

Event Frames and Notifications

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- About this course

Event Frames and Notifications are a powerful combination of features in Asset Framework that help you capture, store, find, compare and analyze important system events and their related data. With notifications, you can send alerts to users in real time about conditions in the system that need specific attention. Corresponding actions can then be taken to be pro-active or to resolve the problem of the current situation.

We hope you enjoy the module and please don't hesitate to get in touch with any comments or feedback.

By the end of this course, you'll...

- Describe the uses and functions of Event Frames and the PI Notifications service.
- Understand the features and advantages of using Event Frame templates.
- Create Event Frames in multiple ways: via asset analytics, manually, and with the Event Frame Generator.
- Interact with different PI System products that utilize Event Frames.
- Install and troubleshoot the PI Notifications service, and create a notification based on an Event Frame.

Audience

This course is for experienced users of PI AF, but is open to anyone who wishes to learn more about Event Frames and Notifications.

Level: Intermediate

Study time: 4 hours

This Course Includes...

- Videos, discussion opportunities and quizzes to help you learn the material
- A sharable certificate of completion

Prerequisites

- Familiarity with the content covered in the courses "PI System Basics" and "Building Asset Hierarchies with PI AF" is advised.

- You can access our [YouTube content](#).
- PDF Reader or equivalent is required to access the workbook and presentation provided.

Further information

1. Once you register for a course, you will have access to the course materials 24/7 on this website.
2. This is a self-paced course. Any questions or assistance needed about the material can be asked in this [course's space in the OSIsoft PI Square community](#)
3. When you complete the examination at the end of the course, you will receive a certificate of completion which can be shared and directly posted on LinkedIn.
4. For more information about our Online Courses please visit our [FAQ page](#)

You can audit the full video lecture content right now on the [OSIsoft Learning YouTube Channel](#)

- Lesson 1: Introduction

Learning outcomes

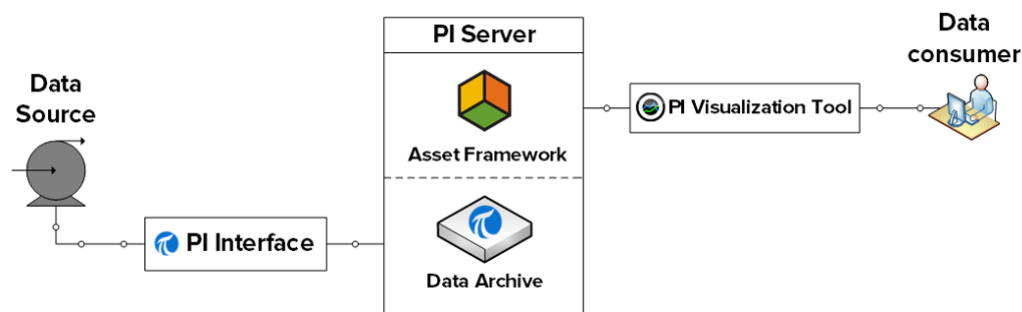
After completing this lesson, you will:

- Understand the basic components of the PI System.
- Be more familiar with the definitions of the terms Event Frames and Notifications.
- Have reviewed Event Frame and Notification examples.

Introduction

The PI System collects, stores, and manages data from your plant or process. Your data sources connect to one or more PI Interface nodes. The PI Interface nodes collect data from your data sources and store into the Data Archive. Asset Framework (AF) organizes and enhances the data and users then consume the data using a tool of the PI Visualization Suite (PVS) such as PI Vision.

The following is a diagram of the components of a simple PI System:



In a more detail, the following components constitute the PI Server:

Data Archive

The Data Archive is a component of the PI Server that provides efficient storage and archiving of time series data enabling high performance data retrieval by client software.

Note: Traditionally, the Data Archive was referred to as the "PI Server".

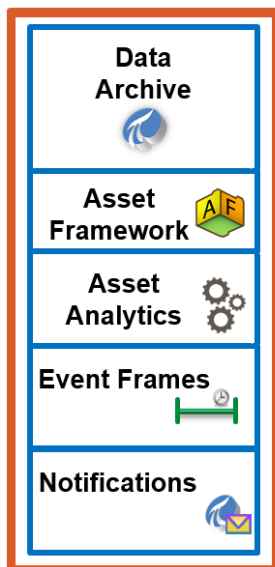
Asset Framework

Asset Framework (AF) is a single repository for asset-centric models, hierarchies, objects, and equipment. It integrates, contextualizes, refines, references, and further analyzes data from multiple sources, including one or more Data Archives and non-PI sources such as external relational databases.

Asset Analytics

A feature of Asset Framework (AF) used to create and manage analyses. Analyses read values of AF attributes, perform calculations, and write results to other attributes or create event frames.

PI Server



Event Frames

Event Frames help to capture, track, compare, or analyze important process or business events and their related data for a repeatable period of time. Event frames represent occurrences in your process that you want to know about, such as asset downtime, process excursions, equipment startup or shutdown, environmental excursions, product tracking batches, product runs, or operator shifts.

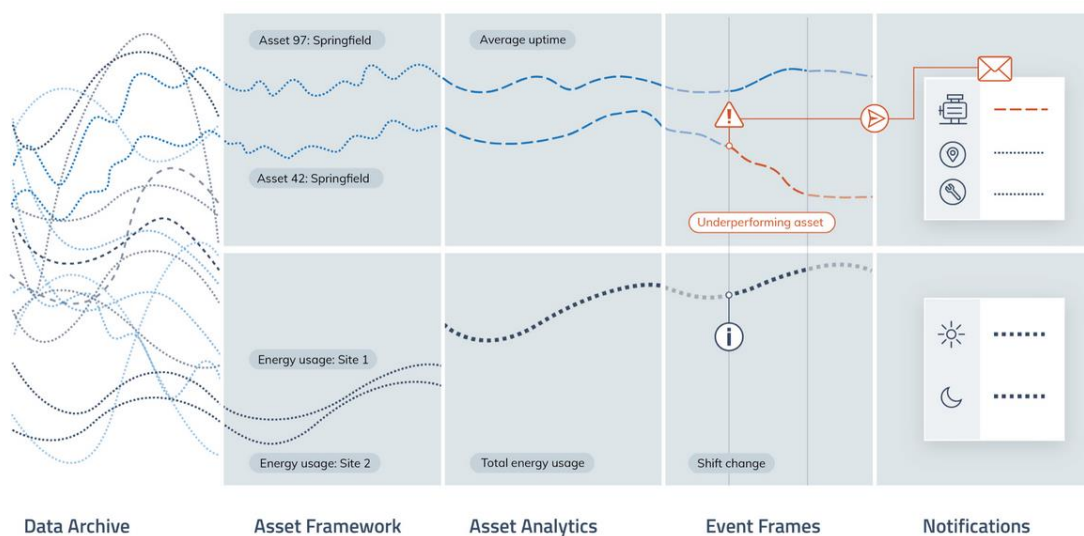
Notifications

The PI System can send notifications to users or systems when key events occur. You set conditions that define these events and specify notifications for them such as what to do when a recipient is unavailable. In operation, the PI System detects the events you specified and automatically generates and sends out notifications for them.

This course will examine **Event Frames** and **Notifications**.

Definitions

Events are important process or business time periods that represent something happening that affects operations. Capturing important events in your process and collecting relevant data around those events can help analyze why they occurred. In the PI System, events are known as **Event Frames**. With Event Frames, you can capture, store, find, compare, and analyze the important events and their related data. The power of Event Frames is that you can analyze your PI data in the context of these events rather than by continuous time periods. Instead of searching by time, Event Frames enable users to easily search the PI System for the specific events they are trying to analyze or report on.



Starting with PI Server 2016 R2, you can use the Asset Framework to configure **notifications** to alert you for conditions that signal Event Frames of interest. Notification messages may be customized to include information that is specifically relevant to the event, and may be sent via email to individuals, groups, or to a web service. Therefore, Notifications is the feature in the Asset Framework (AF) that you use to create and manage notification rules. Notification rules are the mechanism by which users are alerted for response in real time, for conditions that signal events of interest. Furthermore, escalations are also configurable in the notification system.

Notification rule triggers are based on event frames; the event frames may come from different sources like analyses, the Event Frame Generator (EFGGen) interface or custom AF SDK applications. Relevant information for events is stored in event

frames and compatible tools can retrieve such information. Information contained in elements, event frame templates, and other places may also be added to the notification content. Furthermore, event frame annotations contain historical notification information and may also include attachments; all annotations may be viewed using PI Vision or other client tools that support viewing annotations.

Use Cases - Example

You can monitor the following events to identify possible causes or potential points of failure.

- Asset downtime
- Environmental monitoring excursions
- Process excursions
- Product tracking batches
- Equipment startups and shutdowns
- Operator shifts

Example in a wind power generation company

Take the example of a wind power generation company that has different types of windmills across different locations and uses PI AF to organize their data. Their asset framework structure is based off a base element template of type "windmill", and has various child templates based off OEM, model, and megawatt ratings. The wind operator may want to win favorable warranty contracts by showing that the blades are operating safely. Alternatively, the operator may need to monitor parameters such as oil-bearing pressure, maximum voltage, power-factor, or performance of electronic and mechanical brakes in the minutes before process trips occur. In all these cases, the PI System can be used to generate event frames that capture relevant data and context needed to analyze the events.

Some event frames may need notifications to alert personnel or trigger other systems; some examples include:

- Temperature is outside the normal range
- Equipment is shutdown
- Runtime counters have elapsed indicating a maintenance is required
- Amount of supply material is below a critical minimum level

Notification messages can include links and screenshots to pre-configured PI Vision displays, and thereby provide visual representation of the event that triggered the notification. See PI Vision or PI DataLink product documentation for details on notifications feature support.

Learn More

- Event frames in PI AF ([Live Library Article](#))
- [[VIDEO](#)] What are PI Event Frames?

- Lesson 2: Event Frames - Introduction

Learning outcomes

After completing this lesson, you will:

- Be more familiar with Event Frames, especially in the processes of generating, retrieving, and acknowledging them.
- Have understood the features and advantages of using Event Frame templates.
- Have a clear idea of which PI System products support interacting with Event Frames.

Introduction

An Event Frame is defined by three characteristics:

1. **Name:** each Event Frame name must be unique and often includes a timestamp
2. **Start time and End time:** defines the event's time range
3. **Context:** one or more event attributes and referenced AF elements

There are two categories of trackable events that would fit an Event Frame profile:

- **Good events:** Events that you want to track as a normal part of a business such as product tracking, shifts, and so on.
- **Bad events:** Events that are unexpected and need to be analyzed and perhaps fixed quickly if they ever occur such as unexpected shutdowns or excursions. These are events that you want to track and report in aggregate, over time.

You can use data to identify some baseline “average” event and then look for those that are better than average (i.e., let's figure out what we did well and try to repeat) or worse than average (i.e., let's see what went wrong and try to avoid it). So, in a sense, these are events that aren't clearly good or bad but they are both captured with the same type of event frames and analysis logic.

Some of the features and advantages of Event Frames are:

- Flexibility

- Reference multiple elements within the same event.
- Support multiple overlapping events on an AF element.
- Capture any event; a "batch" is just one type of capturable event.
- Powerful search
 - Search by time range, type of event or Event Frame attribute.
- Scalability
 - Event Frames are extremely scalable (whereas search performance degrades with a large number of batches.). The upper limit for the number of Event Frames an AF server can have before experiencing significant performance issues is about a hundred million. More information in [this article](#).

This list of PI System products support interacting with Event Frames:

- Asset Analytics
- Notifications
- Dev Tech (AF SDK, PI Web API, JDBC Driver, etc.)
- EFGGen
- PI Vision
- PI DataLink
- Data Archive (migrate batch data to Event Frames)

Generating Event Frames

Asking questions such as these can help identify events or conditions that must be tracked. These will then be utilized in doing event analysis:

1. What are all the times that event X occurred on this type of asset?
2. Can I associate data from different points for a time-range, or for a single point in time?
3. What is the associated data for a particular time period when a problem occurred or may occur in the future?
4. What are the critical process events that someone needs to be notified on?

There are different ways to generate Event Frames:

- PI Interfaces for Batch Execution Systems:
 - PI Batch Framework 3.x and later versions can create Event Frames within a PI AF database or PI Batch objects within a PI Batch database. For more

information on creating Event Frames and using PI interfaces to populate the PI AF database with events-based data, see:

- [PI interfaces for batch and manufacturing execution systems](#)
- [PI Event Frames Interface Manager](#)
- The Event Frame Generator:
 - PI EFGen uses both PI SDK and AF SDK to create a hierarchy of events or to convert a PI BaGen structure to an Event Frame generator structure. Use PI System Explorer or PI Builder to create the Event Frame templates, associated attributes and PI point references.
 - For instructions on how to create Event Frames with PI EFGen, watch [this video](#).
- AF SDK:
 - You can create your own custom applications using AF SDK and PI ACE to create and monitor events.
- Asset Analytics:
 - you can generate Event Frames directly from AF. Once Event Frames are generated in AF, client tools such as PI DataLink and PI Vision could be used in visualizing and analyzing them.
 - For an example of creating Event Frames using asset analytics, see [Create Event Frames automatically to track inefficiency](#).

Although you can create Event Frames with several different OSIsoft products, **OSIsoft strongly recommends that you use asset analytics in most cases.**

The data needed to trigger Event Frames and populate many of their attributes is in PI Points. So, as long as you have history in the Data Archive, you can backfill your EFs. That means you don't have to set them up and wait for new events. **You can validate your logic against known occurrences and/or discover events from the past that provide value now.**

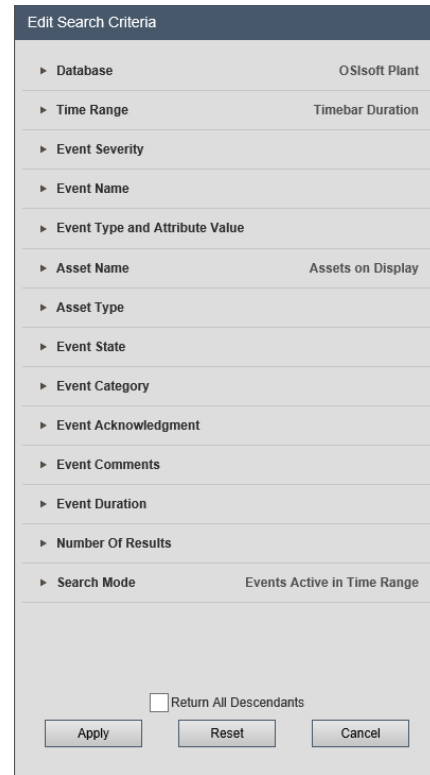
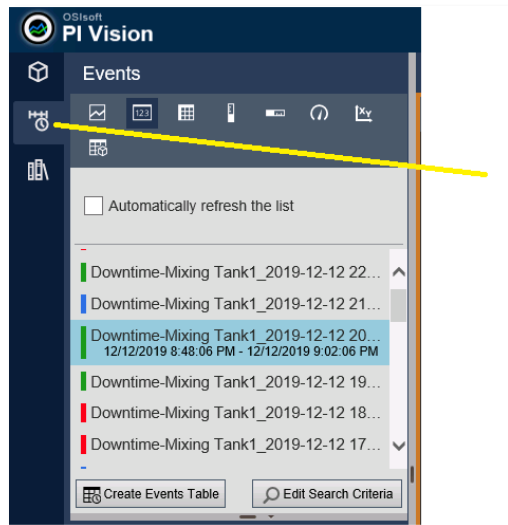
Retrieving Event Frames

Event Frames are stored in the AF Server. Visualization clients, such as PI Vision and PI DataLink access the AF Server to retrieve the events and their related data, providing you with powerful tools to visualize and analyze important events. Here is the list of the client applications that could be used in analyzing the generated Event Frames:

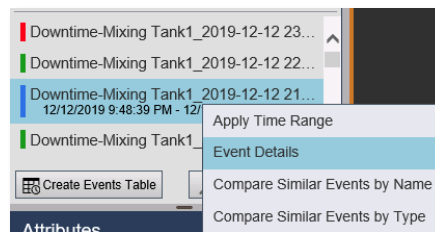
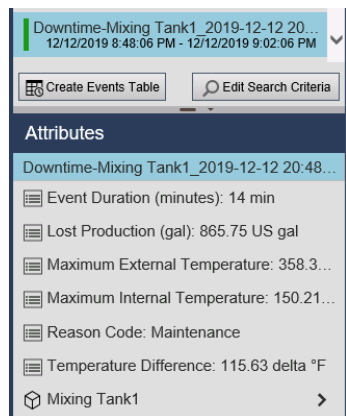
- PI Vision: Event Frames related to assets on a display are discovered by PI Vision. The time range and assets on the display determine what events are shown in the events list, but users may define their own custom searches as well. You can compare similar events to each other using Gantt charts and trend overlays.
- PI System Explorer: You can use PSE to search for events and analyze them. The results are presented in a practical table format that features a Gantt chart and columns for the attributes. Moreover, this is a quick way of verifying the creation of Event Frames.
- PI DataLink: Beginning with PI DataLink v2014, you can use PI DataLink to import Event Frames from AF into Excel and then create reports for viewing and analyzing those events. Pivot tables and pivot charts are great Excel features for summarizing the data and getting better insight into Event Frames

PI Vision: Finding and Acknowledging Event Frames

To view events, open the Events tab on the left side. Here you will find events related to your process, the color to the left of each event indicates its severity. By default, the time range of the display and the context of the symbols in the display determine which events are shown in the Events list. To discover additional events, modify the time range or choose Edit Search Criteria. When editing the search criteria, there are a few filtering options to find the Event Frames you are looking for, as shown.



Select an event to find its Data Items (event attributes) and its start and end time.



By right-clicking on an event, you can choose Event Details. This will create a trend and table with information about the event, click an item to add it to the trend. On the right, will also see the Actions and Comments associated with an event. If you have access to do so, you can add a new comment to the Event Frame and 'Acknowledge' it. The access is controlled in PI System Explorer with the Annotate permission.

Note: acknowledgement must be enabled on the event frame template. Refer to this Live Library article on how to "[Set permissions to allow users to acknowledge and annotate events](#)".



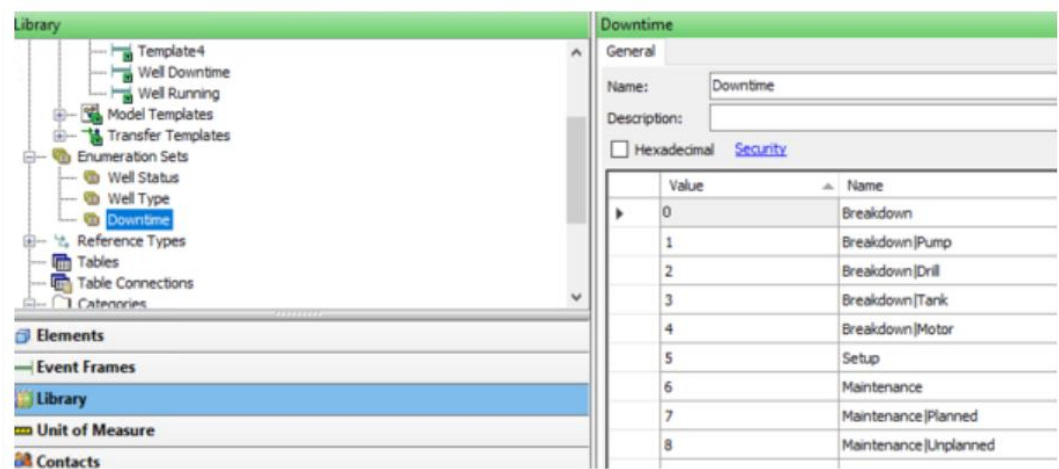
The PI Notifications Service writes an annotation to Event Frames with information about the number of subscribers the notification was sent to. From the Subscriptions pane in PI System Explorer, you can configure the subscribers to be alerted when a notification rule is triggered. A subscriber is an individual entity or group of entities that can receive notification messages by subscribing to notification rules.

More information on Subscriptions in notification rules can be found in the [Live Library](#).

PI Vision: Manual entry of reason codes

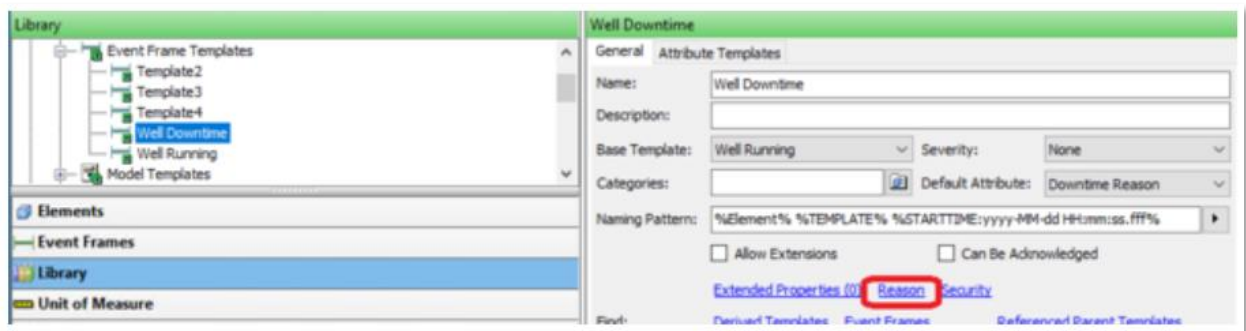
On the Event details page, the Reason pane lists available reasons and shows the reason currently set for an event. You can clear the current reason or select and apply a new reason. The reason attribute can be configured as an enumeration set for an Event Frame template, which can be hierarchical in PI AF version 2017 R2 and later. For users to be able to select and edit reason codes on the Event details page, the user must be mapped to an AF identity that has Write Data permission on the Event Frame template.

1. Create an Enumeration Set containing the possible reason codes.
- In PI System Explorer, navigate to the Library tab. Right-click "Enumeration Sets" and select "New Enumeration Set".
 - Create a new row for each possible reason. Pipe symbols can be used to create a hierarchical structure.

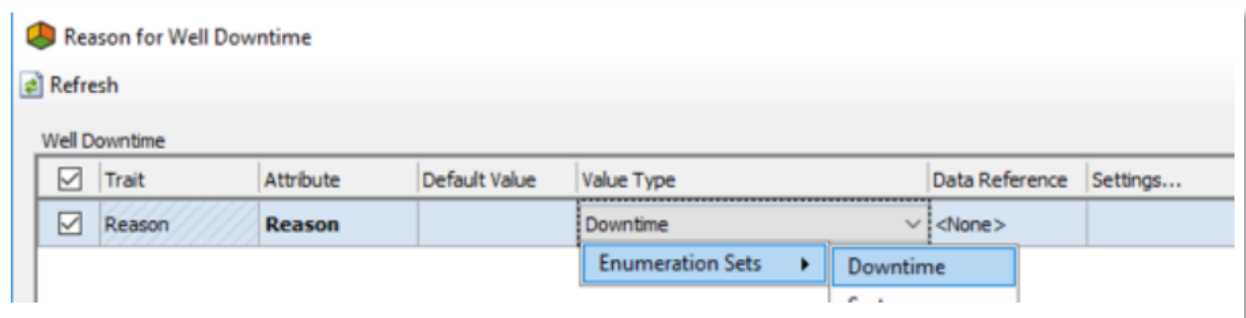


2. Assign the enumeration set to the Event Frame reason attribute.

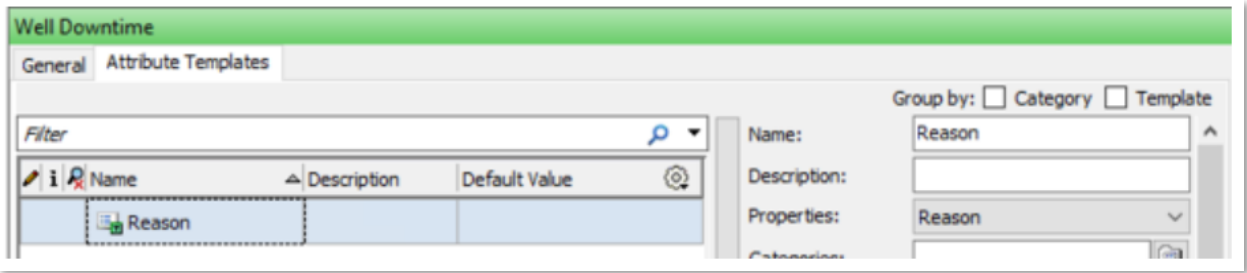
- Under "Event Frame Templates", select the target Event Frame template.
- On the General tab of the Event Frame, select the Reason hyperlink.



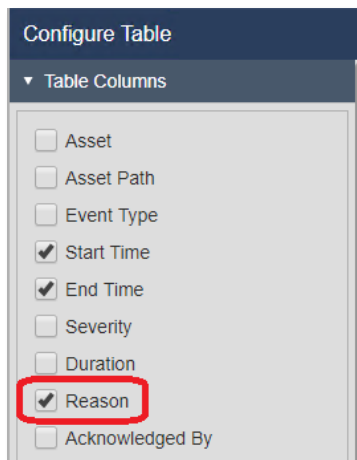
- Under Value Type, browse to the Enumeration Set containing the Reason Codes.



- If selected successfully, the Attribute tab of the Event Frame will now contain an attribute with a name and property of "Reason".



3. Set the Reason Code from the Event Table Symbol on a PI Vision display.
- Use the Event Search pane to find the desired Event Frame and then select Create Events Table.
 - Right-click on the Event Table symbol, select "Configure Table", and then check the Reason box to add the column to the symbol.



- Click the pencil graphic under the Reason column in the Events Table symbol, and then select the appropriate Reason Code.

PI



System
Explorer:
Finding and


Acknowledging Event Frames

In PI AF 2016 and later, you can require that an Event Frame be acknowledged. The acknowledgment feature is used by notifications and PI AF client applications, such as PI Vision.


- How to acknowledge an Event Frame

You acknowledge Event Frames in the Event Frames browser or in the General tab of a selected Event Frame in the Event Frames viewer.


1. In the navigator, click Event Frames.
2. In the Event Frames browser, click an Event Frame Search collection. The contents of the collection are displayed in the viewer.

3. Optional. To group Event Frames by their acknowledged status, click the  column icon.
4. Choose from the following actions.
 - Right-click an Event Frame in the viewer and click Acknowledge on the context menu.
 - Double-click an Event Frame in the viewer and, on the General tab, click the Acknowledge link.
5. Click Yes in response to the “Are you sure you want to acknowledge Event_Frame_Name?” prompt.

The following changes occur:

- In the Event Frame Search collection that is displayed in the viewer, the Acknowledged () column changes to OK status.
- On the General tab, the Acknowledged field is displayed with a time and date stamp. The user ID of the user who made the acknowledgment is displayed in the By field.

- How to find and read Event Frame annotations

You can search for Event Frames that have been annotated. You review annotation status in the viewer for an Event Frame Searches collection, where an “Is Annotated” column is displayed (.

To group Event Frames by their annotation status, you click the  column icon.

Look in this article for information on [Adding annotations to Event Frames](#).

Features of Event Frame Templates

Using Event Frame templates, you can define and standardize the related data (i.e. Event Frame attributes) associated with different types of events. Event Frame attributes provide additional context around the event that are useful for searches and reports. For example, downtime events often have a reason code that users want to search for or filter on during analysis of their downtime events.

You can also configure Event Frame attributes to reference process data in the context of the event. For example, a temperature excursion event is likely to have an attribute for the maximum temperature. You can configure Event Frames to

record those values for you. Additionally, for each event type, you can configure an index for the most-searched attributes: this enables faster and easier searches on the PI AF server when you track several event types or millions of events.

When you create Event Frames dynamically with Event Frame templates, you typically need to reference elements, attributes, templates, or other related objects based on those Event Frame templates. Because each individual Event Frame occurs in a slightly different context, you can use substitution parameters to reference other PI AF objects dynamically, rather than static, absolute references. For example, you can use a downtime Event Frame template for any number of assets, such as a pump, motor, boiler, compressor, and so on.

Following on from our “Example of Event Frames in a wind power generation company”, since all types of turbines share many identical attributes, you can create just one Event Frame template and use it to monitor similar events across the different assets. For example, you may be interested in the RPM attribute to capture a speed-based event. Using the special notation `.\Elements[.]|RPM` in the template, enables you to use the template on any windmill, and access the attribute of the particular referenced element.

For information on how to set up Event Frame templates, watch [this video](#).

Learn More

- For more information
 - on viewing and acknowledging Event Frames using PI Vision, see the PI Vision topic [View event details and annotate events](#).
 - on Event Frame templates, take a look at the [articles on Live Library](#)
- You may choose Batch or Event Frames depending on your process and business needs. More information can be found in [the Live Library](#).

- Lesson 3: Event Frames - Tasks

Learning outcomes

After completing this lesson, you will:

- Have reviewed three different ways to create Event Frames: manually, via Asset Analytics and with the Event Frame Generator.
- Have been introduced to the process of migrating Event Frames that were made with PI PIBaGen (PI Batch Generator).
- Have explored exporting Event Frames with the PI Integrator for Business Analytics.
- Be more familiar with exploring Event Frames in PI DataLink.

Directed Activity - Manual Event Frame Generation

Although you typically use event-frame-generation analyses or PI Event Frames Generator (PI EFGen) to create event frames, you can create an event frame manually. While **not recommended** as a practical or scalable way to generate events in a production environment, manual creation is quite useful as a learning exercise to reinforce understanding of event frame structure and configuration.

To begin with, we will create a single event frame manually to have an example of what we would like to capture for the period of a press downtime.

Let us identify a downtime period for the first press in Houston, **HOU.Press.01**, based on the **Press Status** values.

1. Select **Elements** from the navigator panel and select *Attributes* tab for **HOU.Press.01**.
2. Select the line for Press Status. Select *Time Series Data...* from the right-mouse button context menu and display the values for the last two hours.
3. Identify a period when there was a downtime. It starts with a value that is different from **Running** and ends with a value of **Running** again. In our case below, the press was not running after 1:22:05 PM because of Planned Maintenance, and was not running again before 1:35:05 PM because of another Maintenance.

Attribute: Press Status

Start Time: *-1h End Time: *

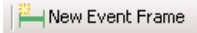
Retrieval Type: Time Range Boundary Type: Inside



Filter: ☐ Show Filtered

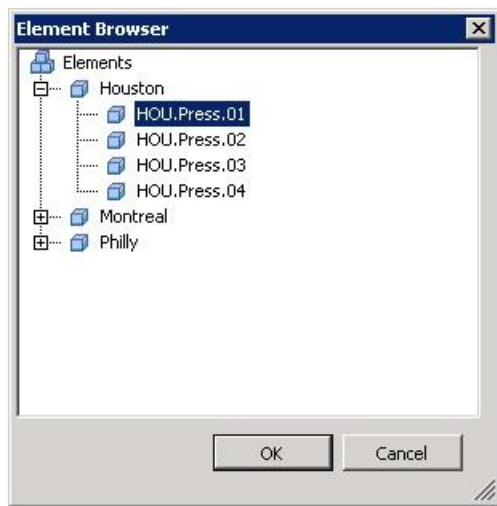
Data		Time Stamp	Value
		11/17/2017 1:15:35 PM	Running
		11/17/2017 1:22:05 PM	Planned Maintenance begin of downtime
		11/17/2017 1:28:35 PM	Maintenance
		11/17/2017 1:35:05 PM	Running end of downtime
		11/17/2017 1:54:35 PM	Press set-up
		11/17/2017 2:01:05 PM	Maintenance
		11/17/2017 2:07:35 PM	Press set-up

Fill in the information for your case in the table below and close the window.

	Example above:	Your case:
Start Time	13:22:05	
End Time	13:35:05	
Time in seconds	780	
Reason for the downtime	Planned Maintenance	

- Select **Event Frames** from the navigator panel and click on the  button. Select <none> for Event Frame Template.
- For name, enter **Downtime Sample Period for HOU.Press.01**. Enter Start and End Times in hh:mm:ss. As you do not specify a date, PSE will assume it is for today.

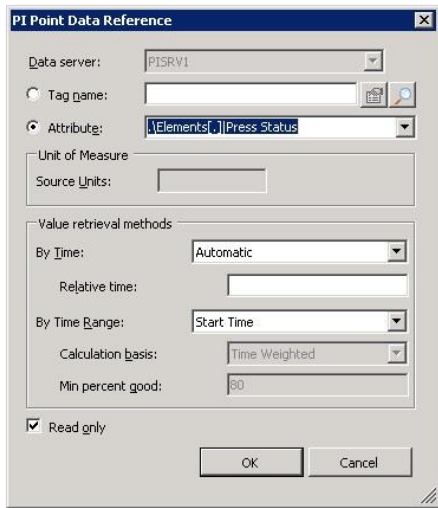
6. On the *Referenced Elements* tab, select the blue [Add Element Reference](#) link, click on the  button in the Single section.
7. In the Element Browser navigate to Houston -> HOU.Press.01 and click  OK.



Event Frame Attribute for the Downtime Reason Code

8. Let us track the reason, why the press had a downtime. It is the value of the **Press Status** attribute at the start of the problem. On the Attributes tab, click on the blue [New Attribute](#) link. For the attribute name, enter **Reason Code**. For value type, select **Press Status** from enumeration sets. For *Data Reference* select *PI Point*. Click on *Settings*.
9. The dropdown offers the attributes of HOU.Press.01, select **.\Elements[.]/Press Status**. For *By Time Range* select *Start*

Time. Click on OK.

The image shows a 'PI Point Data Reference' dialog box. It has a title bar with a close button. Inside, there are several sections: 'Data server' with a dropdown set to 'PISRV1'; 'Tag name' with an empty text box and a search icon; 'Attribute' with a dropdown showing '.\Elements[.]|Press Status'; 'Unit of Measure' with a 'Source Units' text box; 'Value retrieval methods' with 'By Time' set to 'Automatic', 'Relative time' as an empty text box, 'By Time Range' set to 'Start Time', 'Calculation basis' set to 'Time Weighted', and 'Min percent good' set to '90'. At the bottom, there is a 'Read only' checkbox which is checked, and 'OK' and 'Cancel' buttons.

Note that the dropdown has all the reference element's attributes available in the proper reference syntax. The value returned will be the Press Status at the start of the Event Frame.

Note: If the value type was reset, switch it back to Press Status.

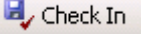
Event Frame Attributes

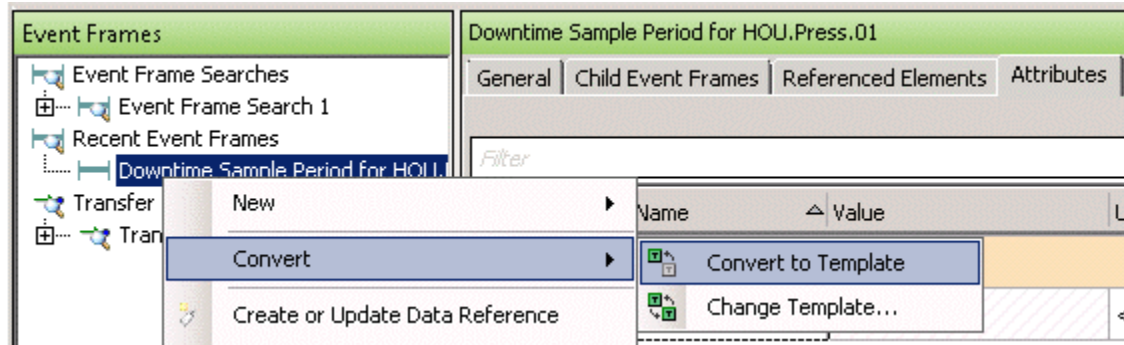
The generic format for attributes of event frames is **.\Elements[.]|Attribute**.

The attribute reference starts with **.\Elements[.]|** to indicate the primary element of the event frame's Elements collection. **.** is the current reference, **[.]** is the default object of the collection. The pipe character (**|**) is used to separate the element from the attribute name.


Create a new Event Frame template based on our manually created event frame.

Now, that we have defined what we would like to record for press downtimes, let us make a template out of it.

1.  **Check In** your changes
2. Select the event frame you created, and from the right mouse button menu, select *Convert > Convert To Template*.




3. For the Reason Code, keep
.\Elements[.]|Press Status;TimeRangeMethod=StartTime
Click on OK.

4.  Check In your changes

Directed Activity - Finalize the event frame template

Let us have a look at the event frame template that has been created and adjust and finalize it.

1. Select **Library** from the navigator panel and expand the structure Templates > Event Frame Templates and select *Downtime Sample Period for HOU.Press.01Template*. Rename to **Press Downtime**.
2. The *Naming Pattern* field enables you to dynamically build the name of the event frames produced from the template so that each event frame will have a unique, identifiable name. Use the arrow on the right () for a list of available substitution parameters. The most common ones are presented in the following table:

%ELEMENT%	Referenced element. Asset where the event happened.
%..\ELEMENT%	Name of the parent element of the referenced element. To retrieve further ancestors, use the ..\ notation, such as %..\..\Element%.
%TEMPLATE%	Name of the event frame template.
%STARTTIME:yyyy-MM-dd HH:mm:ss.fff%	Event start time and format.
%@Attribute%	The value of the event frame's attribute template, represented by the path.

More information on Naming Patterns is available in the [Live Library](#).

3. What naming pattern should we set so the downtime events are called something like the following?

DownTime HOU.Press.01 (Houston) 2015-12-24 23:22:21

Answer: Set the Naming Pattern as Downtime %ELEMENT% (%..\ELEMENT%) %STARTTIME:yyyy-MM-dd HH:mm:ss% where HH is 24-hour format.

Note: In case the **Naming Pattern** field is not set, event frames created with asset analytics will be named NameOfTheAnalysis – Starttime (i.e., Press Downtime – 20140725 11:20:00).

4. To track, whether the event frames was read by an operator, enable the ☒ Can Be Acknowledged option
5. Open the Attribute Templates tab. The **Reason Code** attribute we have defined before is listed here.
6. Add an **Event Duration** attribute (default UOM: second, value type: Int32). The attribute value will be set by the analysis, which we will create in the next step.
7. Producing one tire takes approximately 5 minutes. Based on the duration of the press downtime the number of tires can be calculated that could have been produced in case the press would have been running.
Add a **Production Loss** attribute (default UOM: tires, value type: Double), set Data Reference to *Formula*. To get the amount of production loss, divide the duration in seconds by 300:

Press Downtime					
General Attribute Templates					
Filter					
Name	Unit Of Measure	Value Type	Data Reference	Settings...	
Event Duration	second	Int32	<None>		
Production Loss	Tires	Double	Formula	D=Event Duration/[D/300]	
Reason Code	<None>	Press Status	PI Point	.\Elements[.].Press Status;TimeRangeMethod=StartTime	

8. Check in the changes.

Directed Activity - Backfilling Event Frames



This solo or group exercise is designed to maximize learning in a specific topic area. Your instructor will have instructions and will coach you if you need assistance during the exercise.

Exercise Objectives

- Define and save a search that returns the downtime analyses for all presses.
- Backfill the analyses in bulk.
- Understand the backfill options.

Problem Description

Downtime events are now being tracked in real time for all presses in our company. Management does not want to wait for new events to start analyzing the causes of production loss; they want you to create the event frames for all presses since today midnight.

Approach

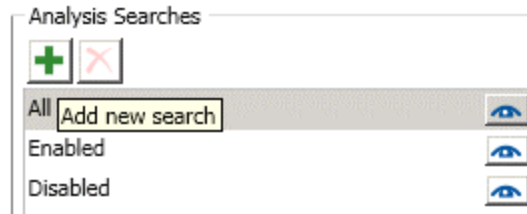
Use the *Management* plugin in the *Navigator Panel* to backfill multiple event frames.

Initially, all analyses in that AF database will be listed.



To work with a specific set of analyses (all the downtime analyses for all presses), you can define and save a search that will filter just those analyses:

1. Click on the green  sign to add a new search:



2. For the search name, enter *Press Downtime Analyses* and select **Template** under the Add Criteria dropdown.
3. From the Template dropdown, select *Press Template\Downtime* and click on OK. Result: the list of analyses on the right hand side lists twelve analyses (four from each location).

To perform a backfill for all Presses:

1. Click on the checkbox on top of the list to select all presses.

Analyses							
12 total analyses selected (12 on this page)							
<input checked="" type="checkbox"/>	Status			Element	Name	Template	Backfilling
<input checked="" type="checkbox"/>	✓		H	Philly\PHI.Press.04	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Philly\PHI.Press.03	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Philly\PHI.Press.02	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Philly\PHI.Press.01	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Montreal\MTL.Press.04	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Montreal\MTL.Press.03	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Montreal\MTL.Press.02	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Montreal\MTL.Press.01	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Houston\HOU.Press.04	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Houston\HOU.Press.03	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Houston\HOU.Press.02	Downtime	Downtime	
<input checked="" type="checkbox"/>	✓		H	Houston\HOU.Press.01	Downtime	Downtime	✓

2. Click on blue [Backfill/Recalculate 12 selected analyses](#) link. Acknowledge that existing event frames in the time range will be deleted, then click on *Queue* button.

Analyses

12 total analyses selected (12 on this page) 1 - 12 of 12

✓	Status	🔍	🗑️	Element	Name	Template	Backfilling
✓	✓			Philly\PHI.Press.04	Downtime	Downtime	
✓	✓			Philly\PHI.Press.03	Downtime	Downtime	
✓	✓			Philly\PHI.Press.02	Downtime	Downtime	
✓	✓			Philly\PHI.Press.01	Downtime	Downtime	
✓	✓			Montreal\MTL.Press.04	Downtime	Downtime	
✓	✓			Montreal\MTL.Press.03	Downtime	Downtime	
✓	✓			Montreal\MTL.Press.02	Downtime	Downtime	
✓	✓			Montreal\MTL.Press.01	Downtime	Downtime	
✓	✓			Houston\HOU.Press.04	Downtime	Downtime	
✓	✓			Houston\HOU.Press.03	Downtime	Downtime	
✓	✓			Houston\HOU.Press.02	Downtime	Downtime	
✓	✓			Houston\HOU.Press.01	Downtime	Downtime	✓

Operations

[Enable 12 selected analyses](#)
[Disable 12 selected analyses](#)
[Enable automatic recalculation for selected analyses](#)
[Disable automatic recalculation for selected analyses](#)
[Backfill/Recalculate 12 selected analyses](#)

Start: *-1d

End: *

What should we do with existing data?

☒ Leave existing data and fill in gaps
☐ Permanently delete existing data and recalculate

☒ I acknowledge that my selection contains event frame analyses. Event frames in the time range will be permanently deleted. This will result in loss of annotations and acknowledgements associated with the event frames.

Queue

Note with regard to the required acknowledgement: For an event-frame-generation analysis (different to the backfill case in context with non event-frame-generation analyses), data is automatically deleted and recalculated. This is the only mode allowed. Be aware that annotations on those event frames will be lost.

Automatic Recalculation: (AF 2017 R2 and later)



In case you expect that data from your inputs will be late-arriving or be out-of-order, you can request automatic recalculation for an analysis. The Management list allows to set this option for multiple analyses within one command. To set the option on an individual analysis base, use Advanced Options on the Analyses tab of an element or an element template.

Creating Event Frames with EFGGen

The PI Event Frames Generator (PI EFGGen) generates events (event frames) in the PI AF database based on values from trigger points in the PI Server. Using event frame templates in PI AF, PI EFGGen populates event frame attributes from point data, handles complex hierarchical events like batches, and migrates existing PI Batch Generator (PIBaGen) configurations to event frames so you can continue using your current batch structure.

The following are notable features of PI Event Frames Generator:

- **Generate events** - Easily configure event generation and automatically generate your events from the trigger points that are already collecting data in the PI Server. The screen shot below shows an example of downtime events being created using PI EFGen:

Name	Start Time	End Time	Primary Reason	Reason Code	Operator	Phase	Level	Temp	Comment
11-11-2012 3:00:00 PM	11-11-2012 4:00:00 PM	RE100	ESTOP	Jackson Davis	Agitate	16.49783708	12.719098175		
11-11-2012 3:14:00 PM	11-11-2012 3:18:00 PM	RE400	ESTOP	Don Wallace	AFTR_OUT	55.277320760	43.705249023		
11-11-2012 3:18:00 PM	11-11-2012 4:00:00 PM	RE200	ESTOP	Vernon White	Heat	40.249450166	56.02674273		
11-11-2012 4:14:00 PM	11-11-2012 4:18:00 PM	RE400	LOOSE SCREW	Don Wallace	Cool	73.41763306	156.38876762		
11-11-2012 4:26:00 PM	11-11-2012 4:29:00 PM	RE100	No OK	Bobby Johnson	Material Add 1	2.6661367416	1.498671073		
11-11-2012 4:56:00 PM	11-11-2012 5:00:00 PM	RE200	DRIVE FAILURE	Vernon White	Agitate	38.61676142	19.232118977		
11-11-2012 5:14:00 PM	11-11-2012 5:18:00 PM	RE400	No OK	Don Wallace	Material Add 1	12.88800296	21.67178491		
11-11-2012 5:26:00 PM	11-11-2012 5:29:00 PM	RE100	UNKNOWNS	Bobby Johnson	Cool	63.63666956	95.045703478		
11-11-2012 5:56:00 PM	11-11-2012 6:00:00 PM	RE200	DRIVE FAILURE	Vernon White	Agitate	19.724266477	14.33191871		
11-11-2012 6:14:00 PM	11-11-2012 6:18:00 PM	RE400	UNKNOWNS	Don Wallace	Inactivate	0.0080556229	0.049 C		
11-11-2012 6:26:00 PM	11-11-2012 6:29:00 PM	RE100	No OK	Bobby Johnson	Material Add 1	6.103240031	2.077080590		
11-11-2012 6:56:00 PM	11-11-2012 7:00:00 PM	RE200	DRIVE FAILURE	Vernon White	Inactivate	0.1	0.027701464		
11-11-2012 7:00:00 PM	11-11-2012 7:00:00 PM	RE300	DRIVE FAILURE	Jason Rice	AFTR_OUT	35.67328372	5.094228742		
11-11-2012 7:14:00 PM	11-11-2012 7:18:00 PM	RE400	No OK	Don Wallace	AFTR_OUT	50.47350918	37.52091116		
11-11-2012 7:26:00 PM	11-11-2012 7:29:00 PM	RE100	TOO HOT	Bobby Johnson	Cool	61.77769241	66.29422095		
11-11-2012 7:56:00 PM	11-11-2012 8:00:00 PM	RE200	DRIVE FAILURE	Vernon White	AFTR_OUT	34.303912178	4.712788596		
11-11-2012 8:14:00 PM	11-11-2012 8:18:00 PM	RE400	LOOSE SCREW	Don Wallace	Cool	64.616856384	93.70509460		
11-11-2012 8:26:00 PM	11-11-2012 8:29:00 PM	RE100	No OK	Bobby Johnson	Material Add 1	11.80890608	6.580240741		
11-11-2012 8:56:00 PM	11-11-2012 9:00:00 PM	RE200	LOOSE SCREW	Vernon White	Cool	44.767096762	85.93836301		
11-11-2012 9:14:00 PM	11-11-2012 9:18:00 PM	RE400	No OK	Don Wallace	Agitate	18.446390555	37.616405487		
11-11-2012 9:26:00 PM	11-11-2012 9:29:00 PM	RE100	TOO HOT	Bobby Johnson	Cool	63.443388003	85.63340888		

- **Handle multiple event types** - Generate all your different event types, such as downtime, excursions, batches, and other events, on the same asset with no restrictions on overlapping events. Please note that we can have multiple EF generation analyses using the same or different templates running and generating EF in parallel.
- **Standardize using event frame templates and populate event attributes** - Different event types have different attributes and information that are important for analysis. Standardize your events using event frame templates and use PIEFGen to automatically populate event's attributes with data from PI points.
- **Generate complex event hierarchies like batches** - This is the biggest advantage of the EF Gen Interface. Create and relate complex events such as batch processes, which have levels of events like procedures, unit procedures, operations, and phases, while maintaining the parent/child relationships.
- **Recover history and backfill events** - if PIEFGen loses its connection to the PI Server, your events are recovered upon reconnection, using built in history recovery. You never lose events when you have the underlying PI System data. Unlike the legacy PI Batch Generator (PIBaGen), you can recover events without manually deleting records before recovery. PIEFGen enables you to define your history recovery time window, then it recovers the events from previous time periods automatically.

- **High availability and failover** - if you have a primary and secondary PI Server (HA PI Server Collective), PIEFGen can be configured to retrieve the trigger point information from the secondary PI Server automatically upon failure. To ensure continuous creation of events, you can run multiple instances of PIEFGen using interface-level failover. Finally, if you have a high-availability PI AF server, your events are stored redundantly, so the data is always available.
- **Flexible deployment** - Unlike PIBaGen, PIEFGen can be run anywhere in your PI System architecture. OSIsoft recommends that you install it on your PI AF Server or on a PI interface node.
- **Easy migration from PI Batch Generator** - Using the PIBaGen Converter tool, existing PIBaGen configurations that write to PI Batch can easily be migrated to PIEFGen to create the same events using event frames. After migrating, you can enhance your configuration to take advantage of features like event frame templates and attributes.
- **Configuration tool** - Event Frames Interface Manager enables you to configure all event frame interfaces using a graphical user interface, rather than manually editing text files.

For more information on “Preparing batch data sources and consumers for migration” look at this [article in the Live Library](#).

Migrating from PI Batch to Event Frames

Starting with PI Server 2015, you can migrate your PI Batch Database and PI Batch Subsystem data to event frames. Because you will need different client applications to manage batch data in event frames than you have been using with the Batch Database, do not migrate to event frames until the solutions you need for event frames are all in place. Also, once you start the migration, the Batch Database becomes read only, and you will not be able to revert to it.

OSIsoft does not recommend that you run the PI Batch Database and use event frames in parallel for the same batch data. OSIsoft envisions that you will migrate all batch data at one time from the PI Batch Database. An exception is if you decide to create event frames to support non-batch data (such as for monitoring equipment downtime) at the same time as you create batches in the PI Batch Database.

Note:

- OSIsoft recommends that, unless you have non-critical migration requirements or a very simple environment, you test the migration of your batch data to event frames and the cutover to event frame data sources and consumers.
- Allow approximately 90 minutes per million event frames for the migration, bearing in mind that this time will vary greatly depending on network, hardware and other factors.

For more information on “Preparing batch data sources and consumers for migration” look at this [article in the Live Library](#).

PI interfaces for batch and manufacturing execution systems are scan-based interfaces that populate the PI AF database (with event frames and assets) or the PI Batch Database and PI Module Database (with batches, modules and properties) based on events and data read from a data source. For more information, access [this article](#).

Filter by Event Frames with the PI Integrator for Business Analytics

PI Integrator for Business Analytics transforms PI System data into a decision-ready format that can be consumed by business intelligence (BI) tools, such as Microsoft Power BI, Tableau, and others. With BI tools, you can run retrospective analyses on large sets of your real-time PI System data.

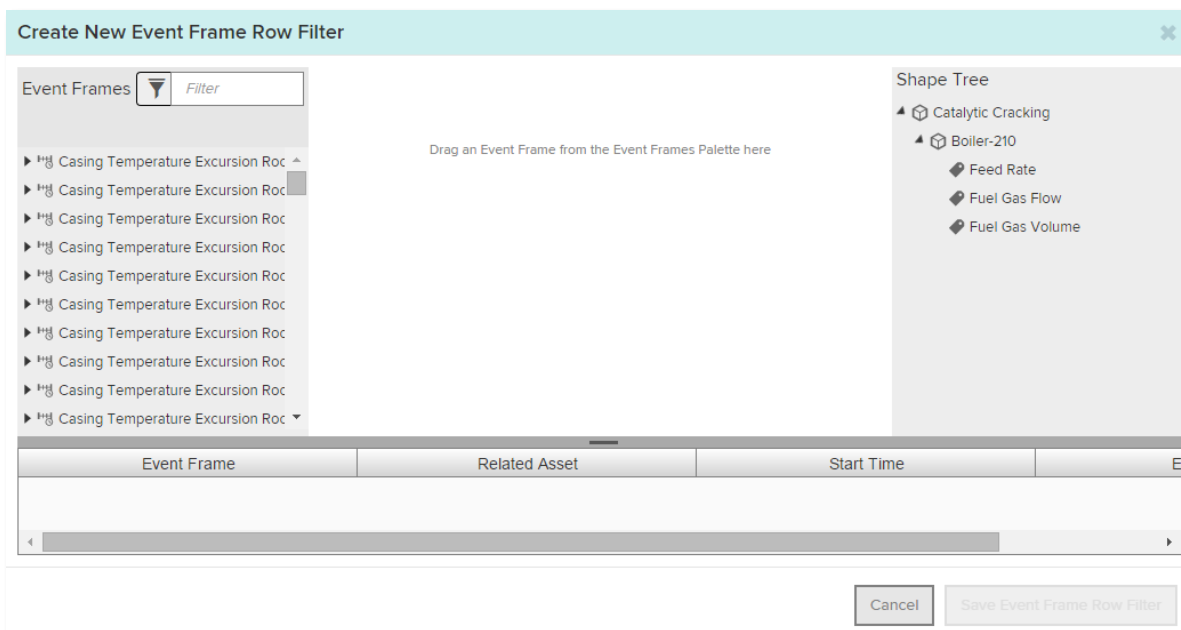
The following procedure shows how to create, modify, and apply an event view.


When you define an asset shape, you create a collection of matches that meet the same criteria. When you apply an event frame filter to this view, you define an event shape that creates a collection of matches for a set of event frames. PI Integrator for Business Analytics then joins these two collections based on a common asset to obtain the subset of data that matches both.

For example, assume you have a number of wells where a certain piece of equipment is run one at a time at each well, and event frames are used to record the data collected by this equipment. Each event frame has a different start and end time and applies to a different well. You can use the event frame row filter to include asset view data for the well only for the period that the equipment was running on that well.

Procedure

1. On the My Views page, select the view that you want to modify and click Modify View. Then click Next to open the Modify View page. **Note:** If you are already on the Modify View page, skip to the next step.
2. Use the Start Time and End Time fields to adjust the time range to include the times when the event frames of interest were recorded. **Note:** If the start and end times are outside the event frame time range, no event frames will be found.
3. Click Edit Row Filters and choose Event Frame for the type of filter. PI Integrator for Business Analytics now searches for event frames on your PI AF database for this view and displays a subset of the ones it finds.



4. Click the  icon to open the menu. Click the right-angle bracket (>) on one of the filtering categories to open the related panel.

Enter Event name or string match pattern

- Filter Events by Time
- Filter Events by Assets
- Filter Events by Events
- More Options

In the filtering fields, specify parameters to narrow down the event frames to find the ones you are looking for. For example, enter a pattern-matching string in the Event Name field or select a template in Event Template.

Event Frames

Enter Event name or string match pattern

< BACK

Event Name

Enter Event name or string match pattern

Event Template

Clear All Filters Apply Filters

- Click Apply Filters.
- From the event frames found, drag an event frame to the center pane. The filter now includes rows for which this event frame is active.
- Optionally, you can broaden the row filter search criteria to include all event frames with the same template or category. To do this, use the drop-down list to change the search from Event Name to Event Template or Event Categories.

Create New Event Frame Row Filter

Event Frames Filter

Include rows with this Event Frame Active

Event Name matches EventFrameAnalysis 20150612 01:46:32

Event Name

Event Template It is any. Drag an element from the Shape Tree to specify.

Event Categories


EventFrameAnalysis 20150612 01:46:32

EventFrameAnalysis 20150612 01:46:32

EventFrameAnalysis 20150612 01:46:32

EventFrameAnalysis 20150612 01:46:32

EventFrameAnalysis 20150612 01:46:32

8. Click the icon  next to the event condition. PI Integrator for Business Analytics fetches matching event frames and shows them in the preview pane at the bottom of the window.
9. To align the event frames with the correct asset, drag the asset or attribute from the Shape Tree onto the filter criteria. This step defines the relationship between the two data sets (the event frame data set and the asset and attributes data set). This is similar to the clause in a relational table join that equates an attribute in one table (or dataset) to an attribute in the other table (dataset). Here, we are equating the asset "owning" the event frame to the asset from your Shape Tree. PI Integrator for Business Analytics updates the display of matching event frames in the preview.
10. When you have finished defining the filter, click Save Event Frame Row Filter.

For more information on the “PI Integrator for Business Analytics” look at this [article in the Live Library](#).

- Lesson 4: Event Frame Analysis

Learning outcomes

After completing this lesson, you will:

- Have gone through the process of creating an EF Generation Analysis
- Know about converting an analysis into a template
- Have understood Event Frame reports in PI Datalink

Directed Activity - Creating an EF Generation Analysis

Let us create an EF generation analysis to track the downtime events in our curing presses. Create it directly under *Houston's press1*. Once we validate that this is working fine, we will convert the analysis into a template for deployment to all the presses in our company.

Event frame analyses are configured in a similar way to expressions and rollup analyses. Browse to Houston's press1 and under the *Analyses* tab select *Event Frame Generation*. Give a meaningful name and description to your analysis.

An event frame analysis is based on an event frame template, go ahead and select the template from the dropdown list.

Tip: Before you create an EF generation analysis, be sure an event frame template is available for it.

The screenshot shows the 'PressTemplate' application window. The 'General' tab is active, displaying the template's name 'Downtime', description 'Generation of Downtime events', and categories. The 'Analysis Type' is set to 'Event Frame Generation'. The 'Example Element' is 'Houston\HOU.Press.01'. The 'Event Frame Template' is set to 'Press Downtime'. The 'Triggers' section contains a table with three start triggers and one end trigger. The 'Functions' panel on the right lists various mathematical and logical functions. Annotations with arrows point to the 'EF Template (required)' dropdown, the 'Triggers' table, and the 'Advanced Event Frame Settings...' button.

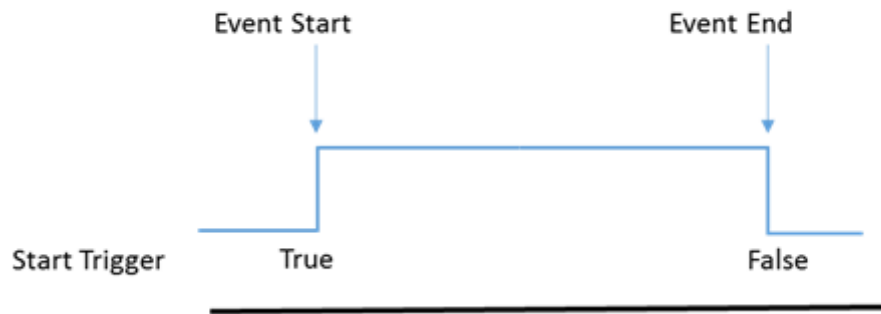
Name	Expression	True for	Severity	Value at Evaluat	Value at Last Tri
StartTrigger1	'Press Status'="Planned Maintena	Set (optional)	Information		
StartTrigger2	'Press Status'="Maintenance"	Set (optional)	Minor		
StartTrigger3	'Press Status'="No Operator"	Set (optional)	Major		
EndTrigger	'Press Status'="Running"				

Triggering Conditions (Start Trigger Only)

It is time to enter the conditions that will trigger the start and end event: StartTrigger and EndTrigger. These conditions are entered as expressions using the PE syntax presented earlier.

When a single condition triggers both the start and the end of an event frame, only the *StartTrigger* expression is needed. When the expression evaluates to *TRUE* the event frame is started, and when it evaluates to *FALSE* the event frame is closed. For example, a tank's level rising above a threshold might start an overflow event, the event would end when level is below the threshold.

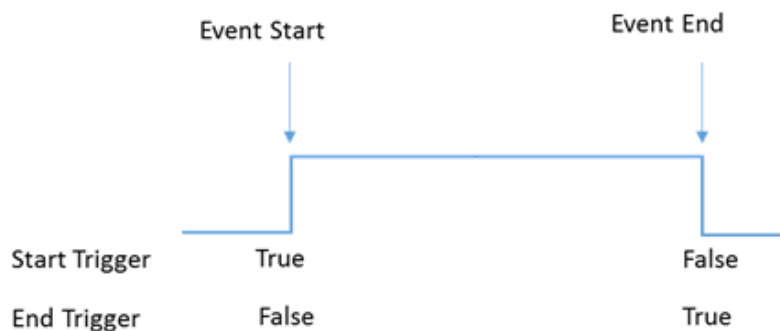
Event Frame Generation with Start Trigger only



Triggering Conditions (Start and End Trigger)

You can specify an EndTrigger expression when the start and end conditions are different:

Event Frame Generation with Start and end Triggers

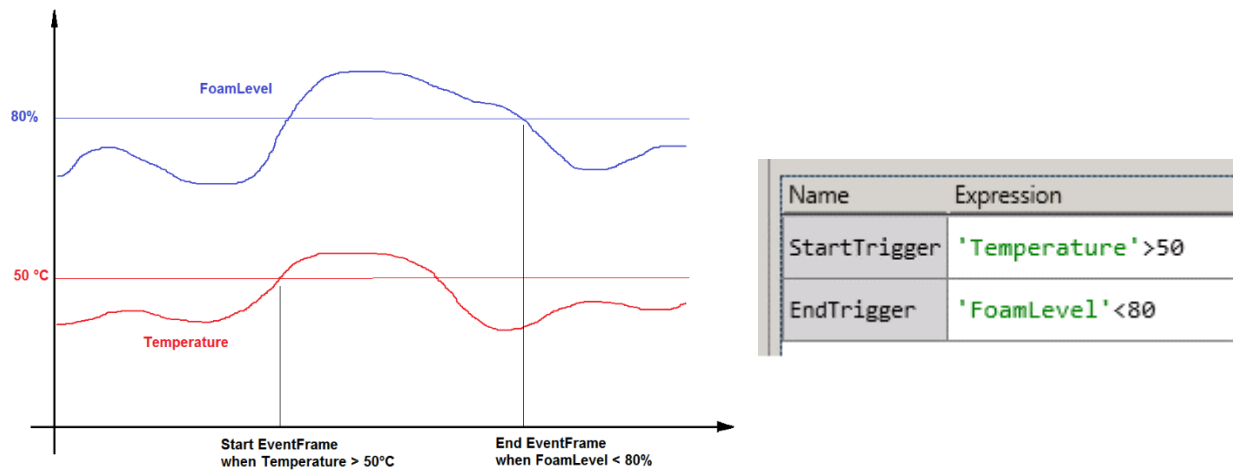


In the case with Start and End Triggers, the end of the event is dependent on the End Trigger condition only. So after the event has started, the event ends when the End Trigger becomes true, independent from whether the Start Trigger is True or False.

Tip: If using start and end triggers, make sure the expressions never evaluate to TRUE at the same time since this may lead to event frames with zero second durations. Try to configure your event frames to use only a StartTrigger expression.

For example, if the temperature rises in your reactor the foam level rises accordingly. When the temperature drops again, the foam level drops as well, but with some delay in time.

You would like to capture the time, when temperature is too high until foam level is back to normal:



Defining Triggering Condition for the Press Downtime

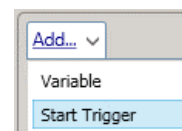
Since AF 2016 it is possible to define several start trigger conditions and associate them with different event frame severities. This meets our requirement to have event frames with different severity based on the reason why the press was down. Let us look at the first situation, when the press stopped running because of a *Planned maintenance* or a *Press set-up*.

The expression to start the event in that case is:

'Press Status'="Planned Maintenance" or 'Press Status'="Press set-up"

Assign an *Information* severity level.

To enter start and end triggers, click on blue [Add...](#) link and select corresponding option from the dropdown.



Enter the start and end trigger expressions and assign the severity levels as follows:

Event Frame Template:

[Add...](#) ▾

Name	Expression	True for	Severity
Start triggers			
StartTrigger1	'Press Status'="Planned Maintenance" or 'Press Status'="Press set-up"	Set (optional)	Information ▾
StartTrigger2	'Press Status'="Maintenance"	Set (optional)	Minor ▾
StartTrigger3	'Press Status'="No Operator"	Set (optional)	Major ▾
End trigger			
EndTrigger	'Press Status'="Running"		

Tip: Use the StartTrigger *True for* option to require the start trigger remain true for a set time interval before creating the event frame. This is useful for attributes with continuous, non-stepped data to prevent spikes in the input data from generating unwanted event frames.

Note: In the example above, the start triggers are all mutually exclusive. In other cases, however, multiple start triggers can be true at the same time. This leads to **EF hierarchy generation**. More information can be found in the [Live Library](#).

Store the duration in the corresponding event frame attribute

Since AF 2017 R2 there is an *EventFrame* function, which allows to get event frame properties such as the event frame duration in an easy way.

> Functions

Insert functions into the expression

Event Frame Properties ▾

EventFrame

EventFrame(string parameter)
Return the value of an event frame property.
Example: TagAvg("att1", EventFrame("StartTime"), EventFrame("EndTime")) [Find the time-weighted average of values of 'att1' during an event frame]

To store the event frame duration in the **Event Duration** attribute of the event frame:

1. To enter an output expression, click on blue [Add...](#) link on top of the triggers section and select *Output Expression* option from the dropdown.

2. For the expression, enter `EventFrame("Duration")`
3. Click on the blue [Map](#) link at the right hand side, and select the **Event Duration** attribute.

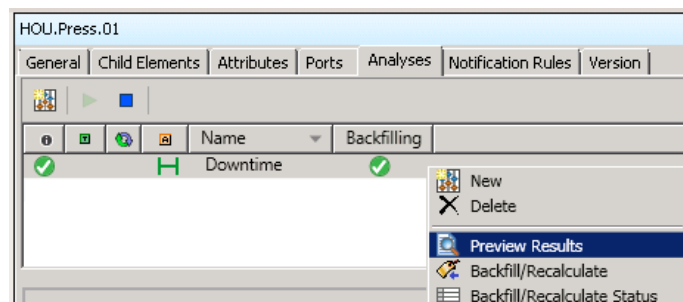
Outputs at close						
Output1	EventFrame("Duration")				Duration	⊗

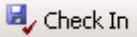
An alternative way is to use a Formula Data Reference attribute configured to return the value of %Duration%. If the Value Type of the Formula Data Reference is set to "String" the value will have the format: hh:mm:ss. More information can be found in this [article](#).

Scheduling an Event Frame Analysis

The last thing to do is to schedule the event frame analysis. As with expressions and rollups, two scheduling options are available: Event-Trigger and Periodic. For this exercise, schedule it as Event-Triggered.

- **Directed Activity - Previewing analysis results and starting the analysis**
- You can now use the *Preview Results* feature to validate whether the events that would be generated are as expected. Select the Downtime analysis in the list of analyses. From the right mouse context menu, select *Preview Results*.



- If the results are OK, click on  **Check In** changes. Result: the analysis will start running:

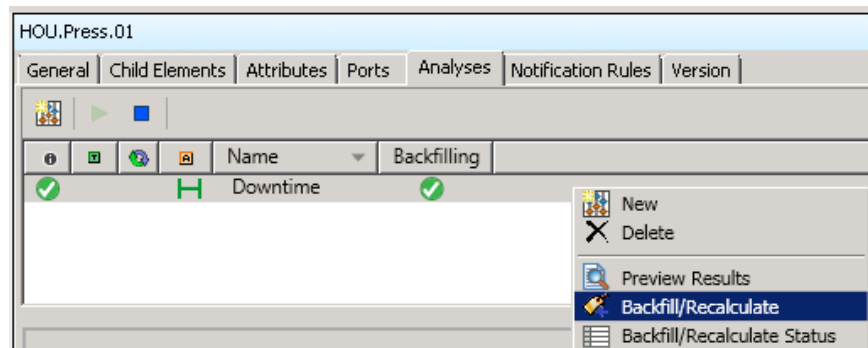


Directed Activity - Backfilling Event Frame analysis

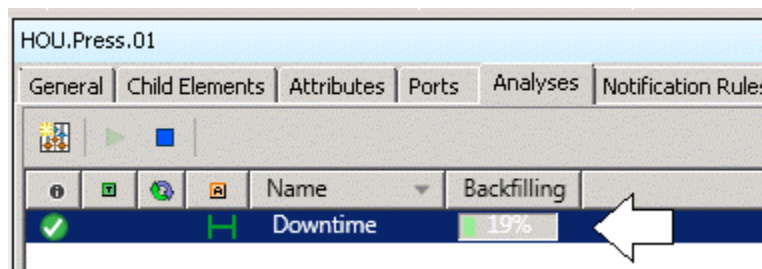
The analysis we have created will monitor the Press Status from now on. However, with the Backfill function of analysis, it is possible to also backfill past periods in time! This means that the archived values for Press Status will be examined and event frames with dates in the past will be created accordingly.

To backfill the time since midnight:

1. Select the Downtime analysis in the list of analyses. From the right mouse context menu, select *Backfill/Recalculate*.



2. For Start Time, enter a t (=today midnight), for End Time enter a * (=now). Click on Start button. The *Backfilling* column will show the progress of the backfill activity.

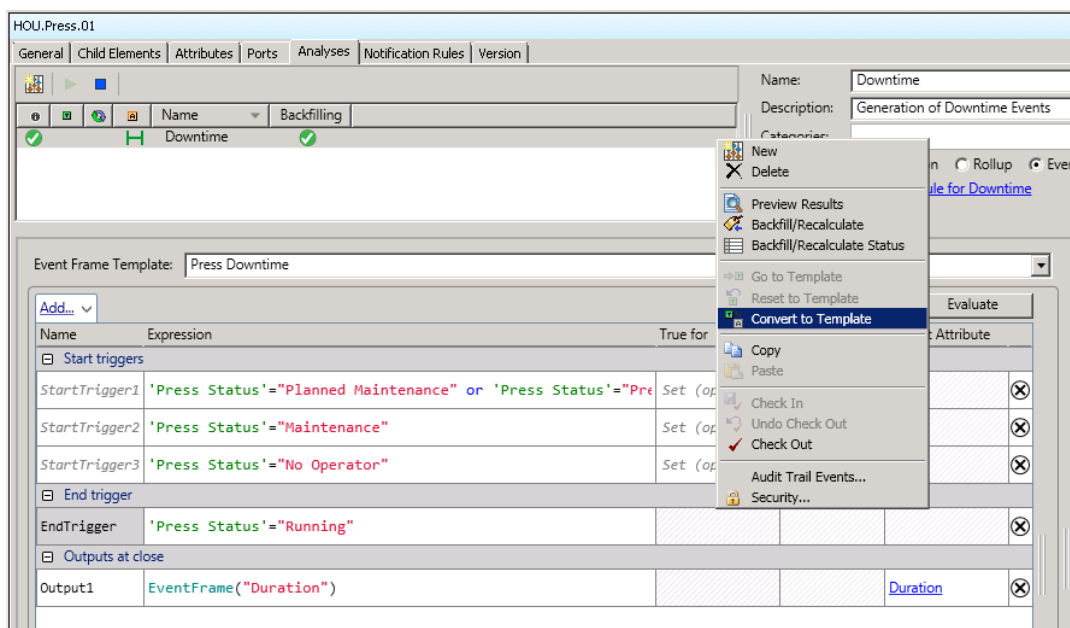


3. After backfilling is completed, switch to the General tab and click on the blue [Event Frames](#) link. You will get a list with all event frames linked with that element.
4. (optional) Verification: what is the start time of the first event frame? The first event will be from some time past today midnight, because we backfilled from today midnight onwards.

5. (optional) Scroll through the list and locate the manually created event frame. There will be a further corresponding event frame with same start and end time that was created by the analysis. Select the manually created event frame and select *Delete...* from the right mouse button context menu. This event frame is not required any more.

- **Directed Activity - Converting an Analysis into a Template**
- It is very common that customers create and test an analysis directly on an element (e.g. Houston's Press01) before adding it to a template (e.g. Press template). Analyses can be added to a template so you do not need to configure them once again at the template level. Just right click the analysis and select *Convert to Template* as seen in the figure below. Then check-in.

- **Note:** *Convert to Template* does not create an element template; it just adds an analysis to an already existing one.



- **Note:** The analysis will be added to all assets created from the element template. Analyses will be started automatically after the Check-in.

Event Frame Reports in Excel with PI Datalink

You can use PI Datalink (2014 or later) to import event frames from AF into Excel and then create reports for viewing and analyzing those events. Pivot tables and pivot charts are great Excel features for summarizing the data and getting better insight into event frames

Under the PI Datalink ribbon in Excel you will find two functions (buttons) to import event frame data into Excel: The **Explore Events** function and the **Compare Events** function.

The **Explore Events** function returns one event per row, which is useful to analyze events sharing the same EF template.

	A	B	C	D	E
1	Event name	Start time	End time	Primary element	Temp.Max
2	Batch 1222	30/01/2015 12:23:07	30/01/2015 14:05:07	RE100	89.56497955
3	Batch 1317	30/01/2015 13:18:37	30/01/2015 14:19:37	RE200	73.08377075
4	Batch 1327	30/01/2015 13:28:07	30/01/2015 14:04:07	RE300	92.61405945
5	Batch 1410	30/01/2015 14:11:07	30/01/2015 14:47:07	RE300	101.1487427

Here: maximum temperature of event frame named *Batch 1222* has been highlighted above in yellow (89.56).

In case an event frame has child events, it is possible to also list child elements in further lines below the parent event. In the example below, there are nine child event frames (Material Add 1, Agitate, ,...):

	A	B	C	D	E	F
1	Event name	Child 1	Start time	End time	Primary element	Temp.Max
2	Batch 1222		30/01/2015 12:23:07	30/01/2015 14:05:07	RE100	89.56497955
3	Batch 1222	Material Add 1	30/01/2015 12:24:37	30/01/2015 12:35:07		12.45047569
4	Batch 1222	Agitate	30/01/2015 12:35:07	30/01/2015 12:41:37		13.08228683
5	Batch 1222	Material Add 2	30/01/2015 12:41:37	30/01/2015 12:56:37		14.34287834
6	Batch 1222	Agitate	30/01/2015 12:56:37	30/01/2015 13:07:37		16.33535957
7	Batch 1222	Heat	30/01/2015 13:07:37	30/01/2015 13:14:07		41.38076401
8	Batch 1222	Dwell	30/01/2015 13:14:07	30/01/2015 13:34:37		89.26969147
9	Batch 1222	Agitate	30/01/2015 13:34:37	30/01/2015 13:39:37		89.56497955
10	Batch 1222	Cool	30/01/2015 13:39:37	30/01/2015 13:53:37		89.56497955
11	Batch 1222	XFER_OUT	30/01/2015 13:53:37	30/01/2015 14:05:07		47.95473671
12	Batch 1317		30/01/2015 13:18:37	30/01/2015 14:19:37	RE200	73.08377075
13	Batch 1317	Material Add 1	30/01/2015 13:20:07	30/01/2015 13:25:07		19.77932739
14	Batch 1317	Agitate	30/01/2015 13:25:07	30/01/2015 13:32:37		19.77932739
15	Batch 1317	Material Add 2	30/01/2015 13:32:37	30/01/2015 13:42:07		19.32192421
16	Batch 1317	Agitate	30/01/2015 13:42:07	30/01/2015 13:46:07		18.90079117
17	Batch 1317	Heat	30/01/2015 13:46:07	30/01/2015 13:55:37		72.09648132
18	Batch 1317	Dwell	30/01/2015 13:55:37	30/01/2015 14:06:37		73.08377075
19	Batch 1317	Agitate	30/01/2015 14:06:37	30/01/2015 14:08:37		71.17395782
20	Batch 1317	Cool	30/01/2015 14:08:37	30/01/2015 14:13:37		60.78569031
21	Batch 1317	XFER_OUT	30/01/2015 14:13:37	30/01/2015 14:19:37		3.42448926
22	Batch 1327		30/01/2015 13:28:07	30/01/2015 14:04:07	RE300	92.61405945
23	Batch 1327	Material Add 1	30/01/2015 13:28:07	30/01/2015 13:31:07		21.78729439

Here: the maximum temperature of child event frames *Material Add 1* and *Agitate* have been highlighted in green (12.45 and 13.08).

The second function, **Compare Events**, allows you to compare hierarchical events, in other words, events with child events. The compare events function shows attributes from both the parent event and the child event(s). In the following example maximum temperature for the complete production batch as well as for the first child event frames *Material Add 1* and *Agitate* is returned:

	A	B	C	D	E	F	G
1	. Event name	. Start time	. End time	. Primary element	. Temp.Max	.\Material Add 1 Temp.Max	.\Agitate[1] Temp.Max
2	Batch 1222	30/01/2015 12:23:07	30/01/2015 14:05:07	RE100	89.56497955	12.45047569	13.08228683
3	Batch 1247	30/01/2015 12:48:07	30/01/2015 13:49:07	RE400	113.7231445	35.76528931	43.35900879
4	Batch 1317	30/01/2015 13:18:37	30/01/2015 14:19:37	RE200	73.08377075	19.77932739	19.77932739
5	Batch 1327	30/01/2015 13:28:07	30/01/2015 14:04:07	RE300	92.61405945	21.78729439	23.9196682
6	Batch 1410	30/01/2015 14:11:07	30/01/2015 14:47:07	RE300	101.1487427	21.77057076	22.690979

Directed Activity - Creating Event Frame Reports with PI Datalink

Activity Objectives

- Learn how to import event frame data into Excel.

Problem

Management wants to answer the following questions about the downtime events:

- What is the most offending cause of downtimes?
- How much production are we losing because of downtime events?

The best way to find an answer to these questions is by creating an Excel report which imports the event frames into an Excel spreadsheet. Excel offers some useful business intelligence tools that will help us aggregate the data so management can make decisions.

Requirements

Before completing this activity, you must have already created the appropriate Event Frame template and EF Generation analysis.

Approach

We will be using PI Datalink to import the event frame information and then use Excel PowerPivot and PowerChart to analyze the downtime events.

Building the DownTime Analysis Report

For this exercise, I'll be using a template: *Press DownTime Analysis.xlsx*, located in the class\exercises folder. The template contains two sheets; I'll be importing the event frames data into the *Raw Data* sheet, which will be read from the *Report* sheet via a pivot table and a pivot chart.

Since we want to analyze the downtime events which are all based on the same EF template, we will be taking advantage of the *Explore function* in PI Datalink. Go to the *Raw Data* sheet, set the cursor into cell A2 and click on the *Explore function* in the PI Datalink ribbon



Configuring the Explore Events Function

The *Explore Events* pane will show up. This pane offers several fields for you to refine your event frames search. Moreover, it features a results preview section.

For the *Search start* and *Search end* fields point to the corresponding cells on the *Report sheet* (see figure).

Keep * for event name and element name.

Note: It is expected you will not get Event Frames that are not yet finished. To exclude Event Frames that are not finished, click on *More Search Options* and select *entirely in range* under the search mode.

Select the seven columns to display; you can as well set the column order. The columns are actually the event frame attributes. The following columns are needed for the analysis:

Make sure you selected *Event Duration* attribute (gives you the number of seconds), and **not** Duration (would give you the time in a format hh:mm:ss, such as e.g. 0:06:30).

Hit OK to display all event frame information in the *Raw Data* sheet.

	A	B	C	D	E	F	G	H
1	This sheet retrieves the event frames raw data. The "Report" sheet queries the data from this spreadsheet							
2	Event name	Start time	End time	Primary element	Event Duration	Production Loss	Reason Code	
3	Downtime PHI.Press.03 (Philly) 2017-01-08 23:37:53	08-Jan-17 23:37:53	09-Jan-17 00:23:23	PHI.Press.03	2730	9.1	Press set-up	
4	Downtime MTL.Press.03 (Montreal) 2017-01-08 23:50:53	08-Jan-17 23:50:53	09-Jan-17 00:03:53	MTL.Press.03	780	2.6	No Operator	
5	Downtime MTL.Press.01 (Montreal) 2017-01-08 23:50:53	08-Jan-17 23:50:53	09-Jan-17 00:03:53	MTL.Press.01	780	2.6	Maintenance	
6	Downtime MTL.Press.01 (Montreal) 2017-01-08 23:50:53	08-Jan-17 23:50:53	09-Jan-17 00:10:23	MTL.Press.01	1170	3.9	Maintenance	
7	Downtime PHI.Press.03 (Philly) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	PHI.Press.03	390	1.3	Maintenance	
8	Downtime MTL.Press.03 (Montreal) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	MTL.Press.03	390	1.3	Planned Maintenance	
9	Downtime HOU.Press.03 (Houston) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	HOU.Press.03	390	1.3	Planned Maintenance	
10	Downtime HOU.Press.01 (Houston) 2017-01-08 23:57:23	08-Jan-17 23:57:23	09-Jan-17 00:03:53	HOU.Press.01	390	1.3	No Operator	
11	Downtime PHI.Press.04 (Philly) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	PHI.Press.04	390	1.3	Planned Maintenance	
12	Downtime PHI.Press.03 (Philly) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	PHI.Press.03	390	1.3	Planned Maintenance	
13	Downtime MTL.Press.01 (Montreal) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	MTL.Press.01	390	1.3	Press set-up	
14	Downtime HOU.Press.04 (Houston) 2017-01-09 00:03:53	09-Jan-17 00:03:53	09-Jan-17 00:10:23	HOU.Press.04	390	1.3	No Operator	
15	Downtime PHI.Press.03 (Philly) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:23:23	PHI.Press.03	780	2.6	No Operator	
16	Downtime PHI.Press.01 (Philly) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:16:53	PHI.Press.01	390	1.3	Planned Maintenance	
17	Downtime MTL.Press.03 (Montreal) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:23:23	MTL.Press.03	780	2.6	No Operator	
18	Downtime HOU.Press.01 (Houston) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:16:53	HOU.Press.01	390	1.3	Press set-up	
19	Downtime HOU.Press.01 (Houston) 2017-01-09 00:10:23	09-Jan-17 00:10:23	09-Jan-17 00:23:23	HOU.Press.01	780	2.6	Press set-up	
20	Downtime MTL.Press.04 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:29:53	MTL.Press.04	780	2.6	No Operator	
21	Downtime MTL.Press.04 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:49:23	MTL.Press.04	1950	6.5	No Operator	
22	Downtime MTL.Press.01 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:29:53	MTL.Press.01	780	2.6	Planned Maintenance	
23	Downtime MTL.Press.01 (Montreal) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:36:23	MTL.Press.01	1170	3.9	Planned Maintenance	
24	Downtime HOU.Press.03 (Houston) 2017-01-09 00:16:53	09-Jan-17 00:16:53	09-Jan-17 00:23:23	HOU.Press.03	390	1.3	Press set-up	
25	Downtime HOU.Press.02 (Houston) 2017-01-09 00:23:23	09-Jan-17 00:23:23	09-Jan-17 00:28:23	HOU.Press.02	390	1.3	No Operator	
26	Downtime HOU.Press.01 (Houston) 2017-01-09 00:23:23	09-Jan-17 00:23:23	09-Jan-17 00:28:23	HOU.Press.01	390	1.3	Maintenance	

Just by looking at this spreadsheet, it is very difficult to identify the most offending downtime cause, or the production lost. By using an Excel tool, *Pivot tables*, we will be able to automatically extract, organize, and summarize the event frame data. PivotTables, and their graphical companions, Pivot Charts, are very versatile and easy to create. No formulas needed!

- Lesson 5: Notifications

Learning outcomes

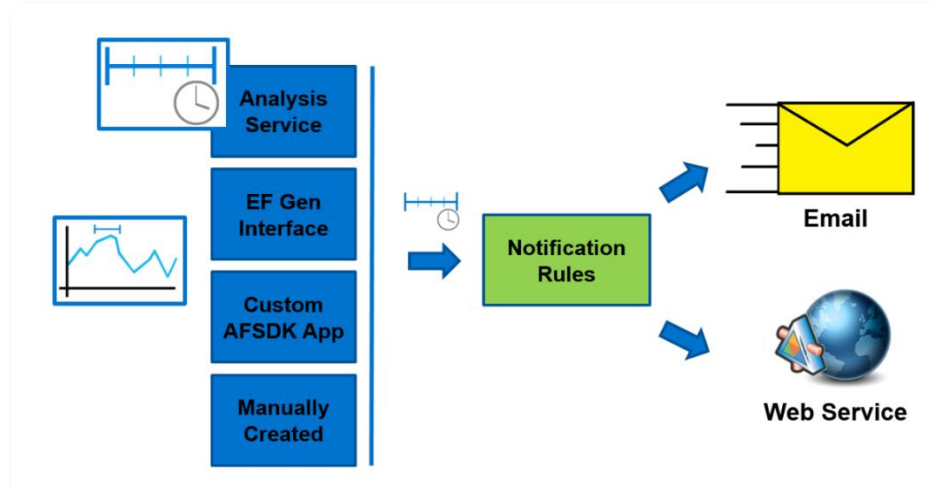
After completing this lesson, you will:

- Have a better understanding of Notifications, delivery channels and trigger criteria.
- Know how to configure dynamic endpoints and setup escalation teams.
- Installing the PI Notifications service.
- Creating a notification based on an Event Frame.
- Troubleshooting the PI Notification service with performance counters.

Introduction

Within PI System Explorer, you can configure and manage notification rules from the Notification Rules tab (visible after you select an element), and from the Management plug-in.

With AF 2016 R2, notifications are triggered when new Event Frames are generated in Asset Framework. Conditions for the trigger are defined in notification rules.



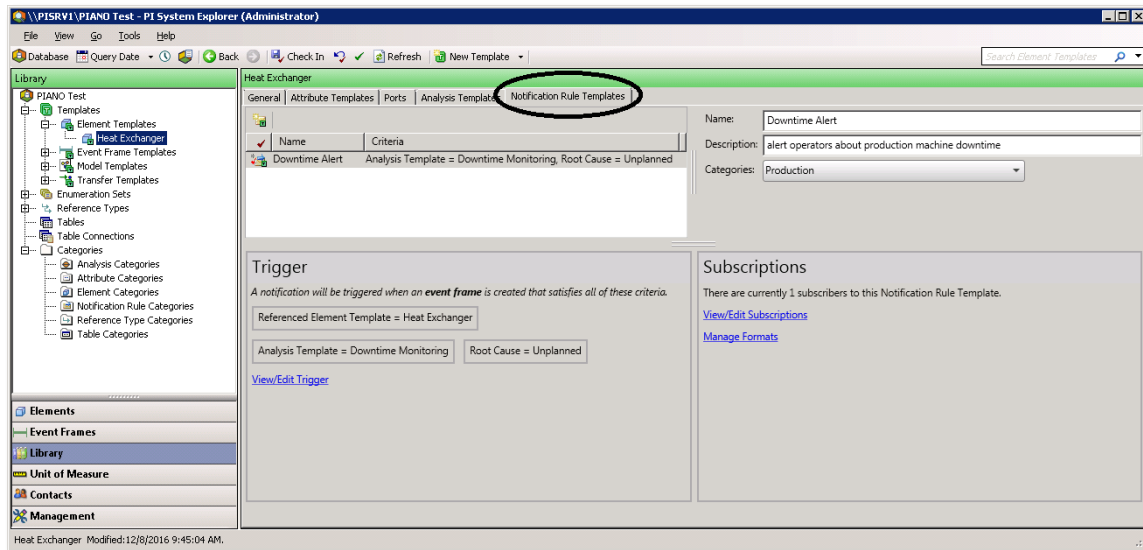
There are three components to PI Notifications:

PI Notifications Service

The PI Notifications Service processes event frames defined in the Asset Framework (AF) in real-time and sends out email and web service notifications. The service is installed from the AF Server 2016 R2 Install Kit.

Notification Rule tab (PI System Explorer)

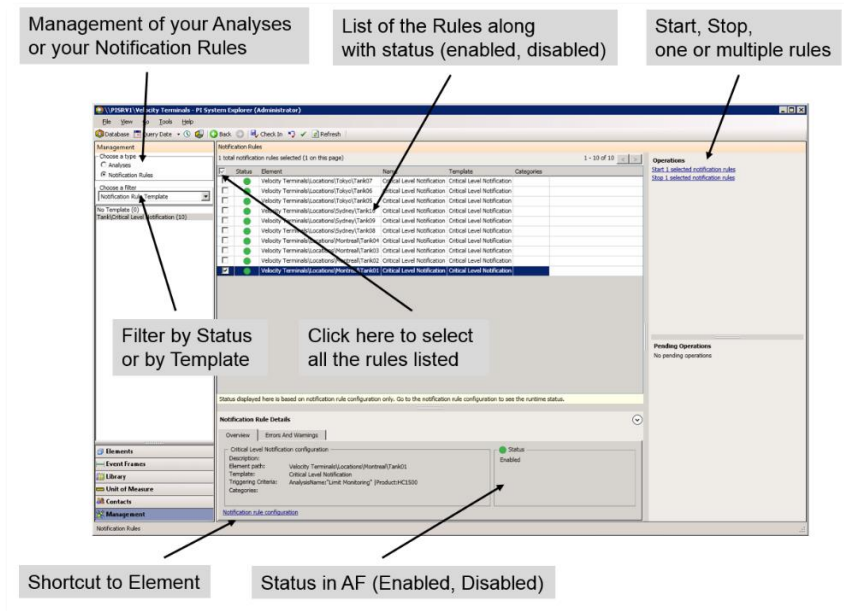
Notification Rules can be defined for individual elements or be created as a template. The User Interface for configuring notification rules in PI System Explorer is in a dedicated tab on elements and element templates:



The definition includes the trigger criteria, adding subscribers to the notification rule, and formatting the message to suit the needs of your organization. The recipients for the notifications (“subscribers”) have the option to acknowledge notifications. For situations that require actions, lack of acknowledgement can be used to trigger a resend of the notification or escalation to another subscriber.

Management Plug-In (PI System Explorer)

Allows management of analyses and notification rules on the AF Server for a particular AF database. The Management Plug-In allows for bulk management of Notification Rules e.g., enabling or disabling many notification rules at once.



Delivering Notifications – options and settings

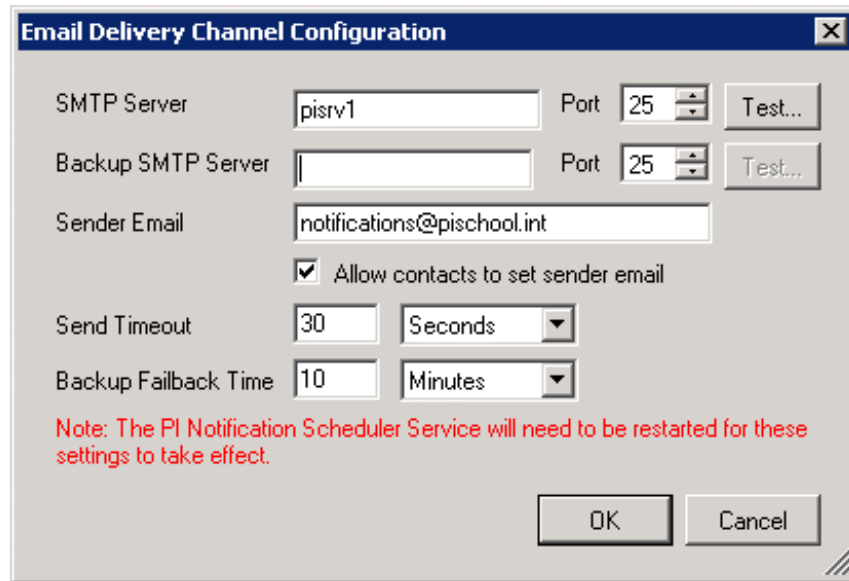
Notifications Delivery Channels provide for the mechanism by which alerts are delivered to subscribers. With the standard installation of Notifications, the following delivery channels are available:

- Email - supports sending emails with notification alerts via an SMTP Mail Server.
- Web Service - supports providing information to a web service by calling one of its methods.

Email Delivery Channel

The settings for the Email delivery channel allow you to configure the primary and backup SMTP server to relay the emails as well as the “From” email address for the alerts. The IT department should indicate which servers and ports to use for the primary and backup SMTP servers. As for the “Sender Email”, this address is not validated and can thus be set to any address desired. In most cases, the “Allow contacts to set sender email” should not be enabled.

This article contains information on how to [configure the email delivery channel](#) to be able to receive email notifications. This must be done once for each PI AF server.



The dialog box is titled "Email Delivery Channel Configuration". It contains the following fields and controls:

- SMTP Server:** A text box containing "pisrv1".
- Port:** A spinner box set to "25".
- Test...:** A button next to the Port field.
- Backup SMTP Server:** An empty text box.
- Port:** A spinner box set to "25".
- Test...:** A button next to the Port field.
- Sender Email:** A text box containing "notifications@pischool.int".
- Allow contacts to set sender email:** A checked checkbox.
- Send Timeout:** A text box containing "30" and a dropdown menu set to "Seconds".
- Backup Failback Time:** A text box containing "10" and a dropdown menu set to "Minutes".
- Note:** A red text line stating "Note: The PI Notification Scheduler Service will need to be restarted for these settings to take effect."
- OK:** A button at the bottom right.
- Cancel:** A button at the bottom right.

Once the email delivery channel is setup, most email addresses should be provided by **Active Directory** (AD). AD Groups are supported as well.

AD access is configured separately from PSE > File > Server Properties > Configure Active Directory Access for Contacts. Please see the '[Configure Active Directory access for contacts](#)' article for more details. If the AD does not include all email addresses needed, it will be possible to create additional emails and groups within the Contacts section of PI System Explorer.

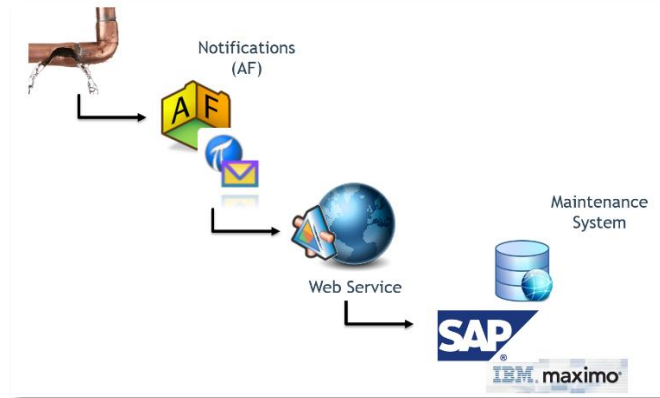
Web Service Delivery Channel

The web service delivery channel allows Notifications to contact and provide information to a web service by calling one of its methods. To use this delivery channel, a web service must thus be available on a web server.

There are many web services commercially available, and many development environments offer templates and other tools to develop custom Web services.

Notifications can use either SOAP or REST APIs to contact web services. Check out the following links for additional documentation on configuration: [REST](#), [SOAP](#).

Example: A custom Web Service could process the received information and generate corresponding work orders in a customer Maintenance System:



Trigger criteria for Notifications

Configuring a notification rule includes specifying the trigger criteria, adding subscribers to the notification rule, and formatting the message to suit the needs of your organization.

1. Select the element or element template on which Notification Rule will be created
2. Create a new Notification Rule:
 - a) Define the notification trigger conditions
 - b) Format the Notification message
 - c) Add the subscribers
3. Test the Notification

who will receive the notification?

Which conditions will trigger the notification?

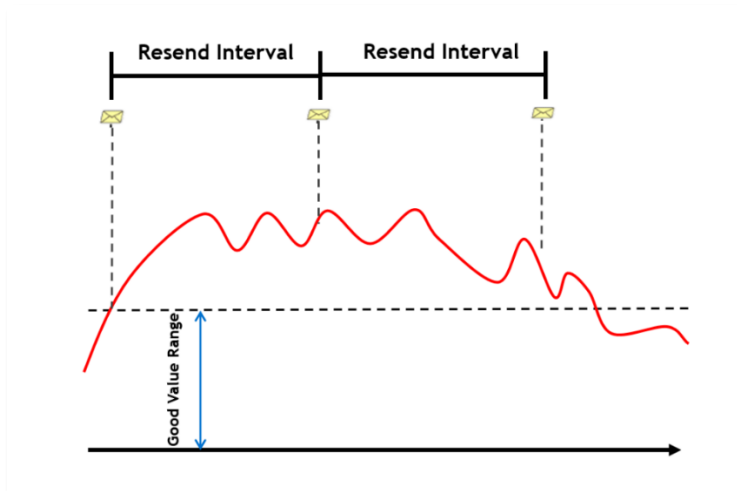
what information is included in the notification message?

When the Trigger Criteria are defined, the following options can be set:

Options	
Resend Interval: <input type="text" value="0"/> Seconds	Choose when to be notified if child event frames are created for multiple trigger conditions <input checked="" type="radio"/> When the severity is higher than any previously true trigger condition <input type="radio"/> When the severity is higher than the previous true trigger condition <input type="radio"/> When any trigger condition is true
Non-repetition Interval: <input type="text" value="0"/> Seconds	
<input checked="" type="checkbox"/> Event Frame can be acknowledged	

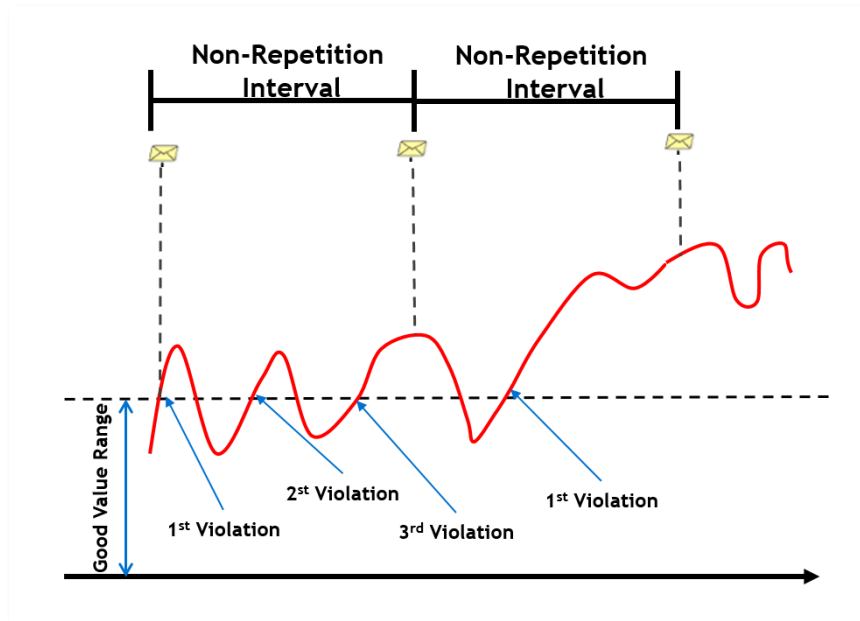
Resend Interval

The time interval after which PI Notifications Service will send additional alerts until the event frame matching the notification rule is acknowledged or closed.



Non-Repetition Interval

The time interval during which PI Notifications Service will not send similar alerts associated with the same notification rule.



Event Frame Can be acknowledged

Option to enable event frame to be acknowledged; the event frame template is also modified accordingly. This option is automatically selected if the event frame template has been configured for acknowledgement.

Severity Option

This option applies only to event frame generation analyses. If you have configured multiple start triggers for your analysis, you may choose to be notified in these ways:

- When the current trigger severity is higher than any trigger severity encountered so far.
- When the current trigger severity is higher than the previous trigger severity.
- Every time a trigger condition is true, regardless of its relative severity to other previous triggers.

Choose when to be notified if child event frames are created for multiple trigger conditions

- ☒ When the severity is higher than any previously true trigger condition
- ☐ When the severity is higher than the previous true trigger condition
- ☐ When any trigger condition is true

Dynamic endpoints

In PI AF 2017 R2, you can configure an email delivery endpoint as a value of an attribute. This provides an additional flexibility in situations where notification emails can be sent to different recipients without making changes to the notification rule template. To configure a dynamic email delivery endpoint and add an email subscriber to your notification rule, follow this procedure.

For a conventional email delivery endpoint configuration, see [Configure an email delivery endpoint](#).

Configure a dynamic email delivery endpoint

1. Navigate to the element that you want to receive the notifications from and add an attribute with your email address as a value. The value of this attribute must be a string. You can enter multiple email addresses delimited by comma.
2. Navigate to **Notification Rules** tab to configure and add an email delivery endpoint as a subscriber to your notification rule.
 - a. Click **View/Edit subscriptions** in the Subscriptions pane of the notification rule.
 - b. Click **Create a new dynamic endpoint** under **Dynamic Endpoints**.
 - c. Select an email attribute configured in step 1.
 - d. Click **Create**.
 - e. Drag and drop the configured contact from the Contacts to the Subscriptions pane.
 - f. Click **OK**.
3. Go to **Contacts** plug-in to edit or delete a configured delivery endpoint. It will be found in **Delivery Endpoints** folder.


Notification groups and escalation teams

You can set up an escalation structure to ensure that the right people are notified with the right information, and in the right order.


In the PI System, an **escalation team** is an ordered collection of delivery endpoints. When a notification is not acknowledged for a specified period of time, notification




messages are sent sequentially to members of the escalation team. An escalation team can contain other groups.

Create a group

1. Right-click the **Groups** folder and click **New Group**.
2. In the **Name** field, enter a unique name for the group.
3. Choose from the following actions:
 - a. Click  and, in the Select a Contact window, locate a contact with a new search, or select another group, an escalation team, or a delivery endpoint, and click **OK**. Repeat as needed.
 - b. In the Contacts palette, locate a contact with a new search, or select another group, an escalation team, or a delivery endpoint, and drag it onto the viewer. Repeat as needed.
4. Set notification contact options for the group.
 - a. Right-click each subscriber delivery endpoint, click **Options**, and enter notification contact options in the **Retry interval** and **Maximum Retries** fields.
 - b. If escalation teams are included in a group, right-click each escalation team, click **Options**, and enter notification contact options in the **Escalation period** and select an **If not acknowledged** option.

Create an escalation team

1. Right-click the **Escalation Teams** folder and click **New Escalation Team**.
2. In the **Name** field, enter a unique name for the escalation team.
3. In **Escalation period**, specify how long you want an escalation to last.
4. In **If not acknowledged**, specify the action to be taken if the notification is not acknowledged after being sent to all contacts in a team:
 - a. To stop the escalation process, select **End escalation**.
 - b. To repeat the escalation process for a specified number of times until the notification closes or is acknowledged, select **Repeat N times**.
 - c. To repeat the escalation process indefinitely until the notification closes or is acknowledged, select **Repeat while active**.
5. Choose from the following actions:
 - a. Click  and, in the Select a Contact window, locate a contact with a new search, or select another group, or a delivery endpoint, and click **OK**.

- b. In the Contacts palette, locate a contact with a new search, or select another group, or a delivery endpoint, and drag it onto the viewer.
6. Configure the sequence for the escalation chain.
 - a. Click a subscriber and click  and  to position as needed.
 - b. To remove a subscriber, click the subscriber to be removed and click .

Look at this [Learning Library article](#) for more information on:

- editing an existing contact,
- creating a custom contact that is not already in Active Directory,
- creating a delivery endpoint, such as a stand-alone email or a web service.

Installing the PI Notifications services

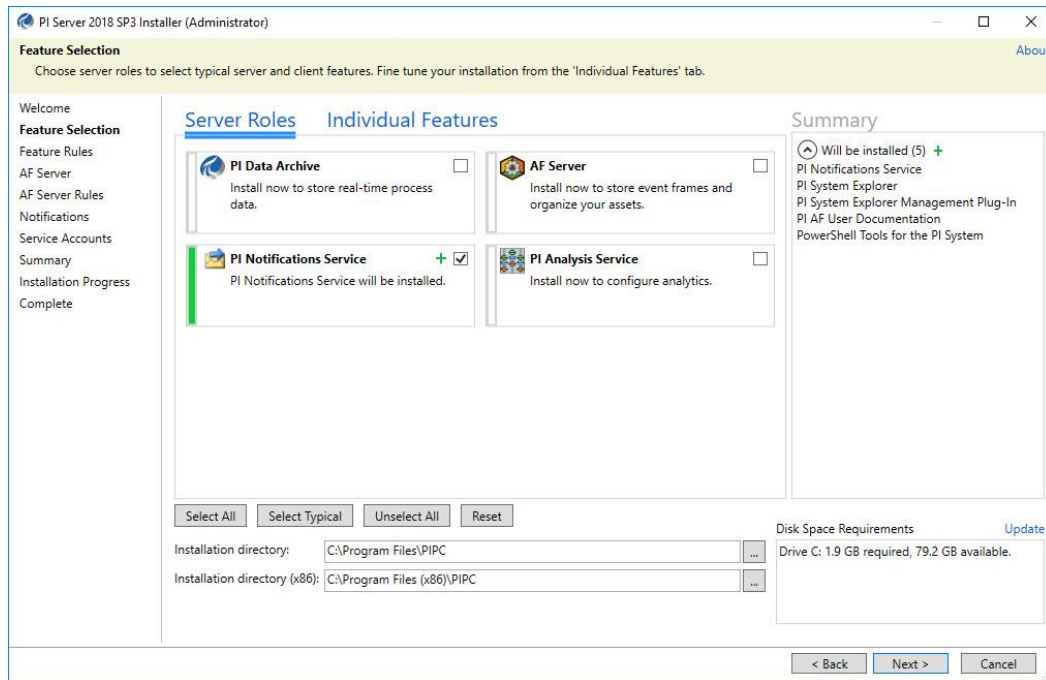
Use the PI Server install kit to install PI Notifications Service. This section provides details specifically on installing the PI Notifications Service through the install kit.

Before you start:

- Ensure that the computer on which you are installing PI Notifications Service meets all the system requirements. See [System requirements for PI Notifications Service](#).
- Install the PI AF server. A connection is required to PI AF Server to complete the installation. OSIsoft recommends adding additional PI Server individual features after PI AF server has been fully setup.

Process:

1. Go to the directory where you downloaded the PI Server install kit and double-click the setup file to launch the installation. The Welcome window appears.
2. Click Next. The Feature Selection window appears.



The PI Server install kit provides a simple and easy-to-use UI that provides selectable Server Roles to choose from for your installation. These Server Roles automatically select the PI components necessary to install a typical deployment of the PI Server feature you select. Alternatively, you can click the Individual Features tab to manually select and customize your installation of any PI Server feature(s) to meet your deployment requirements.

3. In the Server Roles tab, select PI Notifications Service. A list of components to be installed is displayed in the Summary panel.
4. Click Next - The AF Server window appears.
5. Enter the PI AF server name to associate with the PI Notifications Service.
6. Click Next to proceed with the setup. The Notifications window appears.
7. Specify the SMTP Server with port number, Backup SMTP Server with port number and From Email Address to configure for PI Notifications Service.
8. Click on the Use TLS checkboxes to enable TLS encryption for the SMTP server or backup SMTP server connection. Specify the PI Vision Server URL address to integrate PI Notifications Service with PI Vision.
9. Click Next to proceed with the setup. The Service Accounts window appears.
10. Specify the service account for PI Notifications Service. Select the default account NT SERVICE\PINotificationsService or specify a different service

account. If the AF Server is remote to the PI Notifications service, then you must use a domain account or a Managed Service Account because the service account credentials will be mapped to the Notifications identity on the AF Server. If your computer is in a Workgroup the installation must be run silently and additional steps might be necessary to guarantee that the PI Notifications Service has access to AF Server. Since the PI Notifications Service also needs read access to PI Points, a domain account or Managed Service Account may also be desired for configuring Windows integrated security in the Data Archive.

11. Click Next to proceed with the setup. The Summary window appears, listing the selected features and version numbers scheduled for the installation.
12. Click Install. The Installation Progress window opens. The Complete window opens when the installation is complete. **Note:** If you cancel the installation before it is complete, the PI AF SQL database might have already been created and you will need to remove the database manually.
13. Click Close.

To enable high availability for PI Notifications Service, you must install the service in each node of a failover cluster. More information can be found in [this article](#).

Account permissions for the PI Notification service

The account that PI Notifications Service uses requires read access to the PI point database (PIPOINT) on each **Data Archive** server that the service accesses. The PI Notifications Service account also requires specific permissions to **PI AF objects and local directories**.

Configure Data Archive access for PI Notifications Service

1. Use PI SMT to grant the PI Notifications Service account read access to the PIPOINT database on any Data Archive to which PI Notifications Service requires access:
 - a) Create a new PI identity (Security > Identities, Users, & Groups).
 - b) Give the identity read access to the PIPOINT database (Security > Database Security). For more information on access permissions for PI points, see the PI SMT topic PI point access permissions [article](#).

- c) Create a mapping between the PI identity and the account that runs the service (Security > Mappings and Trusts). If you are using the virtual account, you will need to use the PI AF server machine's computer account to create the mapping. See also the Microsoft article [Understanding Computer Accounts](#).

After you grant the PI Notifications Service account access to the PIPOINT database, the service will, by default, have the necessary access to all points subsequently created on that Data Archive server.

2. For any pre-existing points that you will use for notifications, make sure that the PI Notifications Service account has the following access permissions:

PtSecurity	(r)
DataSecurity	(r)

You can use PI SMT or PI Builder to configure the point access for PI Notifications Service.

PI AF object and local machine permissions for PI Notifications Service

The PI Notifications Service setup process using the PI Server install kit creates the PI AF identity Notifications, maps the PI Notifications Service account to that identity, and grants that identity the PI AF object permissions shown in the following tables. The setup process also grants the PI Notifications Service account permission to access the local machine directory.

- If an account has administration privileges on the PI AF server, then the account has all security rights to all objects within the PI AF server, including all databases. This is true whether the account is granted or denied specific rights on individual objects.
- If you change the PI Notifications Service log on account after installation, you must make sure the new user has permissions to access necessary AF objects. The easiest way to do this is to add a mapping for the user to the Notifications identity in the PI AF Server. The sections below describe the necessary permissions in detail.

PI AF Object	Permissions
---------------------	--------------------

PI AF server and children ¹	Read/Write, Read/Write Data
Event Frames	Read/Write, Read/Write Data, Annotate

¹ Children of PI AF server include but are not limited to database, elements, element templates, notification rules, enumeration sets, contacts, and categories.

Local Machine Directory	Permissions
%ProgramData%\OSIsoft\PINotifications	Read, Write, Modify

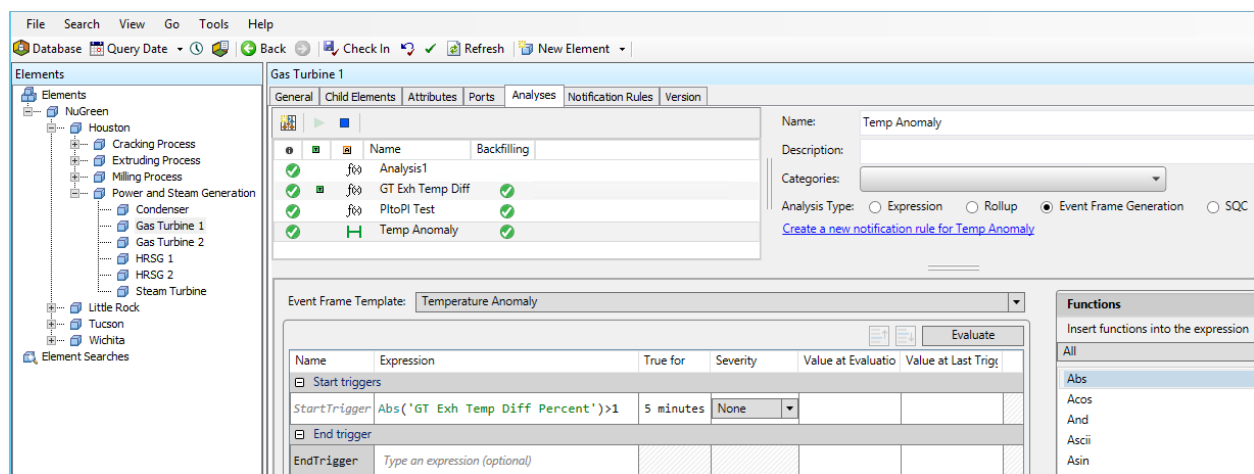
Create a notification based on an Event Frame

If you have already configured analyses to detect anomalies in your PI AF asset data, or you wish to configure such analyses, follow this procedure to configure notification rules on configured analyses.

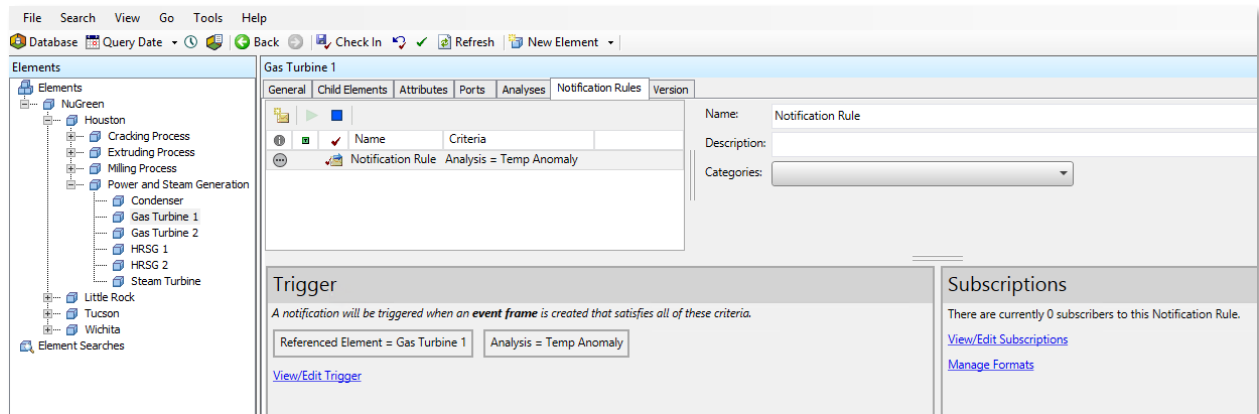
If you want to configure notification rules to trigger on event frames from sources like event frame interfaces or custom applications, see [Configure notification rules for user-defined event frames](#).

Configure notification rules from analyses

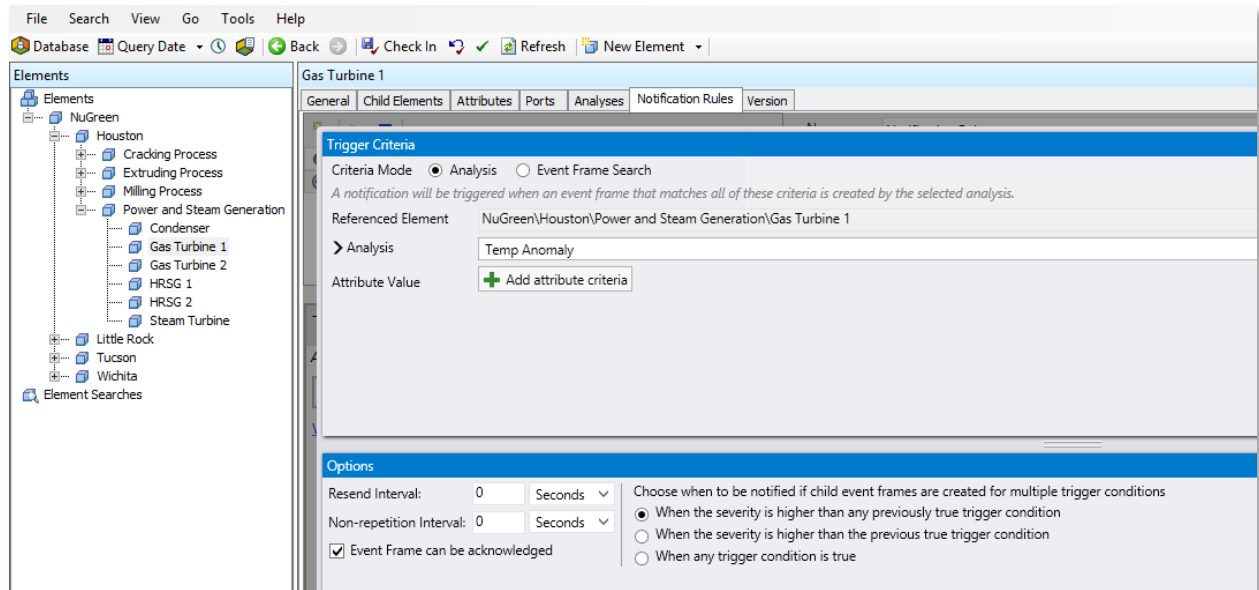
1. Select the existing event frame generation analysis for which you want to create a notification rule.



2. Click **Create a new notification rule for the selected analysis**. You see the **Notifications Rules** tab highlighted, as well as the options to configure a notification rule with the default name "Notification Rule".



3. Edit the created notification rule.
 - a. Provide one or more of the specified criteria; some of your criteria may be pre-selected from your analysis. The notification rule is triggered when all criteria are satisfied. You should change the name of the notification rule from the default, add a suitable description, and select a suitable category.
 - b. Selecting a category aids in organizing and searching for your notification rules.
4. Click **View/Edit Trigger** - The Trigger Criteria pane allows you to configure either of these trigger criteria modes: **Analysis** or **Event Frame Search**. Make sure that the **Analysis** criteria mode is selected.
5. *Steps 5-7 are optional depending on your goals, the information provided here is for your reference:* Configure options in the Trigger Criteria pane.
 - a. You see the details of the selected analysis such as the event frame template name, the start and end triggers, and so on.
 - b. You can configure a new analysis of type **Event Frame Generation** or **SQC**. When you choose to create a new analysis with either the default or a custom name, you see the same analysis creation window as from the **Analyses** tab of PI System Explorer.
 - c. For more information, see [Trigger criteria in notification rules](#).

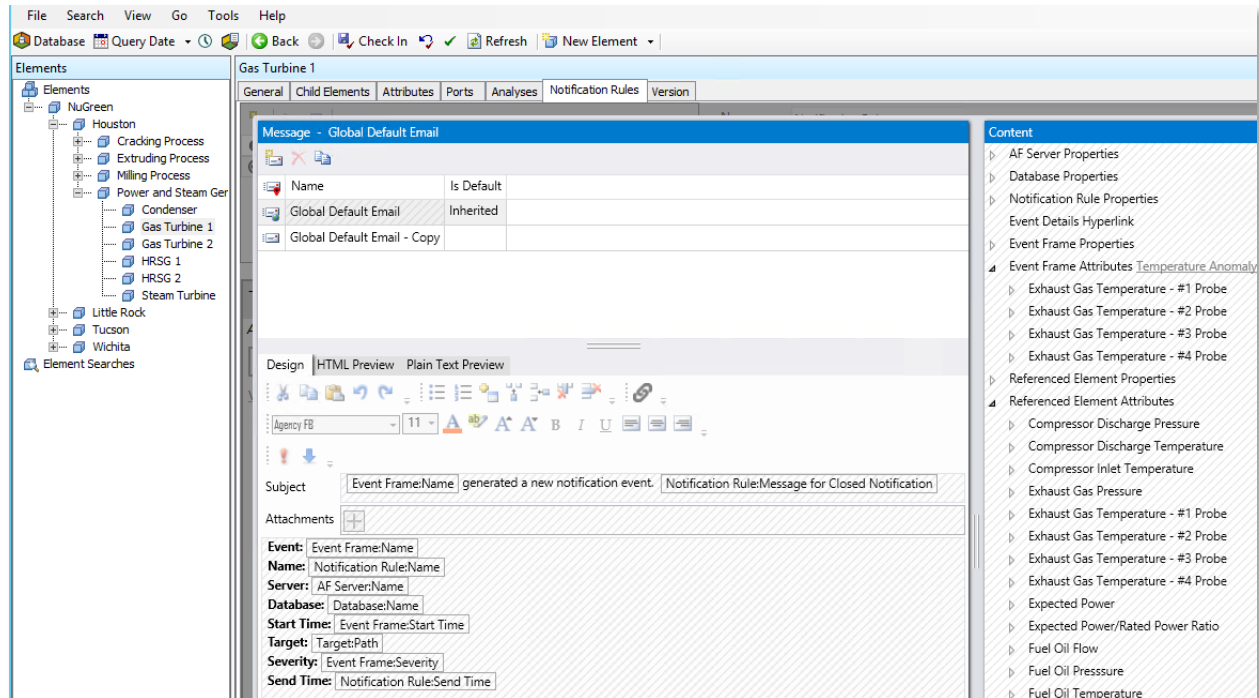




6. Configure options in the Options pane.


- a. Optional. **Resend Interval.** Select the time interval at which PI Notifications Service will send additional alerts if the event frame matching the notification rule is not acknowledged or closed. For more information, see [Resend Interval in notification rules](#).
 - b. Optional. **Non-repetition Interval.** Select the time interval for which PI Notifications Service will not send similar alerts associated with the same notification rule. For more information, see [Non-Repetition Interval in notification rules](#).
 - c. **Event Frame Can Be Acknowledged.** This option is automatically selected if the event frame template has been configured for acknowledgment.
 - d. Optional. Options based on multiple start triggers. If you have configured multiple start triggers for your analysis, choose between the options of being notified (a) when the current trigger severity is higher than any trigger severity encountered so far, (b) when the current trigger severity is higher than the previous trigger severity, or (c) every time a trigger condition is true, regardless of its relative severity to other previous triggers.
7. Optional. To configure the email format, click **Manage Formats** in the Subscriptions pane. You see the Message and Content panes. By default, the notifications feature uses the Global Default Email format for each

subscriber. For more information, see [Delivery formats in notification rules](#).

Note: If the Content pane has a message indicating that your selected format is "read-only", you must first add a new format before you can customize it.

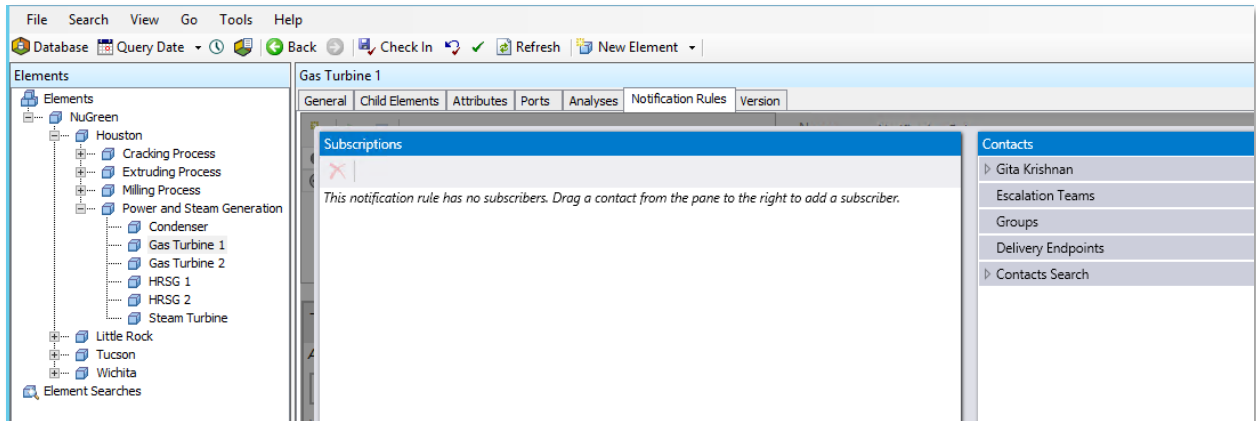


8. Optional. To create a custom delivery email format, copy the default **Global Default Email** format by clicking on the copy icon  in the Message pane. Alternatively, you can create a new delivery format by clicking the new delivery format icon . The default format includes basic notification information such as the notification rule name, trigger time and event frame start time, as well as system information such as system and database names. To add more information to your custom format, drag and drop information from the Content pane to the Message pane. You can designate your custom format as the default by clicking the **Is Default** box in the Message pane.

a. Alternatively: To create a custom delivery email format, copy the system-provided, default **Global Default Email** format by clicking on the copy icon  in the Message pane (for more details on global email formats see [Delivery formats in notification rules](#))

9. Click **View/edit subscriptions** in the Subscriptions pane. You can search for contacts using **Contacts Search** in the Contacts pane. To add a subscriber,

drag and drop a specific contact from the Contacts pane to the Subscriptions pane. Make sure to select your customized email format if you have created one, or pick the Global Default Email format. For more information, see [Subscriptions in notification rules](#).



10.Optional. Configure escalation teams.

- a. You can configure members of escalation teams from the Contacts plug-in on PI System Explorer, as described in [Manage contacts](#). The escalation team contacts, or groups will be notified one by one at the end of time segments specified in **Escalation period**. You can also control the frequency of the escalation notification.
- b. **Note:** Escalations are triggered on event frame templates that can be acknowledged. Open the **Library** plug-in on PI System Explorer, select your event frame template and verify that the **Event Frame Can Be Acknowledged** check box is selected.

11.Check in the notification rule - When the event of interest occurs, an email will be sent to the subscriber's mailbox. The email shows the event frame that triggered the notification rule with customized details that you have configured.

To manage your notification rules, use the **Management** plug-in on PI System Explorer. See [Management of notification rules](#).

Troubleshooting the PI Notifications Service

1. Configure logging for the PI Notifications Service

Notifications message logs contain useful information to troubleshoot issues with PI Notifications Service. Adjusting the severity level and verbosity of message logs can assist with identifying issues more easily and better troubleshooting.

At the end of installation, the notifications folder (*%PIHOME64%\Notifications* or *<Drive name>:\Program Files\PIPC\Notifications*) contains the:

- PINotifications.exe.config file for each process and
- the Notifications.UserNLog.config file for NLog configuration, a popular logging tool for [troubleshooting](#).


Caution: Increasing the debug level from the default can flood the logs and decrease performance. Do not leave the debug level higher than the default for longer than necessary.

%programdata%\OSIsoft\PINotifications\Logs is the default directory that the logs are written to. More information on configuring logging can be found [here](#).

2. Access Performance Counters

The PI Notifications Service has performance counters for monitoring the status of notification rules.

To gather statistics around PI Notifications service, use Windows performance counters. You can view and access available performance counters with the Windows Performance Monitor.

1. On the Windows system hosting the service, click **Control Panel > System and Security > Administrative Tools**. A list of administrative tools are listed.
2. Double-click **Performance Monitor** to open Windows Performance Monitor.
3. Expand **Monitoring Tools** and click on **Performance Monitor** in the navigation panel on the left.
4. Click the  button. The **Add Counters** window appears.
5. In the **Available counters** panel, expand **PI Notifications Service**. The list of PI Notifications Service performance counters is here.

For a full list of the available counters explained, have a look at [this article](#).

- Next Steps

Thank you for taking this course!

Continue learning with our self-paced courses on the Asset Framework:

- [Configuring Analytics with PI AF](#)
 - Learn how to create different types of asset analytics to gain more insight into your data. Using Asset Framework (AF), we will explore a range of analyses including expressions with multi-line calculations, roll-ups for aggregate attributes, event frames to capture important events in your process, and notifications to trigger alerts based on the real-time changes in your asset.
- [Asset Maintenance: Using a Layered Approach](#)
 - We walk through scenarios to illustrate the use of process data and machine condition data and a layered approach to maintenance via usage-based, condition-based and predictive maintenance. Data sources include traditional plant instrumentation such as PLCs and SCADA, the newer IoT devices, and from machine condition monitoring such as vibration, oil analysis etc. In this lab will also discuss predictive maintenance use cases that require advanced analytics, including machine learning, such as APR (advanced pattern recognition), anomaly detection, and others.
- [Easy Wins to Improve your Asset Framework Experience](#)
 - Best practices and hands-on exercises on how to get started with Asset Framework (AF) and Asset Analytics. The course will cover setting the scope and modelling accordingly, dealing with asset variations and tag naming conventions, integrating external data in AF, building well-configured AF analyses and propagating changes between separate environments (test-to-production or central-to-local systems).