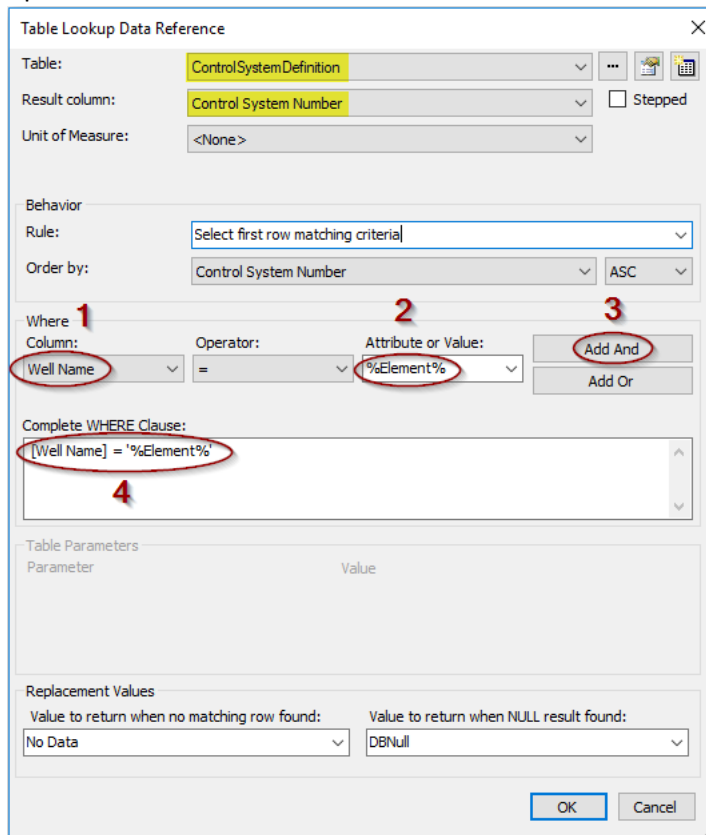
Tip

Don't be afraid to use Tables. AF is a secure place to store Tables and Table Lookups are fast to configure.

17. We will be using a Table Lookup Data Reference to get the Control System Number based on the well name. In the **WellTemplate\_NamingConvention2** Template, select the Attribute Template **TagNamePart2**. Assign it to a Table Lookup Data Reference and click “Settings...”.
18. In the Table Lookup Data Reference Window we will define the table to use, how to find the correct row in the table, and what result to return. In Table: select **ControlSystemDefinition**.

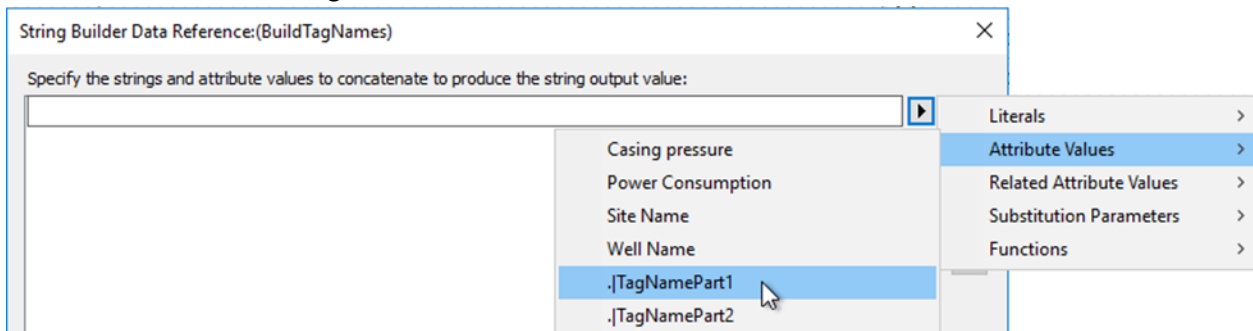


19. The “Result column:” is “**Control System Number**”.
20. The “Where” statement defines what row to select. We want “Column:” to be “**Well Name**” (1) and “Attribute or Value:” to be “**%Element%**” (2) (the substitution parameter for our Well Name). Click “Add And” (3) to build the WHERE clause (4). It’s possible to use multiple WHERE statements with AND or OR conditions to select the correct row in the Table. We’ll need to do that in a later example.

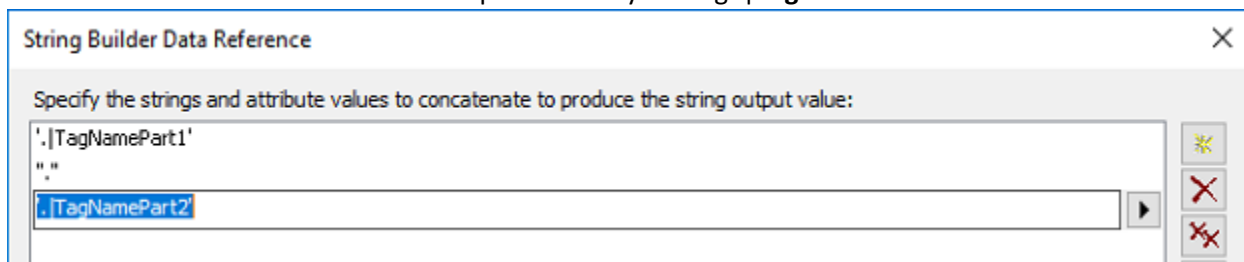


21. Click OK. The box under settings should have populated with the following SQL statement:  
**SELECT [Control System Number] FROM ControlSystemDefinition WHERE [Well Name] = '%Element%'**
22. Let’s combine **Lon** and **749** into **Lon.749** to be used by both our **Casing pressure** and **Power Consumption** attributes. In **WellTemplate\_NamingConvention2**, click on the **BuildTagNames** Attribute Template. Assign it as a String Builder and click “Settings...”.

23. Click the star icon at the right. Under Attribute Values select **.|TagNamePart1**. This will pull in **Lon** from the Child Attribute TagNamePart1.



24. Click the star icon to create a second line. Type **“.”** (including the quotes) to tell string building to add a period.
25. Click the start icon a third time and pull in **749** by finding **.|TagNamePart2** as an Attribute Value.



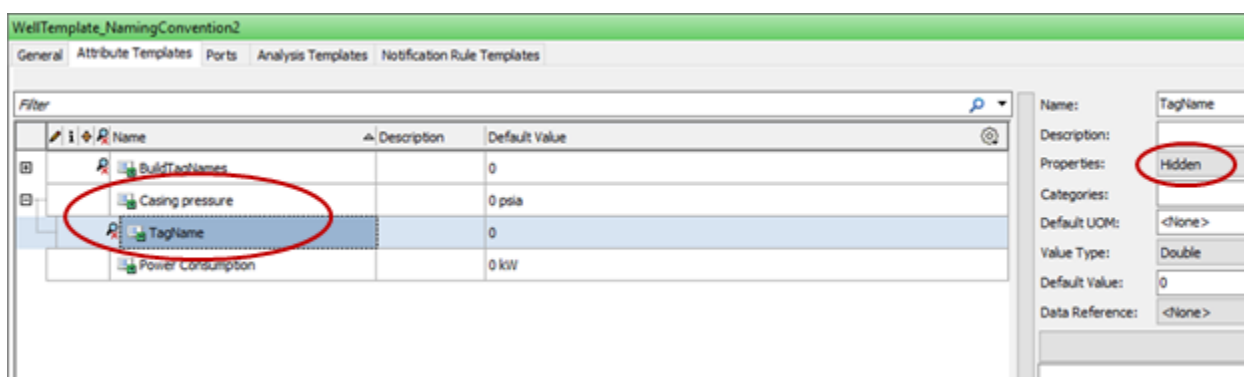
26. Click OK.
27. Go back to the Elements tab in the lower left. Right click the **London** Element and create a New Child Element from **WellTemplate\_NamingConvention2**. Rename the Element **LO Well01**. (When we make our first PI Vision display, we will discuss why we named the well this way.) Make sure to check that your **TagNamePart1**, **TagNamePart2**, and **BuildTagNames** appear as the screenshot below. **BuildTagNames** should now show **Lon.749**.


LO Well01		
General Child Elements Attributes Ports Analyses Notification Rules		
Filter		
	Name	Value
	BuildTagNames	Lon. 749
	TagNamePart1	Lon
	TagNamePart2	749
	Casing pressure	0 psia
	Power Consumption	0 kW

## Section 5C. Configuring a Tag to Reference Another Attribute

Let's finish building the specific tag names for **Casing pressure** and **Power Consumption**, and then use those to populate the PI Point Data Reference tag name. As a reminder, these tags already exist on the PI Data Archive, but we are teaching AF how to find them based on the name of our site and the Control System Number found in a Table.

1. In the **Library Tab** find **WellTemplate\_NamingConvention2**, right click **Casing pressure** and create a New Child Attribute Template. We will recreate the full tag name here, and then reference it in the **Casing pressure** attribute.
2. Rename the Child Attribute **TagName** and give it a Hidden Property.

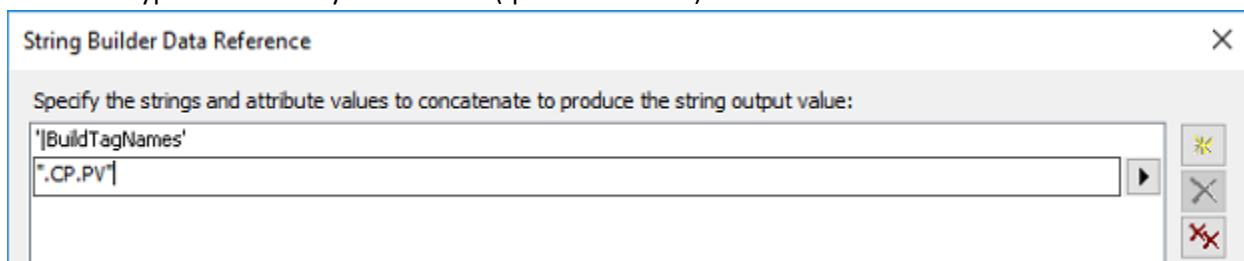




Tip

You don't need to make **TagName** hidden if you don't want to. Many users may have uses for being able to see the tag name we're referencing in the PI Point Data Reference.

3. Assign the **TagName** Attribute as a String Builder Data Reference. Build the following two lines in String Builder Data Reference Window. The first line can be found in Attribute Values. The second line is typed in manually as **".CP.PV"** (quotes included).



4. If you've built it correctly, **Well01** should now be showing **Lon.749.CP.PV**. You can check this on the **Elements Tab**.

5. To configure the next attribute of **Power Consumption**, you have a few options. 1) You can complete steps 1-4 for the new attribute. 2) You can copy and paste the String Builder configuration under “Settings...”, from **Casing pressure** to **Power Consumption**, using “**.PC.PV**” instead of “**.CP.PV**”. 3) You can copy and paste the entire attribute and then change the String Builder settings.

Name	Value
BuildTagNames	Lon.749
Casing pressure	0 psia
TagName	Lon.749.CP.PV
Power Consumption	0 kW
TagName	Lon.749.PC.PV

6. In **WellTemplate\_NamingConvention2**, let's tell the **Casing pressure** and **Power Consumption** Attributes to reference their respective **TagName** Child Attributes. Click on **Casing pressure** and click “Settings...” at the right. Since no Data Reference type was assigned, it will default to a PI Point Data Reference and the configuration window will open. In the Tag Name box, type **%@.|TagName%**. This will pull in the value of the Child Attribute **TagName**. Explicitly define the Source Units as **psia**.

PI Point Data Reference

Data server: %Server%

☒ Tag name: %@.|TagName%

☐ Tag Creation

☐ Attribute:

Unit of Measure

Source Units: psia

Value retrieval methods

By Time: Automatic

Relative time:

By Time Range: End Time

Calculation basis: Time Weighted

Min percent good: 80

Preview

Example instance: [Select example instance](#)

Configuration:

Value:

☒ Read only

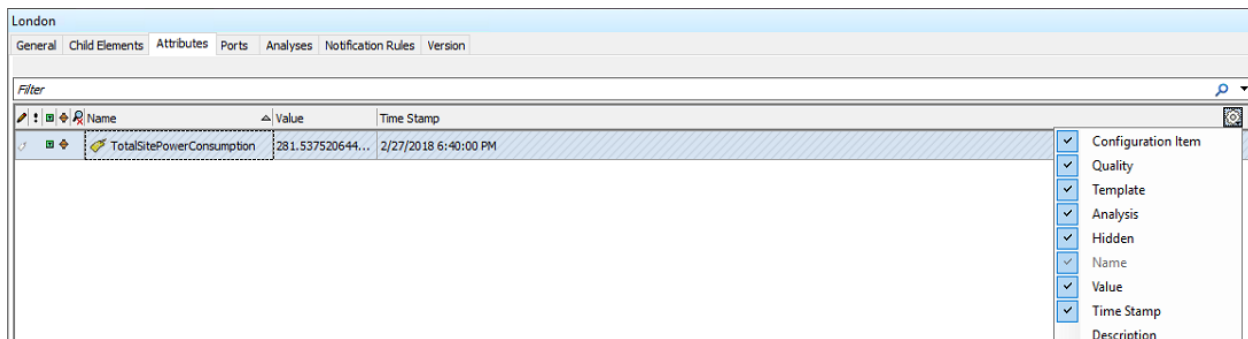
OK Cancel




Tip

Referencing a Child Attribute in a PI Point Data Reference is common. Remember %@.|TagName%

7. Complete step 36 for the **Power Consumption** attribute, assigning the Source Units as **kW**.
8. Check **LO Well01**, and you should now be getting values for **Casing pressure** and **Power Consumption**.
9. Create **LO Well02**, **LO Well03**, and **LO Well04** under the **London** Element and make sure you can view data for **Casing pressure** and **Power Consumption** for each well. Be sure to use the correct well Template for this site.
10. Confirm that the **TotalSitePowerConsumption** Attribute at the London site is updating and the value makes sense based on the well values. We setup the analysis to only trigger every 5 minutes, so you may need to wait until the next trigger after you created all of the wells. You can check the timestamp of the most recent trigger by clicking on the gear icon and adding Timestamp as a column.



Name	Value	Time Stamp
TotalSitePowerConsumption	281.537520644...	2/27/2018 6:40:00 PM



Tip

To check the history of a PI Point Data Reference directly in PSE, right click the Attribute and select Time Series Data or Trend.

11. Be sure to Check In your changes to commit them to the AF database before we try visualizing our data with PI Vision.

## Section 6. PI Vision Part 1: Visualizing our AF Hierarchy

In this section we will:

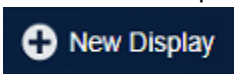
- Create a simple display to visualize **Casing pressure** at any of our wells
- Discuss the weaknesses of our current AF hierarchy and how we can make improvements (to be completed later in the lab)

Now that we've built out two sites using a Base Template and Derived Template, let's see how this works with PI Vision.

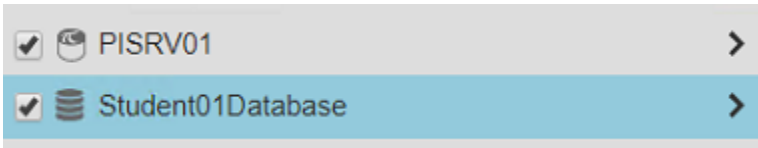
1. Navigate to PI Vision from the Chrome shortcut on the Desktop.



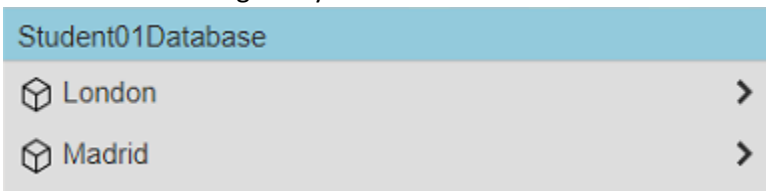
2. Click on the New Display icon.



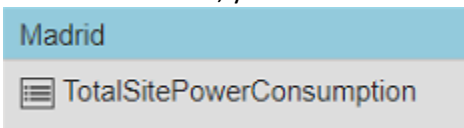
3. Find the AF database corresponding to your student number. All of the student databases should already be visible in PI Vision.



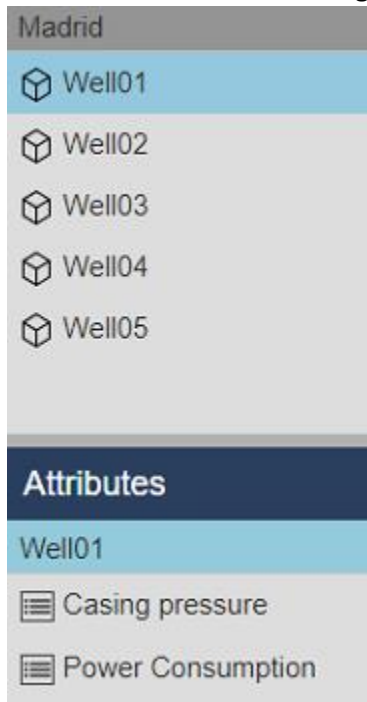
4. Click the arrow to the right of your database to view the AF structure you built.



5. If you Click on **Madrid**, you will be able to see **TotalSitePowerConsumption** as an Attribute.



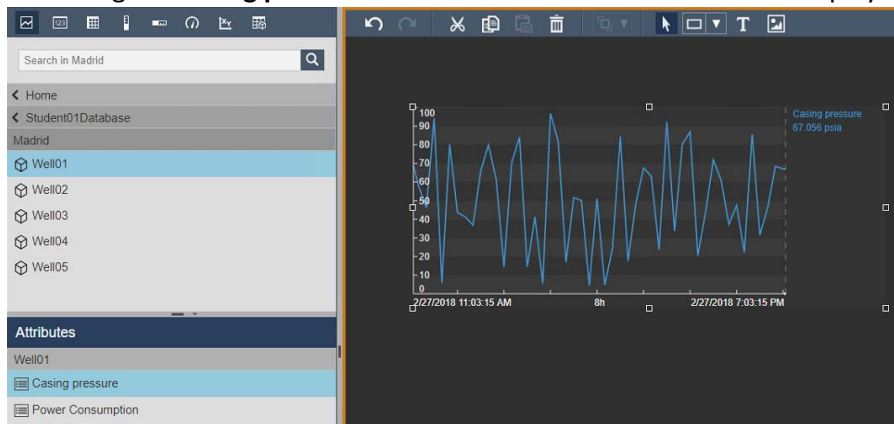
- Drill down further in your AF structure by clicking the right arrow next to **Madrid**. You should now see **Well01-Well05** and the **Casing pressure** and **Power Consumption** Attributes.



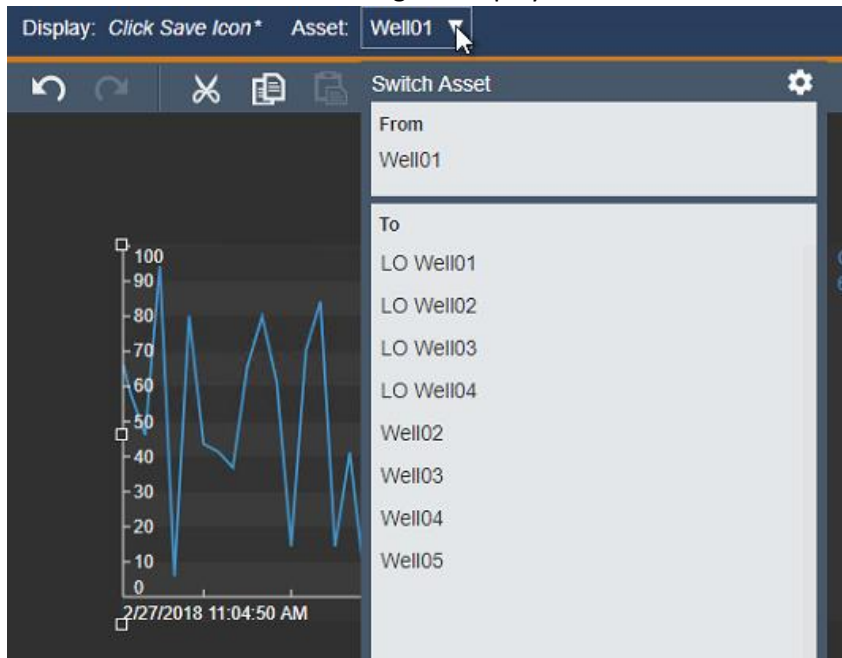
- Let's build a trend of the **Casing pressure** for **Well01**. Click on the trend icon on the top left.



- Click and drag the **Casing pressure** Attribute into the main area of the display.



9. One of the major benefits of using AF with Templates is being able to quickly swap between assets. Click on the Asset Swap dropdown at the top of the display and notice that we can quickly swap between our wells without rebuilding the display.



Questions on our PI Vision display:

1. Try building the display using the Casing pressure from LO Well01 at the London site instead of the Madrid site. Are the assets available for swapping in the dropdown menu different? Can you explain why?
2. Are there additional pieces of general information you would like added to the display for ease of use?
3. What would the Asset Swap Dropdown Menu look like if we called the wells at the London site Well01 instead of LO Well01?
4. Why does the Attribute BuildTagNames not show up for the London site?
5. As the number of Attributes increases in the lower left pane, we would like a way to better organize them. Do you know how this can be configured?

**Bonus:** The Madrid Site currently uses **Well01** as an Element name. Update the Element names at the Madrid Site to say **MA Well01**. You will then need to fix the tag references since the **%Element%.%Attribute%** naming convention no longer applies.

## Part 2: Take-home Bonus Material

### Section 7. Optimizing our AF Templates

In this section we will:

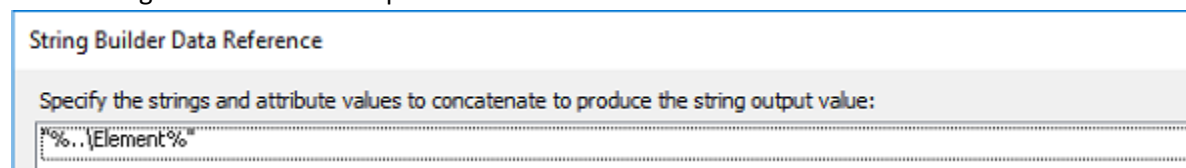
- Add well name and site name as Attributes in the Base Well Template, will also propagate to Derived Templates
- Assign Categories to better organize our well Attributes
- Use Enumeration Sets to convert PI tag integer values to more meaningful information for display in PI System Explorer or PI Vision
- Add Limits to Attributes to indicate Minimum, Maximum and Target values for use in PI Vision displays

When trying to visualize our data in PI Vision, we noticed some weaknesses in our display. We will further optimize our Templates a few ways in this section.

#### Section 7A. Site Name and Well Name as Attributes


Let's add the site name and well name as Attributes in **WellTemplate** for use in Visualization tools. We only need to do this in the Base Template since it will automatically be included in all Derived Templates.

1. Create a New Attribute Template in **WellTemplate** called **Site Name**.
2. Define this Attribute as a String Builder Data Reference Type.
3. In the String Builder Data Reference Windows, bring in the Substitution Parameter **"%..\Element%"** to bring in the name of the parent Element relative to the well.



The screenshot shows a window titled "String Builder Data Reference". Inside, there is a text box with the instruction "Specify the strings and attribute values to concatenate to produce the string output value:". Below this, a text input field contains the substitution parameter `"%..\Element%"`.

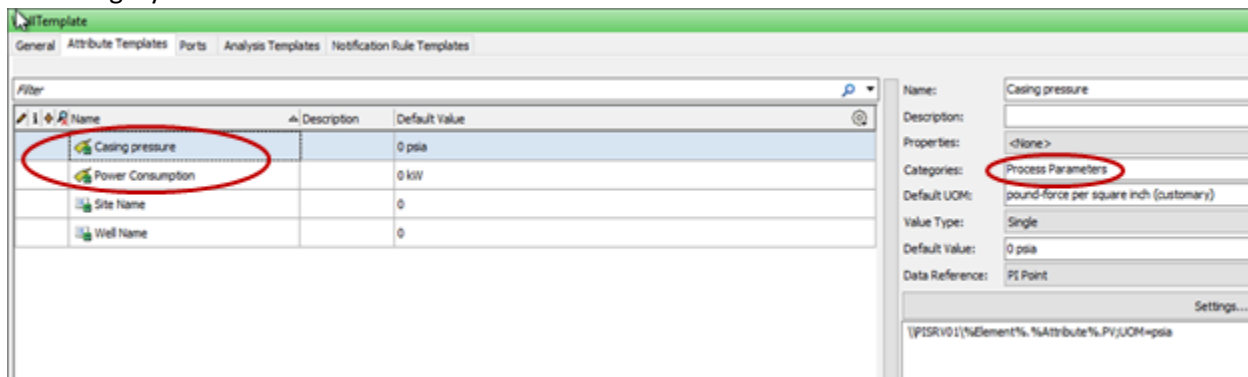
4. Create a New Attribute Template in **WellTemplate** called **Well Name**.
5. Define this Attribute as a String Builder Data Reference Type.
6. In the String Builder Data Reference Window, bring in the Substitution Parameter **"%Element%"** to bring in the name of the current well.
7. Going back to any of the wells at either site, you should now see the **Site Name** and **Well Name**.

 Best Practice	Get in the habit of creating Attributes that contain useful names for visualization.
--	--

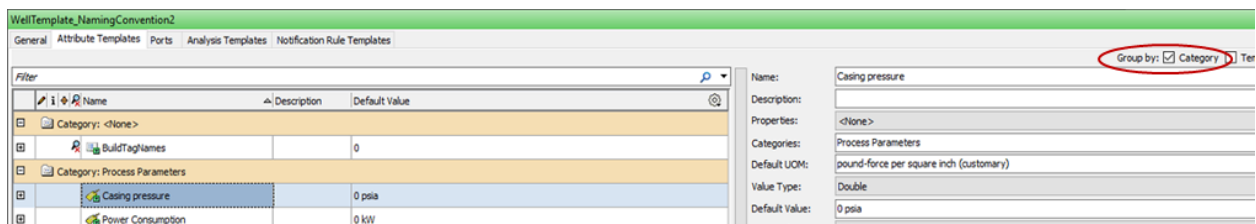
## Section 7B. Using Categories

As the number of Attributes continues to grow, it will be helpful to separate them into Categories. This will help with finding them in PI Vision or PI System Explorer, as well as searching.

1. In the Library go to Categories→Attribute Categories and create three new Categories: **Process Parameters**, **Naming**, and **Status**. Notice that Categories exist for other AF items such as Analysis, Elements, and Notification Rules.
2. For **WellTemplate**, assign **Casing pressure** and **Power Consumption** to the **Process Parameters** Category. You can select multiple Attributes at once by holding Shift or Control. Then assign the Category.



3. Assign **Site Name** and **Well Name** to the **Naming Category**.
4. You will also need to add the **Process Parameters** Category to **Casing pressure** and **Power Consumption** in **WellTemplate\_NamingConvention2**. When you create an Attribute in a Derived Template with the same name as exists in the Base Template, all settings need to be set again at the Derived Template level.
5. You can organize Attributes in PI System Explorer by Checking Group by Category at the top right corner.



Best Practice

Utilize categories for finding Attributes when using Client tools, along with searching for Analyses, Elements, and Notifications.

## Section 7C. Enumeration Sets

You may have Integer PI tags that represent different states of your process, (e.g. 0 represents OFF, 1 represents ON). Interpreting these states was often done using Digital States in System Management Tools. In AF, we use Enumeration Sets to interpret these states and provide better context in PSE or PI Vision.

1. Each well at the Madrid site has an existing tag which represents the current state of the well. The tag for **Well01** is called **Well01.Status Message.PV**, so it follows our **%Element%.%Attribute%.PV** naming convention. Start by creating a new Attribute Template in **WellTemplate** called **Status Message**.
2. Assign it a Value Type of Enumeration Set → Well State. This is a custom Enumeration Set that was already created in your database.

Name	Description	Default Value
Casing pressure		0 psia
Power Consumption		0 kW
Site Name		0
Status Message		
Well Name		0

Properties for Status Message:

- Name: Status Message
- Description:
- Properties: <None>
- Categories: Status
- Default UOM: <None>
- Value Type: Well State
- Default Value:
- Data Reference: <None>

3. Click the “Settings...” button to automatically assign it as PI Point Data Reference.
4. The default tag name convention is **%Element%.%Attribute%**. Change it to **%Element%.%Attribute%.PV**.

PI Point Data Reference

Data server: %Server%

Tag name: %Element%.%Attribute%.PV

Tag Creation

Attribute:

Unit of Measure

Source Units: <None>

Value retrieval methods

By Time: Automatic

Relative time:

By Time Range: End Time

Calculation basis: Time Weighted

Min percent good: 80

Preview

Example instance: [Select example instance](#)

Configuration:

Value:

☒ Read only

OK Cancel

- Assign the **Status Message** Attribute Template to the **Status** Category.
- The tag **Well01.WellState.PV** will range in values from 0 to 5, and automatically be converted to a String based on the **Well State** Enumeration Set. The Enumeration Set can be viewed in Library → Enumeration Sets → Well State.

The screenshot shows the 'Library' pane on the left with the 'Well State' Enumeration Set selected under 'Enumeration Sets'. The right pane shows the 'Well State' configuration with the following table:

Value	Name
0	Offline
1	Running
2	Installation
3	Down
4	Draw Down Testing
5	Faulted
*	

- Viewing **Well01** from the Madrid Site (in the Elements Tab), you can see that it is currently Running, but the underlying tag is actually a value of 1. AF is converting this value using the Enumeration Set.

The screenshot shows the 'Elements' pane on the left with 'Well01' selected under the 'Madrid' site. The right pane shows the 'Well01' configuration with the following table:

Name	Value
Casing pressure	38.53699 psia
Power Consumption	85.2853524476687 kW
Site Name	Madrid
Status Message	Running
Well Name	Well01

- It is left to you to create a Status Message Attribute in **WellTemplate\_NamingConvention2** using the London site tag naming convention. The tag for **Well01** at the London site already exists and is named **Lon.749.SM.PV**.



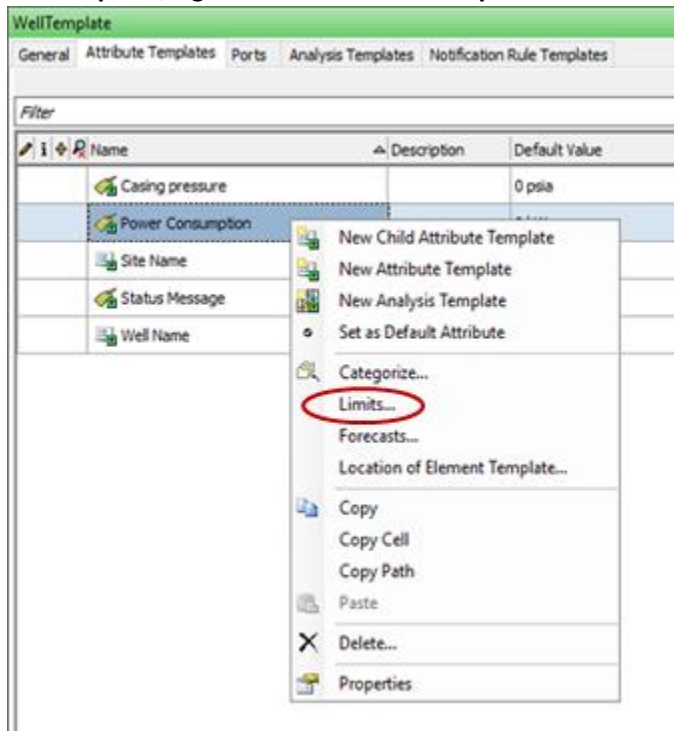
Best Practice

Enumeration Sets provide context for PI tag integer values. They can also restrict the values for manually entered Attributes.

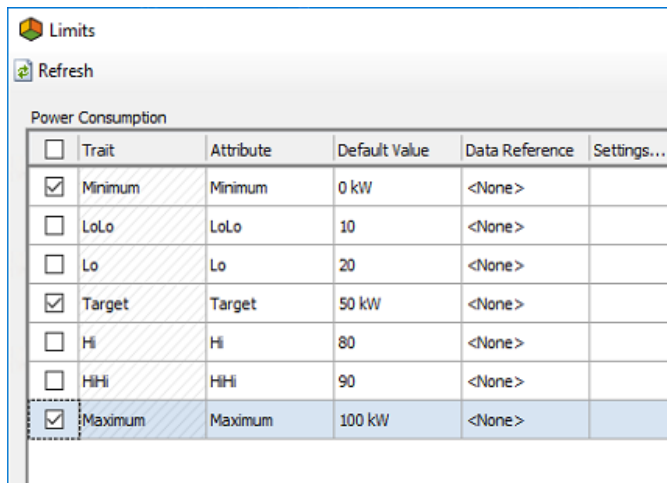
## Section 7D. Limits

Limits can be added to Attributes, which can be used to define the Minimum and Maximum axis values in plots in PI Vision, various levels of Multi-States, and are a convenient way to add Targets to plots. Let's add Limits to our **Power Consumption** Attribute Template to be used as the Minimum and Maximum in our PI Vision plot, as well as a Target.

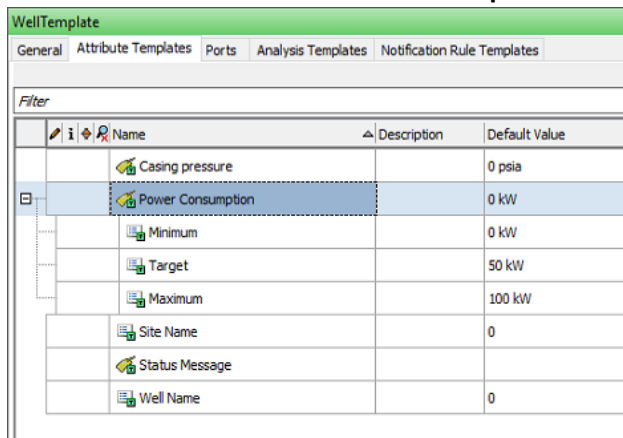
1. In **WellTemplate**, right click **Power Consumption** and Select Limits.



2. Check the boxes next to Minimum, Target, and Maximum. We will keep the defaults value of 0kW for Minimum, 50kW for Target, and 100kW for Maximum. However, these can be highly customized by assigning Limits to Data References. Because of this, Limits can be dynamic, and change with time or be different for each Element created from the Template.



3. You should now see three Limits in **WellTemplate** as Child Attributes to **Power Consumption**.



WellTemplate		
General Attribute Templates Ports Analysis Templates Notification Rule Templates		
Filter		
	Name	Default Value
	Casing pressure	0 psia
	Power Consumption	0 kW
	Minimum	0 kW
	Target	50 kW
	Maximum	100 kW
	Site Name	0
	Status Message	
	Well Name	0

4. Create Limits for the **Power Consumption** Attribute in **WellTemplateNameConvention2**, using 25kW for Minimum, 75kW for Target, and 125kW for Maximum.



Tip

Limits can be extended to be dynamic in time by referencing a PI point or referencing another Attribute. This means targets and plot axis can change in time in PI Vision.

## Section 8. PI Vision Part 2: Improving Visualization with Optimized Templates

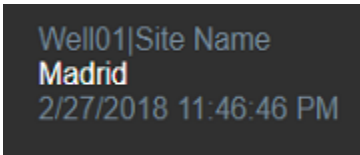
In this section we will:

- Add the **Site Name** and **Well Name** Attributes to a PI Vision display
- Show how Categories organize Attributes
- Provide context in displays using Enumeration Sets
- Use Limits (**Minimum**, **Maximum** and **Target**) for better visualization

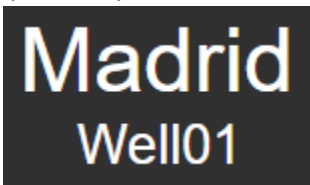
1. Start by creating a new display in PI Vision.
2. Wells at the Madrid Site now contains additional Attributes: **Site Name** and **Well Name**.
3. Select the Value Symbol.



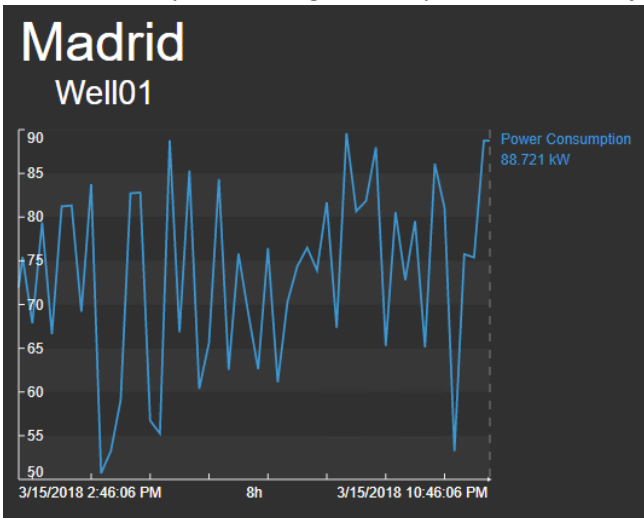
4. Drag and Drop **Site Name** onto the display.



5. Right click the symbol and select "Format Value...". Under Visibility, uncheck Label, Unit and Timestamp.
6. Complete Steps 4 and 5 for **Well Name** to end up with the following.



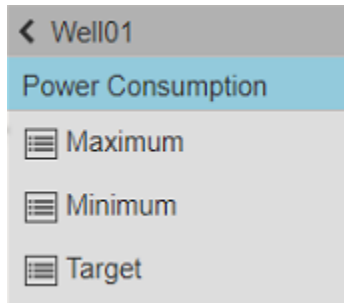
7. Select the Trend Symbol. Drag and Drop **Power Consumption** onto the Display.



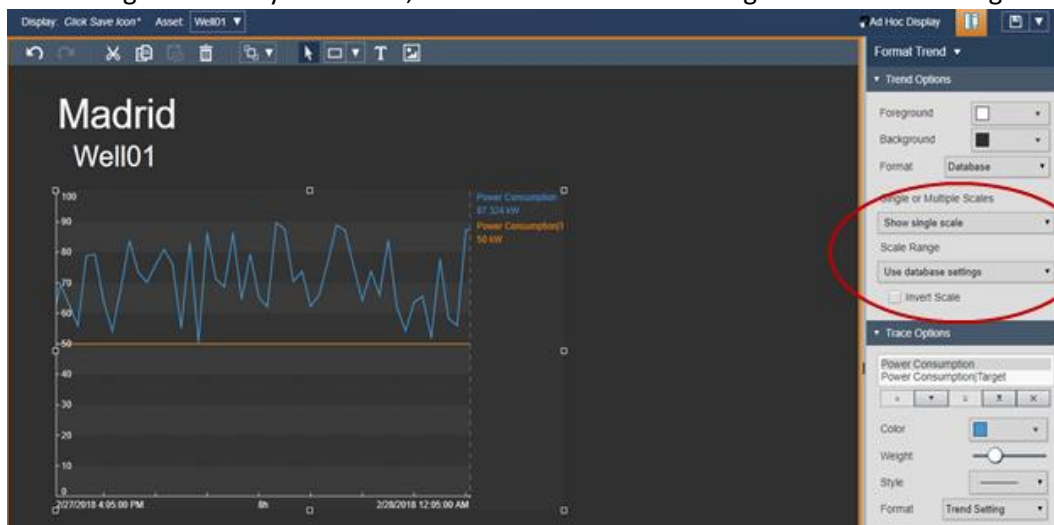
- Try asset swapping to a well at the London site. Notice how **Site Name**, **Well Name**, and the trend all update.
- Notice that your Attributes are now organized by Category in the lower left corner of PI Vision. This can be very useful when you have a large number of Attributes.

## Limits and Enumeration Sets Exercises

- Clicking the right Arrow next to **Power Consumption** shows the **Maximum**, **Minimum**, and **Target** Attributes. If you just added these in PSE, you may need to wait a few minutes for them to show up in PI Vision. Also be sure you Checked In your changes in PSE.



- Drag the **Target** Limit onto the **Power Consumption** trend.
- Right click the trend and select Format Trend.
- To have **Power Consumption** and **Power Consumption Target** on the same scale, select "Show single scale" from "Single or Multiple Scales". To have the plot use **Minimum** and **Maximum** settings defined by our Limits, select "Use database settings" in the "Scale Range".



*Note that Gauge symbols will use the Maximum and Minimum Limits by default but Trends do not, which is why we had to manually select "Use database settings". Also, it is not currently possible to overlay Limits onto Gauges.*

- Try adding the **Status Message** to your display. You should see this as a String, not the numerical value of the PI tag, since it is assigned to an Enumeration set.

## Section 9. Expanding to a Site with No Tag Naming Conventions

In this section we will:

- Create a Derived Template for the Las Vegas Site, a site with hardly any tag naming convention
- Use a Table Lookup to reference a master tag list containing a list of all tags at the Las Vegas site to be mapped to Attributes in AF

*The Las Vegas Site has almost no tag naming convention across wells. There are a few approaches that can be used in this scenario. One approach is to override each individual attribute of every well to a specific tag. This can be done in bulk with PI Builder. See the Appendix for PI World 2018 - Tips and Tricks with PI System Explorer and PI Builder. The method described in that lab still risks losing the tag names if a Reset to Template occurs. Another method, which we use here, is to create an Internal Table to AF that stores the Element, Attribute, and tag information which is then referenced using a Table Lookup.*

1. Let's start by looking at the **TagNameMapping** Table in the Library. We already received a tag list from our PI admin and mapped it over to columns that contain the Well and Attribute names to be used in our AF hierarchy. Let's start building a template that uses this table to populate our tag names.

TagNameMapping				
General Table Define Table Version				
TagNameMapping				
Filter				
	Well Number	Site Name	Attribute	Tag
▶	LV Well01	Las Vegas	Casing pressure	LV.CasingPressure.W1.PV
	LV Well01	Las Vegas	Power Consumption	LV.PowerConsumption.W1.PV
	LV Well02	Las Vegas	Casing pressure	Well02.CP.PV
	LV Well02	Las Vegas	Power Consumption	Well02.PC.PV
	LV Well03	Las Vegas	Casing pressure	W3CasingPressure
	LV Well03	Las Vegas	Power Consumption	W3PowerConsumption
	LV Well04	Las Vegas	Casing pressure	Well4LVCasingP
	LV Well04	Las Vegas	Power Consumption	Well4LVPowerC
	LV Well05	Las Vegas	Casing pressure	CasingPressureWell5
	LV Well05	Las Vegas	Power Consumption	PowerConsumptionWell5
	LV Well01	Las Vegas	Status Message	LV.StatusMessage.W1
	LV Well02	Las Vegas	Status Message	Well02.SM
	LV Well03	Las Vegas	Status Message	W3StatusMessage
	LV Well04	Las Vegas	Status Message	Well4LVStatusM
	LV Well05	Las Vegas	Status Message	StatusMessageWell5
*				

*This method should not be used with a Table more than 10,000 rows.*

2. In Library → Element Templates, Right Click **WellTemplate** and create a New Derived Template.
3. Rename this Template to **WellTemplate\_NoConvention**.

4. Create three new Attributes Templates: **Casing pressure** (UOM: **psia**, Category: **Process Parameters**), **Power Consumption** (UOM: **kW**, Category: **Process Parameters**), and **Status Message** (Category: **Status**). You can add Limits to Power Consumption if you would like.
  - a. **Shortcut:** If you Group by: Template – you can copy and paste attributes from the base template.
5. Under each of these three Attributes, create a Hidden Attribute called **TagName**. Make sure the Value Type for each **TagName** is **String**.

WellTemplate_NoConvention			
<div>General Attribute Templates Ports Analysis Templates Notification Rule Templates</div>			
Filter			
	Name	Description	Default Value
Category: Process Parameters			
	Casing pressure		0 psia
	TagName		
	Power Consumption		0 kW
	TagName		
Category: Status			
	Status Message		
	TagName		

6. Create a Table Lookup Data Reference for **TagName** under **Casing pressure**. In Settings, select the Table **TagNameMapping**. The Result column is **Tag**.

7. We now need to define our Where clause. There will be two parts to this. The Well Number Column is **%Element%** and the Attribute Column is **%.|Attribute%** (the name of the parent Element of **TagName**, in this case Casing pressure). These should be used with an **AND** statement.

8. Click OK and you should see the following below “Settings...”:  
**SELECT Tag FROM TagNameMapping WHERE [Well Number] = '%Element%' AND Attribute = '%..|Attribute%' ORDER BY Tag**
9. Follow the same procedure for **Power Consumption** and **Status Message**, or you can Copy/Paste the entire attribute.
10. We’ve now pulled the correct tag name from the **TagNameMapping** Table but have not assigned the PI Point Data Reference for **Casing pressure**, **Power Consumption**, and **Status Message**. Before doing this, let’s make sure the tag names are coming in as expected. Go to the Element tab in the lower left and create a new Element from **SiteTemplate** called **Las Vegas**.

11. Create a new Child Element under **Las Vegas** from the **WellTemplate\_NoConvention** Template. Name this Element **LV Well01**.

The screenshot shows the 'Elements' tree on the left with 'Las Vegas' expanded, showing 'LV Well01' as a child. On the right, the 'LV Well01' configuration panel is open, showing the 'General' tab. The 'Name' field is set to 'LV Well01', the 'Template' is 'WellTemplate\_NoConvention', and the 'Categories' field is empty. Below the 'Find' section, there are links for 'Extended Properties (0)', 'Annotations (0)', 'Location', 'Security', 'Parents', 'Children', 'Event Frames', 'Models', 'Layers', and 'Connections'.

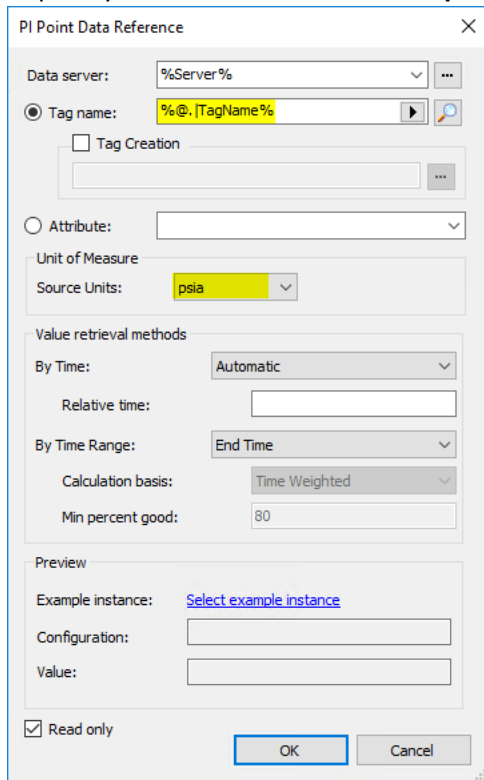
12. Check the Attributes tab for **LV Well01** to confirm the correct tag names are being populated from the Table.

The screenshot shows the 'LV Well01' configuration panel with the 'Attributes' tab selected. The table below lists attributes for 'LV Well01'.

Category	Name	Value	Time Stamp
Category: Naming	Site Name	Las Vegas	1/1/1970 12:00:00 AM
	Well Name	LV Well01	1/1/1970 12:00:00 AM
Category: Process Parameters	Casing pressure	0 psia	1/1/1970 12:00:00 AM
	TagName	LV.CasingPressure.W1.PV	1/1/1970 12:00:00 AM
	Power Consumption	0 kW	1/1/1970 12:00:00 AM
	TagName	LV.PowerConsumption.W1.PV	1/1/1970 12:00:00 AM
Category: Status	Status Message		1/1/1970 12:00:00 AM
	TagName	LV.StatusMessage.W1	1/1/1970 12:00:00 AM

13. The final step is to configure **Casing pressure**, **Power Consumption**, and **Status Message** as PI Point Data References and pull in the tag data from their corresponding **TagName** Child Attributes. In the Template **WellTemplate\_NoConvention**, click on the **Casing pressure** Attribute and click "Settings..." to assign this Attribute as a PI Point Data Reference.

14. In the PI Point Data Reference Configuration Window, change the Tag Name to **%@.|TagName%** and explicitly set the Unit of Measure to **psia**.



The screenshot shows the 'PI Point Data Reference' configuration window. The 'Tag name' field is set to '%@.|TagName%' and the 'Unit of Measure' is set to 'psia'. The 'Value retrieval methods' section shows 'By Time' set to 'Automatic', 'By Time Range' set to 'End Time', and 'Calculation basis' set to 'Time Weighted'. The 'Min percent good' is set to 80. The 'Preview' section shows 'Example instance' as 'Select example instance', 'Configuration' as an empty field, and 'Value' as an empty field. The 'Read only' checkbox is checked. The 'OK' and 'Cancel' buttons are at the bottom right.

15. Complete steps 13 and 14 for **Power Consumption** (UOM = **kW**) and Status Message.
16. Going back to **LV Well01**, you should now see the tag values populated for **Casing pressure**, **Power Consumption**, and **Status Message**.

LV Well01

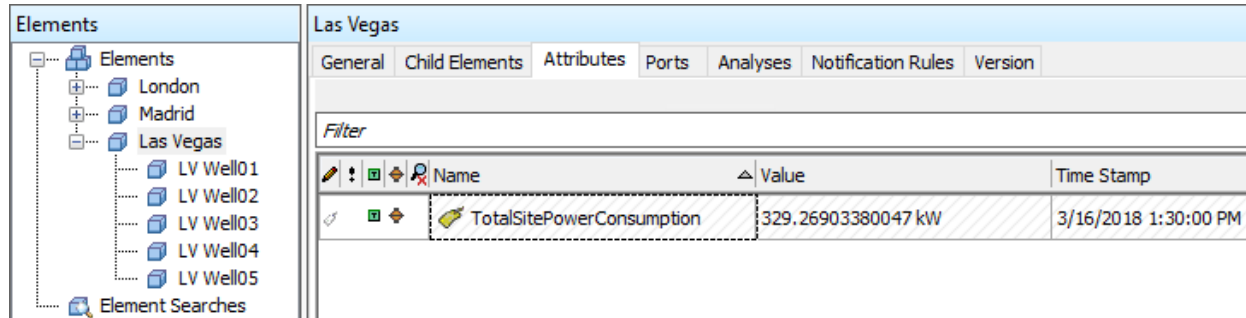
GeneralChild ElementsAttributesPortsAnalysesNotification RulesVersion

Filter

	Name	Value	Time Stamp
Category: Naming			
	Site Name	Las Vegas	1/1/1970 12:00:00 AM
	Well Name	LV Well01	1/1/1970 12:00:00 AM
Category: Process Parameters			
	Casing pressure	43.7915840148926 psia	2/28/2018 4:30:00 PM
	Power Consumption	84.537276604463 kW	2/28/2018 4:30:00 PM
Category: Status			
	Status Message	1	2/8/2018 4:49:00 PM

17. Build all five wells under the **Las Vegas** Element and confirm their PI Point Data References are all updating.

18. Confirm the **TotalSitePowerConsumption** Attribute is updating for the Las Vegas. If the tag does not yet exist, right click the **TotalSitePowerConsumption** Attribute and select Create or Update PI Point.



The screenshot shows the PI System Explorer interface. On the left, the 'Elements' tree is expanded, showing a hierarchy: 'Elements' > 'Las Vegas' > 'LV Well01' through 'LV Well05'. The 'Las Vegas' element is selected. On the right, the 'Attributes' tab is active for the 'Las Vegas' element. It displays a table with the following data:

Name	Value	Time Stamp
TotalSitePowerConsumption	329.26903380047 kW	3/16/2018 1:30:00 PM



Tip

Using a Table Lookup of a master tag list is one way to use AF for sites with little or no tag naming conventions. Do not use with Tables of more than 10,000 rows.



Tip

An alternate approach of using PI Builder to push tag names into a Child Attribute in bulk is discussed in the lab: PI World 2018 - Tips and Tricks with PI System Explorer and PIBuilder. This method does have some risks of losing the tag names if a "Reset to Template" is completed.

## Section 10. Creating Tags via AF

In this section we will:

- Create a Derived Template for the San Francisco site
- Since tags do not yet exist for this site, we will create a well-defined tag naming convention
- Use String Builder to have AF create the tag names and references to OPC Server Items IDs
- Configure a PI Point Data Reference to have AF create PI tags on the PI Data Archive
- Build out the AF hierarchy for the San Francisco site, including tag creation by AF

We have one final site to add to our AF hierarchy: San Francisco. The OPC Server and PI Interface for OPC Interface are installed, configured and running at this site (Point Source = OPC, location 1 = 1), but no tags have been created. We would like to use PI System Explorer to create the tags as we create each well.

- Can you think of a use case to create tags through PI System Explorer?

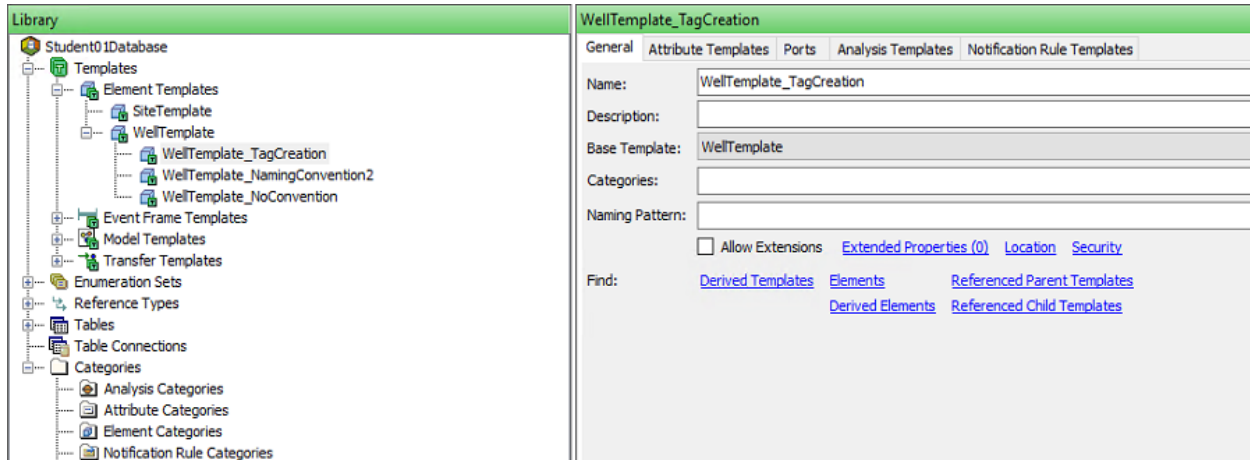
We will need to configure our Template to have all of the relevant tag configuration information so the new tags are automatically picked up by the PI Interface for OPC and start collecting data. Two very important items that will need to be included in the tag configuration information in the Template are:

1. Define a naming pattern for the new tags to be created on the PI Data Archive
2. Properly assign the Instrument Tag field for each tag, this is the Item ID on the OPC Server that contains the relevant data for each tag

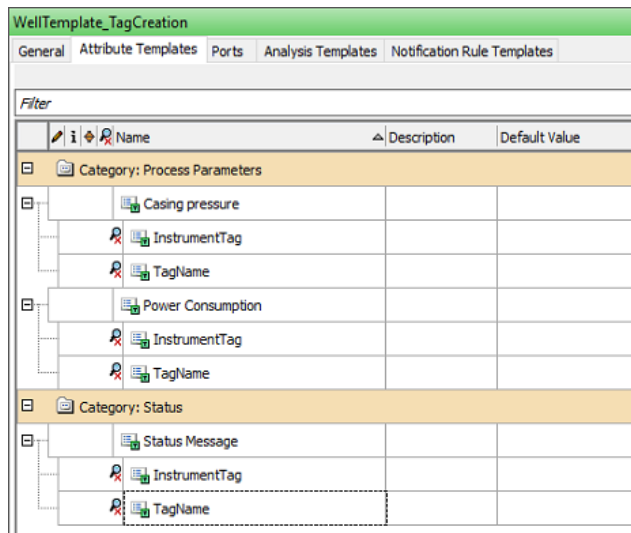
The following table is a list of Instrument Tags (Item IDs) that already exist on the OPC Server. The table also includes the list of tags we would like to automatically create when each well is created. These tags DO NOT currently exist on the PI Data Archive.

<b>Well Name</b>	<b>Attribute Name</b>	<b>Tag Name on PI Data Archive (to be created by PSE)</b>	<b>Instrument Tag (Item ID on OPC Server)</b>
<i>SF Well01</i>	<i>Casing pressure</i>	<i>San Francisco.SF Well01.Casing pressure.PV.student01</i>	<i>.W01CP</i>
<i>SF Well01</i>	<i>Power Consumption</i>	<i>San Francisco.SF Well01.Power Consumption.PV.student01</i>	<i>.W01PC</i>
<i>SF Well01</i>	<i>Status Message</i>	<i>San Francisco.SF Well01.Status Message.PV.student01</i>	<i>.W01SM</i>

- Let's start by creating a new Derived Template from **WellTemplate**, calling it **WellTemplate\_TagCreation**.



- On the Attribute Templates tab, create **Casing pressure**, **Power Consumption**, and **Status Message** Attribute Templates.
- Assign them to their appropriate Categories.
- Under each of these three attributes, create Child Attribute Templates called **InstrumentTag** and **TagName**. Make these Child Attribute Templates Hidden.



We will start by use Substitution Parameters with String Builder in the **TagName** Attribute to build the desired tag names to be created on the PI Data Archive. We will do the same for the **InstrumentTag** Attribute to build the Instrument Tag (Item ID) that already exists on the OPC Server. We will then configure the PI Point Data Reference to use these to create the tags on the PI Data Archive when each well is create.

- Let's start by showing the desired tag name on the PI Data Archive for **SF Well01** and edit the student number to match your assigned student number:

**San Francisco.SF Well01.Casing pressure.PV.student01**

which can be built using String Builder with the following Substitution Parameters:

**%..\Element%.%Element%.%..|Attribute%.PV.student01**

- In the **WellTemplate\_TagCreation** Derived Template, assign the **TagName** Child Attribute of **Casing pressure** as a String Builder Data Reference. In the "Settings..." button, configure the following:

**"%..\Element%"**

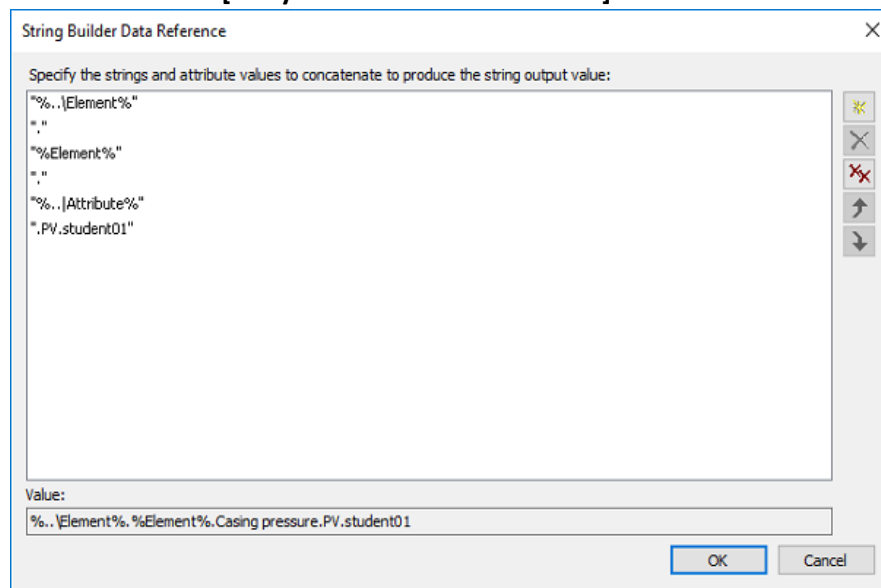
**"."**

**"%Element%"**

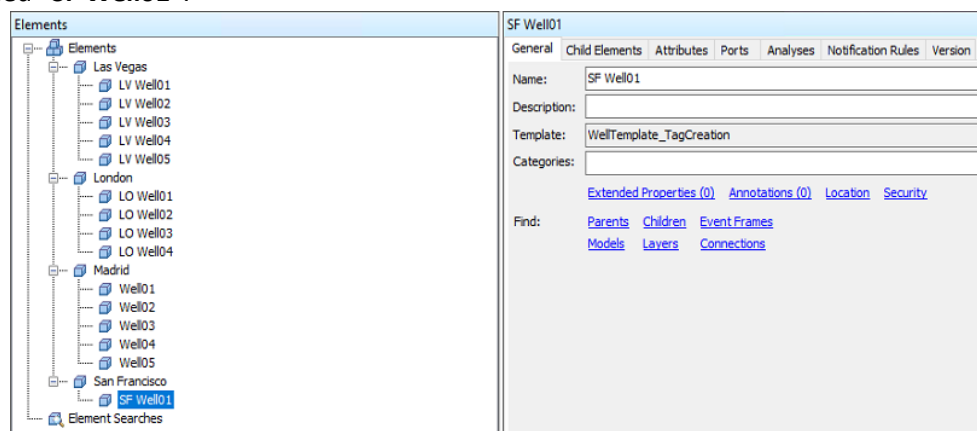
**"."**

**"%..|Attribute%"**

**".PV.student01" [use your student number here]**

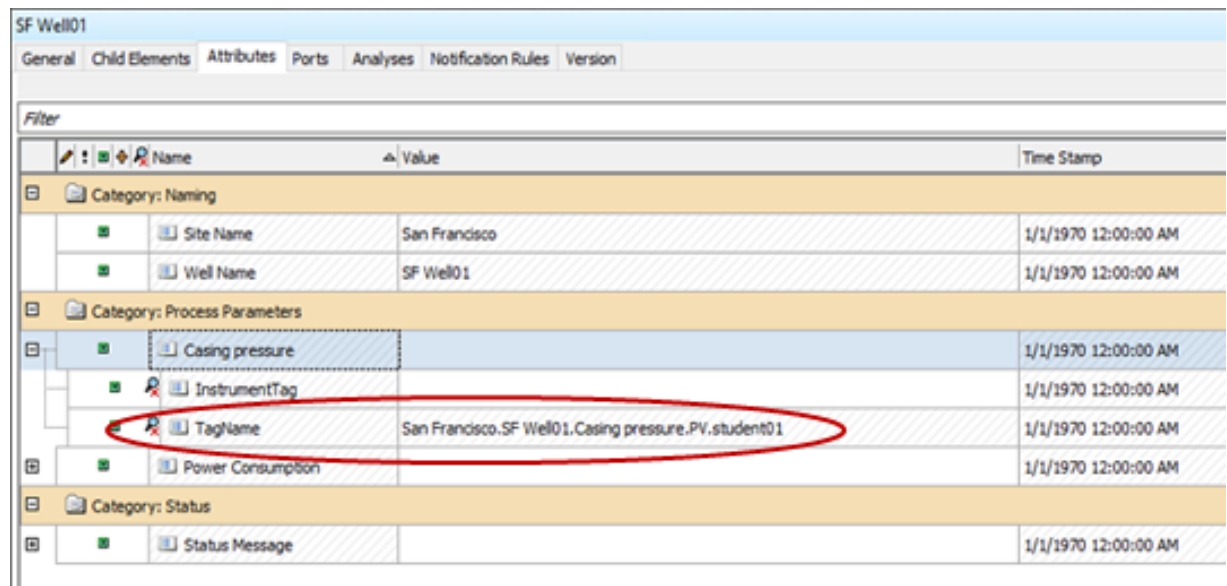


- Let's check if this is creating the desired tag name. Create a new **SiteTemplate** Element called **San Francisco**. As a Child Element to **San Francisco**, create a new **WellTemplate\_TagCreation** Element called **"SF Well01"**.



8. Check the **Casing pressure TagName** Child Attribute to see if it populated with the desired tag name (no tag has been created yet).

### San Francisco.SF Well01.Casing pressure.PV.student01

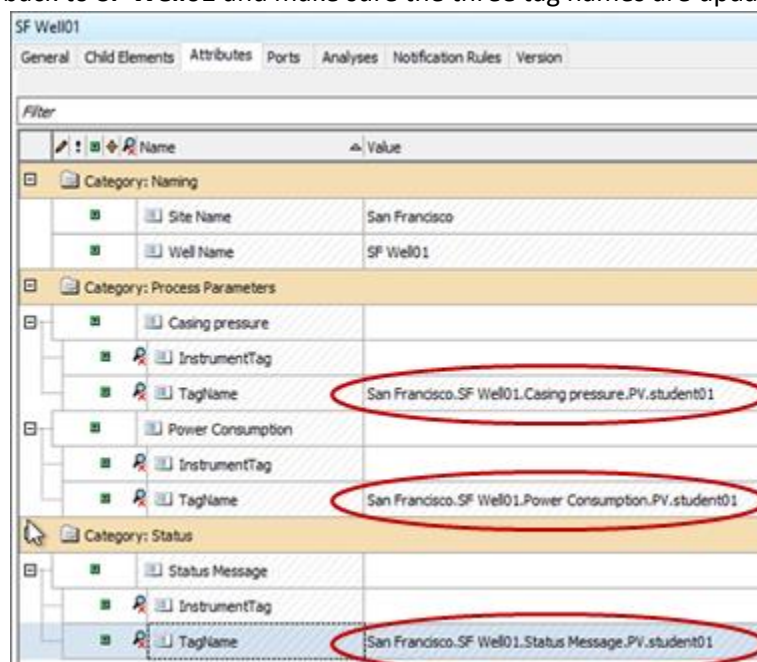


SF Well01			
General Child Elements Attributes Ports Analyses Notification Rules Version			
Filter			
	Name	Value	Time Stamp
Category: Naming			
	Site Name	San Francisco	1/1/1970 12:00:00 AM
	Well Name	SF Well01	1/1/1970 12:00:00 AM
Category: Process Parameters			
	Casing pressure		1/1/1970 12:00:00 AM
	InstrumentTag		1/1/1970 12:00:00 AM
	TagName	San Francisco.SF Well01.Casing pressure.PV.student01	1/1/1970 12:00:00 AM
	Power Consumption		1/1/1970 12:00:00 AM
Category: Status			
	Status Message		1/1/1970 12:00:00 AM

9. Assign the **TagName** Child Attribute Templates for **Power Consumption** and **Status Message** as String Builder Data Reference Types. You can copy and paste the configuration data below "Settings...". Be sure to complete this in the Template.

`"%..\Element%";".";"%Element%";".";"%..\Attribute%";".PV.student01";`

10. Go back to **SF Well01** and make sure the three tag names are updating as expected.



SF Well01			
General Child Elements Attributes Ports Analyses Notification Rules Version			
Filter			
	Name	Value	
Category: Naming			
	Site Name	San Francisco	
	Well Name	SF Well01	
Category: Process Parameters			
	Casing pressure		
	InstrumentTag		
	TagName	San Francisco.SF Well01.Casing pressure.PV.student01	
	Power Consumption		
	InstrumentTag		
	TagName	San Francisco.SF Well01.Power Consumption.PV.student01	
Category: Status			
	Status Message		
	InstrumentTag		
	TagName	San Francisco.SF Well01.Status Message.PV.student01	

We now need to build the InstrumentTag (Item ID) for each Attribute Template. For **Casing pressure**, the Item ID on the OPC Server is:

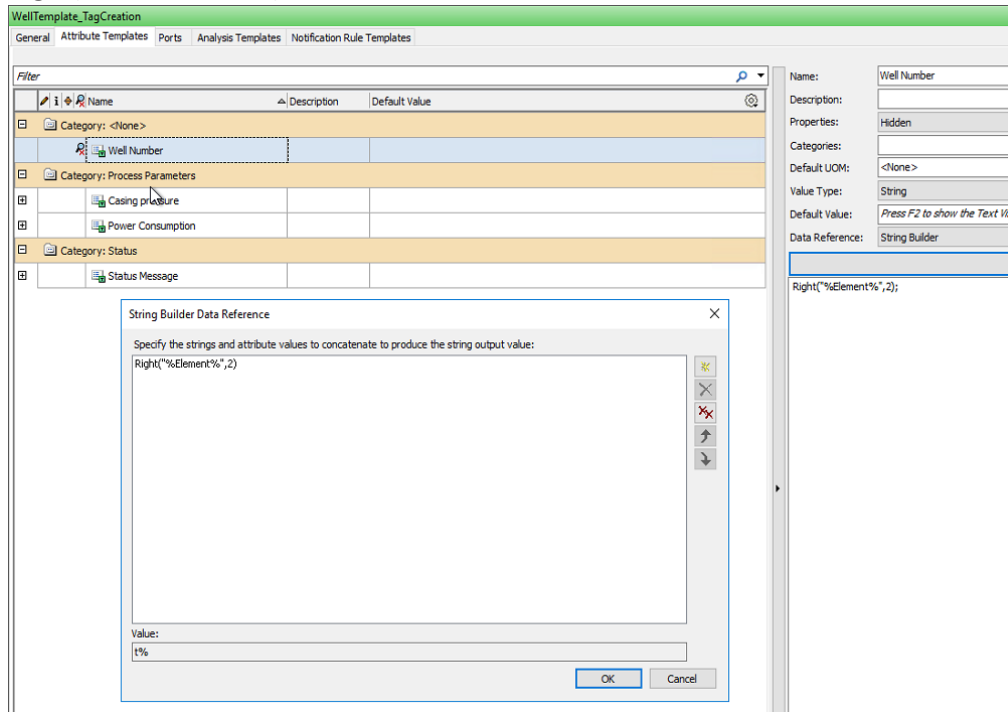
**.W01CP**

We can hardcode the “.W” at the beginning and the “CP” at the end, but the “01” needs to be truncated from the well name. Since it will be used for multiple Attributes, do that first outside of any specific Attribute.

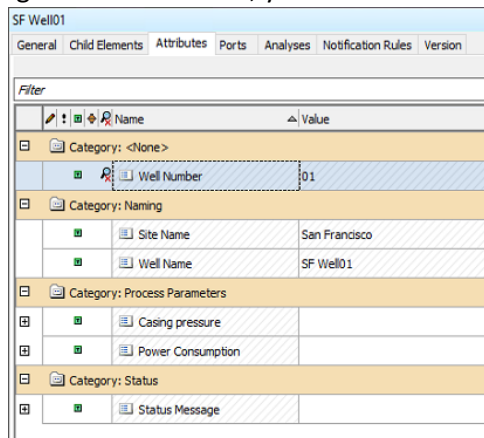
11. Create a new Attribute in the Template **WellTemplate\_TagCreation** called **Well Number**. Make this Attribute Hidden.

12. Assign **Well Number** as a String Builder Data Reference Type and configure with the following:

**Right("%Element%",2);**



13. Going back to **SF Well01**, you should now see an Attribute Well Number populated with **01**.



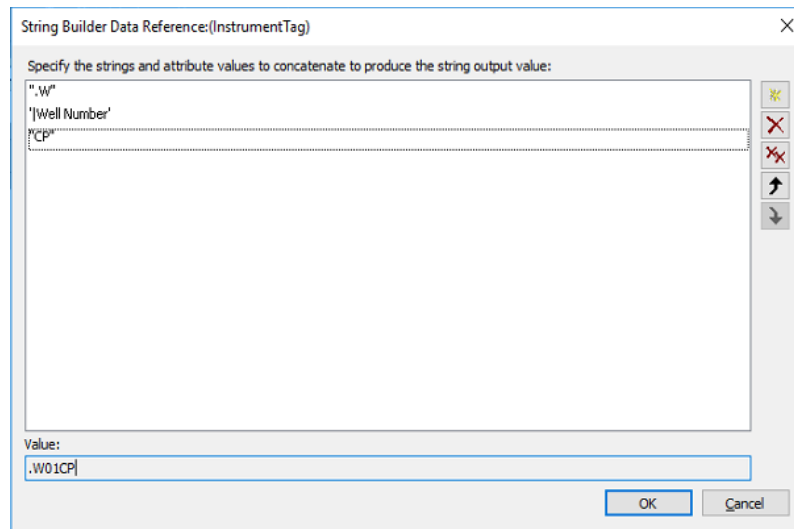
14. Let's use the **Well Number** Attribute to build the **InstrumentTag** Attributes for **Casing pressure**, **Power Consumption**, and **Status Message**. Assign **Casing pressure** Child Attribute **InstrumentTag** as String Builder Data Reference Type.

15. Configure **InstrumentTag** as the following:

“.W”

“|WellNumber”

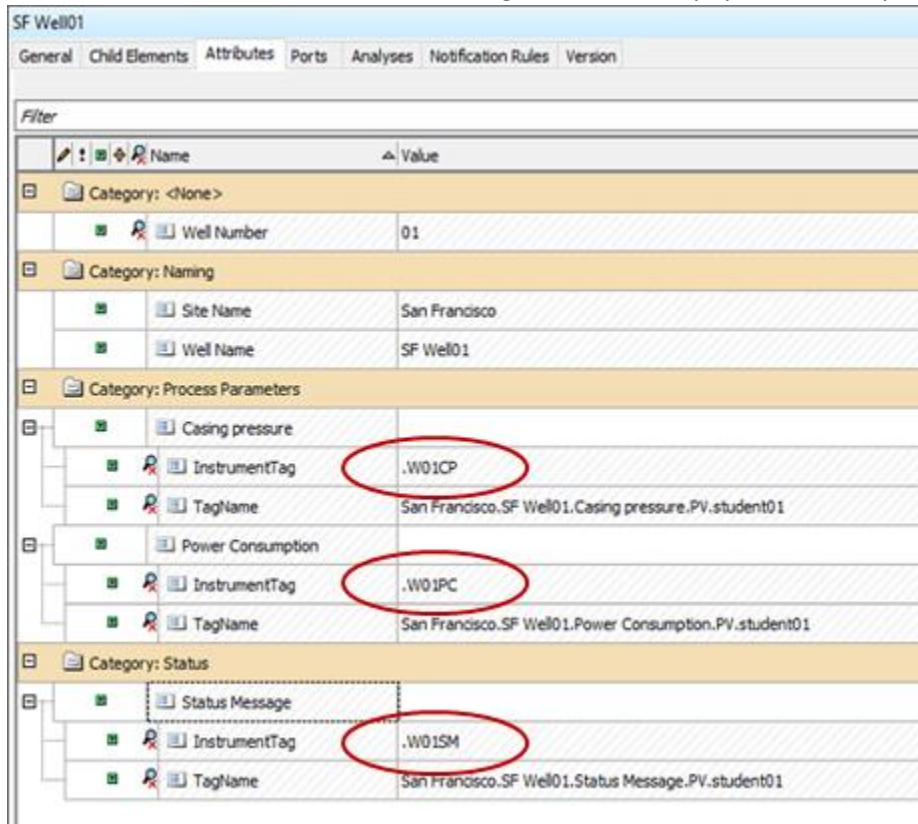
“CP”



The screenshot shows a dialog box titled "String Builder Data Reference:(InstrumentTag)". Inside, there is a text area labeled "Specify the strings and attribute values to concatenate to produce the string output value:". The text area contains three lines: ".W", "|Well Number", and "CP". To the right of the text area are four icons: a yellow star, a red X, a red X with a slash, and a black arrow pointing up. Below the text area is a "Value:" label and a text box containing ".W01CP". At the bottom right are "OK" and "Cancel" buttons.

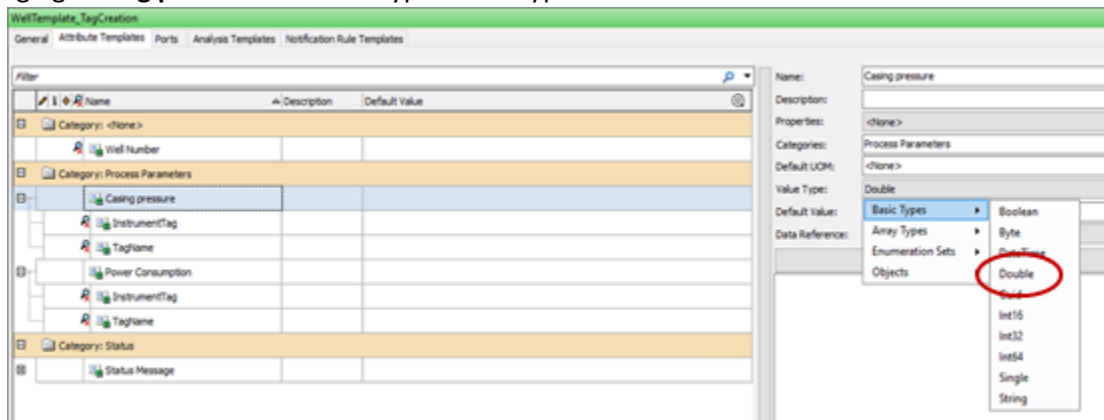
16. Complete steps 13 and 14 for **InstrumentTag** for **Power Consumption** and **Status Message** being sure to use **PC** and **SM** instead of **CP** for **Casing pressure**.

17. Check SF Well01 to confirm the InstrumentTag Attributes are populated as expected.



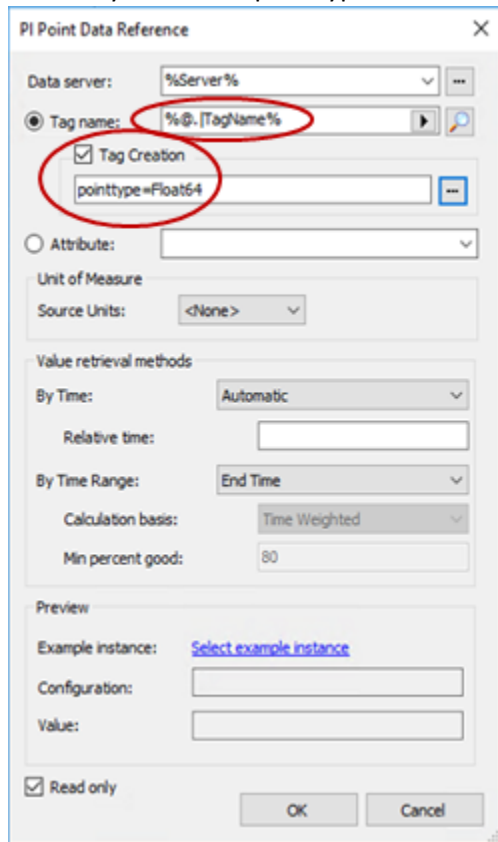
We have built the desired tag names for each Attribute, as well as the Instrument Tag (Item ID) that should be used from the OPC Server for each Attribute. This procedure can continue for any other tag fields that need to be customized during tag creation. This overall approach is relevant for interfaces beyond just PI Interface for OPC DA/HDA.

18. Let's configure the **Casing pressure** Attribute Template to create the tag correctly. Let's start by changing **Casing pressure** to Value Type: Basic Types→Double.



19. Click "Settings..." on the right to automatically assign it as a PI Point Data Reference.

20. For Tag name, use **%@.|TagName%** and check Tag Creation. The box under Tag Creation should have automatically filled with pointtype=Float64.



We referenced the desired tag name to be created by using **%@.|TagName%** and provided the minimum amount of information (pointtype = Float64) by checking Tag Creation. However, we need to configure even more than this. We want AF to fill in all of the additional information required for this tag to be picked up by the PI Interface for OPC DA (need Point Source and location 1 code), get data from the correct Item ID on the OPC Server (need InstrumentTag), and update at the correct rate (need location 3 and location 4). We will be using the following parameters:

Point Source = OPC

Location 1 = 1

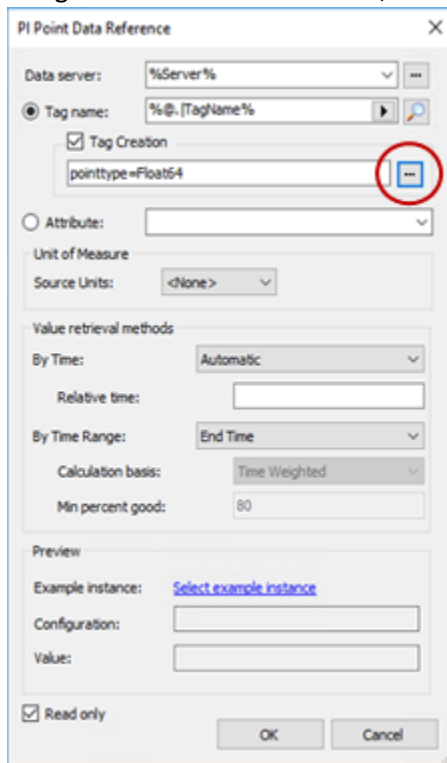
Location 3 = 1

Location 4 = 1

Instrument Tag = <from **InstrumentTag** Child Attribute>

The details of how to configure tags for PI Interface for OPC DA will not be discussed in this lab.

21. To configure these additional items, click on the button to the right of Tag Creation.



PI Point Data Reference

Data server: %Server%

Tag name: %@. [TagName%]

☒ Tag Creation

pointtype=Float64

Attribute:

Unit of Measure

Source Units: <None>

Value retrieval methods

By Time: Automatic

Relative time:

By Time Range: End Time

Calculation basis: Time Weighted

Min percent good: 80

Preview

Example instance: [Select example instance](#)

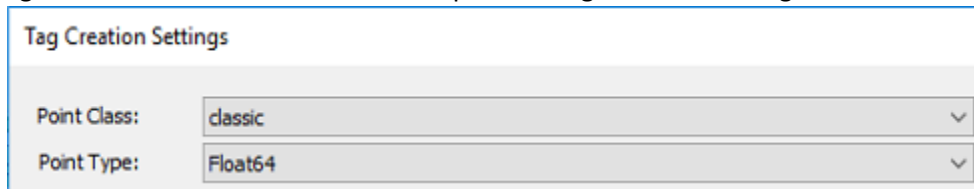
Configuration:

Value:

☒ Read only

OK Cancel

22. Change the Point Class to classic at the top of the Tag Creation Setting Window.



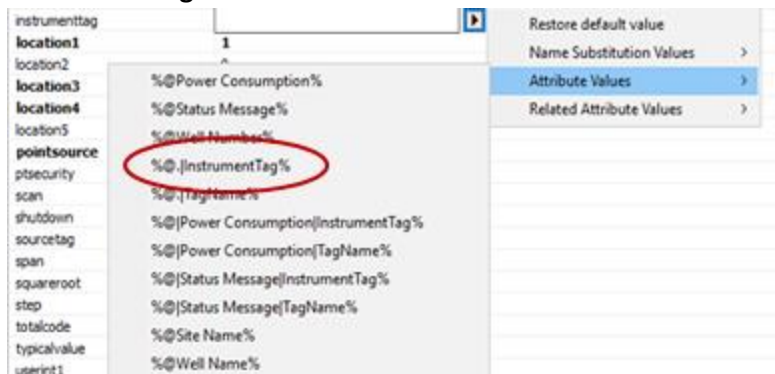
Tag Creation Settings

Point Class: classic

Point Type: Float64

23. Change location 1 to 1, location 3 to 1, and location 4 to 1 by directly typing in the values. Type in OPC for pointsource.

24. For instrumenttag, click the arrow to the right of the box and under Attribute Values select %@.InstrumentTag%.



instrumenttag

location1: 1

location2:

location3: 1

location4: 1

location5:

pointsource: OPC

ptsecurity:

scan:

shutdown:

source:

span:

squareroot:

step:

totalcode:

typicalvalue:

userint1:

Attribute Values

Restore default value

Name Substitution Values

Attribute Values

Related Attribute Values

%@.InstrumentTag%

25. Click OK twice after you have confirmed the Tag Creation Settings look correct.

Tag Creation Settings

Point Class: classic

Point Type: Float64

Point Attribute	Value
archiving	1
compdev	0.2
compdevpercent	0.2
compmax	28800
compmin	0
compressing	1
convers	1
datasecurity	piadmin: A(r,w)   piadmins: A(r,w)   PIWo...
descriptor	
digitalset	
displaydigits	-5
engunits	
excdev	0.1
excdevpercent	0.1
excmax	600
excmin	0
exdesc	
filtercode	0
future	0
instrumenttag	%%@. InstrumentTag%
location1	1
location2	0
location3	1
location4	1
location5	0
pointsource	OPC
ptsecurity	piadmin: A(r,w)   piadmins: A(r,w)   PIWo...
scan	1
shutdown	1
sourcetag	
span	100
squareroot	0
step	0
totalcode	0
typicalvalue	50
userint1	0
userint2	0
userreal1	0
userreal2	0
zero	0

26. You can copy and paste the configuration below “Settings...” into **Power Consumption** and **Status Message**. However, before doing this, change the Value Type to Double for **Power Consumption** and Int16 for **Status Message** (we will not be using the Enumeration Set at this site). You will also need to change the pointtype to Int16 for **Status Message** in the Tag Create Settings Window.

27. Head back to **SF Well01** and you should see some error messages that the tags do not exist. However, if you look below settings, you can see the tag configuration that will occur when you do create those tags.

SF Well01

General Child Elements Attributes Ports Analyses Notification Rules Version

Filter

	Name	Value	Time Stamp
Category: <None>			
Well Number	01		1/1/1970 12:00:00 AM
Category: Naming			
Site Name	San Francisco		1/1/1970 12:00:00 AM
Well Name	SF Well01		1/1/1970 12:00:00 AM
Category: Process Parameters			
Casing pressure	PI Point not found 'San Francisco.SF Well01.Casing pressure.PV.student01'.		2/28/2018 6:44:00.814 PM
InstrumentTag	.W01CP		1/1/1970 12:00:00 AM
TagName	San Francisco.SF Well01.Casing pressure.PV.student01		1/1/1970 12:00:00 AM
Power Consumption	PI Point not found 'San Francisco.SF Well01.Power Consumption.PV.student01'.		2/28/2018 6:44:00.814 PM
InstrumentTag	.W01PC		1/1/1970 12:00:00 AM
TagName	San Francisco.SF Well01.Power Consumption.PV.student01		1/1/1970 12:00:00 AM
Category: Status			
Status Message	PI Point not found 'San Francisco.SF Well01.Status Message.PV.student01'.		2/28/2018 6:44:00.814 PM
InstrumentTag	.W01SM		1/1/1970 12:00:00 AM
TagName	San Francisco.SF Well01.Status Message.PV.student01		1/1/1970 12:00:00 AM

Group by: ☒ Category ☐ Template

Name: Casing pressure

Description:

Properties: <None>

Categories: Process Parameters

Default UOM: <None>

Value Type: Double

Value: PI Point not found 'San Francisco.SF Well01.Casing pressure.PV.student01'.

Data Reference: PI Point

Settings...

```
\\PISRV01\San Francisco.SF Well01.Casing pressure.PV.student01;ptclassname=classic;pointtype=Float64;instrumenttag=.W01CP;location1=1;location3=1;location4=1;pointsource=OPC
```

28. To individually create each of the three tags for these three Attributes, right click on each Attribute and select Create or Update PI Point. Alternately, you can create all three at the same time by right clicking on **SF Well01** and selecting "Create or Update Data Reference". This will create the fully-configured tags on the PI Data Archive. They should now show as Pt Created.

SF Well01			
General Child Elements Attributes Ports Analyses Notification Rules Version			
Filter			
	Name		Value
Category: <None>			
	Well Number		01
Category: Naming			
	Site Name		San Francisco
	Well Name		SF Well01
Category: Process Parameters			
	Casing pressure		Pt Created
	InstrumentTag		.W01CP
	TagName		San Francisco.SF Well01.Casing pressure.PV.student01
	Power Consumption		Pt Created
	InstrumentTag		.W01PC
	TagName		San Francisco.SF Well01.Power Consumption.PV.student01
Category: Status			
	Status Message		Pt Created
	InstrumentTag		.W01SM
	TagName		San Francisco.SF Well01.Status Message.PV.student01

29. Since we have used Point Source OPC and Location 1, the PI Interface for OPC DA that is currently running will take up to two minutes to pick up these new tags. You can click Refresh as the top of PSE to see if the values has change from Pt Created. If Location 3, Location 4, and InstrumentTag have been configured correctly, and the PI Interface and OPC Server are running correctly, the tags should start updating in a few minutes.

SF Well01		
General Child Elements Attributes Ports Analyses Notification Rules Version		
Filter		
	Name	Value
Category: <None>		
Well Number		01
Category: Naming		
Site Name		San Francisco
Well Name		SF Well01
Category: Process Parameters		
Casing pressure		21916.486328125
Power Consumption		4062.34704975
Category: Status		
Status Message		116

Note: do not worry about the exact values obtained from the OPC Server for the San Francisco site.

30. You can now create **SF Well02-SF Well05** at the San Francisco site. Right-clicking on San Francisco and selecting Create or Update Data Reference will create all remaining tags for this site, along with the TotalSitePowerConsumption tag.



Tip

For new sites, having AF create the fully-configured tags for you in bulk can be a time-saving option.

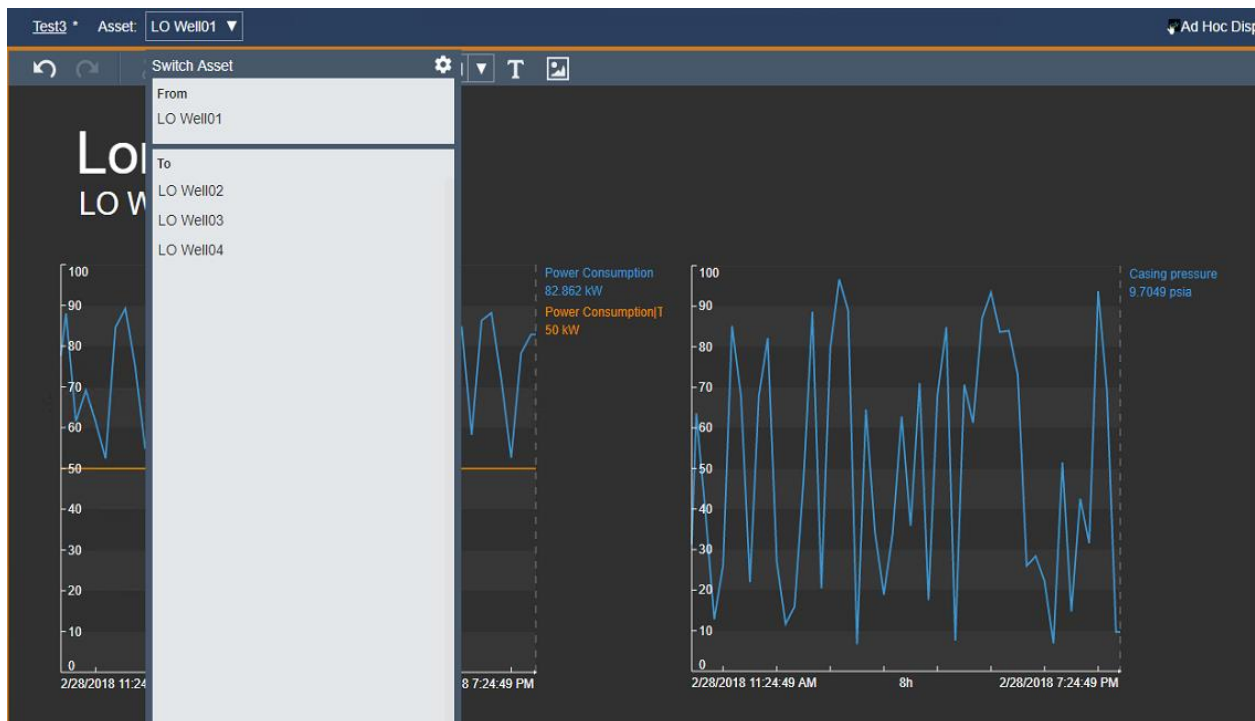
## Section 11. PI Vision Part 3: Optimizing Asset Swapping

In this section we will:

- Learn how to better optimize Asset Swapping. This includes two methods:
  - Editing the Search Criteria for the Asset Swap Dropdown Menu
  - Creating an Asset Comparison Table with Navigation Links

As we've discussed already, if you create your PI Vision display using Attributes from an Element created from a Derived Template, assets from the parent Template or adjacent Derived Templates will not be included in the Asset Swap Dropdown Menu. For example, I created a display for a well at the London Site, and the dropdown menu includes only wells created from the same Derived Template:

**WellTemplate\_NamingConvention2.**

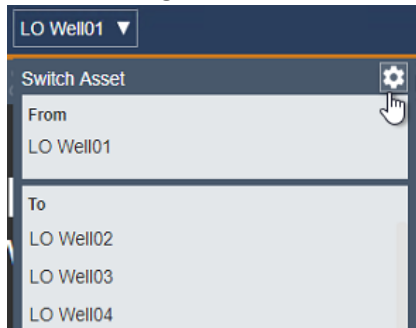


However, if I created a display using Attributes from the Madrid Site (Template **WellTemplate**), the Asset Swap dropdown includes wells from all Elements created from **WellTemplate** or any of its Derived Templates. This is the default behavior of the Asset Swap Dropdown Menu.

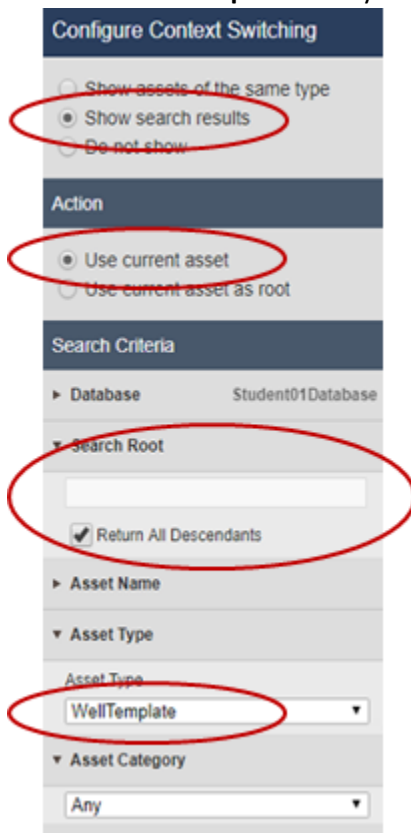
There are two methods of overcoming this. We can Configure Context Switching or Create an Asset Comparison Table with Navigation Links. Let's go through both of these methods.

### Configure Context Switching

1. Start by creating a simple display using Attributes from a well at the London, Las Vegas, or San Francisco site. When opening the Asset Swap Dropdown, you should only see wells from that site.
2. At the top right corner of the Asset Swap Dropdown, click the gear icon to open Configure Asset Context Switching.



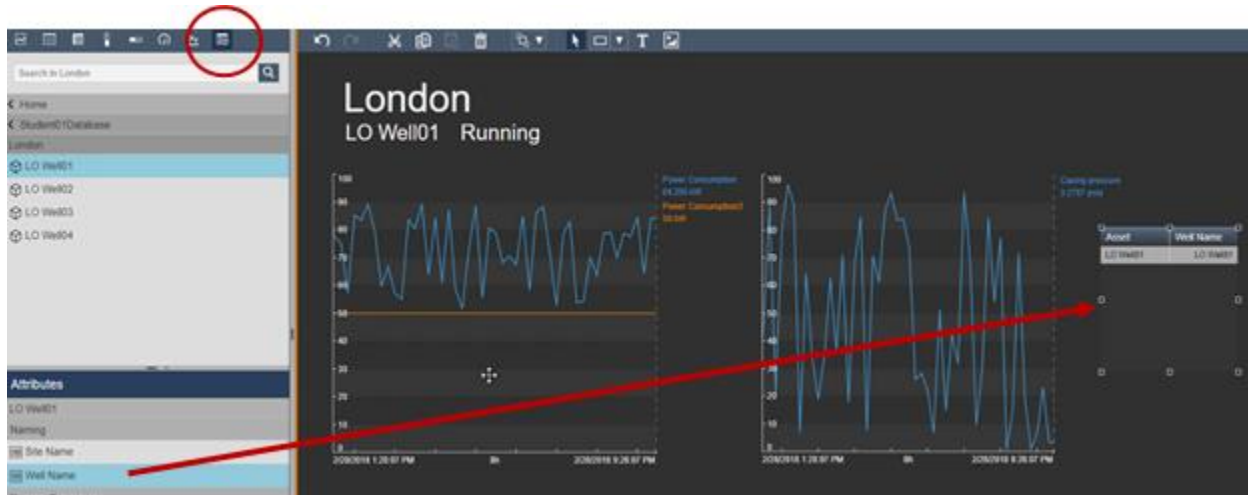
3. In the right pane, select "Show search results".
4. Remove the site name from the Search Root and Check Return All Descendents.
5. Under Asset Type, Select **WellTemplate**. This configuration will return all Elements in your database created from **WellTemplate** or any of its Derived Templates.



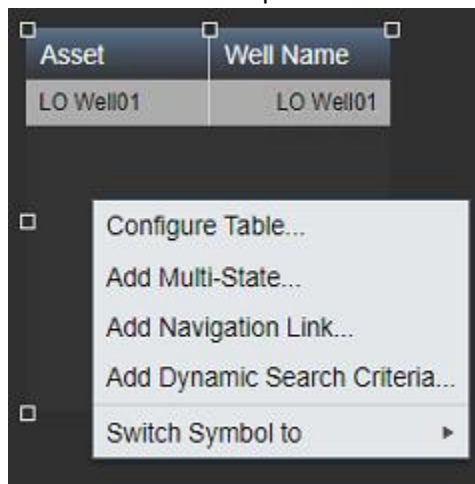
6. The contents of the Asset Swap Dropdown should now include all wells created from **WellTemplate** and all of its Derived Templates. When you save the display, the search criteria used to define the Asset Swap dropdown will be preserved.

## Create an Asset Comparison Table with Navigation Links

1. Working from the same display, add an Asset Comparison Table to your display. Do this by selecting the Asset Comparison icon and dragging the Well Name Attribute onto the display.



2. Right Click the Asset Comparison Table in the display and Select Add Dynamic Search Criteria.



3. Remove the Site Name from Search Root and Check Return All Descendants.
4. Under Asset Type, Select **WellTemplate**.

5. Increase the Number of Results to 20 and click Refresh.

**Edit Search Criteria** ▼

► Database Student01Database

▼ Search Root

☒ Return All Descendants

► Asset Name

▼ Asset Type Selected

Asset Type

WellTemplate ▼

Asset Attribute

► Asset Category

▼ Number of Results 20

20

► Asset Order Ascending

6. Right Click the Table and Select Configure Table. Click on Asset and then Click on the Down Arrow to remove it from the list.

**Configure Table** ▼

▼ Columns

Current Columns:

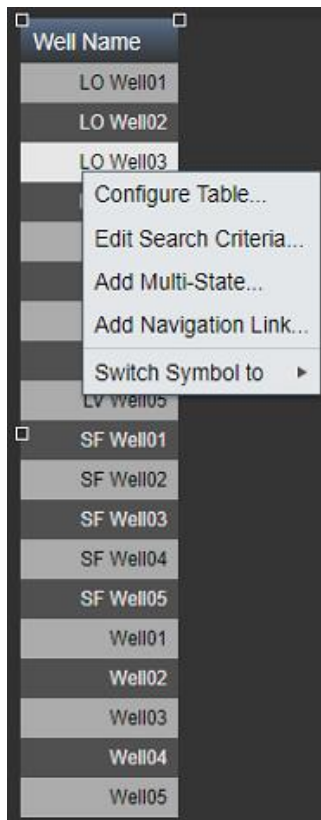
Well Name

☐ Show Units

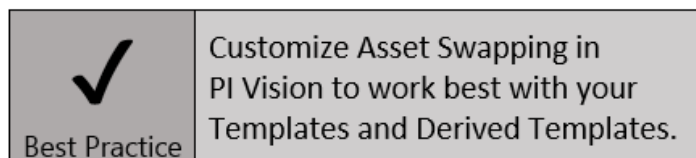
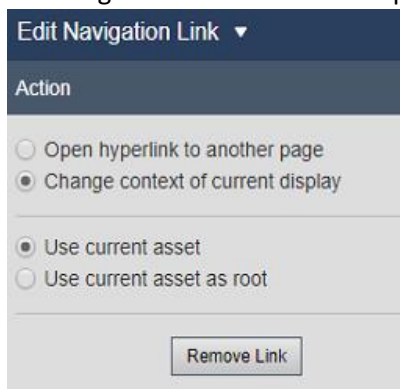
Additional Attributes:

Asset  
Casing pressure  
Power Consumption  
Power Consumption|Maximum  
Power Consumption|Minimum  
Power Consumption|Target  
Site Name  
Status Message

7. We now have a list of all the wells. Right Click the Table and Select Add Navigation Link.



8. Select Change Context of current display. Select Use current asset.











9. Click in the display to close the Edit Navigation Link Window.
10. Exit out of configuring your display by clicking the orange icon at the top right. It will be blue once you are in viewing mode



11. As you double click on each Well Name in the Asset Comparison Table, the Asset Swap Menu should update at the top of the screen. Within a few seconds, the entire display should update to include information from the selected well.

## Section 12. Solutions to Exercises

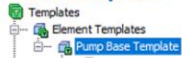
 **London**
 **LO Well01**
 **LO Well02**
 **LO Well03**
**LO Well01**

General Child Elements Attributes Ports Analyses Notification Rules Version				
Filter				
	Name	Value	Settings...	
	 Casing pressure	5.82035493850708 psia	\\PISRV01\Lon.749.CP.PV;UOM=psia	
	 Power Consumption	62.881441643872 kW	\\PISRV01\Lon.749.PC.PV;UOM=kW	
	 Site Name	London	←→	"%..\Element%";
	 Well Name	LO Well01	←→	"%Element%";

## Template Inheritance Activity 1

### Element Template Design

#### Base template



Filter
Name
Inlet Pressure
Outlet Pressure
Power Consumption
Stage 1 Compression Ratio

Elements created from the 2 State Pump Template  
Derived Template will contain all 6 Attributes.

#### Derived template



Filter
Name
Stage 1 Outlet Pressure
State 2 Compression Ratio

General	Child Elements	Attributes	Ports	Analysis
Filter				
Name				
Category: <None>				
Inlet Pressure				
Outlet Pressure				
Power Consumption				
Stage 1 Compression Ratio				

General	Child Elements	Attributes	Ports
Name:	Pump5		
Description:			
Template:	2 Stage Pump Template		
Categories:			

General	Child Elements	Attributes	Ports	Analysis
Filter				
Name				
Category: <None>				
Inlet Pressure				
Outlet Pressure				
Power Consumption				
Stage 1 Compression Ratio				
Stage 1 Outlet Pressure				
State 2 Compression Ratio				

## Template Inheritance Activity 2

### Element Template Design

#### Base template

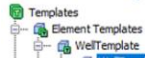


General	Attribute Templates	Ports	Analysis Templates
Filter			
Name			
Casing pressure			
Power Consumption			
Site Name			
Well Name			

These two Attributes have the same names as those in the Base Template but are configured differently.

Elements created from the  
WellTemplate\_NamingConvention2 Derived  
Template will contain 4 Attributes.

#### Derived template



General	Attribute Templates	Ports	Analysis Templates
Filter			
Name			
Casing pressure			
Power Consumption			

General	Child Elements	Attributes	Ports	Analysis
Name:	LO Well01			
Description:				
Template:	WellTemplate_NamingConvention2			

General	Child Elements	Attributes	Ports	Analyses	Notification Rules	Version
Filter						
Name						
Value						
Settings...						
Casing pressure						
Power Consumption						
Site Name						
Well Name						

## Appendix

There is a huge amount of information on using Asset Framework, and it's not always the easiest to find. Here are is a curated list of extremely helpful resources that you may not be aware of.

### **PI World 2018 - Tips and Tricks with PI System Explorer and PI Builder**

<https://techsupport.osisoft.com/Downloads/File/9d380542-8cb4-4439-b87c-a2dcf7eccfcf>

Part 2 of Tips and Tricks with PSE and PI Builder covers using PI Builder. There is a section called Setting PI Tag name in Attributes. This section goes through pushing tag names into a Child Attribute of a PI Point Data Reference. You then configure the PI Point Data Reference to point to this Child Attribute by using %@.|TagName%. There is still some risk that resetting to template can clear out tag name stored in the Child Attribute. This is why we instead suggest to store the list of tag names in an Internal Table in AF (less than 10,000 rows) and configure a Table Lookup Data Reference.

### **AF Templates Whitepaper**

<https://pisquare.osisoft.com/docs/DOC-2951-pi-af-templates>

A wealth of additional information on AF Best Practices. There is a lot more information here than can be covered in a hands-on lab.

### **Substitution Parameter Reference**

<https://pisquare.osisoft.com/thread/11188>

We have used some simple Substitution Parameters in this lab. However, if you need to do anything slightly different than what we have done, it can be difficult to figure out. This resource should be very helpful.

### **Asset Analytics Tips and Tricks**

<https://pisquare.osisoft.com/videos/2073-pi-developers-club-webinar-series-asset-analytics-tips-and-tricks>

As you continue to use AF, you will likely use Asset Analytics extensively. This is a great resource on Asset Analytics Tips and Tricks.



Have an idea how to  
improve our products?  
**OSIssoft wants to hear  
from you!**

<https://feedback.osisoft.com/>





Save the Date!

OSIsoft PI World Users Conference in Gothenburg, Sweden. September 16-19, 2019.

Register your interest now to receive updates and notification early bird registration opening.

[https://pages.osisoft.com/UC-EMEA-Q3-19-PIWorldGBG-RegisterYourInterest\\_RegisterYourInterest-LP.html?\\_ga=2.20661553.86037572.1539782043-591736536.1533567354](https://pages.osisoft.com/UC-EMEA-Q3-19-PIWorldGBG-RegisterYourInterest_RegisterYourInterest-LP.html?_ga=2.20661553.86037572.1539782043-591736536.1533567354)

