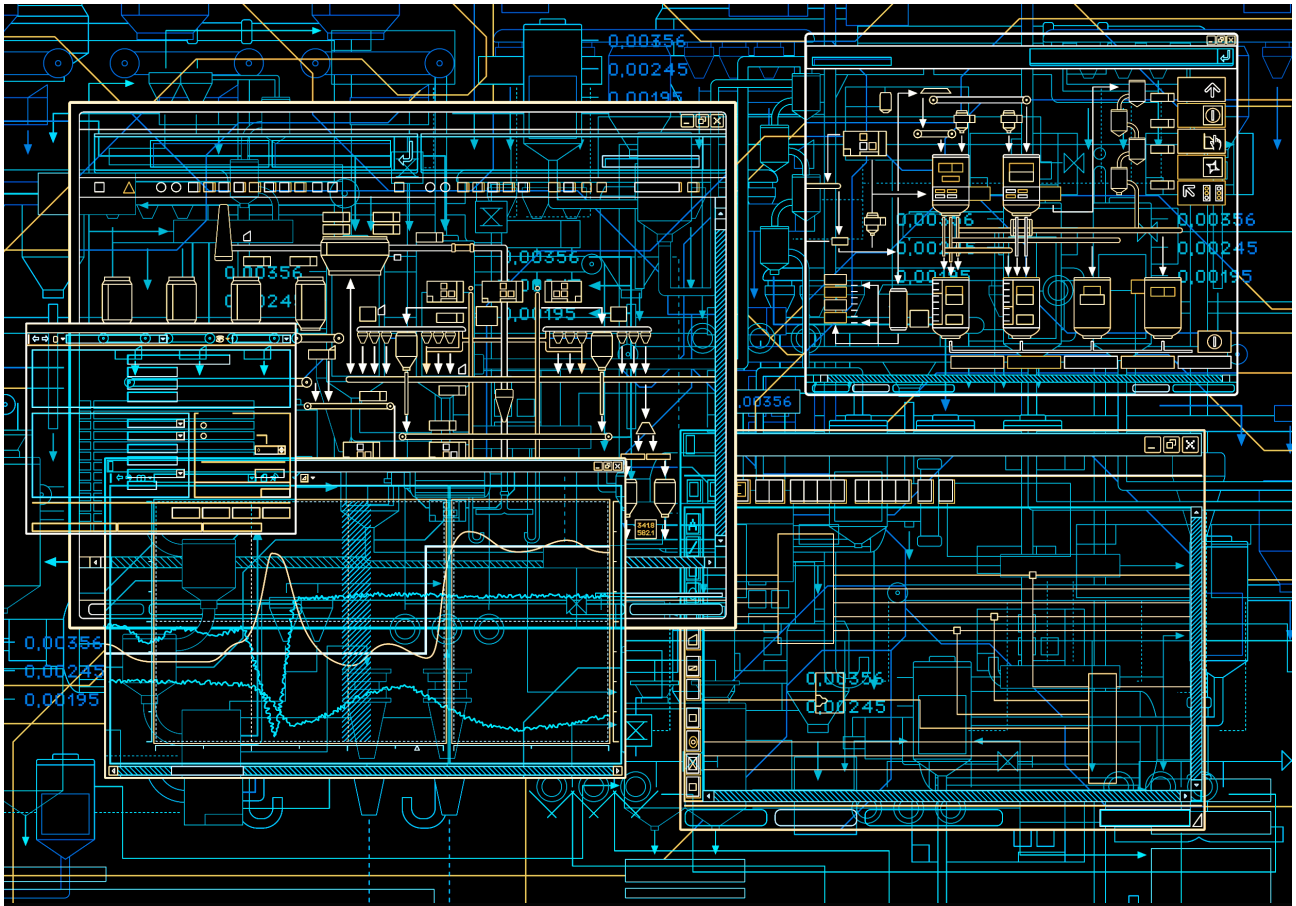

System 800xA Asset Optimization

Operation

System Version 6.0

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System 800xA Asset Optimization

Operation

System Version 6.0

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TRADEMARKS

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Table of Contents

About This User Manual

General 11
User Manual Conventions 11
Warning, Caution, Information, and Tip Icons 11
Documentation of Third Party Software 12
Terminology....12
Released User Manuals and Release Notes....13

Section 1 - Introduction

Product Overview 15
Product Scope....15

Section 2 - Maintenance Workplace and Asset Structure

Introduction 19
Launching the Maintenance Workplace 19
Maintenance Workplace 19
Maintenance Workplace 2 22
Navigation Flow 24
Asset Viewer View 25
Aspect List 26
Asset Reporter View....26
Asset Condition Details View 26
Link to AO Server 26
Maintenance Filter....27

Section 3 - Condition Reporting and Monitoring

Introduction 29
Asset Viewer 29
Asset Reporter 36
Condition Details, Asset Monitor Status, and Diagnostics Link 39
Fault Report Viewer 41
Asset Monitor Properties 42
AM Engine Properties 44

Section 4 - AO Server Operation

Introduction 47
Asset Optimization Event Log 47
All Asset Condition Alarms List 48
All Asset Monitoring Status Alarms List 49
All Asset Optimization Alarms List 49
Asset Optimization Server 50
    AO Server Tab 50
    Asset Monitors Tab 51
    Runtime Statistics Tab 52

Section 5 - Condition Event Handling

Introduction 57
Submitting Fault Reports 57
Creating and Submitting Fault Reports 61
Alarm and Event List Operation 63
CMMS Views For Maximo Integration 65
    Active Work Orders View 66
    Work Order History View 68
    Equipment Status View 69
    Preventive Maintenance Schedule View 69
    Spare Parts/Availability of Spare Parts Views 70
CMMS Views For SAP/PM Integration 71
    Active Work Orders View 71

Work Order History View 74
Equipment Status View 75
Preventive Maintenance Schedule View 76

Section 6 - Web-Enabled Views

Operation 77

Section 7 - Faceplates

Introduction 79
Runtime Faceplate 79
Generic Counter Check Faceplate 82

Section 8 - Control Loop Asset Monitor (CLAM)

Introduction 85
Running the Control Loop Asset Monitor 86
Basic Loop Monitoring Mode (Unlicensed) 86
Enhanced Control Loop Monitoring Mode (Licensed mode) 92
Operation 97
Final Control Element Summary 98
Loop Performance Summary 99
Performance indices 100
Input Data Plots 107
Alarm List for Loops 109
CLAM Diagnostics 110
Final Control Element Diagnostics 111
Loop Performance Diagnostics 113

Section 9 - Heat Exchanger Asset Monitor (HXAM)

Introduction 117
Objective 118
Terminology 119
Generic Heat Exchanger Asset Monitor (HXAM-G) 119
Description 119

Methodology 121
Generic Heat Exchanger Asset Monitor Operation 124
HXAM_G_Faceplate 125
Trends and Logs 142
History Source 142
Log Template 142
Log Configuration 142
Trend Template 143
Trend Display 144
Asset Monitor Properties 144
Log File Description (.csv file) 144
Shell and Tube Heat Exchanger Asset Monitor (HXAM-ST) 148
Description 148
Methodology 150
Shell and Tube Heat Exchanger Asset Monitor Operation 154
HXAM_ST_Faceplate 155
Trends and Logs 177
History Source 178
Log Template 178
Log Configuration 178
Trend Template 180
Trend Display 180
Asset Monitor Properties 180
Log File Description (.csv file) 180

Section 10 - Asset Optimization Reporting

Introduction 185
AO Asset Condition History Report 186
AO Running Time Report 186
Working with Asset Optimization Reports 186

Appendix A - Heat Exchanger Specific Terminology

Heat Exchanger Specific Terminology 191

Revision History

Updates in Revision Index A 195

Index

About This User Manual

General

Any security measures described in this User Manual, for example, for user access, password security, network security, firewalls, virus protection, etc., represent possible steps that a user of an 800xA System may want to consider based on a risk assessment for a particular application and installation. This risk assessment, as well as the proper implementation, configuration, installation, operation, administration, and maintenance of all relevant security related equipment, software, and procedures, are the responsibility of the user of the 800xA System.

This User Manual describes operational activities for Asset Optimization Asset Monitoring, Maximo Integration, SAP/Plant Management (SAP/PM) Integration, Calibration Integration as an engineered solution, Control Loop Asset Monitor (CLAM), Generic (HXAM-G), and Shell and Tube (HXAM-ST) Heat Exchanger Asset Monitors. This product functionality consists of system extensions to the 800xA Base System.

User Manual Conventions

Microsoft Windows conventions are normally used for the standard presentation of material when entering text, key sequences, prompts, messages, menu items, screen elements, etc.

Warning, Caution, Information, and Tip Icons

This User Manual includes Warning, Caution, and Information where appropriate to point out safety related or other important information. It also includes Tip to point

out useful hints to the reader. The corresponding symbols should be interpreted as follows:

Electrical warning icon indicates the presence of a hazard that could result in *electrical shock.*

Warning icon indicates the presence of a hazard that could result in *personal injury.*

Caution icon indicates important information or warning related to the concept discussed in the text. It might indicate the presence of a hazard that could result in *corruption of software or damage to equipment/property.*

Information icon alerts the reader to pertinent facts and conditions.

Tip icon indicates advice on, for example, how to design your project or how to use a certain function

Although Warning hazards are related to personal injury, and Caution hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, fully comply with all Warning and Caution notices.

Documentation of Third Party Software

This User Manual describes third party software to the extent that it applies to Asset Optimization. Specific information relating to the installation, setup, configuration, and operation of third party software can be found in the manufacturer's documentation.

Terminology

A complete and comprehensive list of terms is included in *System 800xA System Guide Functional Description (3BSE038018*).* The listing includes terms and definitions that apply to the 800xA System where the usage is different from commonly accepted industry standard definitions and definitions given in standard dictionaries such as Webster's Dictionary of Computer Terms.

Released User Manuals and Release Notes

A complete list of all User Manuals and Release Notes applicable to System 800xA is provided in *System 800xA Released User Manuals and Release Notes (3BUA000263*)*.

System 800xA Released User Manuals and Release Notes (3BUA000263)* is updated each time a document is updated or a new document is released. It is in pdf format and is provided in the following ways:

- Included on the documentation media provided with the system and published to ABB SolutionsBank when released as part of a major or minor release, Service Pack, Feature Pack, or System Revision.
- Published to ABB SolutionsBank when a User Manual or Release Note is updated in between any of the release cycles listed in the first bullet.

A product bulletin is published each time *System 800xA Released User Manuals and Release Notes (3BUA000263*)* is updated and published to ABB SolutionsBank.

Section 1 Introduction

Product Overview

System 800xA - Asset Optimization consists of system extensions to the 800xA Base System. Asset Optimization functionality includes Asset Condition Reporting, Asset Monitoring, CMMS (Computerized Maintenance Management System) Integration, and a separate engineered solution for calibration integration to the 800xA System. This optimizes the use of plant equipment and processes. When integrated with SMS and e-mail Messaging, Asset Optimization provides a method of sending messages based on alarm and event information through SMS and e-mail.

When integrated with Device Management FOUNDATION Fieldbus or Device Management PROFIBUS & HART, Asset Optimization provides a method to detect and notify problems with field devices.

Product Scope

The Asset Optimization software provides for the following functionality:

- Maintenance Workplace and Asset Structure.
- Asset Health Condition Reporting.
  - Asset Viewer.
  - Asset Reporter.
- Asset Monitoring.
  - Basic Asset Monitors.

  - Process Asset Monitors (includes Control Loop Asset Monitor (CLAM), Heat Exchanger Asset Monitor - Shell and Tube (HXAM - ST), and Heat Exchanger Asset Monitor - Generic (HXAM - G).

The Control Loop Asset Monitor (CLAM) has two licensing modes: Enhanced Control Loop Monitoring mode (licensed) and Basic Control Loop Monitoring mode (unlicensed).

  - System Status Asset Monitor.
  - HART Asset Monitoring.
  - Device Management FOUNDATION Fieldbus Asset Monitoring.
  - PROFIBUS Asset Monitoring.

- Seamless Interaction Between Process and Maintenance.
  - Maximo Integration.
  - SAP/PM Integration.
- Asset Optimization Reporting.

Figure 1 shows the interaction between the various functional components of Asset Optimization.

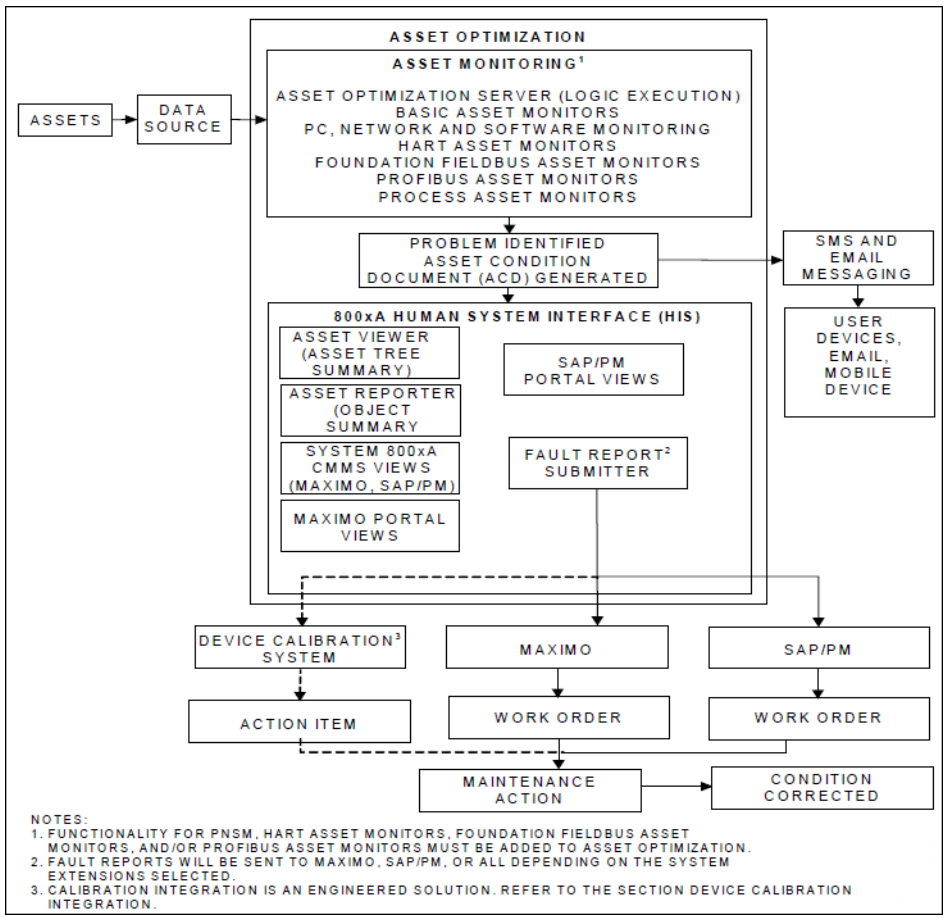

Figure 1. Asset Optimization Functionality

Section 2 Maintenance Workplace and Asset Structure

Introduction

Asset Optimization information can be accessed from any workplace in the 800xA System. The Maintenance Workplace is a default workplace for maintenance personnel. It is a Plant Explorer Workplace with an Alarm Band that shows Asset Monitoring Alarms for default Asset groups.

The Asset Structure provides maintenance personal with a way to group and arrange plant assets for efficient daily work. Control topology constraints can be overcome and even devices with different fieldbus protocols can be grouped together if they require similar maintenance procedures.

The Asset Structure comes by default with five major groups of assets:

- Drives.
- Field Instruments.
- IT Assets.
- Motors.
- Process Equipment.

Launching the Maintenance Workplace

To launch the Maintenance Workplace, double click on the Maintenance Workplace or Maintenance Workplace 2 icon on the desktop.

Maintenance Workplace

The Maintenance Workplace is shown in Figure 2.

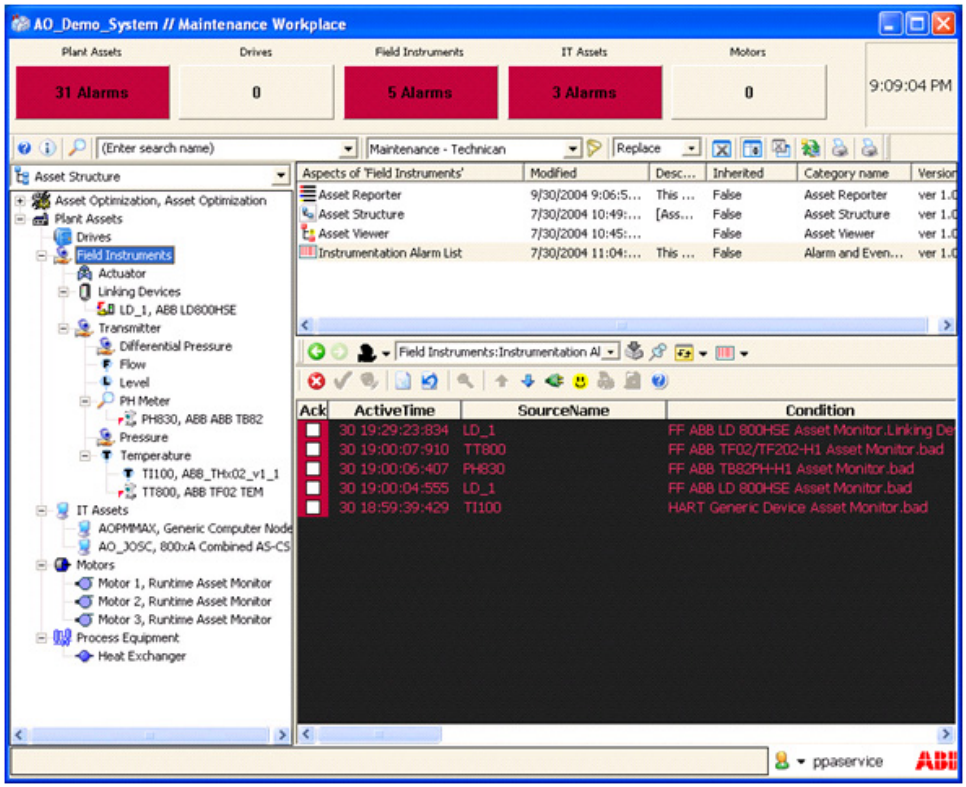

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Figure 2. Maintenance Workplace

The Maintenance Workplace exposes an Alarm Band (top) and three splitter windows. The splitter windows show:

- The selected structure in a tree view (left).
- All aspects of any selected object (middle right).
- The detailed view of the selected Aspect of that object (bottom right).

The typical structure to work with in the Maintenance Workplace is the Asset Structure (Figure 3). The Asset Structure shows, by default, five groups of plant assets. The Field Instruments group has subgroups for Actuator, Linking Devices, and Transmitters. The Transmitter group is further structured to allow a unique group for the different transmitter types.

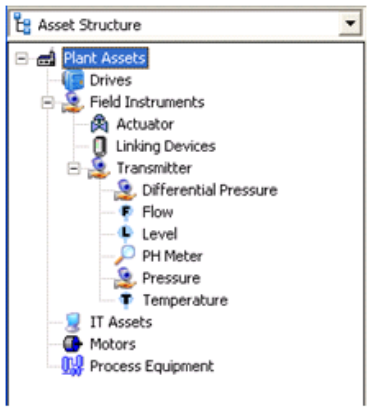


Figure 3. Asset Structure

The user is able to change the structure at any time by adding, renaming, rearranging, or deleting Asset Groups or subgroups. Refer to *System 800xA Operations Operator Workplace Configuration (3BSE030322*)* for details.

The five primary Asset Groups have Alarm List aspects that report the Asset Alarms from all objects beneath them. These Alarm Lists drive the five Alarm Groups in the Alarm Band of the Maintenance Workplace (Figure 4). Asset Alarms are Asset Health Condition information reported by Asset Monitors.

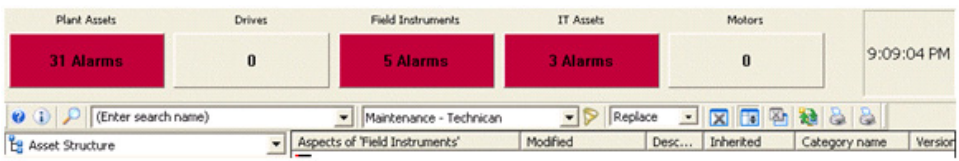


Figure 4. Alarm Band

Maintenance Workplace 2

The new workplace provides an easy, enhanced and efficient way for the user to view the Asset status and condition details in few clicks. The Maintenance Workplace 2 is based on the Asset Structure. All the assets that are engineered in the system has to be inserted into the Asset Structure.

The Maintenance Workplace 2 should not be used on the Subscriber node to view the Asset Status and Condition details of the remote Objects.

The new Maintenance Workplace 2 User Interface (UI) and its layout is as shown in the Figure 5.

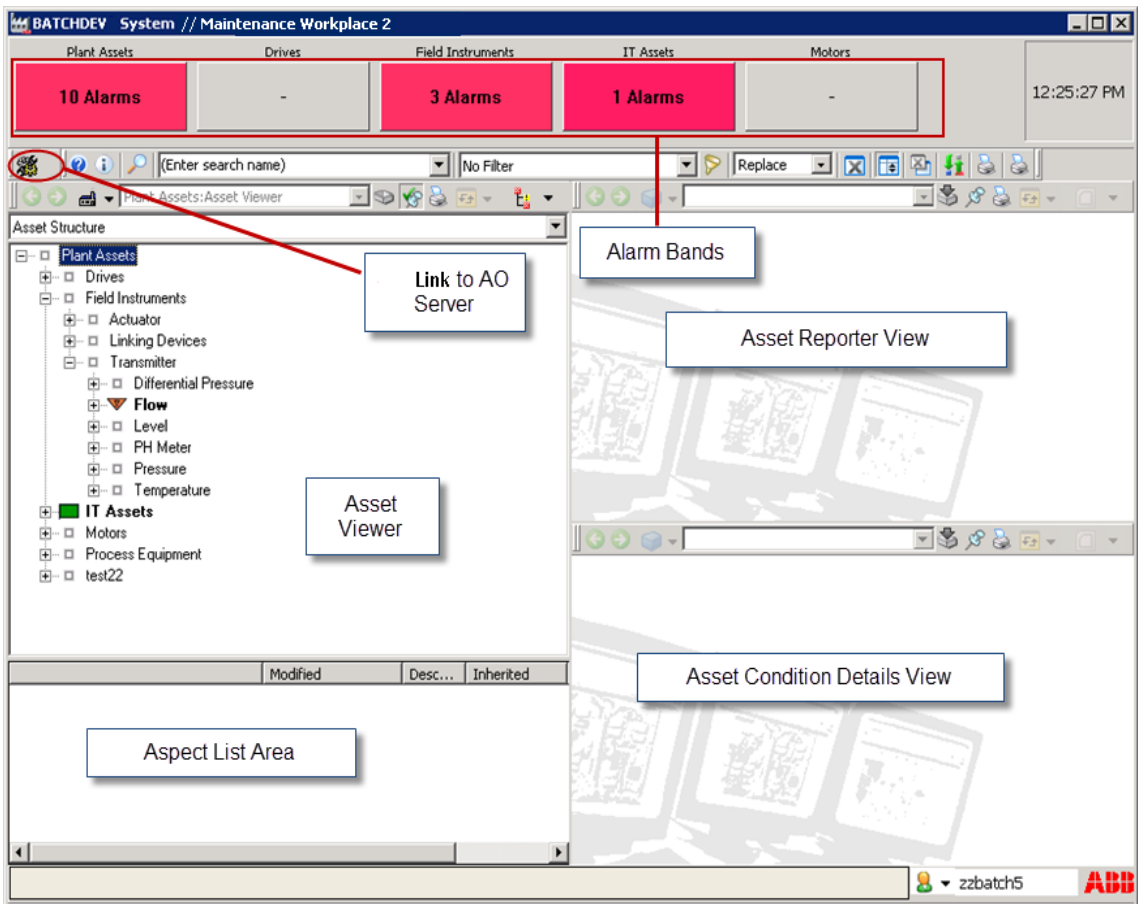


Figure 5. Maintenance Workplace 2 User Interface

The layout consists of four views:

1. Alarm Band in the Top Horizontal Panel.
2. Asset Viewer view in the Top Left Panel.
3. Aspect List view in the Bottom Left Panel.

4. Asset Reporter View in the Top Right Panel.
5. Asset Condition Details View in the Bottom Right Panel.

The Maintenance Workplace 2 uses the Asset viewer aspect to navigate to the Objects in the Asset Structure. The root object shows the overall status. It is possible for users to find the affected Object by expanding the tree structure.

Navigation Flow

1. Select the Object in the Asset Viewer. All the Aspects of the Object selected will be loaded in the Aspect List and Asset Reporter View is displayed.
2. Click on the **Condition List** item in the grid, the Condition Details information is loaded in the Condition Details Viewer area.

After all the operations are performed, the User Interface is seen as shown in the Figure 6.

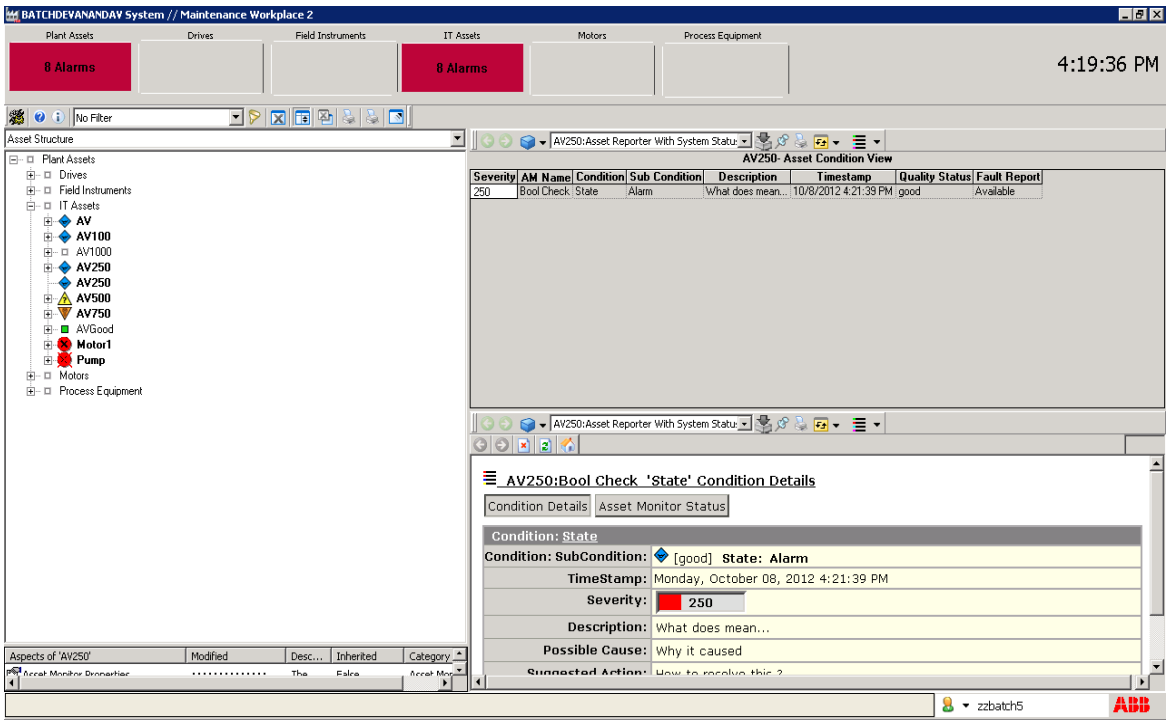


Figure 6. Maintenance Workplace 2 User Interface

Asset Viewer View

This part of the UI displays the preview of the **Asset Viewer** Aspect present under **Plant Assets** object of the Asset Structure in Process Portal A (PPA). As a part of the installation, the Asset Viewer Aspect will be loaded into the system in the Asset Structure under **Plant Assets** object.

The deletion of the imported Asset viewer Aspect will display an error message in the Maintenance Workplace 2.

Select the Object in the Asset viewer. All the Aspects of the object selected will be loaded in the Aspect List.

For more information on the Asset Viewer, refer to Asset Viewer on page 29.

Aspect List

The Aspects of the object selected in the Asset Viewer preview will be loaded into the content similar to the normal PPA Aspect List.

Asset Reporter View

This will load the Aspect preview of the Aspect selected in Aspect List. By default, when an object is selected in the Asset Viewer, the Asset Reporter will be set to be selected and its preview will be loaded in this view.

For more information on the Asset Reporter, refer to Asset Reporter on page 36.

Asset Condition Details View

This will be loaded only if the Asset Reporter View contains preview of the Asset Reporter and when the user clicks on the Asset Reporter Condition List items. This view displays the Condition Details of the selected condition item. At the time of the next condition item selected in the grid, Asset Condition Details is updated with the details.

Link to AO Server

In the Maintenance Workplace 2, users will not have access to other structures of the PPA. To provide users access to the default **AO Server 1**, a button is provided in the Application bar, so that the users can access **Asset Optimization Server** Aspect to Enable/Disable the Server and to load the Asset Monitors. However, in a plant operation scenario, there are other AO Servers available and users might need to access these Servers for Configurations.

Maintenance Workplace 2 stops responding if the ***Asset Tree*** Service is down on the Asset Optimization Server.

To know more on how to Add/Modify buttons, refer to *System 800xA Operations Operator Workplace Configuration manual (3BSE030322*).*

Maintenance Filter

The Maintenance Workplace comes with four default filters that are designed to expose only those aspects that are needed for the typical maintenance workflow. Figure 7 highlights the Alarm Band with the Maintenance - Technician filter selected.

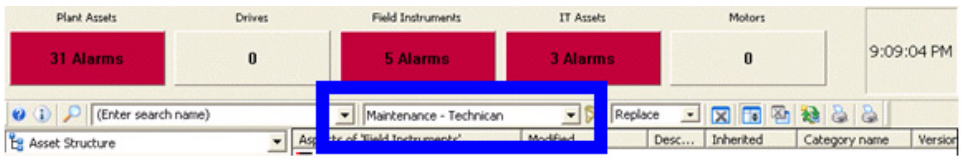


Figure 7. Maintenance Filter

The default filters are:

- Maintenance - Technician: Standard filter for all maintenance technicians. It exposes only those aspects needed to view diagnostic or health condition information, and react to or execute the related actions.
- Maintenance - Manager: More specific diagnostic aspects are available. For example, it provides access to all Asset Monitor aspects rather than just the Asset Reporter.
- Maintenance - Engineer: Shows all aspects needed to do configuration work in the system from a maintenance point of view. For example, adding Asset Monitors to Objects, commissioning Asset Monitors, etc.
- Maintenance Management: This is the standard filter for all the Maintenance users. It exposes all the Aspects that are required to perform the Asset Maintenance related Operations.

Section 3 Condition Reporting and Monitoring

Introduction

The Asset Health Condition Reporting system provides the infrastructure that reports asset status/condition information to notify operators and maintenance personnel when an abnormal condition calls for a maintenance action.

Asset Optimization provides Asset Health Condition Reporting through the Asset Viewer and Asset Reporter, Fault Report Viewer, and the items accessible through their context menus. The Asset Tree, visible in the Asset Viewer, shows the status of associated plant objects (assets) based on Plant Explorer hierarchies. Assets can be control system hardware components, control system networks, control system devices, fieldbus networks, fieldbus components, machines, pumps, motors, process equipment (boiler, reactor), etc.

Condition Monitoring systems can report accessed asset conditions into the Asset Health Condition Reporting infrastructure, Asset Viewer, and Asset Reporter. Condition Monitoring systems include Asset Monitoring and device calibration Integration.

The Asset Viewer, Asset Reporter, and Fault Report Viewer are accessible from the Operator Workplace through context menus from Alarm and Event Lists, process graphics, etc. Refer to *System 800xA Operations (3BSE036904*)* for more information on accessing views through context menus.

Asset Viewer

The Asset Viewer is accessible within the Plant Explorer Workplace, Operator Workplace, and Maintenance Workplace on 800xA System nodes. It is also accessible as a web-enabled view on non-800xA systems. When the Asset Viewer is active in the 800xA client nodes, the status of the assets in the view update

automatically when values change. Web-enabled views require a manual refresh to update the view.

The Asset Viewer Aspect, when added to an object, allows the Asset Tree to be displayed. Asset Tree severity indicators propagate the condition up the Asset Tree based on **Status Propagation** configuration. The indicators distinguish the level of severity using OPC and Asset Monitor severity range (1 to 1000).

The Asset Viewer supports two sets of the icons as described in Table 1 and Table 2.

The Namur Icon severity indicators are shown in Table 2. Users who prefer to use the existing icons instead of Namur icons, should make configuration changes to revert to the existing icons. To know more on how to change, refer to *System 800xA Asset Optimization Configuration (3BUA000118*).*

Table 1 shows and describes the Asset Tree severity indicator icons, their related severities, and Maintenance Alarm definitions

Table 1. Asset Tree Severity Indicator Icons (Old Icons)[1]

Icon	Severity	Maintenance Alarm Definition
	**None**	**None:** No Asset Reporter or Asset Monitor associated with the asset, Asset Monitor is disabled or has never been downloaded, or Asset Monitor has never run for this object.
	**Blank**	**Normal:** No maintenance required.
	**Low:** 1 to 100	**Maintenance required:** Maintenance required ***soon*** to avoid functional restrictions, e.g. caused by a nearly exhausted wear reserve or operational conditions.
	**Low:** 101 to 250	**Maintenance required:** Maintenance required ***now*** to avoid functional restrictions, e.g. caused by an exhausted wear reserve or operational conditions.
	**Medium:** 251 to 500	**Out of specification:** Asset is operating outside specified limits, caused by internal problems or process characteristics.
	**High:** **501 to 750**	**Function check:** Asset functionality might be temporarily restricted, due to ongoing work on the asset, e.g. as local operation, maintenance, simulation, or a function check.

Table 1. Asset Tree Severity Indicator Icons (Old Icons)[1] (Continued)

Icon	Severity	Maintenance Alarm Definition
	**Critical: 751 to 1000**	**Failure:** Asset functionality lost due to malfunction in the asset itself or its peripherals.

NOTE:
1. Severity is defined by an increasing loss of device health and functionality.

Table 2. Asset Tree Severity Indicator Icons (Namur Icons)[1]

Icon	Severity	Maintenance Alarm Definition
	**None**	**None:** No Asset Reporter or Asset Monitor associated with the asset, Asset Monitor is disabled or has never been downloaded, or Asset Monitor has never run for this object.
	**Blank**	**Normal:** No maintenance required.
	**Low:** 1 to 100	**Maintenance required:** Maintenance required ***soon*** to avoid functional restrictions, e.g. caused by a nearly exhausted wear reserve or operational conditions.
	**Low:** 101 to 250	**Maintenance required:** Maintenance required ***now*** to avoid functional restrictions, e.g. caused by an exhausted wear reserve or operational conditions.
	**Medium:** 251 to 500	**Out of specification:** Asset is operating outside specified limits, caused by internal problems or process characteristics.
	**High: 501 to 750**	**Function check:** Asset functionality might be temporarily restricted, due to ongoing work on the asset, e.g. as local operation, maintenance, simulation, or a function check.

Table 2. Asset Tree Severity Indicator Icons (Namur Icons)[1] (Continued)

Icon	Severity	Maintenance Alarm Definition
	**Critical: 751 to 1000**	**Failure:** Asset functionality lost due to malfunction in the asset itself or its peripherals.

NOTE:
1. Severity is defined by an increasing loss of device health and functionality.

When the Asset Tree is collapsed (Figure 8) it provides the propagated severity, quality, and Fault Report availability of an object and all of the children beneath it in the current structure. When the Asset Tree object is expanded (Figure 9) it provides composite severity, quality, and Fault Report availability for all Asset Monitors of that object only. Fault Report availability is indicated by bold text. Context menus permit Fault Report submission directly from within the Asset Viewer.

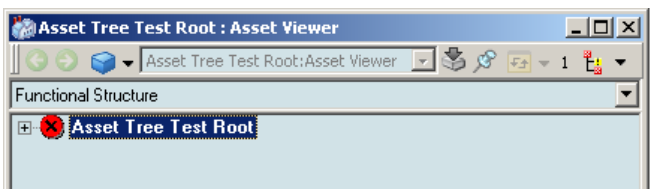


Figure 8. Collapsed Asset Tree

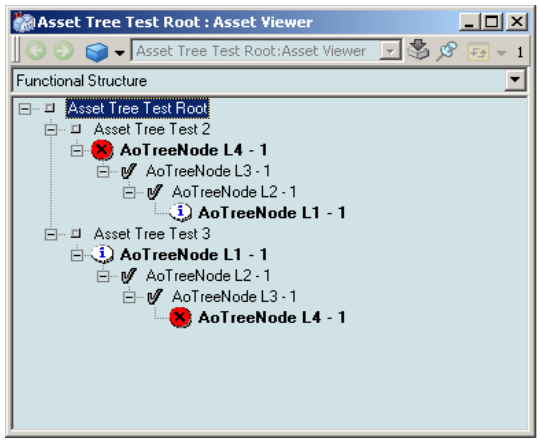


Figure 9. Expanded Asset Tree

A colored frame (Table 3) may appear around the Asset Viewer to indicate its current status. No frame indicates that the current status is accurate.

Table 3. Asset Viewer/Asset Reporter Status

Frame	Status
None	All AO Servers running fine.
Orange	Some AO Servers not enabled, not in service, or Asset Monitoring Engine has not completed first execution cycle.
Red	All AO Servers or Asset Monitoring Engines not running and/or the Asset Tree Service is not enabled.

Quality has three states: Good, Uncertain, and Bad. Table 4 shows and describes the quality indicator overlay icons that appear over the Asset Tree severity indicator icons to represent quality.

Table 4. Quality Indicator Overlay Icons

Icon	Description
None	Good quality.
	Uncertain quality.
	Bad quality.

All information in the Asset Monitors will be automatically propagated to the Asset Tree. It is not necessary to add Asset Reporter aspects (refer to Asset Reporter on page 36) to an object unless detailed information is needed about that object.

To access, interpret, and work with the Asset Viewer:

1. Navigate to the item of interest.
2. Right-click on that item and select **Asset Viewer** from the context menu.

3. Refer to Table 1, Table 4, and Table 3, and Figure 8 and Figure 9, and their related descriptions to read the Asset Tree.

4. Right-click on the desired object in the Asset Tree to produce a context menu in a view such as the one shown in Figure 10.

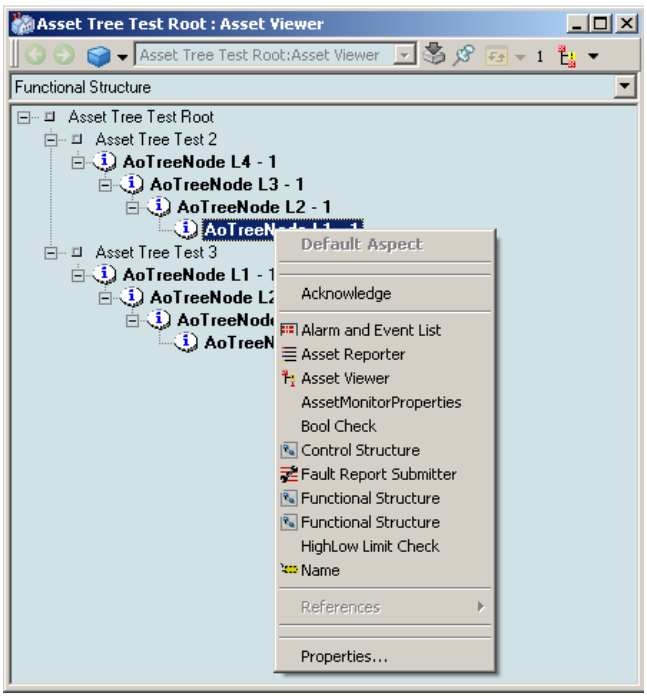


Figure 10. Asset Tree Context Menu

5. Everything that is not dimmed in the context menu is accessible by clicking the item of interest.

   a. The items in the top portion are called verbs and are actions that can be taken. For instance, in the example shown in Figure 10, the operator can acknowledge the alarm.

   b. The items in the bottom portion are items directly associated with the selected asset in the Asset Tree. For instance, in the example shown in Figure 10, the operator can submit a Fault Report for the selected asset, look at other aspects associated with that asset, etc. Not shown in the

figure is the ability to see CMMS views such as active Work Orders for that asset, etc.

The CMMS Views option requires Maximo Integration or SAP/PM Integration functionality. Refer to Section 5, Condition Event Handling for information on working with these views.

Asset Reporter

The Asset Reporter is accessible within the Plant Explorer Workplace, Operator Workplace, and Maintenance Workplace on 800xA System nodes. It is also accessible as a web-enabled view on non-800xA systems. When the Asset Reporter is active in the 800xA clients, the status of the assets in the view update automatically when values change. Web-enabled views require a manual refresh to update the view.

The Asset Reporter is a detailed view of all Asset Monitor conditions for an asset. It displays the severity indicator for an object itself. It displays information available to it from all Asset Monitors and their corresponding current subconditions. For each condition, the Asset Reporter will provide information about current subconditions, severity, Asset Monitor status, and Fault Report availability.

All information in the Asset Monitors will be automatically propagated to the Asset Tree in the Asset Viewer (refer to Asset Viewer on page 29). It is not necessary to add Asset Reporter aspects to an object unless detailed information is needed about that object.

A colored frame (Table 3) may appear around the Asset Reporter to indicate its current status. No frame indicates that the current status is accurate.

There are several options available when viewing the Asset Reporter.

1. Navigate to the item of interest in the Operator Workplace.

2. Right-click on that item and select **Asset Reporter** from the context menu to produce a view such as the one shown in Figure 11.

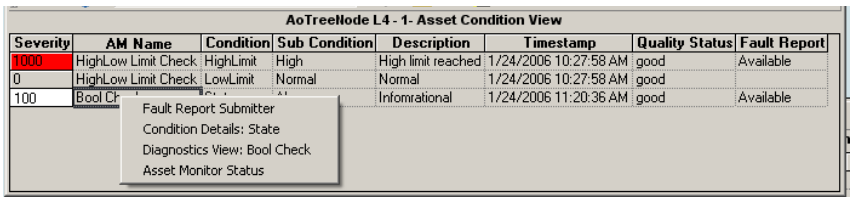


Figure 11. Asset Reporter

3. From left to right, the columns in the Asset Reporter show:
   - **Severity:** the severity of the current subcondition. Table 5 lists the color scheme that appears in the **Severity** column and how the colors relate to the subcondition severity levels.

Table 5. Asset Reporter Color Scheme

Color	Subcondition Severity Level
Gray	Normal
White	1 to 250
Blue	251 to 500
Yellow	501 to 750
Red	751 to 1000

The color scheme tabulated in Table 5 is for the existing icons. If Namur NE 107 icons are used, then the color scheme mentioned in Table 6 is applicable:

   - **AM Name:** the name of the Asset Monitor reporting the condition.
   - **Condition:** the current condition for each Asset Monitor association with this asset.
   - **SubCondition:** the current subcondition for each condition.

Table 6. Asset Reporter Color Scheme for NAMUR NE 107

Color	Subcondition Severity Level
Gray	Normal
Blue	1 to 250
Yellow	251 to 500
Orange	501 to 750
Red	751 to 1000

- **Description:** a description of the current subcondition.
- **TimeStamp:** the time the condition was reported by the Asset Monitor.
- **Quality Status:** the quality status of the data. If the Quality Status is anything but good, the Severity will remain at 1, and the subcondition will not be reported.
- **Fault Report:** indicates availability of a Fault Report.

4. Right-click on the desired row to produce a context menu such as the one shown in Figure 11.
5. The options available in the Asset Reporter are:
   - **Fault Report Submitter:** Opens the Fault Report Viewer (refer to Fault Report Viewer on page 41).
   - **Condition Details <condition>:** opens the Condition Details view.
   - **Diagnostics View <Asset Monitor>:** Opens a web page containing additional information about the monitored asset.
   - **Asset Monitor Status:** only available if the Asset Monitor has been loaded into an Asset Monitoring Engine. This opens the Asset Monitor Status view.
   - **Condition URL:** only available if the Asset Monitor defines a condition specific URL. Opening a web page contains additional information about the selected Condition state.

Condition Details, Asset Monitor Status, and Diagnostics Link

The Condition Details view provides more information about the selected condition in the Asset Reporter. This view also provides the overall Asset Monitor Status text. Select **Condition Details:<condition>** to produce the Condition Details view such as the one shown in Figure 12.

This view is generated using the current state of the Asset Monitor in the Asset Monitoring Engine. The engine must be running for this view to be available.

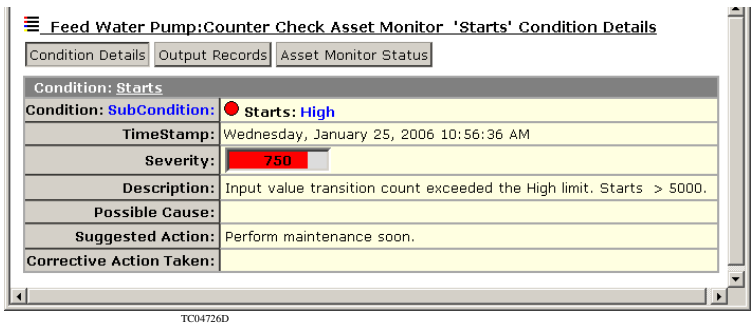


Figure 12. Condition Details

In the new Maintenance Workplace 2, the Condition Details view looks as shown in the Figure 13.

Select **Asset Monitor** Status to produce the Asset Monitor Status view such as the one shown in Figure 14.

The **Input Records** tab in the Asset Monitor Status page (Figure 14) provides an overview of all the OPC items used by the selected Asset Monitor. This view is of particular interest when troubleshooting communication problems with the OPC server or servers.

Some Asset Monitors are configured to expose an additional Diagnostics menu entry in the Asset Reporter and Asset Monitor Conditions view.

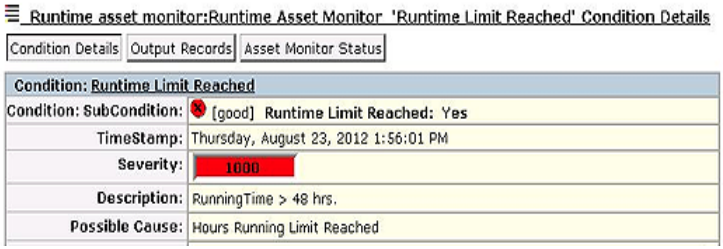


Figure 13. Condition Details View (Maintenance Workplace 2)

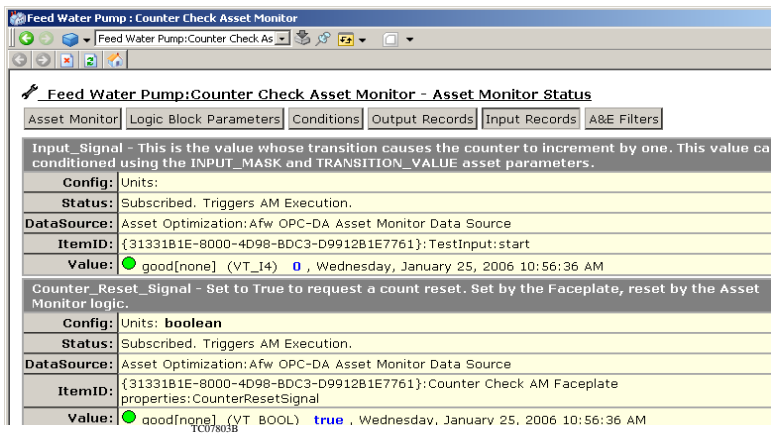


Figure 14. Input Records Tab

The Diagnostics menu will open a web page containing additional information about the monitored asset. To access this view, right-click on the desired Asset

Monitor (Figure 15) and select **Diagnostics** from the context menu.

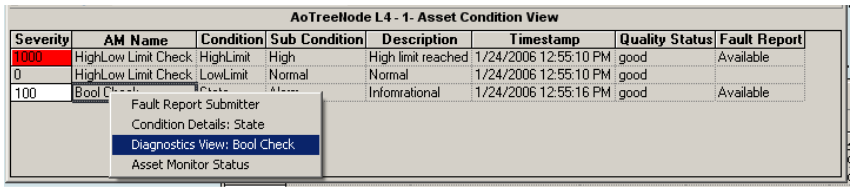


Figure 15. Accessing the Diagnostics Menu

Fault Report Viewer

When an Asset Monitor reports an abnormal asset condition, a Fault Report is created automatically. The Fault Report Viewer makes it possible to see all conditions/subconditions that could be selected to produce Fault Reports for a selected object.

To access the Fault Report Viewer through a context menu selection within the Operator Workplace:

1. Navigate to the asset of interest in the Object Browser.
2. Select **Fault Report Submitter** from the context menu. This opens the Fault Report (condition/subcondition) Viewer like the one shown in Figure 16.

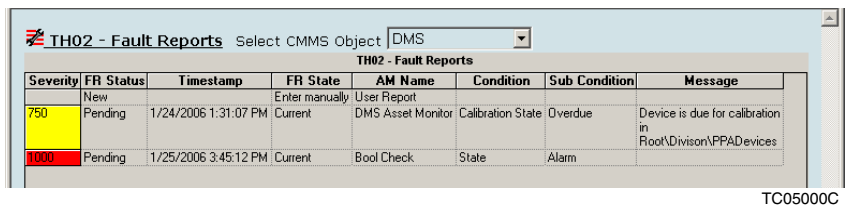


Figure 16. Fault Report Viewer

3. The **Select a CMMS Object** drop-down list box shows all the CMMS Equipment IDs configured for the selected Aspect. Click the down arrow and; for example, select the Maximo Equipment ID for which it is desired to view the Fault Reports.

4. From left to right, the columns in the Fault Report Viewer show:
   - **Severity:** the severity of the condition.
   - **FR Status:** The status of the Fault Report. It is either Pending or Submitted.
   - **TimeStamp:** the time the Fault Report was generated.
   - **FR State:** The state of the Fault Report at any instance in time. It can either be the current condition, or the Most Severe Unacknowledged (MSU) condition of the asset. If the alarm line corresponding to the condition is not acknowledged, the Fault Report Viewer keeps the MSU even when the condition goes back to normal, in which case the **FR State** column reads **Most Severe Unacknowledged**. If the MSU is the current condition, then the **FR State** column reads **Current**.
   - **AM Name:** the name of the Asset Monitor reporting the condition.
   - **Condition:** a description of the condition that generated the Fault Report.
   - **Subcondition:** a description of the condition that generated the Fault Report.
   - **Message:** Descriptive text.
5. To submit a Fault Report to the CMMS, right-click anywhere in the desired row and select **Submit** from the context menu. Refer to Submitting Fault Reports on page 57.
6. To dismiss the Fault Report and acknowledge the alarm line, select **Dismiss** in the context menu.

Asset Monitor Properties

Each instance object containing at least one Asset Monitor Aspect will also contain one AssetMonitorProperties Control Connection aspect. This Aspect publishes the current asset conditions generated by Asset Monitors configured in the object. The elements of an asset condition are exposed as a set of OPC items and related attributes.

The property names follow one of the following conventions:

- <Asset Monitor Aspect Name>.<Attribute Name>
- <Asset Monitor Aspect Name>.<Condition Name>.<Attribute Name>
- <Asset Monitor Aspect Name>.OutputRecords.< OutputRecord Name>.<Attribute Name>

Each Item provides the runtime data in the form of a Value, Quality, and Timestamp. Figure 17 provides an example.

If the Value field reads `AddItem Error`, that indicates the Data Source Key (**System** tab) does not match the correct Asset Monitor Server Data Source Definition. To solve this, load the Asset Monitors configured in this object.

If the quality field reads `Bad (comm. failure)`, that indicates the corresponding AssetMonitoring Service (AO Server) is not running. If desired, enable the AssetMonitoring Service associated with Asset Monitors in this object.

If the quality field reads `Bad` (not connected), that indicates the Asset Monitoring Engine has not reported the value since the last startup of the AssetMonitoring Service. These values will be updated as soon as the Asset Monitoring Engine executes the Asset Monitors in this object.

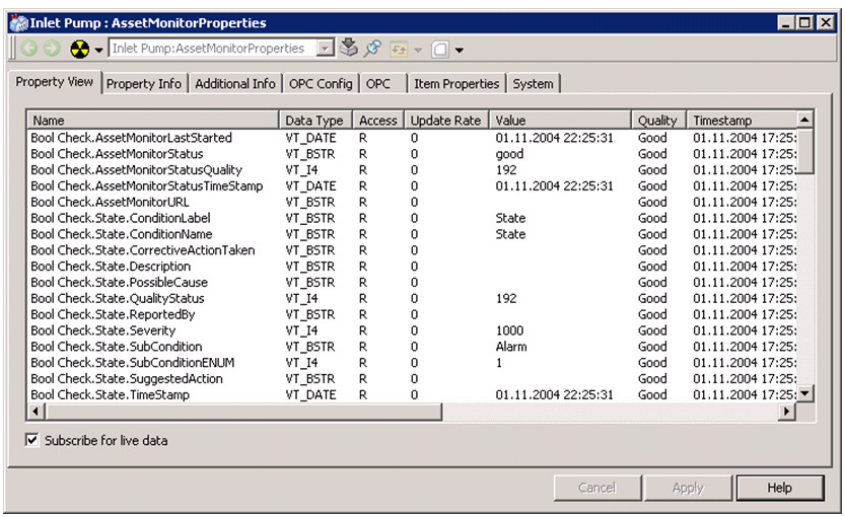


Figure 17. AssetMonitorProperties Control Connection Aspect

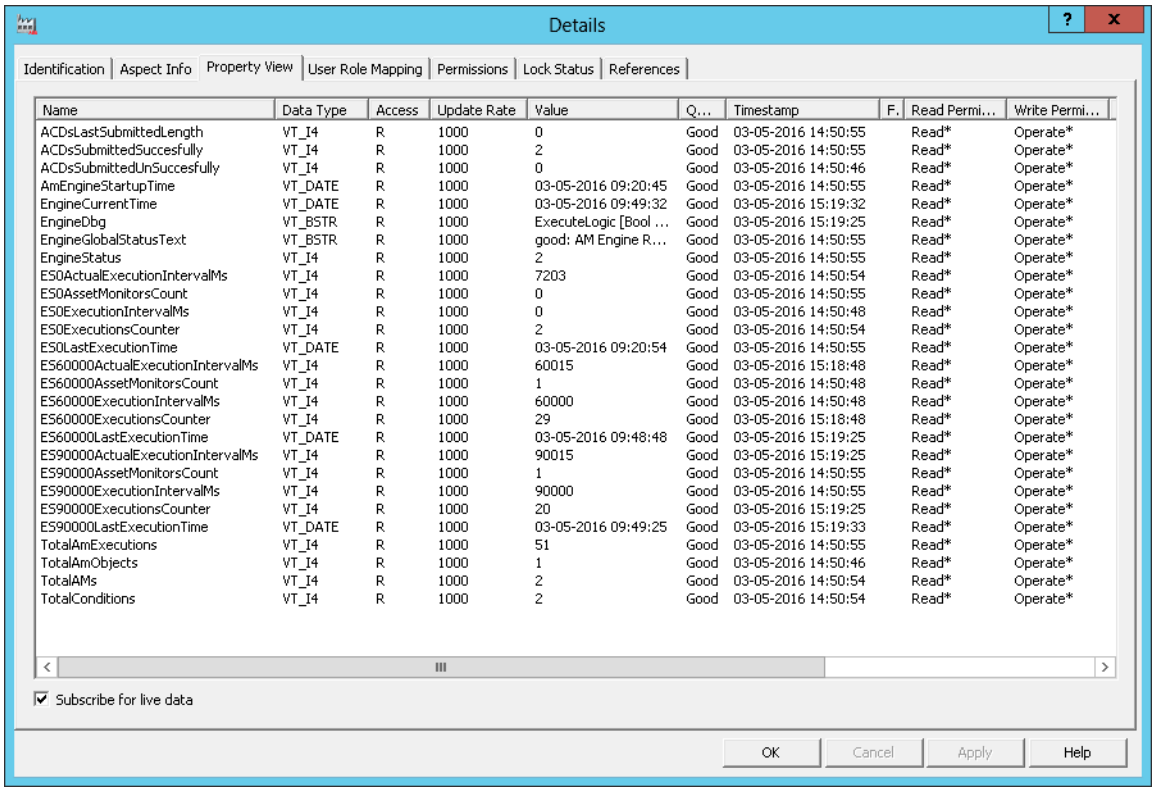
AM Engine Properties

Each instance of AO server object contains one **AM Engine Properties** aspect. This aspect provides the following Asset Monitor details configured in the 800xA

system. The elements of an Asset Monitor details are exposed as a set of OPC items and related attributes.

- Total number of loaded Asset Monitors and unique 800xA System Objects containing them in the Asset Monitoring Engine.
- Total number of Asset Monitor conditions in the Asset Monitoring Engine.
- Execution statistics for each Execution Sequence in the Asset Monitoring Engine. An Execution Sequence represent a collection of Asset Monitors grouped by Logic Execution Interval.
- AM Engine Startup and current time.

Each item provides the runtime data in the form of a Value, Quality, and Timestamp. Figure 18 provides an example.



Name	Data Type	Access	Update Rate	Value	Q...	Timestamp	F.	Read Permi...	Write Permi...
ACDsLastSubmittedLength	VT_I4	R	1000	0	Good	03-05-2016 14:50:55		Read*	Operate*
ACDsSubmittedSuccesfully	VT_I4	R	1000	2	Good	03-05-2016 14:50:55		Read*	Operate*
ACDsSubmittedUnSuccesfully	VT_I4	R	1000	0	Good	03-05-2016 14:50:46		Read*	Operate*
AmEngineStartupTime	VT_DATE	R	1000	03-05-2016 09:20:45	Good	03-05-2016 14:50:55		Read*	Operate*
EngineCurrentTime	VT_DATE	R	1000	03-05-2016 09:49:32	Good	03-05-2016 15:19:32		Read*	Operate*
EngineDbg	VT_BSTR	R	1000	ExecuteLogic [Bool ...	Good	03-05-2016 15:19:25		Read*	Operate*
EngineGlobalStatusText	VT_BSTR	R	1000	good: AM Engine R...	Good	03-05-2016 14:50:55		Read*	Operate*
EngineStatus	VT_I4	R	1000	2	Good	03-05-2016 14:50:55		Read*	Operate*
ES0ActualExecutionIntervalMs	VT_I4	R	1000	7203	Good	03-05-2016 14:50:54		Read*	Operate*
ES0AssetMonitorsCount	VT_I4	R	1000	0	Good	03-05-2016 14:50:55		Read*	Operate*
ES0ExecutionIntervalMs	VT_I4	R	1000	0	Good	03-05-2016 14:50:48		Read*	Operate*
ES0ExecutionsCounter	VT_I4	R	1000	2	Good	03-05-2016 14:50:54		Read*	Operate*
ES0LastExecutionTime	VT_DATE	R	1000	03-05-2016 09:20:54	Good	03-05-2016 14:50:55		Read*	Operate*
ES60000ActualExecutionIntervalMs	VT_I4	R	1000	60015	Good	03-05-2016 15:18:48		Read*	Operate*
ES60000AssetMonitorsCount	VT_I4	R	1000	1	Good	03-05-2016 14:50:48		Read*	Operate*
ES60000ExecutionIntervalMs	VT_I4	R	1000	60000	Good	03-05-2016 14:50:48		Read*	Operate*
ES60000ExecutionsCounter	VT_I4	R	1000	29	Good	03-05-2016 15:18:48		Read*	Operate*
ES60000LastExecutionTime	VT_DATE	R	1000	03-05-2016 09:48:48	Good	03-05-2016 15:19:25		Read*	Operate*
ES90000ActualExecutionIntervalMs	VT_I4	R	1000	90015	Good	03-05-2016 15:19:25		Read*	Operate*
ES90000AssetMonitorsCount	VT_I4	R	1000	1	Good	03-05-2016 14:50:55		Read*	Operate*
ES90000ExecutionIntervalMs	VT_I4	R	1000	90000	Good	03-05-2016 14:50:55		Read*	Operate*
ES90000ExecutionsCounter	VT_I4	R	1000	20	Good	03-05-2016 15:19:25		Read*	Operate*
ES90000LastExecutionTime	VT_DATE	R	1000	03-05-2016 09:49:25	Good	03-05-2016 15:19:33		Read*	Operate*
TotalAmExecutions	VT_I4	R	1000	51	Good	03-05-2016 14:50:55		Read*	Operate*
TotalAmObjects	VT_I4	R	1000	1	Good	03-05-2016 14:50:46		Read*	Operate*
TotalAMs	VT_I4	R	1000	2	Good	03-05-2016 14:50:54		Read*	Operate*
TotalConditions	VT_I4	R	1000	2	Good	03-05-2016 14:50:54		Read*	Operate*

Figure 18. AM Engine Properties aspect

Section 4 AO Server Operation

Introduction

This section describes operation of the AO Server. It includes:

- Asset Optimization Event Log.
- All Asset Condition Alarms List.
- All Asset Monitoring Status Alarms List.
- All Asset Optimization Alarms List.
- Asset Optimization Server.

Asset Optimization Event Log

The Asset Optimization Event Log provides useful information about Asset Optimization activities, such as:

- AssetMonitoring Service startup/shutdown operations, warnings, and errors.
- AO AssetMonitoring Engine startup/shutdown and configuration load operations, warnings, and errors.
- Asset Monitor category update log.

To access the Asset Optimization Event Log:

1. Open Plant Explorer Workplace.
2. Navigate to `Root, Domain, Asset Optimization, Asset Optimization` in the Control Structure.

3. Select `Asset Optimization Event Log` in the Aspect List Area to produce the Asset Optimization Event Log Aspect view in the Preview Area as shown in Figure 19.

4. Logged messages are color coded:

   – Informational messages: cyan.
   – Errors and warning: orange.

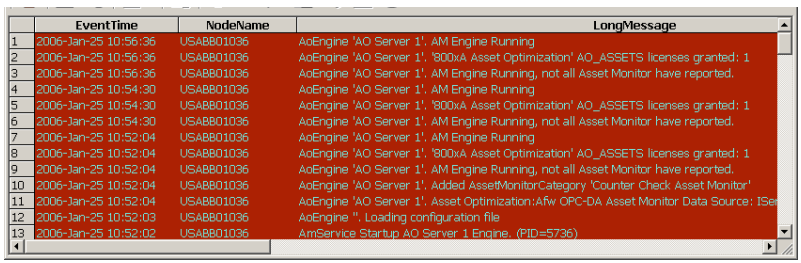


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Figure 19. Asset Optimization Event Log

All Asset Condition Alarms List

The **All Asset Condition Alarms List** provides a list of all the Asset Condition alarms reported by all the running Asset Monitors in the system.

This Alarm List makes use of the following Alarm and Event List Configuration:

- **Asset Optimization Asset Condition Alarms Configuration: Alarm and Event List Configuration:** This Alarm and Event List configuration can be referenced by any user created Alarm Lists requiring these alarm categories to be displayed.

To access the All Asset Condition Alarms List:

1. Open a Plant Explorer Workplace.
2. Navigate to:

   `Root, Domain > Asset Optimization, Asset Optimization`

   in the Control Structure.
3. Select `All Asset Condition Alarms List` in the Aspect List Area to produce the Aspect view in the Preview Area.

All Asset Monitoring Status Alarms List

The All Asset Monitoring Status Alarms List provides a list of all Asset Monitoring Alarms reported by all running Asset Monitors in the system.

While Asset Condition Alarms provide information about the monitored Asset Conditions, Asset Monitoring Alarms are used to report issues with the Asset Monitoring system and related data sources.

This Alarm list makes use of the following Alarm and Event List Configuration:

- **Asset Optimization Asset Monitoring Status Configuration: Alarm and Event List Configuration:** This Alarm and Event List Configuration can be referenced by any user created Alarm Lists requiring these alarm categories to be displayed.

To access the All Asset Monitoring Status Alarms List:

1. Open a Plant Explorer Workplace.
2. Navigate to:

   `Root, Domain, Asset Optimization, Asset Optimization`

   in the Control Structure.
3. Select `All Asset Monitoring Status Alarms List` in the Aspect List Area to produce the Aspect view in the Preview Area.

All Asset Optimization Alarms List

The Asset Optimization Asset Condition and Asset Monitoring Status Configuration: Alarm and Event List Configuration and Asset Monitoring Alarms reported by all the running Asset Monitors in the system.

To access the All Asset Optimization Alarms List:

1. Open a Plant Explorer Workplace.
2. Navigate to:

   `Root, Domain, Asset Optimization, Asset Optimization`

   in the Control Structure.
3. Select `All Asset Optimization Alarms List` in the Aspect List Area to produce the Aspect view in the Preview Area.

Asset Optimization Server

The Asset Optimization Server Aspect provides the main management and diagnostic interface for an AO Server node. To access the Asset Optimization Server Aspect:

1. Open a Plant Explorer Workplace.
2. Navigate to `Root, Domain, Asset Optimization, Asset Optimization` in the Control Structure.
3. Select `Asset Optimization Server` in the Aspect List Area to produce the Asset Optimization Server Aspect view in the Preview Area.
4. The Asset Optimization Server Aspect has three tabs:
   - AO Server Tab.
   - Asset Monitors Tab.
   - Runtime Statistics Tab.

AO Server Tab

The AO Server tab (Figure 20) provides information about both the AssetMonitoring Service and the AssetMonitoring Engine.

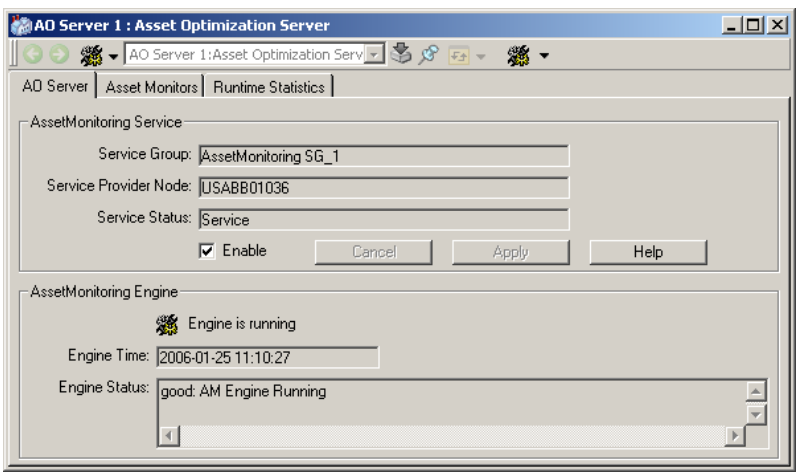

Figure 20. AO Server Tab

To start/stop the AssetMonitoring Service associated with an AO Server, enable/disable the **Enable** check box in the **AO Server** tab and click **Apply**.

Starting/stopping the AssetMonitoring Service will also start/stop the AssetMonitoring Engine.

Asset Monitors Tab

The Asset Monitors tab (Figure 21) provides the following information:

- **AMs Loaded in this AO Server:** Shows the list of Asset Monitors currently loaded in this AO Server.
- **AMs Assigned to this AO Server:** Shows the list of Asset Monitors assigned to this AO Server.
- **All AMs:** Shows the list of all the Asset Monitors in the system.

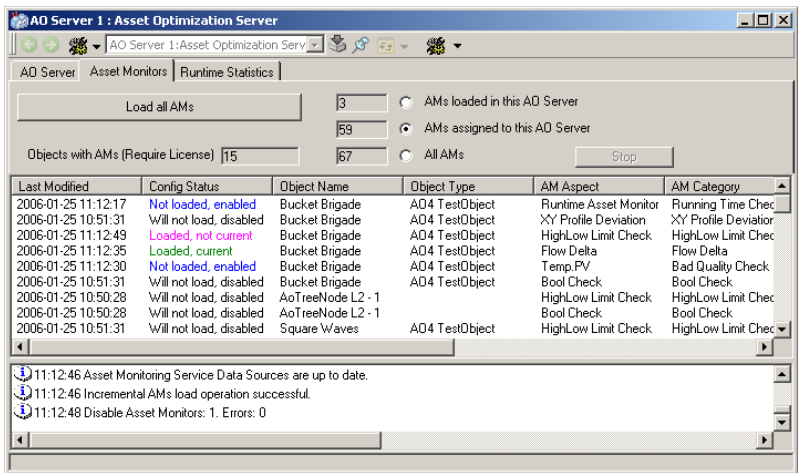

Figure 21. Asset Monitors Tab

When **All AMs** is selected, the Asset Monitors context menu allows reassignment of the selected Asset Monitors to this AO Server by selecting **Assign Asset Monitors to this AO Srv** (Figure 22).

The Asset Monitors tab also provides some configuration statistics such as the number of Asset Monitors assigned to this AO Server.

For licensing proposes the **Objects with Asset Monitors** number is reported. This is the number of unique 800xA Objects containing at least one Asset Monitor that will run in AO AssetMonitoring Engines.

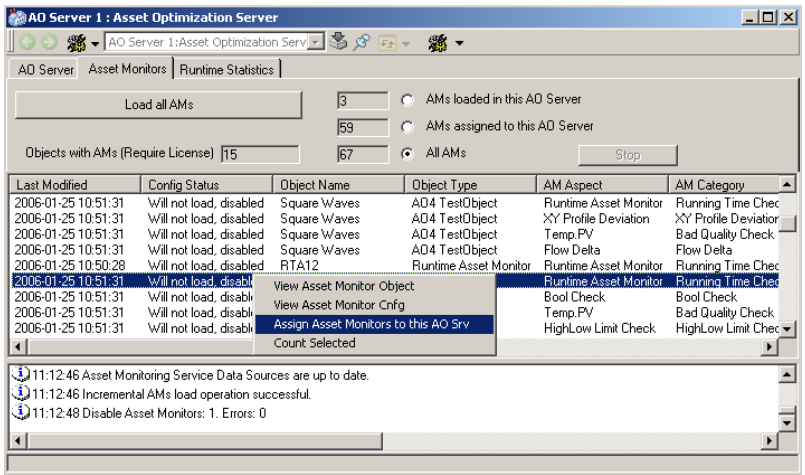

Figure 22. Assign Asset Monitors to this AO Srv Selection

Runtime Statistics Tab

The **Runtime Statistics** tab provides useful diagnostic data about the AssetMonitoring Service and AssetMonitoring Engine.

1. The **Asset Monitoring Runtime Statistics: Monitoring Server** page (Figure 23) provides, among other things, the following information:
   - Startup Time.
   - Total number of loaded Asset Monitors and unique 800xA System Objects containing them.

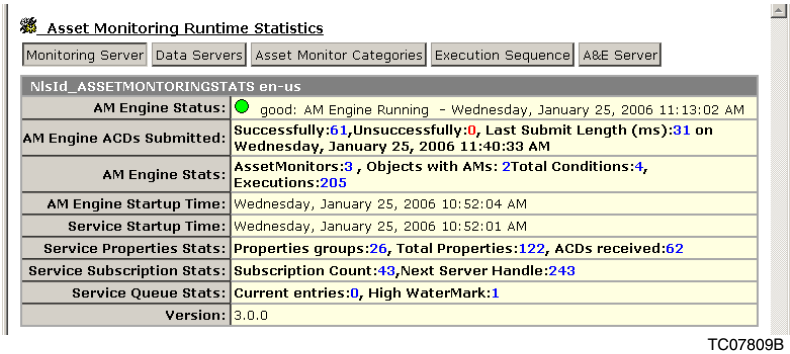

Figure 23. Asset Monitoring Server Runtime Statistics: Monitoring Server Page

– Total number of Asset Monitor conditions (the maximum supported is 30,000).

2. The **Asset Monitoring Runtime Statistics: Data Servers** page (Figure 24) shows the status of each AssetMonitoring Engine connection to an OPC/DA Server (as defined by the Asset Monitor Data Source Aspect). For each OPC/DA Server connection it provides the number of OPCItems successfully added to the OPC group. This number should coincide with the total properties requested by the AssetMonitoring Engine (the blue number).

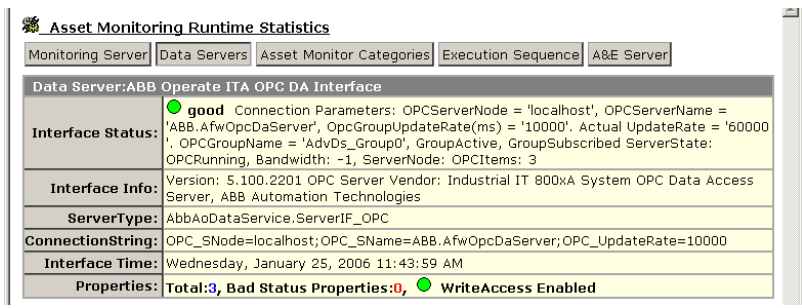

Figure 24. Asset Monitoring Server Runtime Statistics: Data Servers Page

The `Bad Status Properties` value (red) represents the number of properties that either failed to be added to the OPC group (Add Item error) or encountered a problem while reading or writing an OPC value. For additional

information about these properties, navigate to running Asset Monitors that are not in good status and check the **Input Records** tab in the Asset Monitor Status page (refer to Figure 14 under Condition Details, Asset Monitor Status, and Diagnostics Link on page 39).

3. The **Asset Monitoring Runtime Statistics: Asset Monitor Categories** page (Figure 25) shows a list of the different types of Asset Monitor logic (Asset Monitor Categories) loaded in the AssetMonitoring Engine. For each Asset Monitor logic it reports the number of Asset Monitor instances loaded and the total Asset Monitor logic executions counter.

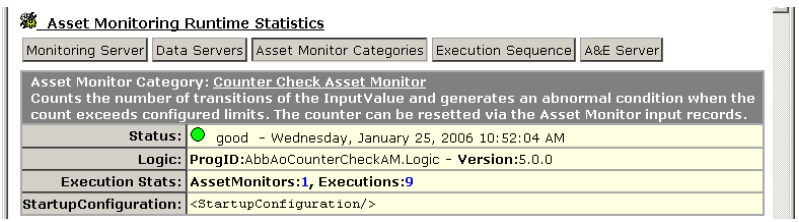

Figure 25. Asset Monitoring Server Runtime Statistics: Asset Monitor Categories Page

4. The **Asset Monitoring Runtime Statistics: Execution Sequences** page (Figure 26) shows execution statistics for each Execution Sequence in the AssetMonitoring Engine. An Execution Sequence represent a collection of Asset Monitors grouped by Logic Execution Interval.

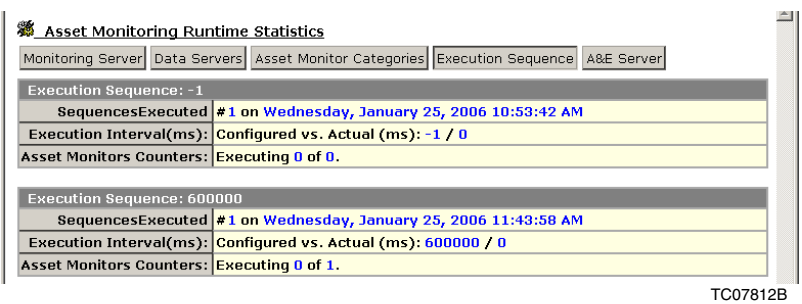

Figure 26. Asset Monitoring Server Runtime Statistics: Execution Sequences Page

5. The **Asset Monitoring Server Runtime Statistics: Alarm and Event Server** page (Figure 27) shows the status of the Asset Monitoring Engine connection to the 800xA Alarm and Event Server, the Active Subscription Status, and a list of the Categories and Attributes supported by the Alarm and Event Server.

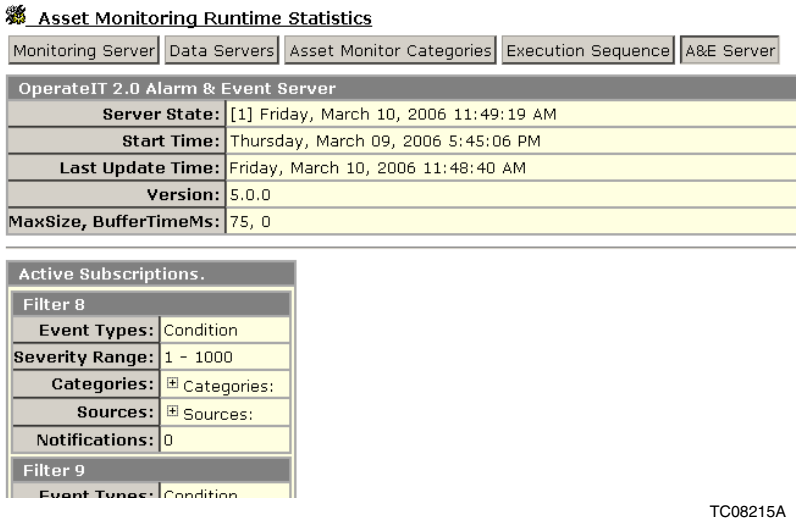

Figure 27. Asset Monitoring Server Runtime Statistics: Alarm and Event Server Page

Section 5 Condition Event Handling

Introduction

Asset Optimization provides asset condition event handling through:

- Submitting Fault Reports.
- Creating and Submitting Fault Reports.
- Alarm and Event List Operation.
- CMMS Views For Maximo Integration.
- CMMS Views For SAP/PM Integration.

The functions described in this section are accessible from the Operator Workplace through context menus from process graphics, etc. Refer to *System 800xA Operations (3BSE036904*)* for more information on accessing views through context menus. Some or all of these functions are also accessible from the context menu on the Asset Viewer (refer to Asset Viewer on page 29), Asset Reporter (refer to Asset Reporter on page 36), and Fault Report Viewer (refer to Fault Report Viewer on page 41).

Submitting Fault Reports

Submitting Fault Reports, generated when an Asset Monitor reports a not normal asset condition, is made possible through the Submit Fault Report view. When a Fault Report is submitted, it generates a Work Order in the CMMS.

The Submit Fault Report View shown in Figure 28 is an example of one of five possible Submit Fault Report Views

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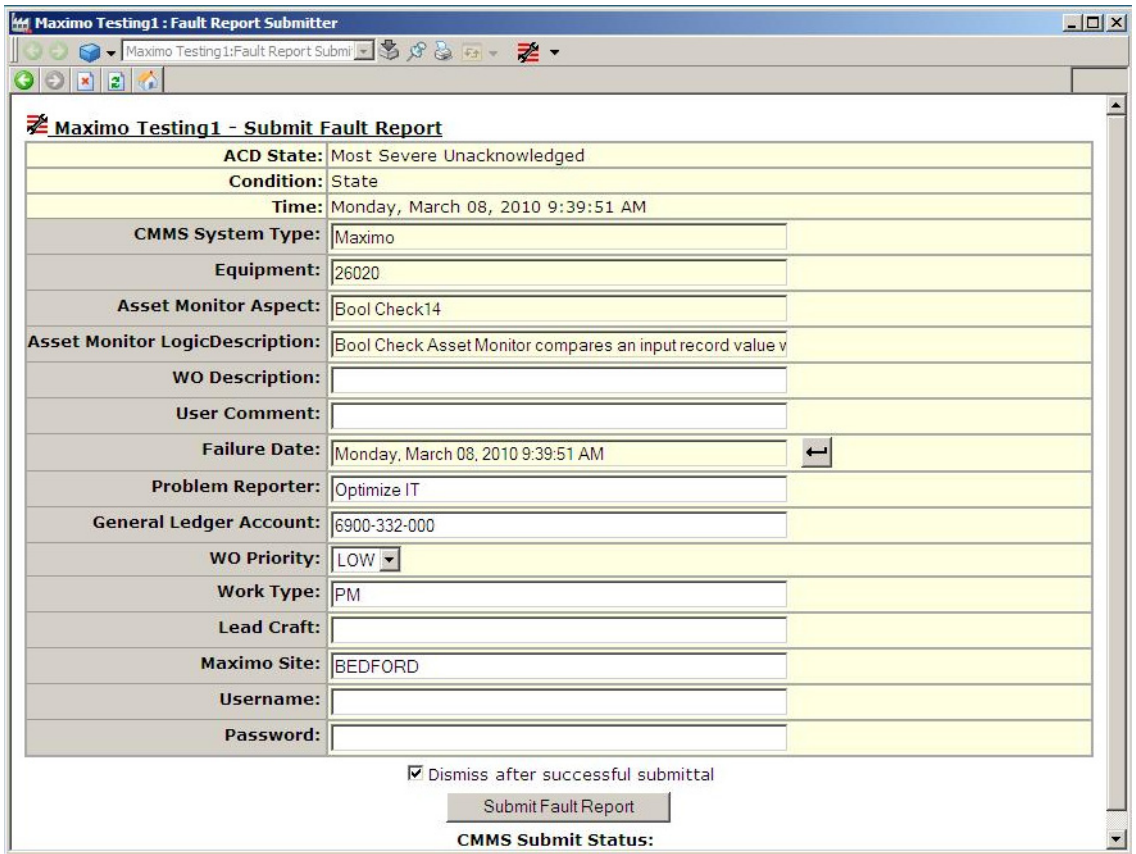

Figure 28. Submit Fault Report View for Maximo Integration

The specific view depends on which integration packages were installed. The fields and content are generated based on the requirements of the specific CMMS.

The **Dismiss after successful submittal** check box is a local override for the default setting (selected or cleared) chosen during Fault Report Submitter Setup (refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* for more information). Selecting it deletes the current condition from the system when it is successfully submitted. It also acknowledges the alarm in the Alarm and Event List and dismisses it if the Alarm and Event List is configured to do so.

1. Select **Submit Fault Report** from a context menu to access a Submit Fault Report view. A different view will appear depending on the functionality of the system.

2. **For submittal to systems with Maximo Integration Functionality only:**

   a. All of the fields in the Fault Report, except **Username:** and **Password:** are filled in by information generated by the asset condition. Either accept the supplied information or change it as desired.

The Username and Password are only required when the *User Credentials* configuration field in the Maximo Equipment ID Aspect is set to some choice other than `True`. In that case, a valid Username and Password for the Maximo system must be entered or the submission will be rejected. Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* for more information.

Click the arrow next to the Failure Date: field to open a calendar that can be used to set the time and date stamp in the Fault Report.

   b. Either accept the default value in the **Dismiss after successful submittal** check box or change it for this Fault Report.

   c. To submit to the Maximo system only, do not select an Action List in the **Select an Action List:** drop-down list box. To submit to both systems, select the check box and make a selection in the drop-down list box.

   d. Click **Submit Fault Report**.

3. **For submittal to systems with SAP/PM Integration Functionality only:**

   a. All the fields in the Fault Report, except for blank fields, are filled in by information generated by the asset condition. Either accept the supplied information or change it as desired.

   b. If required, fill in the **Username:** and **Password:** fields.

The Username and Password are only required when the *Use SAP Credentials* configuration field in the SAP Equipment ID Aspect is set to some choice other than `True`. In that case, a valid Username and Password for the SAP/PM system must be entered . During submission the SAP client and SAP Language should also be configured or the submission will be rejected. Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* for more information.

   c. Either accept the default value in the **Dismiss after successful submittal** check box or change it for this Fault Report.

   d. To submit to the SAP/PM system only, do not select an Action List in the **Select an Action List:** drop-down list box. To submit to both systems, select the check box and make a selection in the drop-down list box.

e. Click **Submit Fault Report**.

Creating and Submitting Fault Reports

The Create Fault Report Form makes it possible to create and submit a new Fault Report for the selected asset without an asset condition being generated by an Asset Monitor. These functions are made possible by the Fault Report Submitter. Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* to set up the Fault Report Submitter.

After filling in the fields with the appropriate information and clicking **Submit Fault Report**, the Submit Status: field indicates whether or not submission of the Fault Report succeeds. If it is unsuccessful, an error message will appear in the Submit Status: field. Upon successful submission, a Work Order is created in the CMMS.

To manually create and submit a Fault Report from a context menu selection within the Operator Workplace:

1. Select the **Fault Report Submitter** Aspect from a context menu.
2. Click the down arrow to display a list of available CMMS objects in a drop-down list box.

The drop-down list box shows all aspects that implement the CMMS interfaces that allow viewing and submitting of Fault Reports/Malfunction Notifications.

3. Select the Maximo, SAP/PM, or any other provider Equipment ID for which it is desired to create a Fault Report. This will produce a view similar to the one shown in Figure 29.
4. Right-click `New` in the FR Status column and select **Create New** from the context menu.

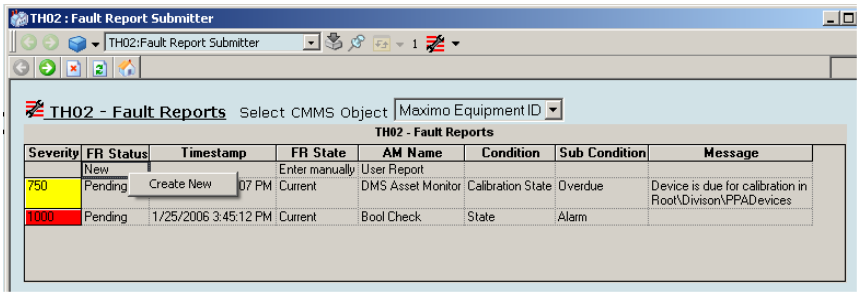

Figure 29. Fault Report Submitter

5. Since there is no asset condition associated with this Fault Report, the fields must be filled in with the appropriate information.

The Username and Password are only required when the *User Credentials* configuration field in the Maximo Equipment ID Aspect, or the *SAP User Credentials* configuration field in the SAP Equipment ID Aspect, is set to some choice other than `True`. In that case, a valid Username and Password for the Maximo or SAP/PM system must be entered or the submission will be rejected. Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* for more information.

For Maximo Integration, click the arrow next to the Failure Date: field to open a calendar that can be used to set the time and date stamp on the Fault Report.

6. To submit to the Maximo or SAP/PM system only, do not select an Action List in the **Select an Action List:** drop-down list box. To submit to the Maximo or SAP/PM select the check box and make a selection in the drop-down list box.

7. Click **Submit Fault Report**.

If an asset monitor assignment changes from one AO server to another, the Fault Reports associated with the Asset Monitor will no longer be accessible. Ensure that the fault reports are reviewed and dispositioned before changing the AO server node assignment.

Alarm and Event List Operation

There are two categories of alarms that are used exclusively by Asset Optimization:

Asset Condition Alarm: Generated by an Asset Monitor when an abnormal asset condition is detected. An example of an Asset Condition Alarm is when the hours of operation of an asset (equipment) has been exceeded. A suggested action might be some periodic preventative maintenance action.

Asset Monitoring Status Alarm: Generated when something is abnormal in the Asset Optimization execution environment. An example of an Asset Monitoring Status Alarm is when the Asset Monitoring Engine is unable to read OPC values. Another example is when a particular Asset Monitor is not properly configured and is unable to execute.

Individual Alarm and Event lists can be configured to filter on these categories. Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* for more detailed information.

Some preconfigured Alarm and Event lists that filter on these categories are automatically loaded with the Asset Optimization system extension. These Alarm and Event Lists are aspects of the Asset Optimization object in the Control Structure.

The All Asset Condition Alarms List Aspect (Figure 30) displays all Asset Condition Alarms in the 800xA System.

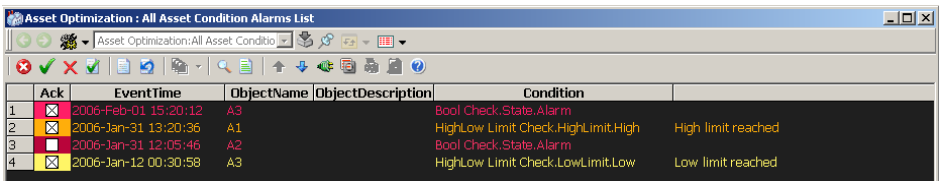

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Figure 30. All Asset Condition Alarms List

The All Asset Monitoring Status Alarms List Aspect (Figure 31) displays all Asset Monitoring Status Alarms in the system.

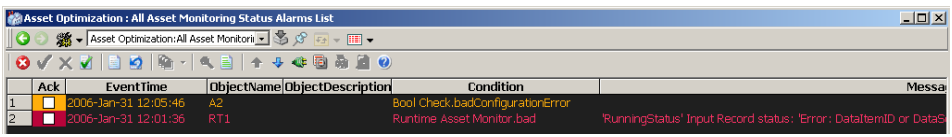

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Figure 31. All Asset Monitoring Status Alarms List

To acknowledge alarms:

1. Select **Alarm and Event List** from a context menu.
2. To acknowledge a single alarm, click on the **Ack State** box for the alarm in the list.
3. To acknowledge multiple alarms:
   a. Click on a row to select it. A selected row becomes highlighted.
   b. To select nonsequential rows: Press the CTRL key and click on another row.
   c. To select sequential groups of rows: Select the first row of interest, press the SHIFT key, and select the last row of interest. For example, select row 2, hold the SHIFT key and then select row 9 to select rows 2 through 9.

   -or-

Click and drag to select a sequence of rows.

d. Either right-click on a selected row and select **Acknowledge** from the context menu or click the green check mark at the top of the Alarm and Event List.

For detailed instructions on working within alarm and event lists, refer to the appropriate System 800xA documentation.

CMMS Views For Maximo Integration

The CMMS views consist of 800xA System views and Maximo portal views.

The CMMS views are similar except for the information that can be accessed or viewed; therefore, only a few representative views will be shown.

A Server Busy message may appear when calling up a CMMS View, Submit Fault Report View, and/or Create Fault Report Form. The server is busy because of concurrent access to any CMMS View, Fault Report Submitter View, and/or Create Fault Report Form from another node.

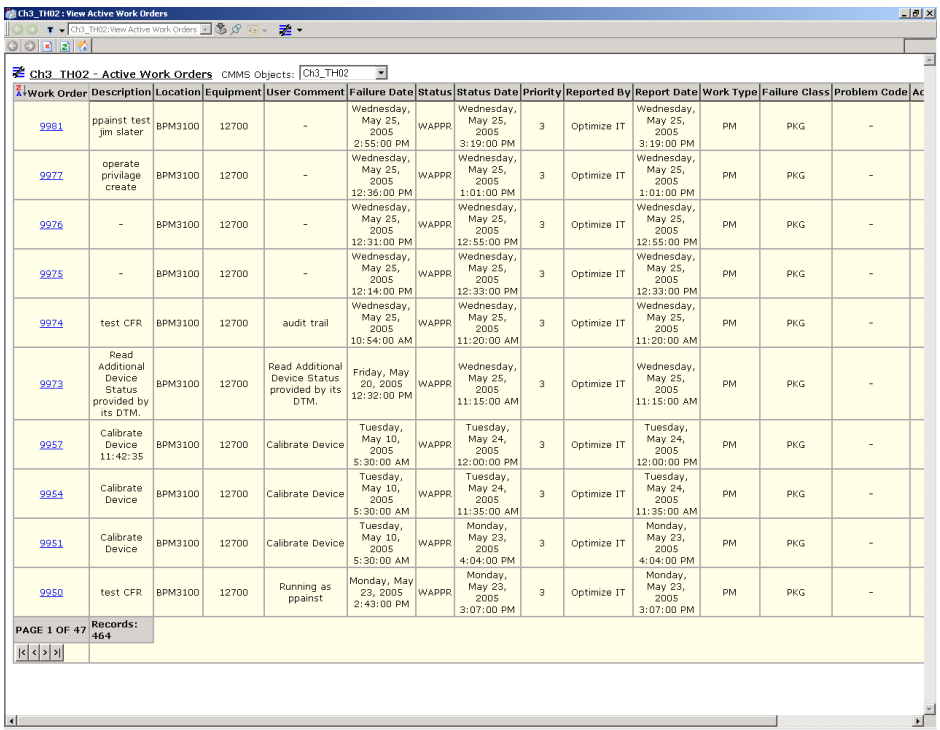
Retry accessing the CMMS view, Submit Fault Report View, and/or Create Fault Report Form. If the retry does not bring up the view, IIS has to be restarted. In order to restart IIS, click **Start** and type **`IISReset.exe`** in the text box and hit **Enter**.

If Asset Optimization is run in a single node environment with Central License Server on the same node, nuisance licensing messages may appear, but system operation is not affected.

Active Work Orders View

The Active Work Orders view lists all active Work Orders in the CMMS for a particular asset or group of assets.

1. Select **View Active Work Orders** from a context menu to open an 800xA System Active Work Orders view such as the one shown in Figure 32.



Work Order	Description	Location	Equipment	User Comment	Failure Date	Status	Status Date	Priority	Reported By	Report Date	Work Type	Failure Class	Problem Code	Ac
9981	ppainst test jim slater	BPM3100	12700	-	Wednesday, May 25, 2005 2:55:00 PM	WAPPR	Wednesday, May 25, 2005 3:19:00 PM	3	Optimize IT	Wednesday, May 25, 2005 3:19:00 PM	PM	PKG	-	
9977	operate privilage create	BPM3100	12700	-	Wednesday, May 25, 2005 12:36:00 PM	WAPPR	Wednesday, May 25, 2005 1:01:00 PM	3	Optimize IT	Wednesday, May 25, 2005 1:01:00 PM	PM	PKG	-	
9976	-	BPM3100	12700	-	Wednesday, May 25, 2005 12:31:00 PM	WAPPR	Wednesday, May 25, 2005 12:55:00 PM	3	Optimize IT	Wednesday, May 25, 2005 12:55:00 PM	PM	PKG	-	
9975	-	BPM3100	12700	-	Wednesday, May 25, 2005 12:14:00 PM	WAPPR	Wednesday, May 25, 2005 12:33:00 PM	3	Optimize IT	Wednesday, May 25, 2005 12:33:00 PM	PM	PKG	-	
9974	test CFR	BPM3100	12700	audit trail	Wednesday, May 25, 2005 10:54:00 AM	WAPPR	Wednesday, May 25, 2005 11:20:00 AM	3	Optimize IT	Wednesday, May 25, 2005 11:20:00 AM	PM	PKG	-	
9973	Read Additional Device Status provided by its DTM.	BPM3100	12700	Read Additional Device Status provided by its DTM.	Friday, May 20, 2005 12:32:00 PM	WAPPR	Wednesday, May 25, 2005 11:15:00 AM	3	Optimize IT	Wednesday, May 25, 2005 11:15:00 AM	PM	PKG	-	
9957	Calibrate Device 11:42:35	BPM3100	12700	Calibrate Device	Tuesday, May 10, 2005 5:30:00 AM	WAPPR	Tuesday, May 24, 2005 12:00:00 PM	3	Optimize IT	Tuesday, May 24, 2005 12:00:00 PM	PM	PKG	-	
9954	Calibrate Device	BPM3100	12700	Calibrate Device	Tuesday, May 10, 2005 5:30:00 AM	WAPPR	Tuesday, May 24, 2005 11:35:00 AM	3	Optimize IT	Tuesday, May 24, 2005 11:35:00 AM	PM	PKG	-	
9951	Calibrate Device	BPM3100	12700	Calibrate Device	Tuesday, May 10, 2005 5:30:00 AM	WAPPR	Monday, May 23, 2005 4:04:00 PM	3	Optimize IT	Monday, May 23, 2005 4:04:00 PM	PM	PKG	-	
9950	test CFR	BPM3100	12700	Running as ppainst	Monday, May 23, 2005 2:43:00 PM	WAPPR	Monday, May 23, 2005 3:07:00 PM	3	Optimize IT	Monday, May 23, 2005 3:07:00 PM	PM	PKG	-	

Figure 32. 800xA System Active Work Orders View (Maximo Integration)

2. The **CMMS Objects:** drop-down list box contains choices of which set of active Work Orders to view.
   a. Selecting the **current asset** shows the Work Orders only for that asset.
   b. Selecting a specific **Operational Structure** will produce a Work Order list for the selected asset and all its children in that particular structure.

c. Selecting **All Structures** will produce Work Order list for the selected asset and all of its children in all structures in which the current asset is contained.

3. To sort the list with respect to a column header topic, click that **column header**.

4. Clicking on a highlighted hyperlink in the **Work Order** column opens a portal into the Maximo web system, navigating to the Work Order information page corresponding to the number highlighted as the hyperlink. This is a Maximo web view that allows direct interaction with the data. If the user has appropriate access, changes to the data can be made.

   Figure 33 shows an example of a Maximo Active Work Order portal view.

The Maximo web system prompts the user to provide the Maximo User Credentials (that is, Maximo Username and Password) while accessing the *Portal View*. Figure 33 is displayed after successful authorization of Maximo User Credentials.

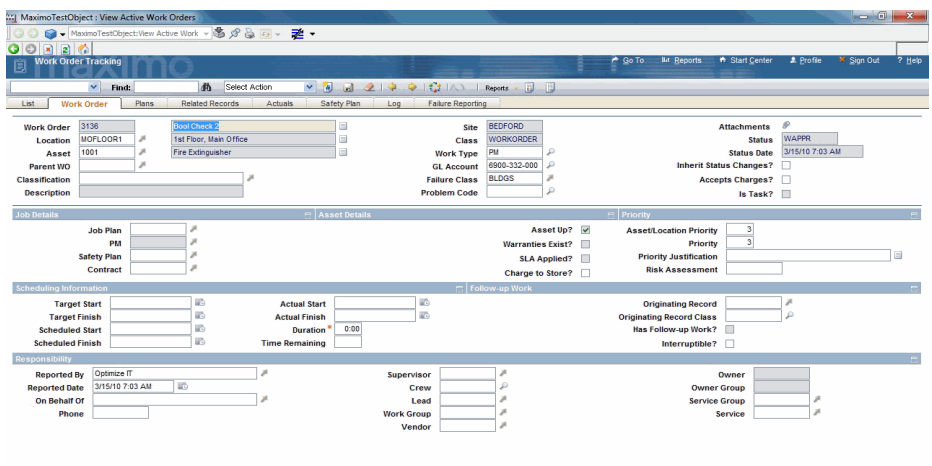


Figure 33. Maximo 6.2 Active Work Order Portal

5. Selecting subsequent hyperlinks in the 800xA System Active Work Orders view will open that Maximo Active Work Order web view in the same window as the previous one. The previous Active Work Order is retained in history and can be accessed by clicking the back button in the web browser.

Work Order History View

The Work Order History view lists the history of all Work Orders in the CMMS for a particular asset or group of assets.

1. Select **View Work Order History** from a context menu to open an 800xA System Work Order History view.
2. The **CMMS Objects:** drop-down list box contains choices of which set of Work Order history to view.
   a. Selecting the **current asset** shows the Work Order history only for that asset.
   b. Selecting a specific **Operational Structure** will produce a Work Order history list for the selected asset and all its children in that particular structure.
   c. Selecting **All Structures** will produce a Work Order history list for the selected asset and all of its children in all structures in which the current asset is contained.
3. To sort the list with respect to a column header topic, click that **column header**.
4. Clicking on a highlighted hyperlink in the **Work Order** column opens a portal into the Maximo web system, navigating to the Work Order History information page corresponding to the number highlighted as the hyperlink. This is a Maximo web view that allows direct interaction with the data. If the user has appropriate access, changes to the data can be made.
5. Selecting subsequent hyperlinks in the 800xA System Work Order History view will open that Maximo Work Order History web view in the same window as the previous one. The previous Work Order History is retained in history and can be accessed by clicking the back button in the web browser.

Equipment Status View

The Equipment Status view shows data returned from a status assessment of an asset or group of assets.

1. Select **View Equipment Status** from a context menu to open an 800xA System Equipment Status view.
2. The **CMMS Objects:** drop-down list box contains choices of which set of equipment status to view.
   a. Selecting the **current asset** shows the equipment status only for that asset.
   b. Selecting a specific **Operational Structure** will produce an equipment status list for the selected asset and all its children in that particular structure.
   c. Selecting **All Structures** will produce an equipment status list for the selected asset and all of its children in all structures in which the current asset is contained.
3. To sort the list with respect to a column header topic, click that **column header**.

Preventive Maintenance Schedule View

The Preventive Maintenance Schedule view lists the preventive maintenance schedule for an asset or group of assets.

1. Select **View Prev Maint Schedule** from a context menu to open an 800xA System Preventive Maintenance Schedule view.
2. The **CMMS Objects:** drop-down list box contains choices of which set of preventive maintenance schedules to view.
   a. Selecting the **current asset** shows the preventive maintenance schedules only for that asset.
   b. Selecting a specific **Operational Structure** will produce a preventive maintenance schedule list for the selected asset and all its children in that particular structure.

c. Selecting **All Structures** will produce a preventive maintenance schedule list for the selected asset and all of its children in all structures in which the current asset is contained.

3. To sort the list with respect to a column header topic, click that **column header**.

Spare Parts/Availability of Spare Parts Views

The Spare Parts view lists spare parts in the CMMS for a particular asset or group of assets. The **Item Number** column contains hyperlinks to the Availability of Spare Parts view that shows the location, quantity available, measurement unit, and cost of the selected spare part.

1. Select **View Spare Parts** from a context menu to open an 800xA System Spare Parts view.
2. The **CMMS Objects:** drop-down list box contains choices of which set of spare parts to view.
   a. Selecting the **current asset** shows the spare parts only for that asset.
   b. Selecting a specific **Operational Structure** will produce a spare parts list for the selected asset and all its children in that particular structure.
   c. Selecting **All Structures** will produce a spare parts list for the selected asset and all of its children in all structures in which the current asset is contained.
3. To sort the list with respect to a column header topic, click that **column header**.
4. To view the availability of spare parts, click on the desired hyperlink in the **Item Number** column and an 800xA System Availability of Spare Parts view appears. If the part selected was not assigned to inventory, the error message shown Figure 34 appears.

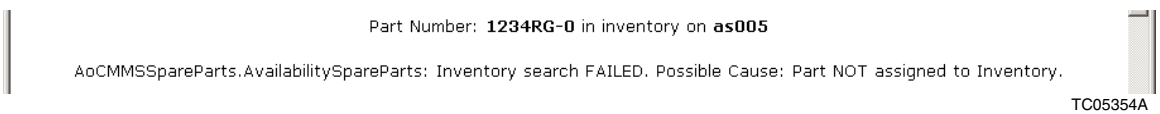


Figure 34. Availability of Spare Parts Error Message (Maximo Integration)

5. To sort the list with respect to a column header topic, click that **column header**.
6. Selecting subsequent hyperlinks in the 800xA System Spare Parts view will open that Spare Part web view in the same window as the previous one. The previous Spare Part is retained in history and can be accessed by clicking the back button in the web browser.

CMMS Views For SAP/PM Integration

The CMMS views consist of 800xA System views and SAP/PM portal views.

The CMMS views are similar except for the information that can be accessed or viewed; therefore, only a few representative views will be shown.

A Server Busy message may appear when calling up a CMMS View, Submit Fault Report View, and/or Create Fault Report Form. The server is busy because of concurrent access to any CMMS View, Fault Report Submitter View, and/or Create Fault Report Form from another node.

Retry accessing the CMMS view, Submit Fault Report View, and/or Create Fault Report Form. If the retry does not bring up the view, IIS has to be restarted. In order to restart IIS, click **Start** and type **`IISReset.exe`** in the text box and hit **Enter**.

If Asset Optimization is run in a single node environment with Central License Server on the same node, nuisance licensing messages may appear, but system operation is not affected.

Active Work Orders View

The Active Work Orders view lists all active Work Orders in the CMMS for a particular asset or group of assets.

1. Select **View Active Work Orders** from a context menu to open an 800xA System Active Work Orders view such as the one shown in Figure 35.

The SAP/PM web system prompts the user to provide the SAP User Credentials (that is, SAP Username and Password) while accessing the *Portal View*. Figure 35 is displayed after successful authorization of SAP User Credentials.

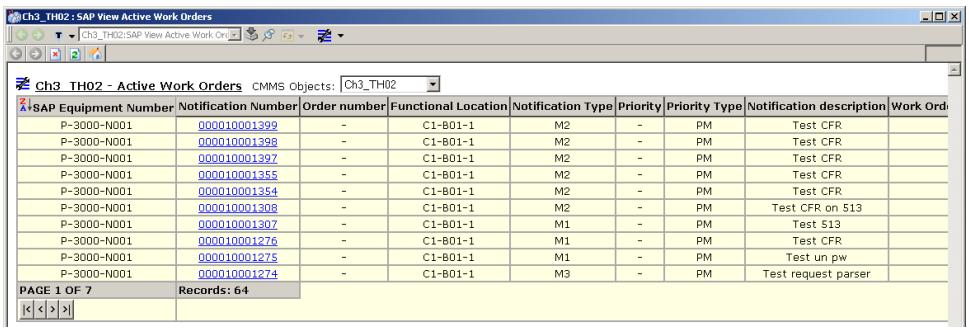


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Figure 35. 800xA System Active Work Orders View (SAP/PM Integration)

2. The **CMMS Objects:** drop-down list box contains choices of which set of active Work Orders to view.
   a. Selecting the **current asset** shows the Work Orders only for that asset.
   b. Selecting a specific **Operational Structure** will produce a Work Order list for the selected asset and all its children in that particular structure.
   c. Selecting **All Structures** will produce a Work Order list for the selected asset and all of its children in all structures in which the current asset is contained.
3. To sort the list with respect to a column header topic, click that **column header.**
4. Clicking on a highlighted hyperlink in the **Notification Number** or **Order Number** column opens a portal into the SAP/PM web system, navigating to the specific data represented by the number of the Notification or Work Order. This is a SAP/PM web view that allows direct interaction with the data. If the user has appropriate access, changes to the data can be made. Figure 36 shows an example of the SAP/PM Notification portal and Figure 37 shows an example of the SAP/PM Work Order portal.
5. The browser window will remain open until it is closed by the operator or until the SAP/PM system closes the session. Select **Menu -> System -> Log Off** to log off from the SAP/PM System before navigating to other Aspect. While the

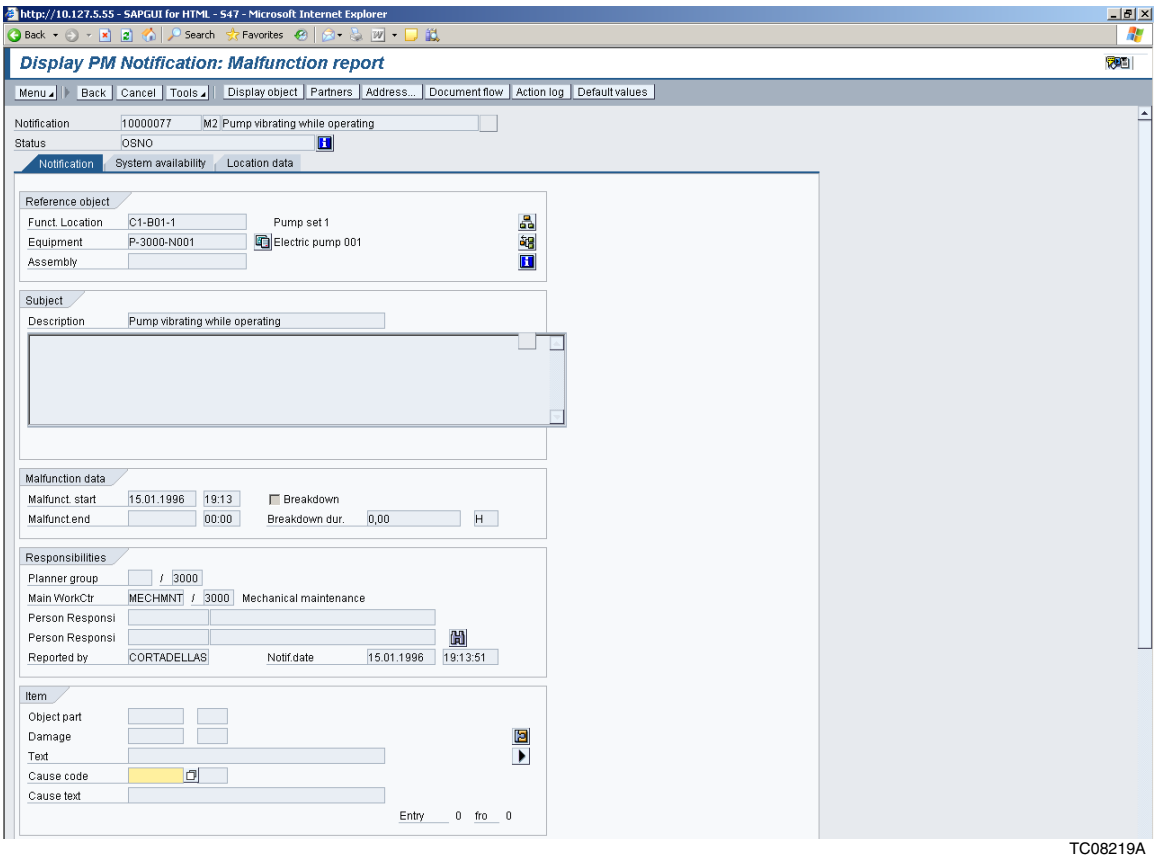

Figure 36. SAP/PM Notification Portal View

window is open, immediate history is available and accessible using the back and forward buttons.

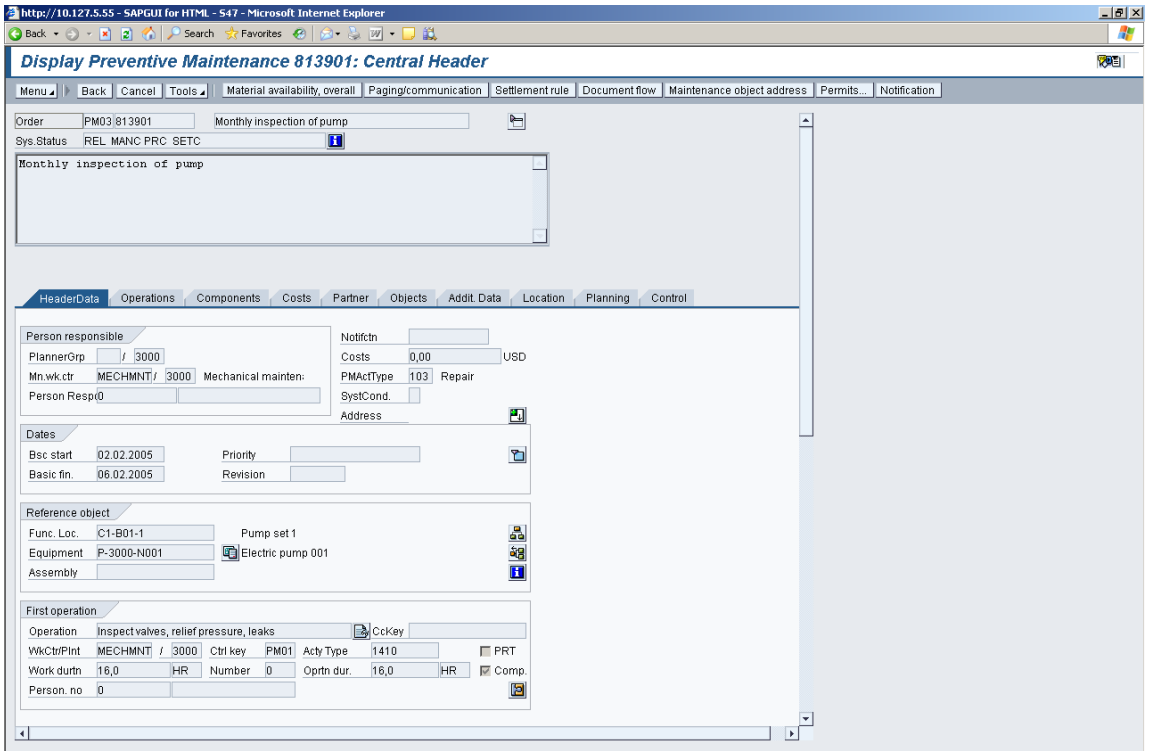

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Figure 37. SAP/PM Work Order Portal View

Work Order History View

The Work Order History view lists the history of all Work Orders in the CMMS for a particular asset or group of assets.

1. Select **View Work Order History** from a context menu to open an 800xA System Work Order History view.
2. The **CMMS Objects:** drop-down list box contains choices of which set of Work Order history to view.

a. Selecting the **current asset** shows the Work Order history only for that asset.

b. Selecting a specific **Operational Structure** will produce a Work Order history list for the selected asset and all its children in that particular structure.

c. Selecting **All Structures** will produce a Work Order history list for the selected asset and all of its children in all structures in which the current asset is contained.

3. To sort the list with respect to a column header topic, click that **column header**.

4. Clicking on a highlighted hyperlink in the **Notification Number** or **Order Number** column opens a portal into the SAP/PM web system, navigating to the specific data represented by the number of the Notification or Work Order. This is a SAP/PM web view that allows direct interaction with the data. If the user has appropriate access, changes to the data can be made.

5. The browser window will remain open until it is closed by the operator or until the SAP/PM system closes the session. Select **Menu** -> **System** -> **Log Off** to log off from the SAP/PM System before navigating to other Aspect. While the window is open, immediate history is available and accessible using the back and forward buttons.

Equipment Status View

The Equipment Status view shows data returned from a status assessment of an asset or group of assets.

1. Select **View Equipment Status** from a context menu to open an 800xA System Equipment Status view.

2. The **CMMS Objects:** drop-down list box contains choices of which set of equipment status to view.

   a. Selecting the **current asset** shows the equipment status only for that asset.

   b. Selecting a specific **Operational Structure** will produce an equipment status list for the selected asset and all its children in that particular structure.

c. Selecting **All Structures** will produce an equipment status list for the selected asset and all of its children in all structures in which the current asset is contained.

3. To sort the list with respect to a column header topic, click that **column header.**

Preventive Maintenance Schedule View

The Preventive Maintenance Schedule view lists the preventive maintenance schedule for an asset or group of assets.

1. Select **View Prev Maint Schedule** from a context menu to open an 800xA System Preventive Maintenance Schedule view.
2. The **CMMS Objects:** drop-down list box contains choices of which set of preventive maintenance schedules to view.
   a. Selecting the **current asset** shows the preventive maintenance schedule only for that asset.
   b. Selecting a specific **Operational Structure** will produce a preventive maintenance schedule list for the selected asset and all its children in that particular structure.
   c. Selecting **All Structures** will produce a preventive maintenance schedule list for the selected asset and all of its children in all structures in which the current asset is contained.
3. To sort the list with respect to a column header topic, click that **column header.**
4. Clicking on a highlighted hyperlink in the **Notification Number** or **Order Number** column opens a portal into the SAP/PM web system, navigating to the specific data represented by the number of the Notification or Work Order. This is a SAP/PM web view that allows direct interaction with the data. If the user has appropriate access, changes to the data can be made.
5. The browser window will remain open until it is closed by the operator or until the SAP/PM system closes the session. Select **Menu -> System -> Log Off** to log off from the SAP/PM System before navigating to other Aspect. While the window is open, immediate history is available and accessible using the back and forward buttons.

Section 6 Web-Enabled Views

Operation

This procedure describes how to access web-enabled views of the Asset Tree from a Windows-based, non-800xA computer running Microsoft Internet Explorer.

1. Open a Microsoft Internet Explorer window.
2. Navigate to the following address:

   http://AoServer/ABBAO

   Where **AoServer** is the AO Main Server node.
3. If prompted to install ActiveX controls, click **Yes**. A view such as the one shown in Figure 38 appears.

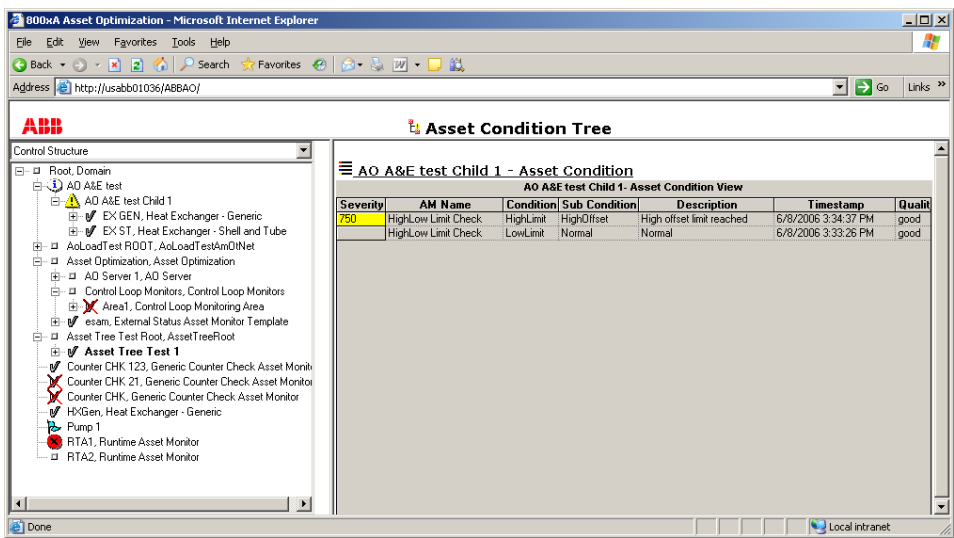

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Figure 38. Web-Enabled View of Asset Tree

The functionality of the Asset Tree is the same as the one described under Asset Viewer on page 29, and all of the functionality described in this User Manual is accessible through the web-enabled views. The difference is that a web-enabled view is not dynamically updated when a condition changes. Therefore, it requires a manual refresh.

Section 7 Faceplates

Introduction

Some Asset Monitors may expose information using faceplates. Asset Monitoring faceplates include:

- Runtime Faceplate.
- Generic Counter Check Faceplate.

Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* to set up and configure the faceplates described in this section.

Runtime Faceplate

The Running Time Check Asset Monitor monitors the accumulated runtime hours of a device and notifies, for preventive maintenance, that the runtime has accumulated up to a configured limit. The Running Time Check Asset Monitor has a user interface (the Runtime Faceplate), that displays runtime data and allows the user to reset the runtime. Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* to set up, configure, and become familiar with the Asset Parameters, Input Records, and Output Records of the Running Time Check Asset Monitor.

Figure 39 shows an example Runtime Faceplate where the Runtime Limit is 24 hours.

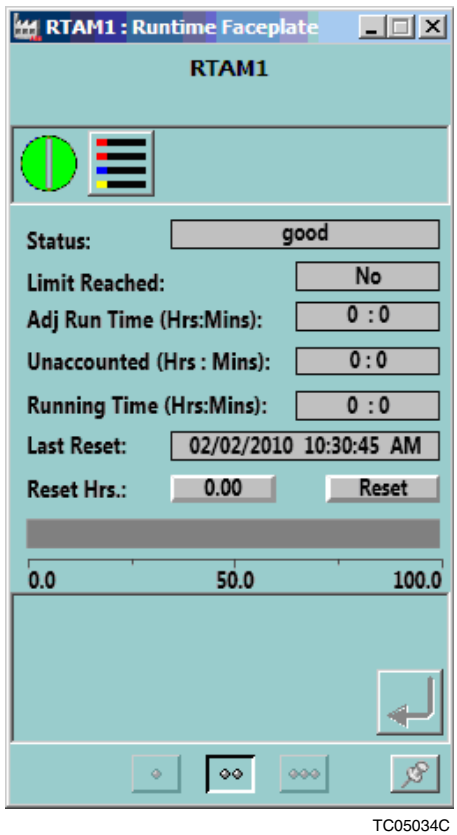


Figure 39. Runtime Faceplate (Example)

Table 7 lists and describes the elements in the Runtime Faceplate.

Table 7. Runtime Faceplate Elements

Element	Description
Status	Displays whether or not the Asset Monitor is monitoring the running status of the asset. An example of when the Asset Monitor may not monitor the running status of the asset is when the Monitoring Server is shut down.

Table 7. Runtime Faceplate Elements (Continued)

Element	Description
Limit Reached	Indicates whether or not the running time limit has been reached.
Adj Run Time Hrs. (adjusted running time hours)	An adjusted running time hours estimate based on the percentage of unaccounted runtime hours (for instance, when the Monitoring Server is shut down) added to the monitored running time hours.
Unaccounted Hrs.	Amount of time the Asset Monitor did not monitor the running status of the asset (for instance, when the Monitoring Server is shut down). The amount of time **Status:** is not good.
Running Time Hrs.	Amount of time the Asset Monitor did monitor the running status of the asset (**Status:** good).
Last Reset	Time and date of the last running time hours reset.
Reset Hrs.	Used to reset the runtime. 1. Click to set the initial runtime hours. 2. Click **Reset**.

Generic Counter Check Faceplate

The Generic Counter Check Asset Monitor Faceplate is provided in the Generic Counter Check Asset Monitor object type. It is a sample that can be customized in the Object Type using the Counter Check Asset Monitor.

Figure 40 shows an example Generic Counter Check Faceplate.

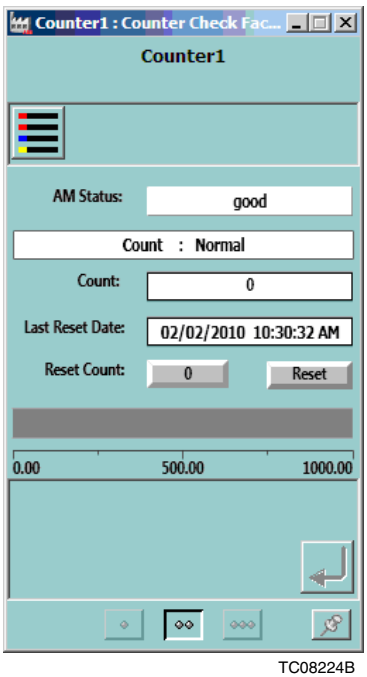


Figure 40. Generic Counter Check Faceplate (Example)

Table 8 lists and describes the elements in the Generic Counter Check Faceplate.

Table 8. Generic Counter Check Faceplate Elements

Element	Description
AM Status	Indicates the overall Asset Monitor status where `good` means that the Asset Monitor is properly configured and operational.

Table 8. Generic Counter Check Faceplate Elements (Continued)

Element	Description
Counter Condition Indication	Reports the counter condition label and its current subcondition text. The text is color coded based on the condition severity.
Count	The current transition count of the monitored asset.
Last Reset Date	The date and time the Asset Monitor count was last reset.
Reset Count Input	Value used as the initial count upon issuing a reset.
Reset Input Button	When pressed, it will signal the Asset Monitor to reset the counter to the specified initial count.

Section 8 Control Loop Asset Monitor (CLAM)

Introduction

Control Loop Asset Monitors (CLAM) are set up in the 800xA System to monitor control loops. They display the complex analysis of control loops in a user friendly manner in real time.

Each Control Loop Asset Monitor is associated with its own control loop. The controllers continuously provide process value (PV), set point (SP), and control output (CO) data. This data is captured by the 800xA System as OPC data. The Control Loop Asset Monitor is configured to receive PV, SP, and CO data from its control loop into its Asset Monitor Input Parameters.

After sufficient data is collected, it is sent to the CLAM auditing logic. Using the Matlab runtime library with this data, the auditing logic performs loop analysis and sends the results back as loop diagnosis. The loop diagnosis is published by the Control Loop Asset Monitor Aspect of the Control Loop Asset Monitor Ex object type instance.

The Control Loop Asset Monitor provides user friendly access to the control loop diagnosis information for a large number of controllers. This information is organized so that it is quick and easy to read and interpret. Multiple stages of loop failure modes are provided, so that a problem can be detected and rectified before it becomes too severe and affects plant operation.

Additional details are provided that are easy to access. These include input data Trend Display to show input data. Diagnosis log files show history of diagnosis results values. Output Records show indices values for in-depth analysis of loop condition.

This section describes Control Loop Asset Monitor operation. It assumes that installation, post installation, and configuration procedures are complete.

Before performing operational activities related to Control Loop Asset Monitors, consider the following:

- The AO Servers should have been configured as part of post installation process. If they have not been configured, refer to the Asset Optimization section in *System 800xA Post Installation (3BUA000156*)*.
- The Control Loop Asset Monitor configurations should have been loaded into the AO Server as part of configuration process. If they have not been loaded, refer to *System 800xA Asset Optimization Configuration (3BUA000118*)*.
- AO Server requires a minimum of three seconds to properly execute each Asset Monitor. The default execution time is 8 hours. The Logic Execution Interval should have been set as part of configuration process. If it has not been set, refer to *System 800xA Asset Optimization Configuration (3BUA000118**).
- When AO Server is not running, the Asset Monitor displays idle state of all Control Loop Asset Monitors.
- If something is wrong or missing, AO Server displays appropriate error messages. Take necessary corrective action to clear error message. After taking corrective action, it may be necessary to reload Control Loop Asset Monitors or stop and restart AO Server.
- Runtime statistics can be used to review and troubleshoot the overall Asset Monitor execution details.

CLAM AO Server Runtime Statistics will not be available while CLAM is under execution.

Running the Control Loop Asset Monitor

Starting the AO Server will start running all loaded Control Loop Asset Monitors. CLAM logic operates in the modes:

- Basic Loop Monitoring mode (Unlicensed).
- Enhanced Control Loop Monitoring mode (Licensed).

Basic Loop Monitoring Mode (Unlicensed)

The CLAM logic uses history services of 800xA System to read PV, SP and CO inputs from log configuration continuously. The Log configuration is necessary for

running a successful CLAM. Refer to ***System 800xA Asset Optimization Configuration (3BUA000118*)*** **- Control Loop Asset Monitor Input Data Storage and Display Configuration** for details about log template. After the specified Data Set size is collected, it sends these values to the Loop Performance Monitoring audit for loop diagnosis information. The diagnosis thus collected are displayed by the CLAM.

In **Control Structure** go to **Control Loop Asset Monitor Ex Object** instance. By default it shows CLAM faceplate Aspect. To see **Control Loop Asset Monitor** Aspect, select **Control Loop Asset Monitor** Aspect in Object type instance.

The CLAM **Asset Monitor** Aspect displays **Condition** details (refer Figure 41) of:

- Final Control Element (FCE) Summary
- Loop Performance Summary

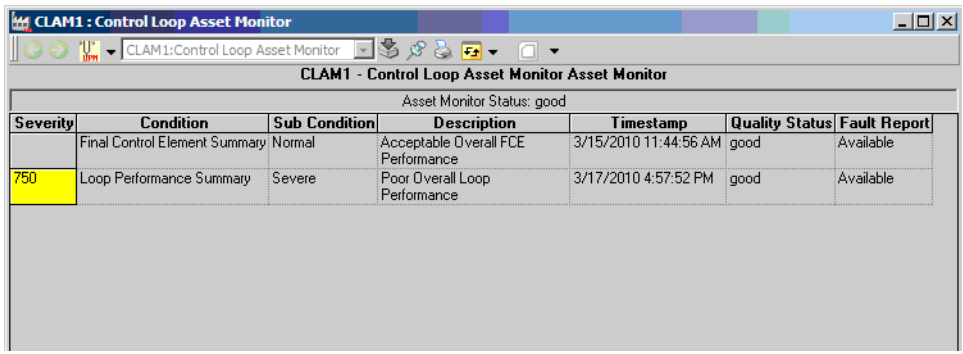


Figure 41. Control Loop Asset Monitor instance (Unlicensed mode operation)

The asset monitor status shows good and condition details of FCE and Loop Performance Summary display as unlicensed. During Unlicensed mode of operation suggested action will be not be displayed. View the asset monitor status by right-clicking **Asset Monitor Status**. Click **Conditions** for Condition details of CLAM

as shown in Figure 42.

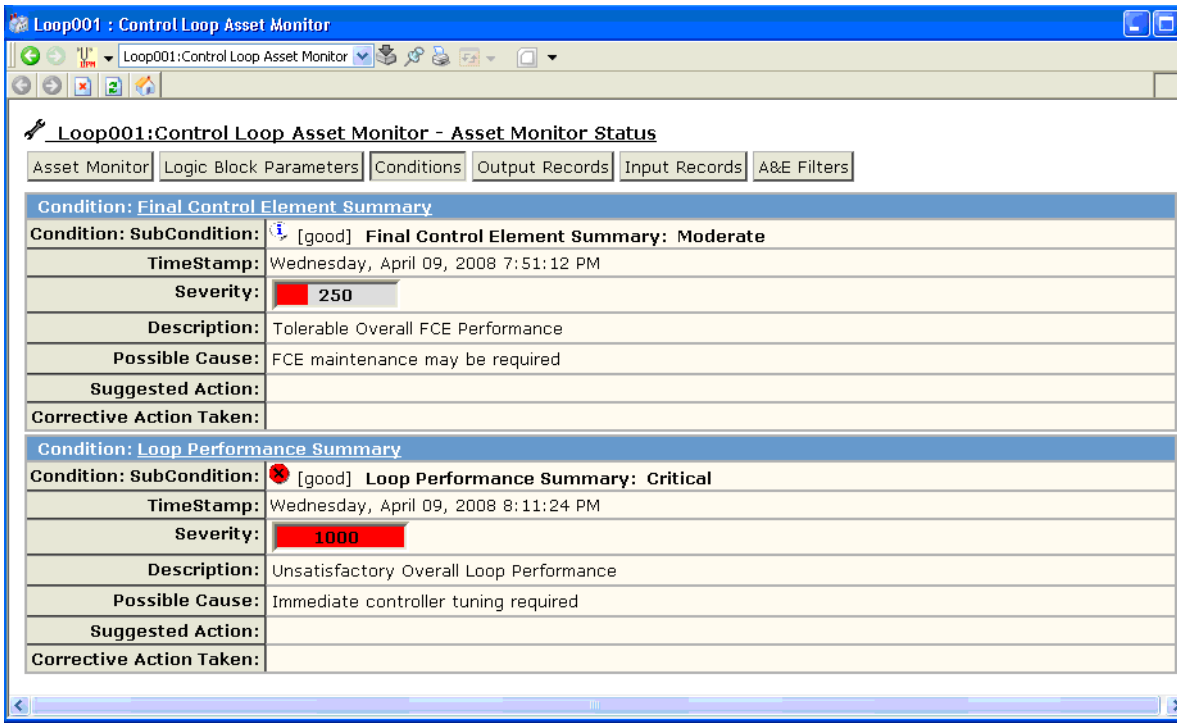


Figure 42. Condition details of Control Loop Asset Monitor

Faceplate has the following tab views in operator mode (Figure 43):

- Status
- Final controller element details
- Loop performance details
- Trend

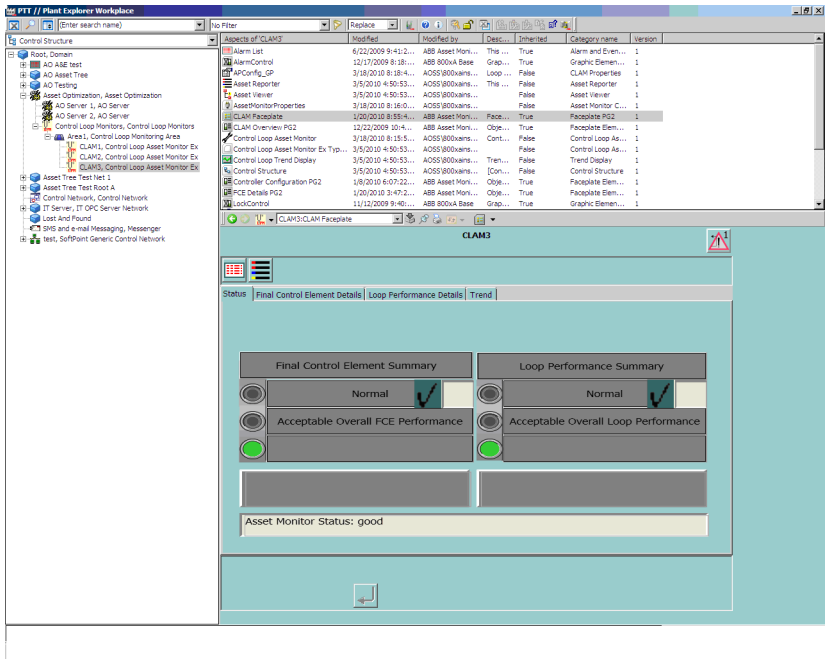


Figure 43. Typical faceplate view in operator's role (Unlicensed)

In addition to the above tabs, an application engineer sees two more tabs. They are:

- Controller configuration
- Loop configuration

These tabs are useful in configuring CLAM for various parameters specific to controller and loop. Figure 44 shows the typical configured CLAM faceplate under application engineer's and operator's role.

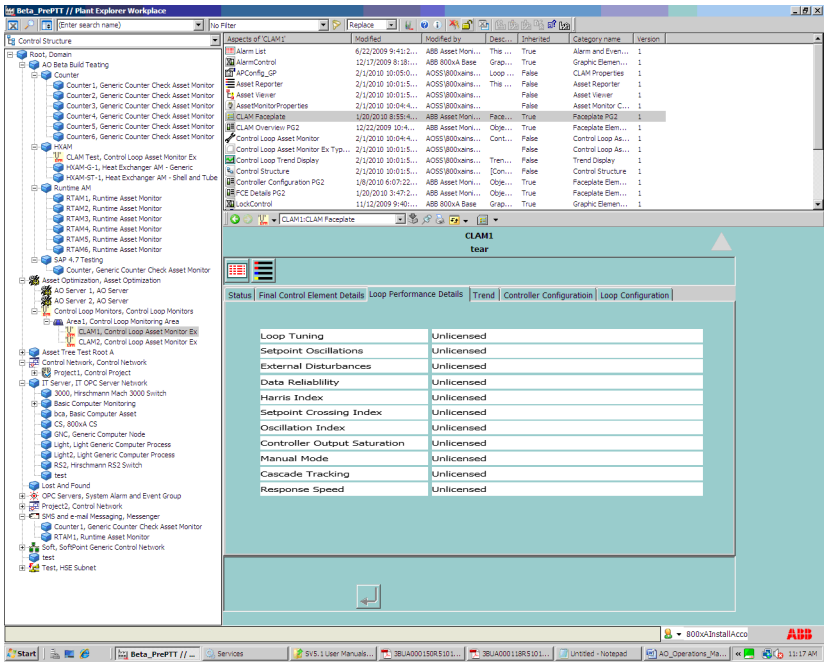


Figure 44. Typical faceplate view in application engineer's role (Unlicensed)

Control Loop Asset Monitor Results

The Control Loop Asset Monitor information is consolidated in the CLAM Loop faceplate. To access the faceplate:

1. Open a Plant Explorer Workplace.
2. Use Structure Selector to open **Control Structure**.
3. Use Object Browser to navigate and select the Control Loop Asset Monitor of interest.

4. Select **CLAM Faceplate** in the Aspect List Area to launch CLAM Faceplate in Preview Area.

The faceplate has multiple tabs with access to the most important aspects for reviewing results or entering configuration. Some of the tabs are:

- **Final Control Element Details** (Figure 45): Used to view final control element diagnosis information and indices. Diagnosis information does not appear in the figure as it is under unlicensed mode.

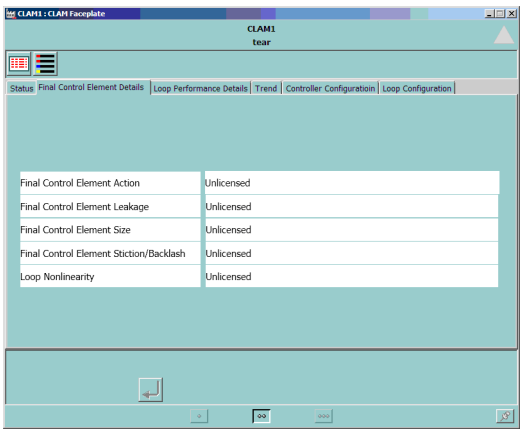


Figure 45. Final Control Element details (Unlicensed)

- **Loop Performance Details** (Figure 46): Used to view Control Loop Asset Monitor summary results. Diagnosis information does not appear in the figure as it is under unlicensed mode.

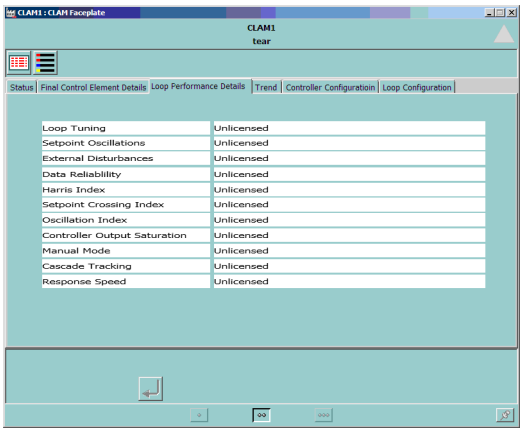


Figure 46. Loop Performance Details (Unlicensed)

Enhanced Control Loop Monitoring Mode (Licensed mode)

The CLAM Asset Monitor Aspect displays **Condition** details (Figure 47) of:

- Final Control Element (FCE) Summary
- Loop Performance Summary.

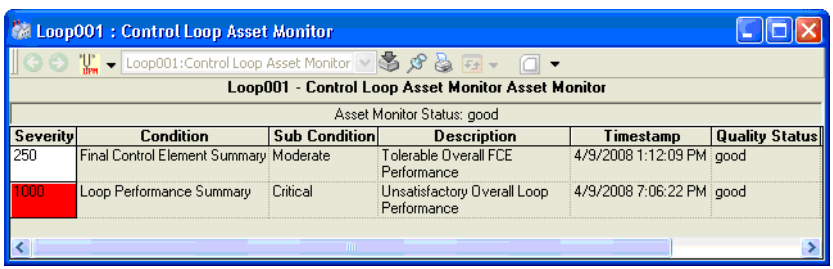


Figure 47. Control Loop Asset Monitor instance (Licensed mode operation)

The Asset Monitor status continuously displays and evaluates **Condition** details of **FCE** and **Loop Performance Summary**. View the asset monitor status by right-clicking **Asset Monitor Status**.

Click **Conditions** for **Condition** details of CLAM as shown in Figure 48. In licensed mode, CLAM diagnostics are displayed as **Suggested Action**.

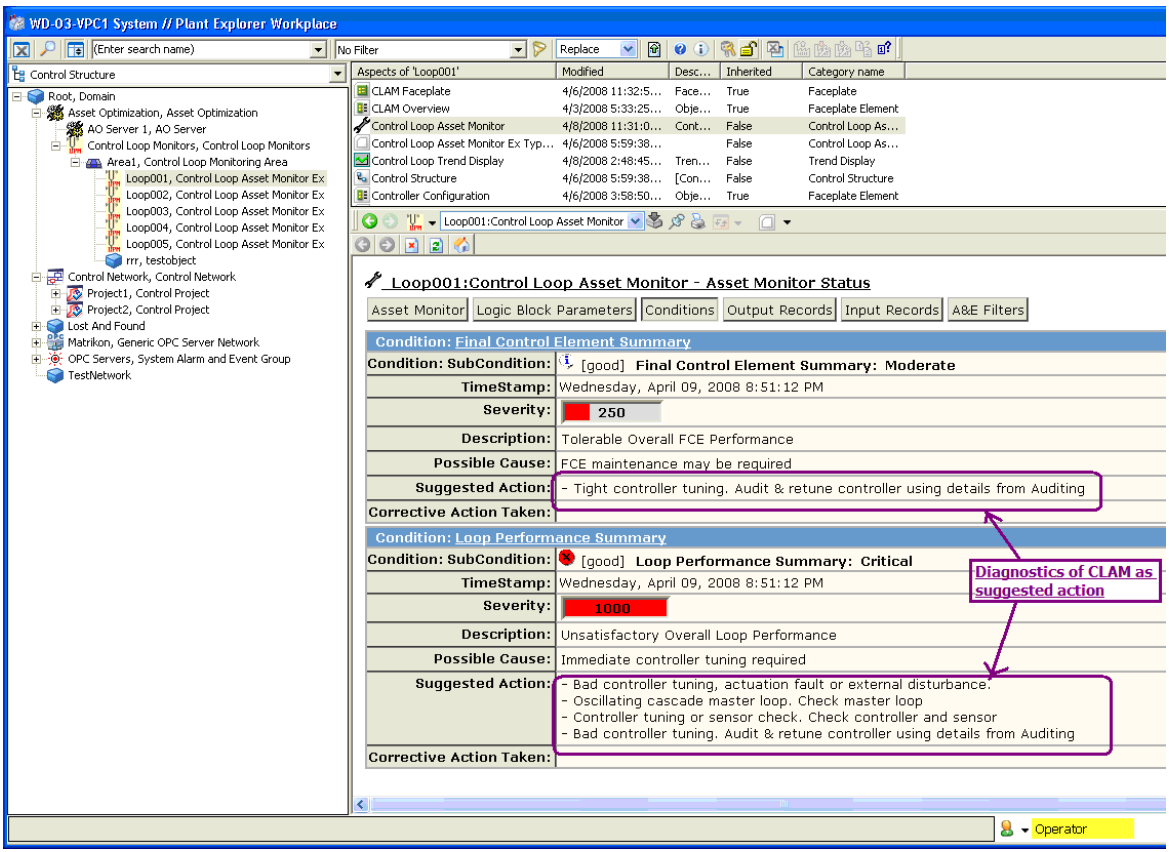


Figure 48. CLAM diagnostics

Faceplate has the following tab views in operator mode (Figure 49):

- Status
- Final controller element details

- Loop performance details
- Trend

In addition to the above tabs, an application engineer sees two more tabs. They are:

- Controller configuration
- Loop configuration

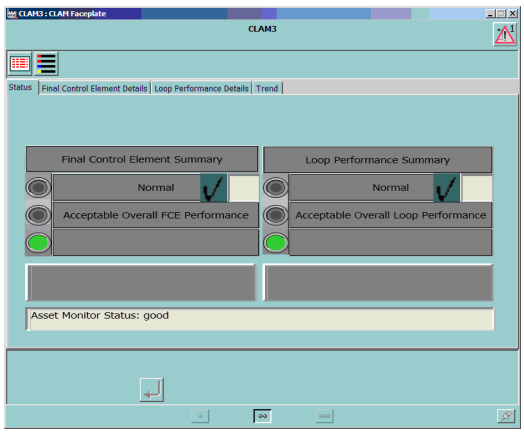


Figure 49. Typical Faceplate view in Operator's mode (licensed)

Control Loop Asset Monitor Results

The Control Loop Asset Monitor information is consolidated in the CLAM faceplate Aspect. To access the faceplate:

- Open a Plant Explorer Workplace.
- Use Structure Selector to open **Control Structure**.
- Use Object Browser to navigate and select the Control Loop Asset Monitor of interest.
- Select **CLAM Faceplate** in the Aspect List Area to launch the CLAM Faceplate in the Preview Area.

The faceplate has multiple tabs with access to the most important aspects for reviewing results or entering configuration. Some of the tabs are:

Final Control Element Details (Figure 50): Used to view final control element diagnosis information and indices. It shows various parameter details of FCE as shown in Figure 50 with diagnosis as tool tip text.

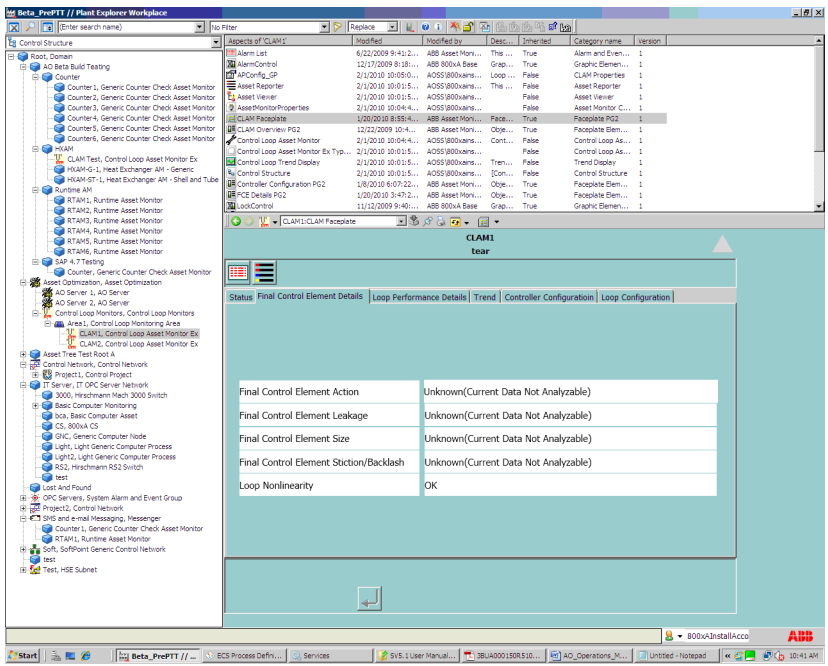


Figure 50. Final Control Element details (Licensed)

- **Loop Performance Details** (Figure 51): Used to view Control Loop Asset Monitor summary results. It shows various parameters details of FCE as shown

in Figure 51 with diagnosis as tool tip text.

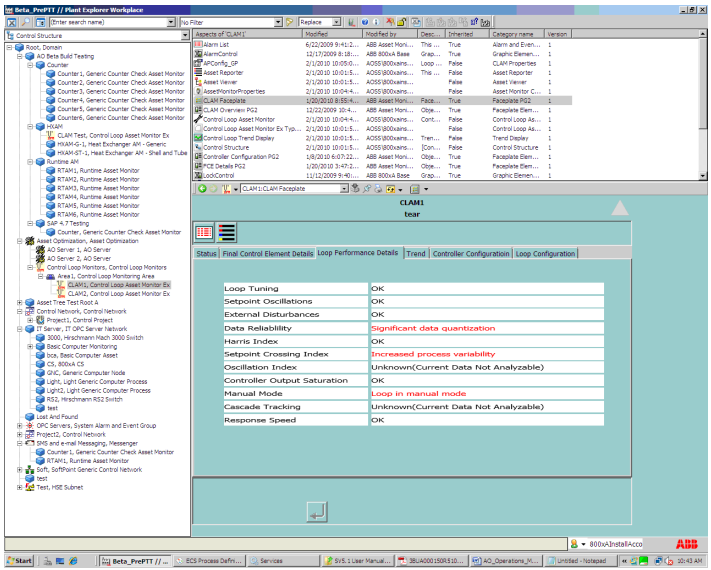


Figure 51. Loop Performance details (Licensed)

The CLAM acquires the parameters PV, SP, and CO of a control loop from history to calculate the Loop Diagnosis. It is worthwhile to consider the diagnosis by CLAM for a control loop when all the latest values (equal to DataSetSize) in the history are of good quality. In case the data set analyzed is not suitable for giving diagnosis, the CLAM will indicate the same on the faceplate. Loop Performance Monitoring Audit calculations evaluate the quality of input data based on the history values. The quality of input data is displayed as Loop Diagnosis information, for example Unknown (Current Data Not Analyzable).

Some parameters under **FCE** and **Loop Performance** tab may show `Unknown(Current Data Not Analyzable)`. This can happen during initial loading of the CLAM when it did not receive complete/sufficient data set values for diagnosis to be published.

After running long enough for loop auditing to execute, if parameters in the **FCE** and **Loop performance** read `Current Data Not Analyzable`, it indicates that

the **Asset Monitor** instance may not be receiving PV, SP, and CO data. Check the **Input Records** tab of the Asset Monitor and correct the **Data Source Items** configuration of that Asset Monitor instance for any errors in the entry. If errors are found in **Input Records**, correct the full path, source Aspect name for PV, SP and CO and the correct tag names for PV, CO and SP in the **Controller Configuration** tab.

Operation

CLAM is an automatic and non-invasive tool for PID control loop performance monitoring. It is based on a number of performance indices monitoring the health of the Final Control Element and the overall Loop Performance.

The principles of the calculations is described in Figure 52.

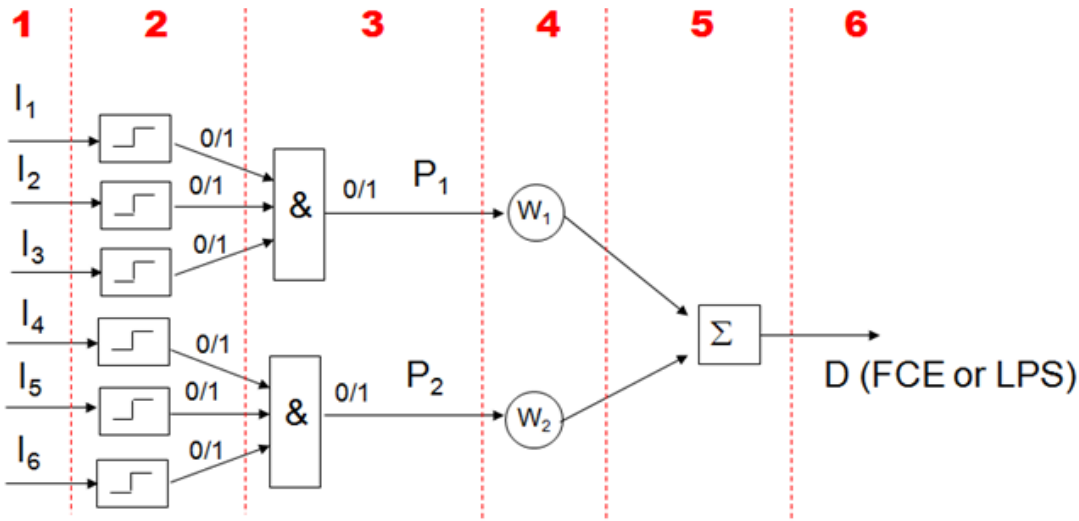


Figure 52. Principles of the calculations

1. First, a large number of performance indices are calculated. These are advanced mathematical calculations generating numerical values that represent the control loop performance or the health of the final control element.

2. The indices are compared with certain thresholds. If the threshold is exceeded, the resulting signal is set to one and to zero if not.
3. The thresholded signals are combined into pre-conditions/diagnoses.
4. The pre-conditions are multiplied with pre-defined weights. All weights are normalized with the sum of all weights so that the weighted signals sum to one if all pre-conditions are true.
5. The weighted signals are then summed together and the result is a numerical value of the loop health.
6. The sum is filtered according to the formula **$D_{current}$ = Filter*D + (1-Filter)*Dpast**. This means that the temporary errors will not affect the result as much as those which are present for a longer period of time.

The filtered sum is compared to certain severity levels and is presented in System 800xA alarm list.

In order to get reliable diagnoses, it is very important that the CLAM configuration parameters are properly configured.

Final Control Element Summary

The Final Control Element Summary calculation is described in Figure 53.

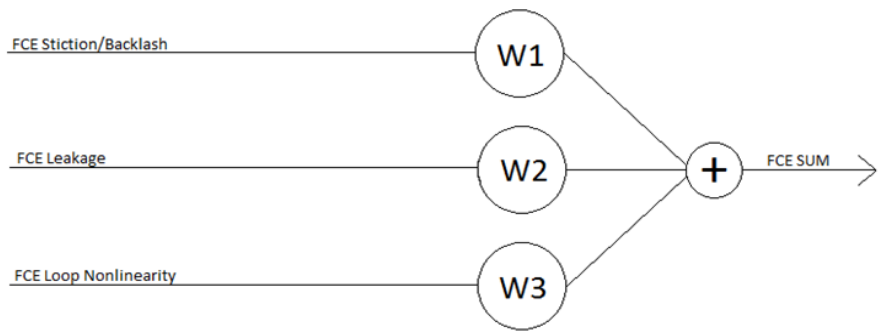


Figure 53. Final Control Element Summary Calculation

Performance indices for stiction/backlash, leakage and non-linearity are thresholded and multiplied with predefined weights.

The weights named W1, W2 and W3 corresponds to the asset parameters Weight_H_FCE_Stiction_Backlash, Weight_H_FCE_Leakage and Weight_H_Loop_Non-linearity as shown in Figure 53.

The weighted signals are summed that represents a health value for the FCE. This value is compared to predefined alarm thresholds to decide if an alarm is necessary.

Loop Performance Summary

The Loop Performance Summary calculation is described in Figure 54.

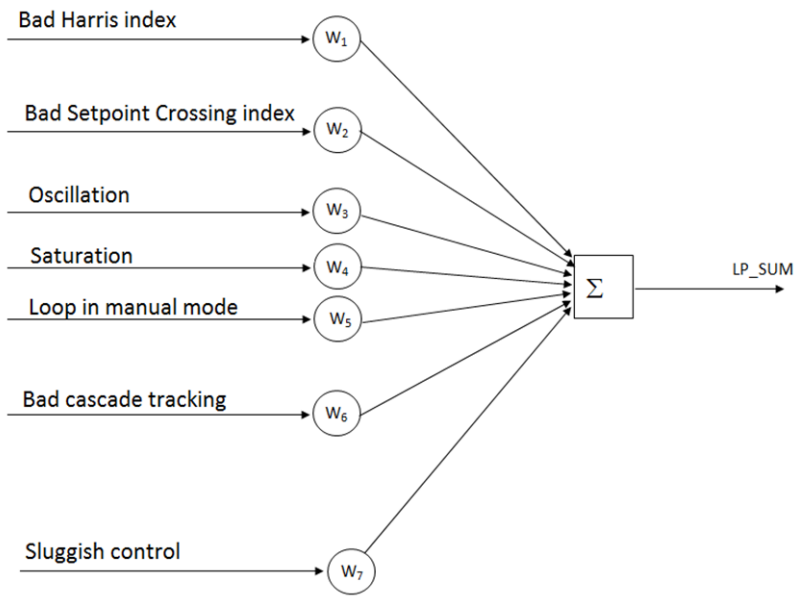


Figure 54. Loop Performance Summary Calculation

A large number of performance indices form the pre-conditions as shown in Figure 54.

These pre-conditions are multiplied with weight parameters with the prefix Weight_P_*, which are defined as asset parameters.

The weighted signals are summed that represents a health value for the loop performance. This value is compared to predefined alarm thresholds to decide if an alarm is necessary.

Performance indices

The performance indices used in CLAM are described in the list below. The result from the index calculations can be reached in the following way:

1. Open **Asset Reporter**.
2. Right-click on the preferred row and choose **Asset Monitor Status**.

Click on the tab **Logic Block Parameters** to see the results of the Index calculations, pre-conditions.

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
1.	Mean Loop Error	Calculates the control error mean. Should be close to zero if no permanent off-set is present. Normalized to the interval [0-100 %].	Basic statistics
2.	Standard Deviation Loop Error (Normalized)	Calculates the standard deviation of the normalized control error. Presented as [0-100 %]. Should be as small as possible, usually [1-5 %].	Basic statistics
3.	Standard Deviation Loop Error (Engineering units)	Same calculations as index 2, but in absolute engineering units. [min-max]. Should be small.	Basic statistics
4.	Mean Process Variable	The mean process value documents the actual operating point used during data collection (no performance index). The mean value can be used to analyze if certain control problems are related to certain operation points. [min-max].	Basic statistics

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
5.	Standard Deviation Controller Output	Calculates the standard deviation of the controller output. The result is a measure of the control effort to keep the loop under automatic control. Result in the interval [0-100 %].Very large values usually indicates a loop problem.	Basic statistics
6.	Skewness Control Error	Calculates the third central moment divided by the cube of the standard deviation. This is a measurement of asymmetry around the mean. $$s = \frac{E(x-\mu)^3}{\sigma^3}$$ This is an important indicator of control problems and should nominally be close to zero (significant outside [-1,1]).	Basic statistics
7.	Kurtosis Control Error	Calculates the forth central moment divided by the forth power of the standard deviation. It is a measurement of how outlier-prone a distribution is. $$k = \frac{E(x-\mu)^4}{\sigma^4}$$ A normal distribution has k=0. Good values within [-1.5,1.5].	Basic statistics
8.	Data Compression Index	Quantifies the amount of compression in the data by looking for linear segments. Nominal values below 3. Used to decide if the data is reliable. [0-inf].	Data validity
9.	Data Quantization Index	Quantifies the amount of quantization in the data. [0-100%]. Usually acceptable if result below 40 %.	Data validity

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
10.	Outlier Index	Simple algorithm for detecting outliers by using a sliding window, checking if single outliers exceed the standard deviation significantly. [0-1000 ‰]. Nominal 0 ‰ (no outlier).	Data validity
11.	Noise Level Index	Quantifies the amount of noise in the control error signal. The actual noise level is compared to the standard deviation of the control error. [0-100 %]. Good operation if Index>50 %.	Loop modes
12.	Ratio Control error vs. controller output Index	Quantifies the standard deviations of the control error and the controller output. Too little control effort resulting in large variation in the process value is indicated with a large value and heavy control effort with very efficient control is indicated with a small value. [0-Inf]. Nominal: all values that are not extremely large or small.	Loop modes
13.	Automatic Mode Index	Quantifies the amount of time the control loops is in automatic mode. Nominal 100 %.	Loop modes
14.	Saturation Index	Quantifies the times where the controller output stays below 3% or above 97 % of the controller output range for a significant amount of time. [0-100%] Nominal 0 %.	Loop modes
15.	Cascade Mode Index	Cascade mode index not directly related to control performance. The index describes if the loop setpoint is changed continuously or stepwise (or not at all). [0-100 %] of samples in data batch.	Loop modes

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
16.	Auto-correlation (ACF) ratio	Describes how fast the auto-correlation function (ACF) of the data decays over time. A comparison is made between a dead time value for the specific loop category and the value where the ACF decreases below 30 %. [0…1]. A value close to 0 means that the ACF decays much slower then benchmark (indicating sluggishness). A value close to 1 means that the ACF decays as fast as the benchmark or faster.	Performance
17.	Setpoint Crossing Index	Quantifies the number of setpoint crossings by looking at the amount of zero crossings for the control error compared to the total number of samples in the data batch. [0-100%]. Nominal>10 %.	Performance
18.	Cascade Tracking Index	Simple index counting all samples that deviate more than 3 % from the desired setpoint value and divide this value with the total number of samples. The result is an indication of setpoint tracking performance. [0-100 %] Nominal<20 %.	Performance
19.	Cascade Travel Ratio Index	Index comparing “travel” per hour for the setpoint with the “travel” for the process value. If the control is good both signals should “travel” equally much. [0.5-Inf]. Nominal: [0.5-1.5].	Performance
20.	Harris Performance Index	Famous performance index comparing current variance with (theoretically) minimum achievable variance. The result is a value in the interval [0-1] where 1 means that minimum achievable variance is achieved. By taking the inverse of this index you get a factor indicating how much the loop variance can be decreased.	Performance

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
21.	Oscillation Index on Control Error	Detects and quantifies oscillating signals. The result is in the interval [-1…1] where a positive value means that an oscillation was found and the closer to one the value is the more regular is the oscillation. Nominal: a value < 0. A value > 0.5 indicates a quite regular oscillation. This index is a pre-requisite for several other indices to be calculated.	Oscillation
22.	Oscillation Index on Setpoint	Detects oscillations of setpoint that is important for detecting external excitation in a control loop. As for the Oscillation Index on Control Error above the result is in the interval [-1…1] where a positive value indicates an oscillation.	Oscillation
23.	Oscillating Period	Index estimating oscillation period. Can be useful for more detailed analysis. [0…Inf].	Oscillation
24.	Oscillation Amplitude	Estimates the average amplitude of a loop that has been found oscillating. Useful for more detailed analysis. [0…100%].	Oscillation
25.	Oscillation Severity Index	Index presenting an analysis of how much the signal power is related to the oscillation when noise effects have been removed (signal spectrum estimation). [0…100%].	Oscillation
26.	Oscillation Amplitude Regularity Index	Quantifies the regularity of the oscillation amplitude. The result is a ratio between the standard deviation of the amplitudes of all half periods compared to their mean. [0…100 %]. Nominal: Oscillations are always not good, but a value below 60 % is considered non-regular.	Oscillation

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
27.	Shut-off Process Value Index	Index detecting valve leakage or zero instrument errors. The index requires the controller output to be zero for a significant amount of time, since it is calculated based on the flow when the output is set to zero. The result is the average process value when during CO=0% and should nominally be 0%.	Valve
28.	Stiction Index 1 (Cross Correlation Method)	When an oscillation is detected this index can be used for Stiction detection for self-regulating loops and non-compressible fluids. The index is based on an analysis of the cross-correlation between the control error and controller output. The result is [-1,0,1] where -1 means that no safe decision could be made, 0 means no Stiction and 1 means that Stiction is detected.	Valve
29.	Stiction Index 2 (Histogram Method)	Index for detecting Stiction based on a histogram method that can be used for both self-regulating and integrating loops. The result is just like Stiction Index 1 [-1,0,1].	Valve
30.	Valve travel per hour	Index that quantifies the valve actuation effort by measuring the distance travelled. [0…Inf] A high value means that the valve has to work a lot and that the controller is aggressively tuned. Nominal: low value (depending on loop type).	Valve
31.	Valve reversals per hour	Index counting the number of valve direction changes during a data batch. The result is [0…Inf], where a high value means that the valve is moving around a lot and this might lead to excessive mechanical wear. Nominal: low value (depending on loop type).	Valve

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
32.	Valve sizing Index	Quantifies the amount of time that the controller output is within normal operating range (10-90%). [0…100%] Nominally the controller should be within normal range > 50 % of time, i.e. index value should be larger than 50 %.	Valve
33.	Non-linearity 1st Index	Index detecting the amount of nonlinearity within a signal using higher-order statistics. The result is dimensionless [0…Inf] and the signal is considered to be linear if the index is below 1.	Nonlinearity
34.	Non-linearity 2nd Index	Index detecting the amount of nonlinearity within a signal by bispectrum analyzing using higher order statistics. Dimensionless result [0…Inf], where a signal is considered to be linear if index below 0.15.	Nonlinearity
35.	Non-Gaussianity Index	Index quantifying the amount of non-Gaussianity within a signal based on bispectrum analysis using higher-order statistics. The result is a dimensionless real number where Non-Gaussian signals should be below 0.01.	Nonlinearity
36.	Oscillation Symmetry Index	Index describing the symmetry of the oscillation half-periods. This is performed by checking for if area under first half of the half-cycle is equal to the area under the second part of the half-cycle. Result is a value in the interval [0…100 %] where an oscillation is considered symmetric for values greater than 40 %.	Nonlinearity
37.	Estimated process time-delay	Index estimating the process time delay that can be used for tuning etc. In order to estimate the delay the data needs to be sufficiently exciting.	Property

Table 9. Indices used in CLAM

Sl.No	Name	Description	Index class
38.	Master Flag	Flag documenting whether a loop is the inner or outer loop in a cascade (no performance index). If a loop is master the flag is set to 1 and 0 otherwise.	Property
39.	Setpoint Step Flag	Flag indicating if a data set contains setpoint steps (no performance index). This can be useful for tuning, model identification etc. If the data contains one or more setpoint steps the flag is set to 1 and 0 otherwise.	Property
40.	Model Fit Flag	Flag indicating if the data set is suitable for model identification (no performance index). If the data is suitable the user does not have to perform own tuning experiments. If the data is suitable for model identification the flag is set to 1 and 0 otherwise.	Property
41.	Static Gain Index	Index storing static input/output gain for tuning purposes (no performance index), i.e. static nonlinearity analysis.	Property
42.	Prediction Horizon	Stores the prediction horizon used by Harris Index (no performance index). This parameter is also used to store error signals from the calculations.	Other
43.	Loop Category	Reports which Loop Category the loop was assigned (no performance index).	Other

Input Data Plots

Input data used for analysis can be viewed through the Control Loop asset Monitor Ex CLAM Faceplate tab - **Trend** as shown in Figure 55. The high and low limits for PV, SP, and CO can be adjusted as necessary.

The duration of the trend display is set to one hour by default. It can be increased to any higher range stored in the CLAM Log Template, which stores four weeks of data by default.

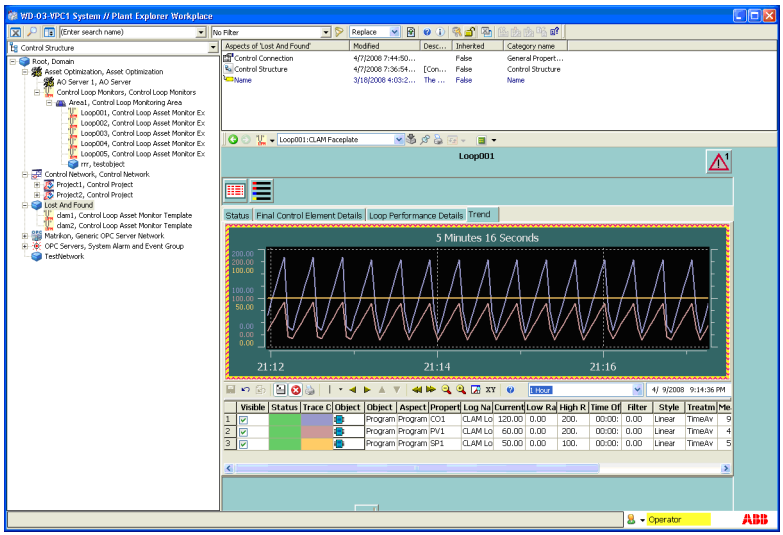


Figure 55. Trend display

Aspect Shortcuts from faceplate

The CLAM faceplate Aspect provides shortcuts/quick links to:

- Alarm List for the CLAM object
- Asset Reporter view

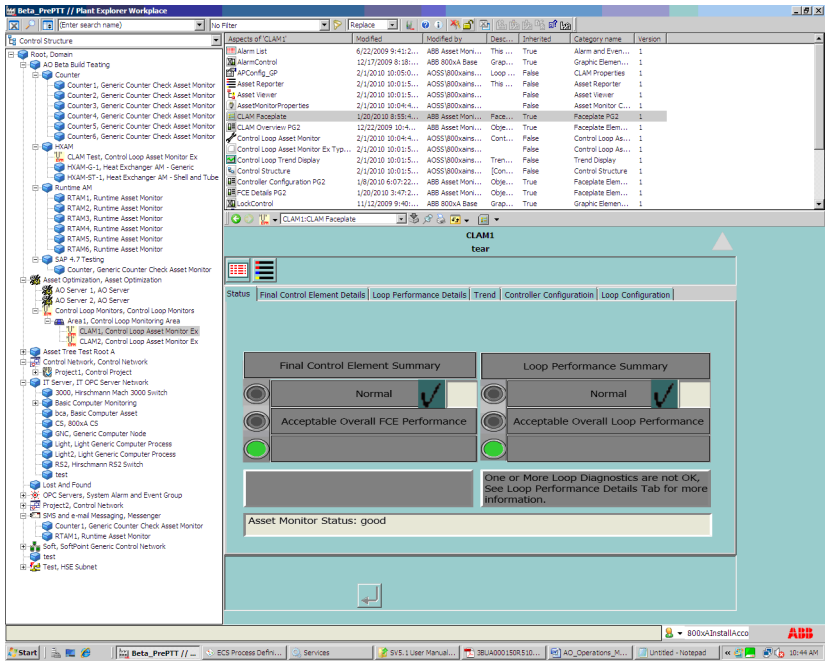


Figure 56. Aspect shortcuts

Alarm List for Loops

The most recent information of all possible alarms triggered by a Control Loop Asset Monitor for the loop it is assigned to, can be viewed from the Alarm List Aspect as shown in Figure 57. The list includes the most recent information on each unique alarm triggered for the Control Loop Asset Monitor with a time stamp. The Alarm List provides a summarized history of alarm information.

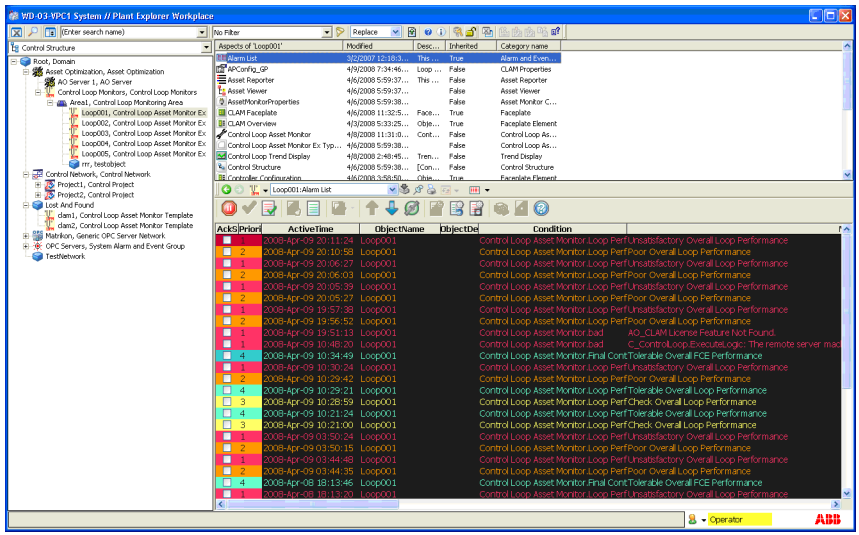


Figure 57. Alarm list

CLAM Diagnostics

The available CLAM Diagnostics are:

1. Final Control Element Diagnostics.
2. Loop Performance Diagnostics.

Final Control Element Diagnostics include the following:

1. FCE Action.
2. FCE Leakage.
3. FCE Size.
4. FCE Stiction/Backlash.
5. Loop Nonlinearity.

Loop Performance Diagnostics include the following:

1. Loop Tuning.
2. SetPoint Oscillation.
3. External Disturbances.
4. Data Reliability.
5. Harris Index.
6. Setpoint Crossing Index.
7. Oscillation Index.
8. Controller Output Saturation.
9. Manual Mode.
10. Cascade Tracking.
11. Response Speed.

To calculate FCE/LPS summary the above diagnostics are used along with the Weight given by user for each hypothesis/precondition.

The subcondition of the FCE/LPS Summary does not depend on a single hypothesis, it is the cumulative of all hypotheses and their corresponding weights. It is not necessary that if one of the hypothesis is not okay then the subcondition will be abnormal. The subcondition also depends on the threshold defined by the user in Asset Parameter. If FCE/LPS summary value goes beyond the threshold, the subcondition will change accordingly. It means that one or more diagnostics related to FCE/LPS is not okay, and the user should check and take appropriate action as necessary

Final Control Element Diagnostics

Final Control Element Diagnostics include the following:

FCE Action

Poor controller performance can decrease the life of the valve, since the valve has to work excessively. This diagnosis indicates excessive valve movement, irrespective of the overall performance (good or bad). The diagnosis is based on the

corresponding indices dealing with valve movement. An important prerequisite is the handling of noise, which is not related to valve movement.

FCE Leakage

Gasket leaks can occur when valves are removed or replaced. These leaks are best detected by visual inspection. If the leaks are severe enough, they can be detected through a noticeable loss of pressure or flow in the valve system. A systemic decrease in packing friction, manifested by decreased stroke time, is an indicator that the packing is wearing out.

Leaks in the air system such as loose fittings or dry-rotted air lines also might occur. This scenario can be simulated by diverting part of the actuator air supply through a needle valve controlled vent. These leaks manifest themselves in the profile by the drifting of the valve stem from the set point. In addition to using the profile to detect the failure, plants can use positioners that are capable of performing a leak test.

FCE Size

Valves are usually designed to operate outside the extreme levels of open or closed positions. If a valve operates within these ranges for a longer period of time, it can be an indication of a wrongly dimensioned valve, which can result in a nonoptimal loop performance. The diagnosis is based on the estimation of time where the valve operates in the extreme positions close to 0 or 100 percent. This value is delivered by the valve dimension index.

FCE Stiction/Backlash

Valve stiction is present in many control loops that involve control valves. The diagnosis of valve stiction is primarily related to clear oscillations in the control loop. Typically, in order to identify valve stiction without oscillations present, set point changes must be performed manually. Valve stiction diagnosis involves quite a few indices, among them are automatic mode, nonlinearity analysis, and stiction indices. This is necessary since stiction is based on several preconditions. It also helps avoid false alarms as much as possible.

Loop Nonlinearity

Many problems in control loop performance are caused by significant nonlinearity within the control loop. If the controller is in manual mode, a significant oscillation is always externally generated. If the controller is in automatic mode, then a significant external oscillation is identified based on the following characteristics:

- The oscillation is rather linear.
- No stiction is detected.
- The oscillation is rather symmetric.
- The loop is not saturated.

The analysis is based on nonlinearity analysis involving several indices.

Loop Performance Diagnostics

Loop Performance Diagnostics include the following:

Loop Tuning

The effectiveness of a Control loop operation depends on the tuning parameters of the control loop. The plant personnel must tune the controllers and keep the process operating at peak efficiency.

Over a period of time, the process may show signs of physical wear or the normal operating point of the plant may shift. These changes degrade the performance of the control loops requiring them to be retuned. When control loop performance shows signs of degradation the Control loop asset monitor identifies and displays the diagnostics on the faceplate.

Non oscillating loops should not exhibit significant nonlinearities and the tuning indices should indicate potential improvement. Oscillating loops should not oscillate due to nonlinearity (stiction and others). The Harris index should be low and the oscillation amplitude should vary significantly.

The oscillation diagnosis is based on the oscillation indices. If an oscillation is detected, then its main period and amplitude are described by different indices. Other relevant measures like symmetry, regularity, severity etc. are important for more detailed analysis. The oscillation diagnosis is not used if the data was quantized.

Set Point Oscillation

The detection of setpoint oscillations is important for the detection of external excitation in a control loop. The setpoint is usually much less distorted and noisy than the control error. The setpoint can only oscillate if it is the output of a master controller in a cascade loop.

External Disturbances

A loop may be oscillating due to a periodic external disturbance. The controller is not able to remove this oscillation, either because it was not designed to do so or because it is insufficiently tuned for that task. If the controller is in manual mode, a significant oscillation is always externally generated. If the controller is in automatic mode, then a significant external oscillation is identified based on the following characteristics:

- The oscillation is somewhat linear
- No stiction is detected
- The oscillation is almost symmetric
- The loop is not saturated

Data Reliability

Any signal-based analysis can be misleading by using data that is not suitable for such analysis. Tests for suitability of current data batch form data reliability diagnosis. Data that has been compressed prior to analysis make results vulnerable to unreliability. The data is tested on data points that are located far from the rest of data (outliers that are removed automatically), compression, and quantization.

Harris Index

This measures performance as a ratio of the performance of the current controller to that of a Minimum Variance Controller (MVC). The MVC is a theoretical controller that provides “best possible feedback control performance” — it tries to bring the PV back to SP in the shortest possible time by adapting to the manipulated variable. The Harris Index works well on fast control loops when there is a good estimate of deadtime

Harris index is therefore a number between 0 and 1: the higher the number, the higher the controller performance to the theoretical maximum.

Setpoint Crossing Index

This index identifies the amount of control error zero crossings related to the total number of samples in a data batch. The aim is to quantify the closeness of the control error to zero. A low value means long periods where the control error is either above or below zero. White noise has a theoretical value of 50%. A value >10% is considered to be good. This index is not used for diagnosis of level loops.

Oscillation Index

The main purpose of the Oscillation Index is to detect oscillatory control error behavior. Detection of oscillations in control loops is a crucial indicator in control loop monitoring. The oscillation detection based on the control error signal is the main pre-requisite for several diagnosis indices, which are evaluated following the detection.

Controller Output Saturation

This control loop asset monitor diagnostics indicates if the controller output has reached saturation. This index quantifies the number of times the controller output is significantly long (below 3% or above 97%) of the controller output range.

Manual Mode

Based on the controller output, this index quantifies the amount of time the control loop is in manual mode. This index checks the variability of the controller output. Control loop performance will not be optimal since the loop is not in automatic mode.

Cascade Tracking Index

This simple index counts all samples that deviate more than 3% of the loop range from the desired set point value. The purpose is to quantify set point tracking performance. This index is defined as the number of samples outside the specification divided by the total number of samples. A high index value means that

the control error is often far away (more than 3% of loop range) from the target. A low index value means that the deviation between process variable and target is within acceptable limits.

Response speed

This parameter measures the response of the control loop. Some applications require the control system to respond to set point changes within a given time. Changes in packing friction, air supply capacity, or component corrosion all act to change the response time, and the process variable will not follow the loop set point well. This failure mode is simulated by changing the control variable of the control system.

Section 9 Heat Exchanger Asset Monitor (HXAM)

Introduction

Heat Exchanger Asset Monitors are intended to alert process and maintenance personnel when the operation of a Heat Exchanger indicates significant decline in performance. The decline in performance may be due to fouling or significant change in operating point. The Heat Exchance Asset Monitors replace the current manual monitoring systems that require the maintenance of paper records and manual interpretation of the data. When CMMS Integration is configured a work order for maintenance request can be generated.

The Heat Exchanger Asset Monitor application begins with the identification of Heat Exchanger Objects configured in the 800xA System Workplace. At the time of configuration, the user identifies process measurement inputs that allow the Heat Exchanger Asset Monitor to track the performance of the physical device. These Asset Monitors provide status and condition information to the user through the standard Asset Optimization interfaces and views.

The Heat Exchanger Asset Monitor does not require any specific data regarding the design or structure of the heat exchanger. It also does not require any configurationspecific information related to the mathematical model of the heat exchanger.

There are two types of Heat Exchanger Asset Monitors:

Generic Heat Exchanger Asset Monitor (HXAM-G)

Shell and Tube Heat Exchanger Asset Monitor (HXAM-ST)

Objective

The objective is to detect drastic drops in heat exchanger efficiency, rather than minute changes. This is accomplished by taking baseline measurements of the critical readable process variables around the heat exchanger and noting any trends indicative of declining performance. One of the major factors affecting heat transfer efficiency is fouling. For each occurrence of the input variable which is a reasonable match for the baseline sets, heat exchanger performance can be compared to the baseline.

The basic approach of the Heat Exchanger Asset Monitor is proprietary modeling and analysis, along with an understanding of the measurable boundary conditions. This approach creates a basic Asset Monitor that alerts maintenance personnel of significant changes in heat exchanger Key Performance Indicators (KPI), such as:

Efficiency:

- Fouling, as indicated by:
  - Delta T profiles drifting at reference Hot and Cold flows.
  - Delta P across the exchanger increasing at reference (constant) flow for either Hot or Cold leg.
  - Low Flow or Low Delta T readings for either leg.
  - Significant changes in operating point which affect efficiency or heat-duty.

Instrumentation Errors:

- Delta T, Delta P, Delta F, or Heat Duty Error resulting in undefined/unreasonable values.

In addtion to the above, HXAM-ST supports the following:

Process Errors:

- Temperature Crossover.
- Low Shell-side Flow.
- Low Heat Transfer.
- High/Low Tube Velocity.
- Low Limiting Approach Temperature.

Terminology

Refer to Heat Exchanger Specific Terminology on page 191 for specific heat exchanger terminology used in this document.

Generic Heat Exchanger Asset Monitor (HXAM-G)

This section describes the salient features of the Generic Heat Exchanger Asset Monitor operation.

Description

The Generic Heat Exchanger Asset Monitor (HXAM-G) is based on Delta T measurements made across the heat exchanger in combination with mass flow information if available from the control system. It treats the heat exchanger as a black-box device, with nothing known about the interior structure and dynamics of the device. It implements a basic definition of what can be called **Performance Factor**, so as not to be confused with **Efficiency** or **Effectiveness**, which are already familiar industry standard terms. The Generic Heat Exchanger Asset Monitor will watch for operational steady state changes in E at one or more Operation Point Set (OPS), that are based on the following process data inputs:

- **Required Data Values:** In the configuration of the HXAM_G Asset Monitor, the user specifies the Data Source Aspect and Data Source Item in the Input Records of the HXAM_G Asset monitor for the following:
  - **T Hot In**.
  - **T Hot Out**.
  - **T Cold Out**.
  - **T Cold In**.
- **Additional Data Values (Recommended):** Depending on what options were specified during configuration, the user specifies the Data Source Aspect and Data Source Item in the Input Records of the HXAM-G Asset Monitor:
  - **W Hot: Alternatively, volume flow and density for the hot side may be used to calculate W.**
  - **W Cold:** Alternatively, volume flow and density for the cold side may be used to calculate W.

– **Delta P Hot:** Alternatively, P In and P Out for the hot side may be used to calculate Delta P.

– **Delta P Cold:** Alternatively, P In and P Out for cold side may be used to calculate Delta P.

If the data values are well outside the reasonable range, then the Heat Exchanger Asset Monitor will assume the values as invalid data. Potential causes for data values that are invalid include faulty transmitters. When invalid data values are detected, the Heat Exchanger Asset Monitor will set the subconditions for conditions directly affected by the relevant inputs to **Instrumentation Error**. Additionally, the Heat Exchanger Asset Monitor will not proceed with training or attempt to monitor efficiency when the bad values continue to exist. During such times, most output values from the Heat Exchanger Asset Monitor will not be updated and their quality will be read as **BadLastKnownValue**. The trend report will show dashed lines during this period due to the bad quality of the logged data.

Since the Output Records will not be updated, Asset Optimization will report the Asset Monitor to be in **BAD** status, with an error string stating that various output records will not be set. This error is not cause for concern, as this is the intended behavior in order to correctly signal the logs and trends that the Heat Exchanger Asset Monitor is not generating valid outputs when the inputs are bad. When the input values return to a more reasonable range, normal training and monitoring will resume.

The Asset Monitor will consider any data to be invalid that is equivalent to any of the following:

- Individual temperatures (T Hot In, T Hot Out, T Cold Out, T Cold In) less than 0 degrees Kelvin.
- Individual temperatures (T Hot In, T Hot Out, T Cold Out, T Cold In) greater than 10,000 degrees Kelvin.
- Temperature differences ((T Hot In - T Hot Out), (T Hot In - T Cold Out), or (T Cold Out - T Cold In) less than 0 degrees Kelvin.
- For a hot side condensing heat exchanger, the temperature difference (T Hot In - T Hot Out) less than -10 degrees Kelvin.
- For cold side evaporating heat exchanger, the temperature difference (T Cold Out - T Cold In) less than -10 degrees Kelvin.

- Mass flow less than 0 Kg/hr.
- Mass flow greater than 1000000 Kg/hr.
- Pressure less than -10,000 (any units).
- Pressure greater than 10,000 (any units).
- Volume flow less than 0 M^3/hr.
- Volume flow greater than 1,000,000 M^3/hr.
- Calculated Values

The calculated values are:

  – **E:** Performance Factor.

  – **HD Hot:** Hot Side Heat Duty.

  – **HD Cold:** Cold Side Heat Duty.

Methodology

The heat exchanger will operate at one or more OPS for long enough to be considered steady state operation, such that Base Operating Point Set (BOPS) and Comparative Operation Point Set (COPS) may be read and saved for comparative Performance Factor calculations.

Monitoring

Before BOPS and COPS are compared, the OPS set pass under low pass filtering and averaging. The HXAM-G will collect the set of input data values at every execution interval (every one minute) till an absolute period of Monitoring Interval time is reached. This is called ***Collection*** phase.

The next cycle is the ***Analysis*** phase, during this phase the collected data is applied with a low pass filtering and the filtered values are averaged. This average value is called COPS and is compared with the BOPS (trained or manually entered). The low pass filtering is not applied if the Monitoring interval of HXAM-G is less than 4 execution time interval. After the analysis phase, the HXAM-G will continue with a fresh collection of COPS values for another period Monitoring Interval. This cycle of collection and analysis continues and this state of the Asset Monitor is called as Monitoring.

During Monitoring, the Asset Monitor at every analysis phase checks the COPS and compares with the available BOPS. If the COPS data falls within the respective tolerance band values (see, BOPS Info Tab) of any particular BOPS data set, Enew and Unew will be calculated and compared to the BOPS stored Ebaseline. The Asset Monitor also evaluates and set all the active subconditions.

Training

The training mode is comprised of collection and analysis cycle. At the end of each collection phase, a new COPS is established as explained in the Monitoring section and these COPS values are used to calculate Ebaseline during the analysis phase. A BOPS will be created for each stable significantly different operating level of the heat exchanger. Significantly different will be determined by a percentage (Delta BOPS) that is configured by the user or greater change in any one or more of the following variables:

- **T Hot In.**
- **T Hot Out.**
- **T Cold Out.**
- **T Cold In.**
- **Delta Tx.**
- **W Hot.**
- **W Cold.**
- **Delta P Hot.**
- **Delta P Cold.**

Stable will be when the BOPS that is significantly different is recorded, remains within one percent of change for three consecutive executions.

All the conditions are set to "Normal" with quality status as "goodLocalOverride" during the period of training.

Reporting Changes

If **Enew** is down by a percentage (E_Decline_Level) that is configured by the user or more of **Ebaseline**, an alarm will be generated. The ACD will inform plant operations personnel that the heat exchanger operational efficacy has declined and that a fault report or work order may be necessary. If **Enew** is down by a percentage (E_Significant_Decline_Level) configured by the user or more of **Ebaseline**, an

ACD will be created. The ACD will inform plant operations personnel that the heat exchanger operational efficacy has fallen significantly and should be investigated further.

Conversely, if **Enew** has gone up by a percentage (E_Improvement_Level) that is configured by the user or more, an ACD will be created indicating that the heat exchanger Performance Factor has improved and similarly, an ACD will be created. The ACD will indicate that the heat exchanger Performance Factor has improved significantly if **Enew** has gone up by a percentage (E_Significant_Improvement_Level) that is configured by the user or more. At this point, the BOPS used for the comparison will be replaced with the current COPS, if it persists for more than three times the execution interval.

The Asset Monitor checks to determine if one or more BOPS have gone stale. A BOPS is defined as going stale when the BOPS has not been referenced during a specific time period. If any one or more BOPS go stale during Monitoring, an ACD is created informing the plant operations personnel that one or more BOPS have gone stale. At this point the Asset Monitor automatically goes back to Training.

Logging Function

If the Logging (Enable_Logging_Data) is enabled at configuration, the following two additional functions will take place during training and operation of the Heat Exchanger Asset Monitor:

- Heat Exchanger Asset Monitor will execute once per minute, regardless of **E** calculation/comparison period.
- During each execution, all field inputs and calculated variables of interest will be recorded in a flat text file by appending a comma delimited line of data to the existing log file.

Refer to Log File Description (.csv file) on page 180 for details on the Log File.

Optional Reporting

Optionally (to be specified at Asset Monitor configuration time), the Heat Exchanger Asset Monitor can also send an ACD reporting any of the following identified conditions:

- **Staleness:** If any one or more of the trained BOPS goes stale, an ACD is created.
- If Delta Tx has exceeded a high or low limit specified at configuration time.
- If any of the following variables has exceeded a high or low limit specified at configuration time:
  - **Delta T Hot.**
  - **Delta T Cold.**
  - **W Hot.**
  - **W Cold.**
  - **Delta P Hot.**
  - **Delta P Cold.**
  - **HD Hot.**
  - **HD Cold.**
  - **Delta HD.**

Generic Heat Exchanger Asset Monitor Operation

Once the Asset Monitor is properly configured, one can start the Asset Monitor (Asset Monitor Aspect Name: HXAM_G) by starting the Asset Monitoring Server.

Figure 58 shows the view of the Asset Monitor when the Asset Monitoring Server is not running. The Quality Status will be set to `badNotConnected`.

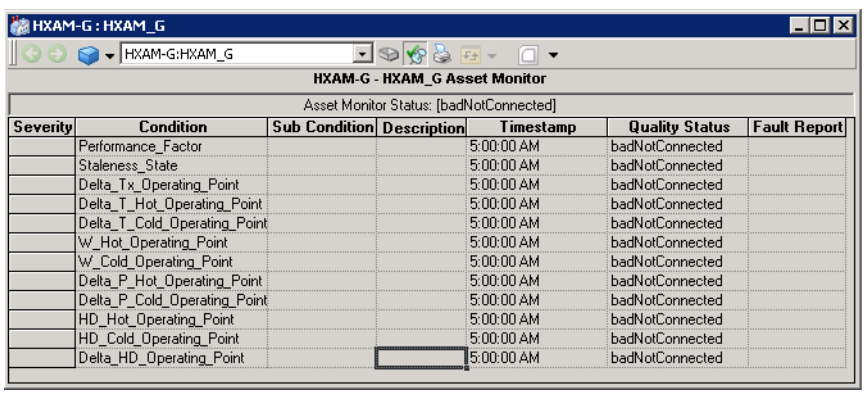


Figure 58. HXAM_G Aspect when Asset Monitoring Server is not Running

Any error in configuration will set the Quality Status to `badConfigurationError` and any other error during execution will set the Quality Status to `bad`. In either case the Asset Monitor will stop executing and will show an error message.

A normal working Asset Monitor without any errors will appear similar to the one shown in Figure 59.

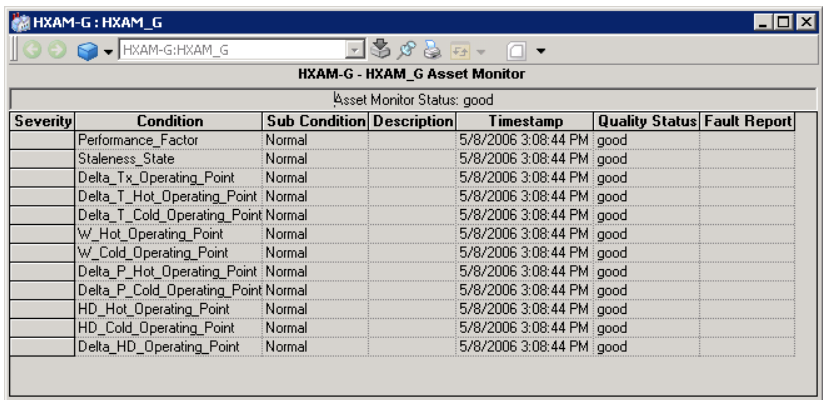


Figure 59. HXAM_G Aspect when HXAM-G Asset Monitor is Working Normally

HXAM_G_Faceplate

A detailed view of the Asset Monitor can be seen from the HXAM_G_Faceplate (Figure 60). The HXAM_G_Faceplate has eight tabs, with each tab showing a detailed picture of the condition being assessed.

Performance Tab

The **Performance** tab (Figure 60) shows the details of the Performance_Factor condition being assessed. This tab is the view of HXAM_G_Performance_FE Aspect.

The fields in the **Performance** tab are:

- **Quality Status:** Gives the working status of the Asset Monitor. The following are the different status values:

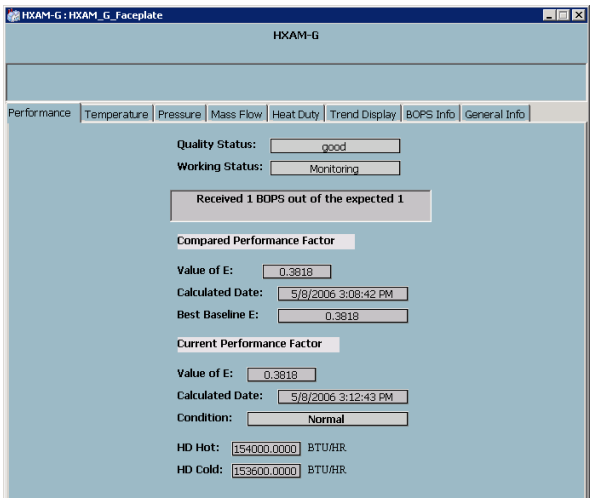


Figure 60. HXAM_G_Faceplate - Performance Tab

- **BadOutOfService:** Asset Monitoring Server Engine is shut down.
- **Good:** Asset Monitor is running smoothly.
- **Bad:** Asset Monitor had encountered some error.
- **BadConfigurationError:** Configuration error in Asset Monitor.
- **GoodLocalOverride:** Asset Monitor is under Training/Asset Monitor is in Monitoring Phase but there is no BOPS recorded/one or more BOPS has gone stale. One of the reasons for this state is that the Asset Monitor is inhibited.

- **Working Status:** Displays Asset Monitor status, as in: `In Training` or `Monitoring` phase.

  The text box in Figure 60 shows the user how many BOPS are received during Training and how many BOPS are received out of the expected number during Monitoring.

- **Compared Performance Factor:**
  - **Value of E:** Shows the **Ebaseline** against which the COPS **E** is being compared against during Monitoring. It shows `-1` during Training.

- **Calculated Date:** Shows the time when the **Ebaseline** was calculated. It shows `Not Available` during Training.
- **Best Baseline E:** Shows the best **Ebaseline** among the trained BOPS. It shows `-1` if any BOPS gets stale and the Asset Monitor goes back to Training.

• **Current Performance Factor:**

- **Value of E:** Shows the **Enew** calculated from the current input data.
- **Calculated Date:** Shows the time when the **Enew** was calculated.
- **Condition:** Shows the Subcondition of the Performance_Factor condition after assessing the data. It always shows `Normal` during Training. The different subconditions that will be reported during Monitoring are as follows:

Normal:	Heat Exchanger Performance is under Normal condition.
Declined:	Heat Exchanger Performance has declined. (**Enew** dropped by E_Decline_Level from **Ebaseline**).
Significantly Declined:	Heat Exchanger Performance has declined significantly. (**Enew** dropped by E_Significant_Decline_Level from **Ebaseline**).
Improving:	Heat Exchanger Performance has improved. (**Enew** raised by E_Improvement_Level from **Ebaseline**).
Significantly Improved:	Heat Exchanger Performance has improved significantly. (**Enew** raised by E_Significant_Improvement_Level from **Ebaseline**).
Cannot Compare:	Heat Exchanger input data cannot be compared against any trained BOPS.

- **HD Hot:** Gives the Heat Duty for the Hot Side.
- **HD Cold:** Gives the Heat Duty for the Cold Side.

Temperature Tab

The **Temperature** tab (Figure 61) shows the details of the Delta_Tx_Operating_Point, Delta_T_Hot_Operating_Point, and Delta_T_Cold_Operating_Point conditions being assessed. This tab is the view of HXAM_G_Temperature_FE Aspect.

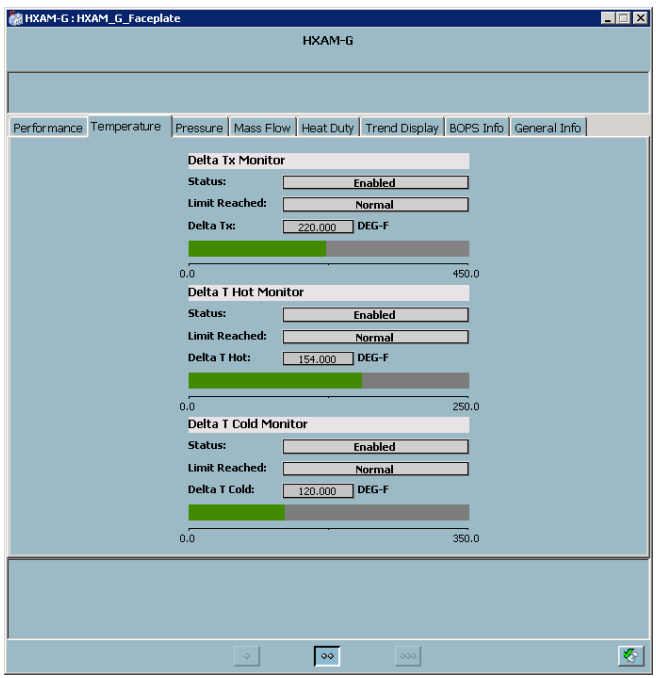


Figure 61. Temperature Tab

The Limit Reached field for all Temperature Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. The values of Delta Tx, Delta

T Hot, and Delta T Cold will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Temperature** tab are:

- **Delta Tx Monitor:**
  - **Status:** Gives the status of the Delta Tx Monitor. The status values are:

    Enabled: If Delta Tx Monitor is enabled.

    Not Enabled: If Delta Tx Monitor is not enabled.

    Stale Data in Trained Set: If one or more BOPS is stale.

    Not Available: During Training.
  - **Limit Reached:** Gives the subcondition for the Delta_Tx_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

    Normal: Delta Tx is within the Normal range.

    Increasing: Delta Tx has crossed the Delta_Tx_Increasing Limit.

    High: Delta Tx has crossed the Delta_Tx_High Limit.

    Decreasing: Delta Tx has crossed the Delta_Tx_Decreasing Limit.

    Low: Delta Tx has crossed the Delta_Tx_Low Limit.
  - **Delta Tx:** Gives the value of Delta Tx for the current OPS.
- **Delta T Hot Monitor:**
  - **Status:** This field gives the status of the Delta T Hot Monitor. The status values are:

    Enabled: If Delta T Hot Monitor is enabled.

    Not Enabled: If Delta T Hot Monitor is not enabled.

    Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

– **Limit Reached:** Gives the subcondition for the Delta_T_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are as follows:

Normal: Delta T Hot is within the Normal range.

Increasing: Delta T Hot has crossed the Delta_T_ Hot _Increasing Limit.

High: Delta T Hot has crossed the Delta_T_Hot _High Limit.

Decreasing: Delta T Hot has crossed the Delta_T_Hot _Decreasing Limit.

Low: Delta T Hot has crossed the Delta_T_ Hot _Low Limit.

– **Delta T Hot:** Gives the value of Delta T Hot for the current OPS.

• **Delta T Cold Monitor:**

– **Status:** This field gives the status of the Delta T Cold Monitor. The different status that one might see here are as follows:

Enabled: If Delta T Cold Monitor is enabled.

Not Enabled: If Delta T Cold Monitor is not enabled.

Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

– **Limit Reached:** Gives the subcondition for the Delta_T_Cold _Operating_Point condition. The different subconditions that will be reported during Monitoring are as follows:

Normal: Delta T Cold is within the Normal range.

Increasing: Delta T Cold has crossed the Delta_T_ Cold _Increasing Limit.

High:	Delta T Cold has crossed the Delta_T_ Cold _High Limit.
Decreasing:	Delta T Cold has crossed the Delta_T_ Cold _Decreasing Limit.
Low:	Delta T Cold has crossed the Delta_T_ Cold _Low Limit.

– **Delta T Cold:** Gives the value of Delta T Cold for the current OPS.

Pressure Tab

The **Pressure** tab (Figure 62) shows the details of the Delta_P_Hot_Operating_Point and Delta_P_Cold_Operating_Point conditions being assessed. This tab is a view of the HXAM_G_Pressure_FE Aspect.

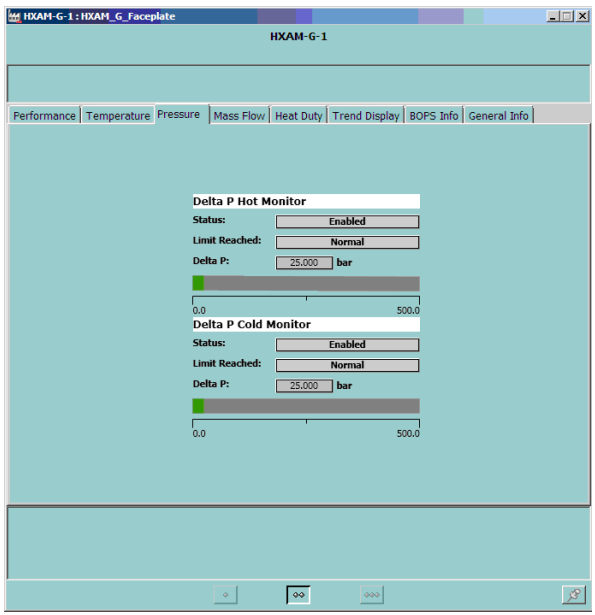


Figure 62. Pressure Tab

The Limit Reached field for both Pressure Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, `Not Enabled`, or `Data Unavailable`. Also the values of Delta P Hot and Delta P Cold will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Pressure** tab are:

- **Delta P Hot Monitor:**
  - **Status:** This field gives the status of the Delta P Hot Monitor. The different status that one might see here are as follows:

    Enabled: If Delta P Hot Monitor is enabled.

    Not Enabled: If Delta P Hot Monitor is not enabled.

    Stale Data in Trained Set: If one or more BOPS is stale.

    Not Available: During Training.

    Data Unavailable: If Delta P Hot Monitor is but Delta P Hot data is not available.
  - **Limit Reached:** Gives the subcondition for the Delta_P_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

    Normal: Delta P Hot is within the Normal range.

    Increasing: Delta P Hot has crossed the Delta_P_ Hot _Increasing Limit.

    High: Delta P Hot has crossed the Delta_P_Hot _High Limit.

    Decreasing: Delta P Hot has crossed the Delta_P_Hot _Decreasing Limit.

    Low: Delta P Hot has crossed the Delta_P_ Hot _Low Limit.
  - **Delta P Hot:** Gives the value of Delta P Hot for the current OPS.
- **Delta P Cold Monitor:**
  - **Status:** This field gives the status of the Delta P Cold Monitor. The status values are:

    Enabled: If Delta P Cold Monitor is enabled.

Not Enabled:	If Delta P Cold Monitor is not enabled.
Stale Data in Trained Set:	If one or more BOPS is stale.
Not Available:	During Training.
Data Unavailable:	If Delta P Cold Monitor is but Delta P Cold data is not available.

– **Limit Reached:** Gives the subcondition for the Delta_ P_Cold _Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Delta P Cold is within the Normal range.
Increasing:	Delta P Cold has crossed the Delta_ P_ Cold _Increasing Limit.
High:	Delta P Cold has crossed the Delta_P_Cold _High Limit.
Decreasing:	Delta P Cold has crossed the Delta_P_Cold _Decreasing Limit.
Low:	Delta P Cold has crossed the Delta_P_Cold _Low Limit.

– **Delta P Cold:** Gives the value of Delta P Cold for the current OPS.

Mass Flow Tab

The **Mass Flow** tab (Figure 63) shows the details of the W_Hot_Operating_Point and W_Cold_Operating_Point conditions being assessed. This tab is the view of HXAM_G_MassFlow_FE Aspect.

The Limit Reached field for both Mass Flow Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, `Not Enabled`, or `Data Unavailable`. The values of Mass Flows will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Mass Flow** tab are:

- **Mass Flow Hot Monitor:**

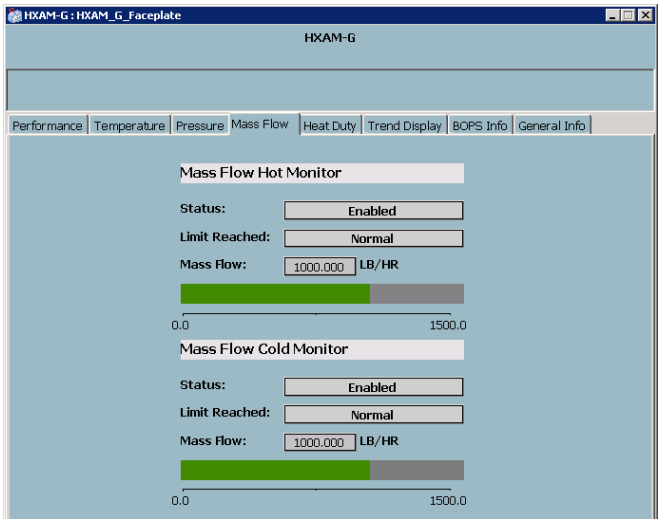


Figure 63. Mass FlowTab

– **Status:** This field gives the status of the Mass Flow Hot Monitor. The status values are:

Enabled:	If Mass Flow Hot Monitor is enabled.
Not Enabled:	If Mass Flow Hot Monitor is not enabled.
Stale Data in Trained Set:	If one or more BOPS is stale.
Not Available:	During Training.
Data Unavailable:	If Mass Flow Hot Monitor is enabled, but Mass Flow Hot is not available.

– **Limit Reached:** Gives the subcondition for the W_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Mass Flow Hot is within the Normal range.

Increasing:	Mass Flow Hot has crossed the W_ Hot _Increasing Limit.
High:	Mass Flow Hot has crossed the W_Hot _High Limit.
Decreasing:	Mass Flow Hot has crossed the W_Hot _Decreasing Limit.
Low:	Mass Flow Hot has crossed the W_ Hot _Low Limit.

  - **Mass Flow Hot:** Gives the value of Mass Flow Hot for the current OPS.

- **Mass Flow Cold Monitor:**
  - **Status:** Gives the status of the Mass Flow Cold Monitor. The status values are:

Enabled:	If Mass Flow Cold Monitor is enabled.
Not Enabled:	If Mass Flow Cold Monitor is not enabled.
Stale Data in Trained Set:	If one or more BOPS is stale.
Not Available:	During Training.
Data Unavailable:	If Mass Flow Cold Monitor is enabled, but Mass Flow Cold is not available.

  - **Limit Reached:** Gives the subcondition for the W_Cold_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Mass Flow Cold is within the Normal range.
Increasing:	Mass Flow Cold has crossed the W_Cold_Increasing Limit.
High:	Mass Flow Cold has crossed the W_Cold_High Limit.
Decreasing:	Mass Flow Cold has crossed the W_Cold_Decreasing Limit.

Low: Mass Flow Cold has crossed the W_Cold_Low Limit.

– **Mass Flow Cold:** Gives the value of Mass Flow Cold for the current OPS.

Heat Duty Tab

The **Heat Duty** tab (Figure 64) shows the details of the Delta_HD_Operating_Point, HD_Hot_Operating_Point, and HD_Cold_Operating_Point conditions being assessed. This tab is a view of the HXAM_G_HeatDuty_FE Aspect.

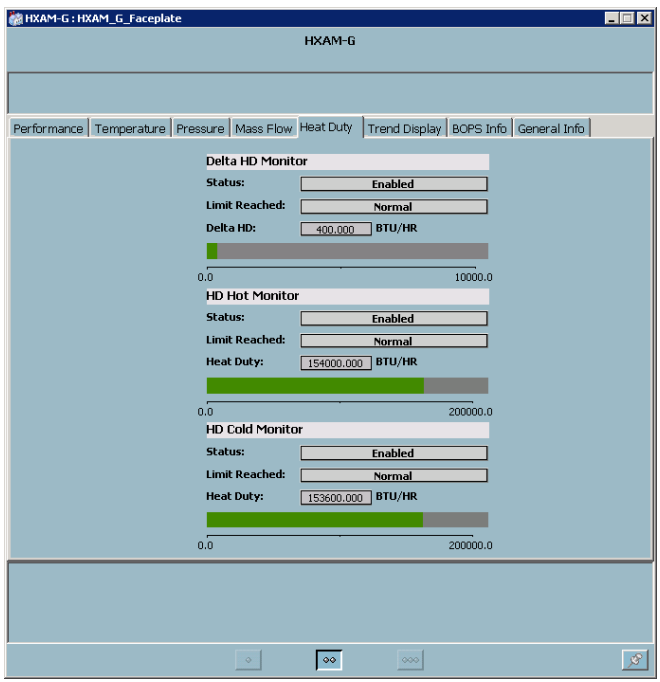


Figure 64. Heat Duty Tab

The Limit Reached field for all Heat Duty Condition Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, `Not Enabled`, or `Data`

`Unavailable`. Also the values of Delta HD, Heat Duty Hot, and Heat Duty Cold will show `0` when the Asset Monitoring Server is not running and `-1` otherwise except when the Status field says `Enabled`.

The fields in the **Heat Duty** tab are:

- **Delta HD Monitor:**
  - **Status:** This field gives the status of the Delta HD Monitor. The different status that one might see here are as follows:

Enabled:	If Delta HD Monitor is enabled
Not Enabled:	If Delta HD Monitor is not enabled
Stale Data in Trained Set:	If one or more BOPS is stale
Not Available:	During Training
Data Unavailable:	If Delta HD Monitor is enabled, but Delta HD data is not available.

  - **Limit Reached:** Gives the subcondition for the Delta_HD_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Delta HD is within the Normal range.
High:	Delta HD has crossed the Delta_HD_High Limit.

  - **Delta HD:** Gives the value of Delta HD for the current OPS.
- **HD Hot Monitor:**
  - **Status:** This field gives the status of the HD Hot Monitor. The different status values are:

Enabled:	If HD Hot Monitor is enabled.
Not Enabled:	If HD Hot Monitor is not enabled.
Stale Data in Trained Set:	If one or more BOPS is stale.
Not Available:	During Training.

Data Unavailable: If HD Hot Monitor is enabled, but HD Hot data is not available.

– **Limit Reached:** Gives the subcondition for the HD_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal: HD Hot is within the Normal range.

High: HD Hot has crossed the HD_Hot_High Limit.

Low: HD Hot has crossed the HD_Hot_Low Limit.

– **HD Hot:** Gives the value of HD Hot for the current OPS.

• **HD Cold Monitor:**

– **Status:** Gives the status of the HD Cold Monitor. The status values are:

Enabled: If HD Cold Monitor is enabled.

Not Enabled: If HD Cold Monitor is not enabled.

Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

Data Unavailable: If HD Cold Monitor is enabled, but HD Cold data is not available.

– **Limit Reached:** Gives the subcondition for the HD_Cold_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal: HD Cold is within the Normal range.

High: HD Cold has crossed the HD_Cold _High Limit.

Low: HD Cold has crossed the HD_Cold_Low Limit.

– **HD Cold:** Gives the value of HD Cold for the current OPS.

Trend Display Tab

The **Trend Display** tab shows the plots of the logged properties against time. This tab is the view of Trend Display Aspect. Three properties are logged and the user can configure for which logged property the trend is to be displayed. Refer to Trends and Logs on page 177 for more details.

BOPS Info Tab

The BOPS Info tab (Figure 65) gives the user information on the trained BOPS. The first text box in Figure 65 will display the same message as the text box in Figure 70 on page 156. The second text box shows the details of the trained BOPS. Clicking **Clear all BOPS and Retrain** gives the user the choice to retrain the Asset Monitor at any time if BOPS have not been manually entered. This view also gives an additional information that will change and dynamically vary depending on some of the configuration parameters and running status of the Asset Monitor. These values are internal calculations and are not available for the user to modify. This tab is a view of the HXAM_G_BOPS_Info_FE Aspect.

A brief explanation of the additional information displayed on BOPS info tab is as

mentioned below:

Last Calculated staleness period

Last calculated staleness period is the time elapsed since a BOPS has not been referenced by the Asset Monitor logic after comparison with COPS. If a BOPS is not referenced by Asset Monitor for more than the staleness period, then the BOPS set is considered to be stale and is then no longer considered for comparing with COPS. Following formula is used for calculating staleness period.

Minimum of:

20 % of Heat Exchanger Service Interval, or

Monitoring Interval * Number of non-Stale BOPS sets.

Tolerance Band

Tolerance Band value is computed by the Asset Monitor logic in order to compare if the COPS values fall within the range of BOPS and track the stability during

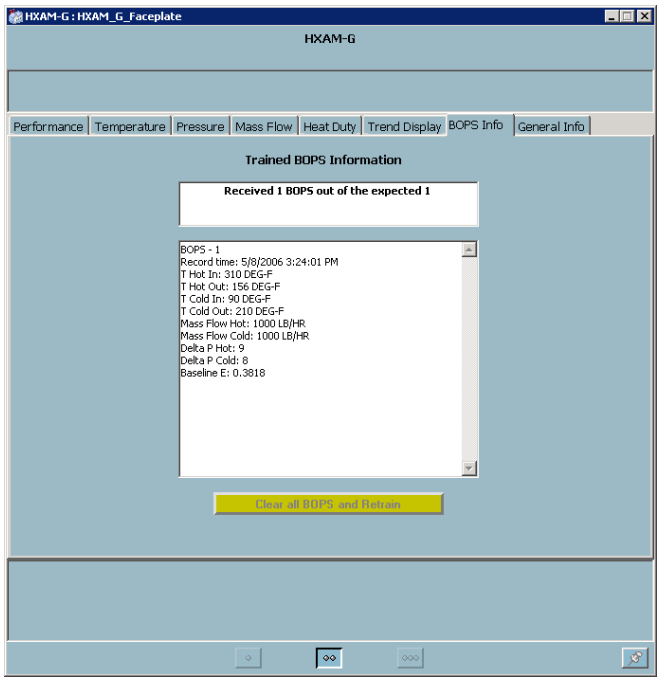


Figure 65. BOPS Info Tab

training. Some of the tolerance values are used by logic to determine the nearest of all BOPS to the COPS.

Last calculated Training period

When all the BOPS go stale or when you press the "Clear BOPS and Retrain" button, the Asset Monitor will go to training mode. The training period is calculated by the Asset Monitor and displayed. The Asset Monitor will try to find all the expected number of BOPS sets till the training period is elapsed. If the Asset Monitor is able to find the required number of BOPS before the training period is elapsed, then it shall come out of training.

The calculated training period and training tolerance band values will be displayed, if the Asset Monitor has gone to training at least once since it was last loaded to AO server.

The following formula is used for calculating the training period:

Minimum of:

1% of Heat Exchanger Service Interval, or

40 * Monitoring Interval * Number of Expected BOPS sets.

General Info Tab

The **General Info** tab (Figure 66) displays general information. For example, it will display the recommended AMSI, if the AMSI configured by the user does not match the recommended value. It also displays the default values taken for any Asset Parameters. This tab is a view of the HXAM_G_General_Info_FE Aspect.

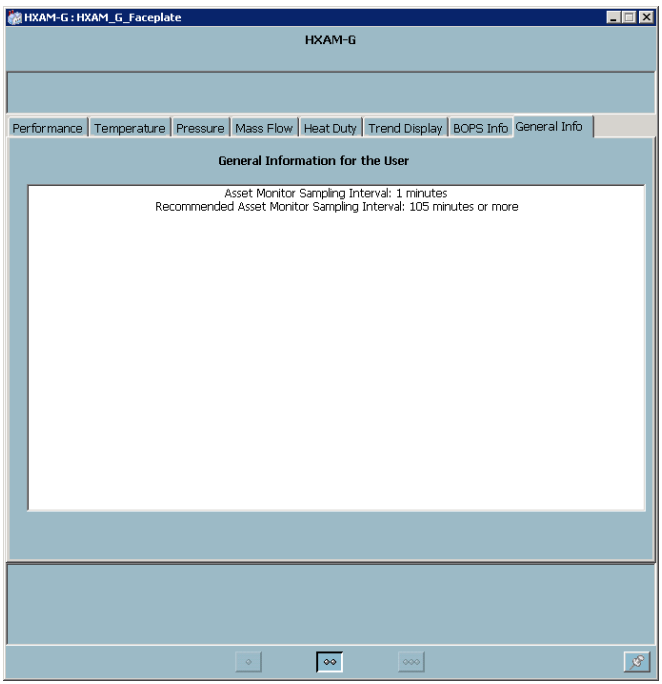


Figure 66. General Info Tab

Trends and Logs

The Trend portion is used to present object properties graphically as a function of time or as an XY-plot. To enable trending, the following seven aspects are used:

- History Source.
- Log Template.
- Log Configuration.
- Trend Template.
- Trend Display.
- AssetMonitorProperties.
- HXAM_G_Available_Logs_FE.

HXAM_G_Available_Logs_FE is not actually used for logging, but displays the values for which logs are configured on the default Heat Exchanger object type

Refer to *System 800xA Operations Operator Workplace Configuration (3BSE030322*)* for more details.

History Source

The History Source Aspect is used to define the Service Group that handles a subset of logs, i.e. the Log Configurations on all child objects. It should be noted that if no History Source is defined no logging will occur.

Log Template

A Log Template is a template for building logs for heat exchanger properties. Modifying the Log Template will affect existing logs that use the Log Template. The template is configured to log data for the last three years.

Log Configuration

The Log Configuration Aspect is used to configure what properties are to be logged. In the Generic Heat Exchanger Asset Monitor the following properties are configured to be logged:

- Relative Performance Factor.
- Current Performance Factor.
- Hot Side Heat Duty.
- Cold Side Heat Duty.

The data for these properties are read from the AssetMonitorProperties Aspect, which is populated by the Asset Monitoring Engine. The view of the Log Configuration Aspect is shown in Figure 67. The logged data for a property can be viewed by selecting the **Status** tab and clicking **Read**. A value of `-1` shows that the Asset Monitoring Server is not running or the Asset Monitor Status Quality is not **good** or not **goodlocaloverride**. Every time the Asset Monitoring Server is started or restarted, the property will take a value of `0` first and then the current value.

The green light (circle in lower left of the display) indicates that logging is working correctly. If it is not green, it means that the History Source is not configured properly.

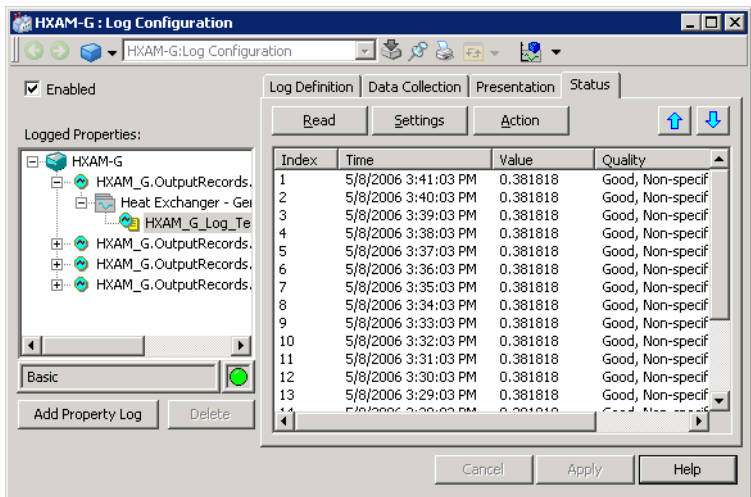


Figure 67. Log Configuration Aspect

Trend Template

A Trend Template is a template for building Trend Displays. Modifying an existing Trend Template will not automatically affect existing trends. Settings that are affected are those that can not be changed in the existing Trend Display such as number of areas and configurable rows, trace colors, and Hide/Show Table. The Trend Template is configured to take four rows in Trend Display Aspect, each row for one of the four logged properties. It also takes four traces (**Colors** tab), each trace representing the plot for the logged property.

Trend Display

The Trend Display Aspect displays the four logged heat exchanger properties graphically as a function of time.

Asset Monitor Properties

The Asset Monitor Properties Aspect displays the values of parameters defined within the HXAM-G object.

Log File Description (.csv file)

The Log File is identified by:

- **Name Of File:** .Asset.ItemGUID & .Asset.AspectGUID & "-LogFile.csv"

  Name of File is given as the combination of the Asset Item Global Unique Identifier (GUID), the Asset Aspect GUID, and "-LogFile.csv".

- **Path Name:** App.Path & "\" & "HXAM_G_Store" & "\" & *Name Of File*

  Path name of the Log File gives the location where the Log File is stored. The Log File is stored in the same location as the Application (App.Path) under a HXAM_G_Store folder under the file name specified by *Name Of File*.

- **Format of File:** The file contains the following information in the following order:

The data in Step 1 and Step 2 are saved only once at the time when the Log File is created. All data in Step 3 and Step 4 will be saved to the Log File for each Start or Download/Restart on the Asset Monitoring Server. All the data in Step 5 is saved to the Log File on every execution of the Asset Monitor logic.

1. Description of what data the file contains.
2. Date and time when the file was created.
3. Date and time when logging started.
4. All the Asset Parameters (With heading **Asset Parameter Name** and **Parameter Value**).

5. All the Process Data, Calculated Data, and ACDs in the order shown in Table 10 (Heading is also provided).

Table 10. Log File Headings and Explanations

Heading	Explanation
Time Stamp	The current time in local time standard when the Asset Monitor started execution.
Execution Time (ms)	The total time the Asset Monitor takes to execute logic in milliseconds, rounded to one decimal.
Phase Of Operation	Tells if the Asset Monitor is *In Training* or *Monitoring*.
BOPS	During Training, it specifies if an OPS has been accepted as a BOPS. If it is a BOPS, then it specifies if it is the first, second, etc. During monitoring the BOPS used for comparison with the COPS is logged.
T Hot In	Hot Side Inlet Temperature
T Hot Out	Hot Side Outlet Temperature
T Cold In	Cold Side Inlet Temperature
T Cold Out	Cold Side Outlet Temperature
Mass Flow Hot	Hot Side Mass Flow
Volume Flow Hot	Cold Side Volume Flow
Mass Flow Cold	Hot Side Mass Flow
Volume Flow Cold	Cold Side Volume Flow
P Hot In	Hot Side Inlet Pressure
P Hot Out	Hot Side Outlet Pressure
Delta P Hot	Hot Side Pressure Difference
P Cold In	Cold Side Inlet Pressure
P Cold Out	Cold Side Outlet Pressure
Delta P Cold	Cold Side Pressure Difference
Delta T Hot	Hot Side Temperature Difference

Table 10. Log File Headings and Explanations (Continued)

Heading	Explanation
Delta T Cold	Cold Side Temperature Difference
Delta Tx	Temperature Difference Across heat exchanger
Is Hot Side Condensing	Specifies if Hot Side is Condensing
Thc Hot Eff	Effective Delta T Hot if Hot Side is Condensing
Delta Thc_x Eff	Effective Delta Tx if Hot Side is Condensing
Is Cold Side Evaporating	Specifies if Cold Side is Evaporating.
Tce Cold Eff	Effective Delta T Hot if Cold Side is Evaporating
Delta Tce_x Eff	Effective Delta Tx if Cold Side is Evaporating.
Delta Thc_ce_x Eff	Effective Delta Tx if Hot Side is Condensing and Cold Side is Evaporating.
Performance Factor (E)	Performance Factor
HD Hot	Hot Side Heat Duty
HD Cold	Cold Side Heat Duty
Delta HD	Heat Duty Difference
Performance ACD	ACD for Performance Factor
Staleness ACD	ACD for Staleness
Delta Tx ACD	ACD for Delta Tx
Delta T Hot ACD	ACD for Delta T Hot
Delta T Cold ACD	ACD for Delta T Cold
W Hot ACD	ACD for W Hot
W Cold ACD	ACD for W Cold
Delta P Hot ACD	ACD for Delta P Hot
Delta P Cold ACD	ACD for Delta P Cold

Table 10. Log File Headings and Explanations (Continued)

Heading	Explanation
HD Hot ACD	ACD for HD Hot
HD Cold ACD	ACD for HD Cold
Delta HD ACD	ACD for Delta HD
Clear BOPS	Clear_BOPS: Specifies if the Asset Monitor has to be retrained

Shell and Tube Heat Exchanger Asset Monitor (HXAM-ST)

The following topics discuss Shell and Tube Heat Exchanger Asset Monitor operation.

Description

The Shell and Tube Heat Exchanger Asset Monitor (HXAM-ST) is based upon Delta T measurements made across the heat exchanger, in combination with mass flow information available from the control system, if they are available. It treats the heat exchanger as a black-box device, with nothing known about the interior structure and dynamics of the device. It implements a basic definition of what shall be called **Performance Factor**, so as not to be confused with **Efficiency** or **Effectiveness**, which are already familiar industry standard terms. The Shell and Tube Heat Exchanger Asset Monitor will watch for operational steady state changes in E at one or more Operation Point Set (OPS), which should be based on the following process data inputs:

- **Required Data Values:** In the configuration of the HXAM_ST Asset Monitor, the user specifies the Data Source Aspect and Data Source Item in the Input Records of the HXAM_ST Asset monitor for the following:
  - **T Hot In.**
  - **T Hot Out**.
  - **T Cold Out**.
  - **T Cold In**.
  - **W Hot:** Alternatively, volume flow and density for the hot side may be used to calculate W.
  - **W Cold:** Alternatively, volume flow and density for the cold side may be used to calculate W.
- **Additional Data Values (Recommended):** Depending on what options were specified during configuration, the user specifies the Data Source Aspect and Data Source Item in the Input Records of the HXAM-ST Asset Monitor:
  - **Delta P Hot:** Alternatively, P In and P Out for the hot side may be used to calculate Delta P.

– **Delta P Cold:** Alternatively, P In and P Out for cold side may be used to calculate Delta P.

If the data values are well outside of reasonable range, then the Heat Exchanger Asset Monitor will assume that these values are not valid data. Potential causes for data values that are invalid include faulty transmitters. If unmistakably invalid data values are detected, the Heat Exchanger Asset Monitor will set the subconditions for conditions directly affected by the relevant inputs to **Instrumentation Error**. Additionally, the Heat Exchanger Asset Monitor will not proceed with training or attempt to monitor efficiency while the bad values continue to exist. During this time most output values from the Heat Exchanger Asset Monitor will not be updated, and their quality will be read as **BadLastKnownValue**. The trend report will show dashed lines during this period due to the bad quality of the logged data.

Since the Output Records will not be updated, Asset Optimization will report the Asset Monitor to be in **BAD** status, with an error string stating that various output records will not be set. This error is not cause for concern, as this is the intended behavior in order to correctly signal the logs and trends that the Heat Exchanger Asset Monitor is not generating valid outputs while the inputs are bad. When the input values return to a more reasonable range, normal training and monitoring will resume.

The Asset Monitor will consider any data to be invalid that is equivalent to any of the following:

- Individual temperatures (T Hot In, T Hot Out, T Cold Out, T Cold In) less than 0 degrees Kelvin.
- Individual temperatures (T Hot In, T Hot Out, T Cold Out, T Cold In) greater than 10,000 degrees Kelvin.
- Temperature differences ((T Hot In - T Hot Out), (T Hot In - T Cold Out), or (T Cold Out - T Cold In) less than 0 degrees Kelvin.
- For a hot side condensing heat exchanger, the temperature difference (T Hot In - T Hot Out) less than -10 degrees Kelvin.
- For cold side evaporating heat exchanger, the temperature difference (T Cold Out - T Cold In) less than -10 degrees Kelvin.
- Mass flow less than 0 Kg/hr.

- Mass flow greater than 1,000,000 Kg/hr.
- Pressure less than -10,000 (no units).
- Pressure greater than 10,000 (no units).
- Volume flow less than 0 M^3/hr.
- Volume flow greater than 1,000,000 M^3/hr.

Calculated Values

The calculated values are:

- **E:** Performance Factor.
- **U:** Heat Transfer Efficiency.
- **HD Hot:** Hot Side Heat Duty.
- **HD Cold:** Cold Side Heat Duty.

Methodology

The heat exchanger will operate at one or more OPS for long enough to be considered steady state operation, such that Base Operating Point Set (BOPS) and Comparative Operation Point Set (COPS) may be read and saved for comparative Performance Factor calculations.

Training

During the Training Period (TP), input plant data sets will be read, and an associated **Ebaseline** and **Ubaseline** will be calculated. A BOP will be created for each stable significantly different operating level of the heat exchanger. *Significantly different* will be determined by a percentage (Delta BOPS) that is configured by the user or greater change in any one or more of the following variables:

- **T Hot In.**
- **T Hot Out.**
- **T Cold Out.**
- **T Cold In.**
- **Delta Tx.**
- **W Hot.**

- **W Cold.**
- **Delta P Hot.**
- **Delta P Cold.**

Stable will be when the BOPS that is significantly different is recorded, remains within one percent of change for three consecutive executions.

If Design Heat Transfer Efficiency (Design U) is configured by the user, the calculated **Ubaseline** will be compared against the Design U during training. If **Ubaseline** is down by a percentage (U_Significant_Decline_Level) that is configured by the user or more of **Ubaseline**, an Asset Condition Document (ACD) will be created informing plant operations personnel that the heat exchanger heat transfer efficiency has declined significantly, and that a fault report or work order may be necessary.

Monitoring

After the TP is over, the Asset Monitor periodically (refer to AMSI in Table 10 on page 145) checks the input data set and compares it against the available BOPS. If the input data falls within one percent of any particular BOPS data set, **Enew** and **Unew** will be calculated, and compared to the BOPS stored **Ebaseline** and **Ubaseline** respectively.

Reporting Changes

If **Enew** is down by a percentage (E_Decline_Level) that is configured by the user or more of **Ebaseline**, an ACD will be created, informing plant operations personnel that the heat exchanger operational efficacy has declined, and that a fault report or work order may be necessary. If **Enew** is down by a percentage (E_Significant_Decline_Level) configured by the user or more of **Ebaseline**, an ACD will be created, informing plant operations personnel that the heat exchanger operational efficacy has fallen significantly, and should be investigated further.

Conversely, if **Enew** has gone up by a percentage (E_Improvement_Level) that is configured by the user or more, an ACD will be created indicating that the heat exchanger Performance Factor has improved and similarly, an ACD will be created indicating that the heat exchanger Performance Factor has improved significantly if **Enew** has gone up by a percentage (E_Significant_Improvement_Level) that is configured by the user or more. At this point, the BOPS used for the comparison

will be replaced with the current COPS, if it persists for more than three times the Asset Monitor Sample Interval (AMSI).

Similarly, ACDs will be created if **Unew** has gone down by a percentage that is configured by the user or more of **Ubaseline**, informing plant operations personnel that the heat exchanger heat transfer efficiency has declined or fallen significantly (based on the drop of **Unew** from **Ubaseline**), and should be investigated further. Also ACDs will be created if **Unew** has gone up by a percentage that is configured by the user or more of **Ubaseline**, indicating that the heat transfer efficiency has improved or significantly improved (based on the rise of **Unew** from **Ubaseline**).

If any one or more BOPS go stale during Monitoring, an ACD is created informing the plant operations personnel that one or more BOPS have gone stale. At this point the Asset Monitor automatically goes back to Training.

Logging Function

If the Logging (Enable_Logging_Data) is enabled at configuration, the following two additional functions will take place during training and operation of the Heat Exchanger Asset Monitor:

- Heat Exchanger Asset Monitor will execute once per minute, regardless of **E** calculation/comparison period.
- During each execution, all field inputs and calculated variables of interest will be recorded in a flat text file by appending a comma delimited line of data to the existing log file.

Refer to Log File Description (.csv file) on page 180 for details on the Log File.

Optional Reporting

Optionally (to be specified at Asset Monitor configuration time), the Heat Exchanger Asset Monitor can also send an ACD reporting any of the following identified conditions:

- **Staleness:** If any one or more of the trained BOPS goes stale, an ACD is created.
- If Delta Tx has exceeded a high or low limit specified at configuration time.

- If any of the following variables has exceeded a high or low limit specified at configuration time:
  - **Delta T Hot.**
  - **Delta T Cold.**
  - **W Hot.**
  - **W Cold.**
  - **Delta P Hot.**
  - **Delta P Cold.**
  - **HD Hot.**
  - **HD Cold.**
  - **Delta HD.**
  - **Limit Approach Temperature:** Warns if it falls below a low limit specified at configuration time.
  - **Thermal Crossover Detection:** Indicates if the Heat Exchanger is operating in **Thermal Crossover**.
  - **Shell Side Flow:** Warns if it falls below a low limit specified at configuration time.
  - **Tube Velocity:** Warns if it has exceeded a high or low limit specified at configuration time.

The Shell Side Flow Condition Monitor checks if the flow at Shell Side, which could be either the Mass Flow if available, else the Volume Flow, has fallen below the configured limit. If Hot Fluid flows through the Shell Side and Mass Flow for Shell Side is available, the Shell Side Flow Condition Monitor and Hot Side Mass Flow Condition Monitor are the same. In this case either one Condition Monitor is to be enabled. It also holds if Cold fluid flows through the Shell and Cold Side Mass Flow is available. The only case where enabling both the Shell Side Flow Condition Monitor and Mass Flow Condition Monitor makes sense is when Mass Flow for that side is unavailable and Volume Flow for that side is available.

Shell and Tube Heat Exchanger Asset Monitor Operation

Once the Asset Monitor is properly configured, one can start the Asset Monitor (Asset Monitor Aspect Name: HXAM_ST) by starting the Asset Monitoring Server. Figure 68 shows the view of the Asset Monitor when the Asset Monitoring Server is not running. The Quality Status will be set to `badNotConnected`.

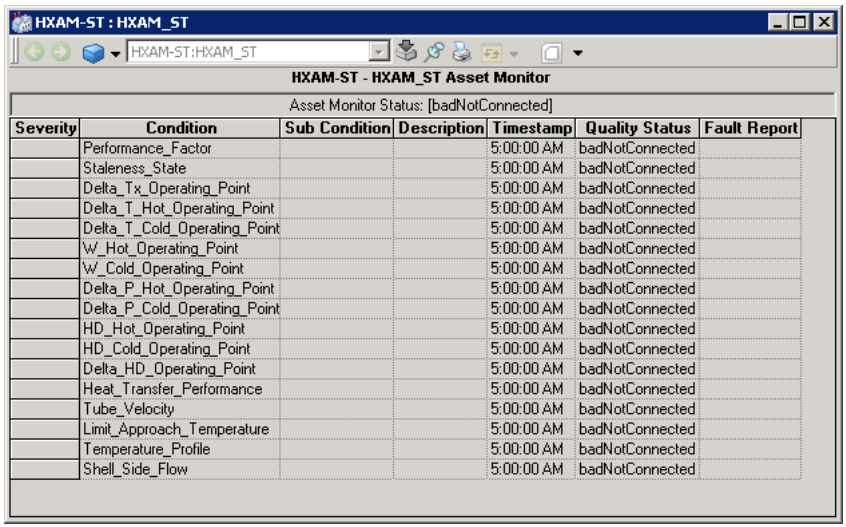
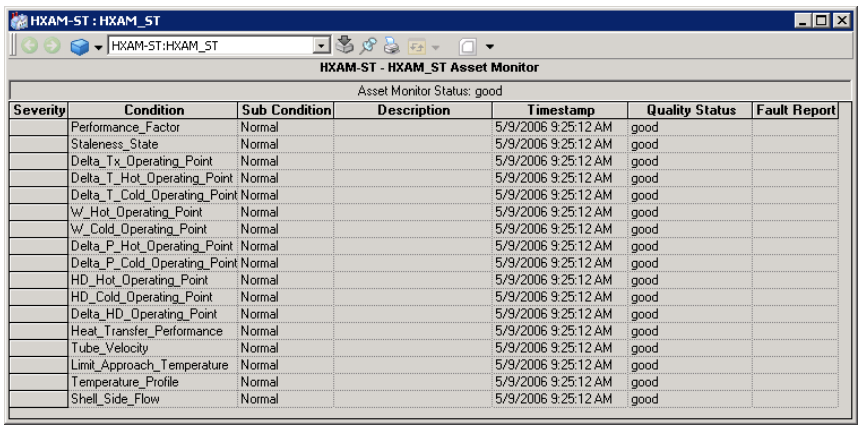


Figure 68. HXAM_ST Aspect when Asset Monitoring Server is not Running

Any error in configuration will set the Quality Status to `badConfigurationError` and any other error during execution will set the Quality Status to `bad`. In either case the Asset Monitor will stop executing and will show an error message.

A normal working Asset Monitor without any errors will appear similar to the one shown in Figure 69.



Severity	Condition	Sub Condition	Description	Timestamp	Quality Status	Fault Report
	Performance_Factor	Normal		5/9/2006 9:25:12 AM	good	
	Staleness_State	Normal		5/9/2006 9:25:12 AM	good	
	Delta_Tx_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	Delta_T_Hot_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	Delta_T_Cold_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	W_Hot_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	W_Cold_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	Delta_P_Hot_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	Delta_P_Cold_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	HD_Hot_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	HD_Cold_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	Delta_HD_Operating_Point	Normal		5/9/2006 9:25:12 AM	good	
	Heat_Transfer_Performance	Normal		5/9/2006 9:25:12 AM	good	
	Tube_Velocity	Normal		5/9/2006 9:25:12 AM	good	
	Limit_Approach_Temperature	Normal		5/9/2006 9:25:12 AM	good	
	Temperature_Profile	Normal		5/9/2006 9:25:12 AM	good	
	Shell_Side_Flow	Normal		5/9/2006 9:25:12 AM	good	

Figure 69. HXAM_ST Aspect when HXAM-ST Asset Monitor is Working Normally

HXAM_ST_Faceplate

A detailed view of the Asset Monitor can be seen from the HXAM_ST_Faceplate. The HXAM_ST_Faceplate has 13 tabs, with each tab showing a detailed picture of the condition being assessed.

Performance Tab

The **Performance** tab (Figure 70) shows the details of the Performance_Factor condition being assessed. This tab is the view of HXAM_ST_Performance_FE Aspect.

The fields in the **Performance** tab are:

- **Quality Status:** Gives the working status of the Asset Monitor. The following are the different status values:
  - **BadOutOfService:** Asset Monitoring Server Engine is shut down.
  - **Good:** Asset Monitor is running smoothly.
  - **Bad:** Asset Monitor had encountered some error.

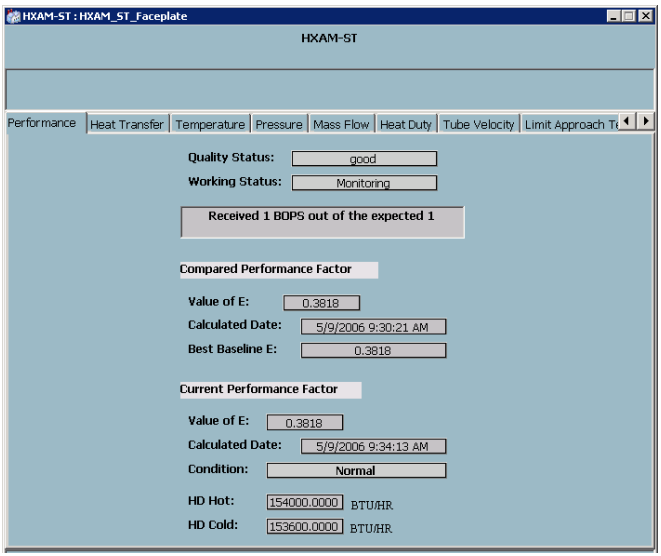


Figure 70. Performance Tab

  - **BadConfigurationError:** Configuration error in Asset Monitor.
  - **GoodLocalOverride:** Asset Monitor is under Training/Asset Monitor is in Monitoring Phase but there is no BOPS recorded/one or more BOPS has gone stale.

- **Working Status:** Displays Asset Monitor status, as in: `In Training` or `Monitoring` phase.

  The text box in Figure 70 shows the user how many BOPS are received during Training and how many BOPS are received out of the expected number during Monitoring.

- **Compared Performance Factor:**
  - **Value of E:** Shows the **Ebaseline** against which the COPS **E** is being compared against during Monitoring. It shows `-1` during Training.
  - **Calculated Date:** Shows the time when the **Ebaseline** was calculated. It shows `Not Available` during Training.

  - **Best Baseline E:** Shows the best **Ebaseline** among the trained BOPS. It shows `-1` if any BOPS gets stale and the Asset Monitor goes back to Training.

- **Current Performance Factor:**
  - **Value of E:** Shows the **Enew** calculated from the current input data.
  - **Calculated Date:** Shows the time when the **Enew** was calculated.
  - **Condition:** Shows the Subcondition of the Performance_Factor condition after assessing the data. It always shows `Normal` during Training. The different subconditions that will be reported during Monitoring are as follows:

    Normal: Heat Exchanger Performance is under Normal condition.

    Declining: Heat Exchanger Performance has declined. (**Enew** dropped by E_Decline_Level from **Ebaseline**).

    Significantly Declining: Heat Exchanger Performance has declined significantly. (**Enew** dropped by E_Significant_Decline_Level from **Ebaseline**).

    Improving: Heat Exchanger Performance has improved. (**Enew** raised by E_Improvement_Level from **Ebaseline**).

    Significantly Improving: Heat Exchanger Performance has improved significantly. (**Enew** raised by E_Significant_Improvement_Level from **Ebaseline**).

    Cannot Compare: Heat Exchanger input data cannot be compared against any trained BOPS.

- **HD Hot:** Gives the Heat Duty for the Hot Side.
- **HD Cold:** Gives the Heat Duty for the Cold Side.

Heat Transfer Tab

The **Heat Transfer** tab (Figure 71) shows the details of the Heat_Transfer_Performance condition being assessed. This tab is a view of the HXAM_ST_Heat_Transfer_FE Aspect.

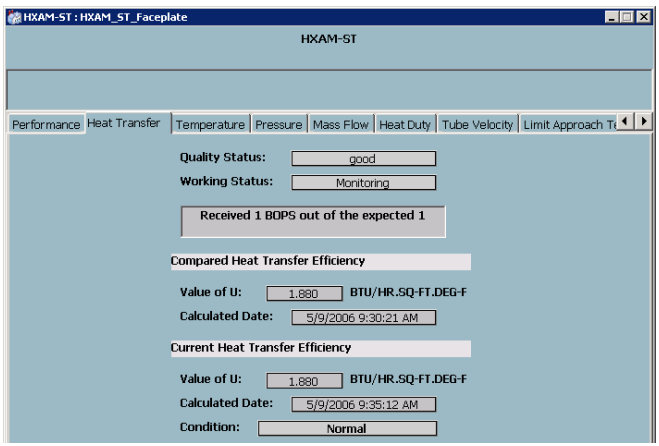


Figure 71. Heat Transfer Tab

The fields in the **Heat Transfer** tab are:

- **Quality Status:** Gives the working status of the Asset Monitor. The following are the different status values:
  - **BadOutOfService:** Asset Monitoring Server Engine is shut down.
  - **Good:** Asset Monitor is running smoothly.
  - **Bad:** Asset Monitor has encountered some error.
  - **BadConfigurationError:** Configuration error in Asset Monitor.
  - **GoodLocalOverride:** Asset Monitor is under Training/Asset Monitor is in Monitoring Phase but there is no BOPS recorded/one or more BOPS has gone stale.
- **Working Status:** Tells if the Asset Monitor is `In Training` or is in `Monitoring` Phase.

The text box in Figure 71 tells the user how many BOPS are received during Training and how many BOPS are received out of the expected number during Monitoring.

- **Compared Heat Transfer Coefficient:**
  - **Value of U:** Shows the **Ubaseline** against which the COPS **U** is being compared against during Monitoring. It shows `-1` during Training.
  - **Calculated Date:** Shows the time when the **Ubaseline** was calculated. It shows `Not Available` during Training.
- **Current Heat Transfer Coefficient:**
  - **Value of U:** Shows the **Unew** calculated from the current input data.
  - **Calculated Date:** Shows the time when the **Unew** was calculated.
  - **Condition:** Shows the Subcondition of the Heat_Transfer_Performance condition after assessing the data. It always shows `Normal` during Training. The different subconditions that will be reported during Monitoring are as follows:

Normal:	Heat Exchanger Heat Transfer Efficiency is under Normal condition.
Declining:	Heat Exchanger Heat Transfer Efficiency has declined. (**Unew** dropped by U_Decline_Level from **Ubaseline**).
Significantly Declining:	Heat Exchanger Heat Transfer Efficiency has declined significantly. (**Unew** dropped by U_Significant_Decline_Level from **Ubaseline**).
Improving:	Heat Exchanger Heat Transfer Efficiency has improved. (**Unew** raised by U_Improvement_Level from **Ubaseline**).
Significantly Improving:	Heat Exchanger Heat Transfer Efficiency has improved significantly. (**Unew** raised by

U_Significant_Improvement_Level from **Ubaseline**).

Cannot Compare: Heat Exchanger input data cannot be compared against any trained BOPS.

Temperature Tab

The **Temperature** tab (Figure 72) shows the details of the Delta_T_Operating_Point, Delta_T_Hot_Operating_Point, and Delta_T_Cold_Operating_Point conditions being assessed. This tab is the view of HXAM_ST_Temperature_FE Aspect.

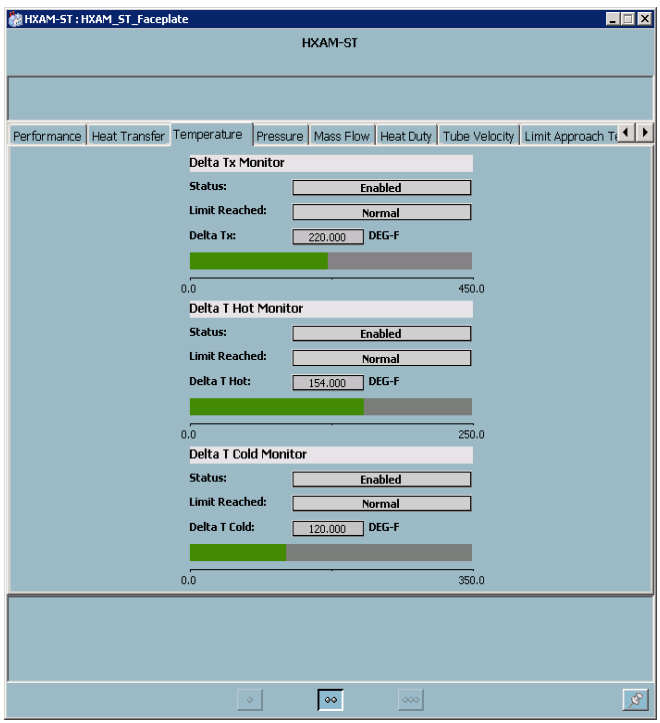


Figure 72. Temperature Tab

The Limit Reached field for all Temperature Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. The values of Delta Tx, Delta T Hot, and Delta T Cold will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Temperature** tab are:

- **Delta Tx Monitor:**
  - **Status:** Gives the status of the Delta Tx Monitor. The status values are:

Enabled:	If Delta Tx Monitor is enabled.
Not Enabled:	If Delta Tx Monitor is not enabled.
Stale Data in Trained Set:	If one or more BOPS is stale.
Not Available:	During Training.

  - **Limit Reached:** Gives the subcondition for the Delta_T_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Delta Tx is within the Normal range.
Increasing:	Delta Tx has crossed the Delta_Tx_Increasing Limit.
High:	Delta Tx has crossed the Delta_Tx_High Limit.
Decreasing:	Delta Tx has crossed the Delta_Tx_Decreasing Limit.
Low:	Delta Tx has crossed the Delta_Tx_Low Limit.

  - **Delta Tx:** Gives the value of Delta Tx for the current OPS.
- **Delta T Hot Monitor:**
  - **Status:** This field gives the status of the Delta T Hot Monitor. The status values are:

Enabled:	If Delta T Hot Monitor is enabled.

Not Enabled: If Delta T Hot Monitor is not enabled.

Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

– **Limit Reached:** Gives the subcondition for the Delta_T_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are as follows:

Normal: Delta T Hot is within the Normal range.

Increasing: Delta T Hot has crossed the Delta_T_ Hot _Increasing Limit.

High: Delta T Hot has crossed the Delta_T_Hot _High Limit.

Decreasing: Delta T Hot has crossed the Delta_T_Hot _Decreasing Limit.

Low: Delta T Hot has crossed the Delta_T_ Hot _Low Limit.

– **Delta T Hot:** Gives the value of Delta T Hot for the current OPS.

• **Delta T Cold Monitor:**

– **Status:** This field gives the status of the Delta T Cold Monitor. The different status that one might see here are as follows:

Enabled: If Delta T Cold Monitor is enabled.

Not Enabled: If Delta T Cold Monitor is not enabled.

Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

– **Limit Reached:** Gives the subcondition for the Delta_T_Cold _Operating_Point condition. The different subconditions that will be reported during Monitoring are as follows:

Normal: Delta T Cold is within the Normal range.

Increasing:	Delta T Cold has crossed the Delta_T_ Cold _Increasing Limit.
High:	Delta T Cold has crossed the Delta_T_ Cold _High Limit.
Decreasing:	Delta T Cold has crossed the Delta_T_ Cold _Decreasing Limit.
Low:	Delta T Cold has crossed the Delta_T_ Cold _Low Limit.

– **Delta T Cold:** Gives the value of Delta T Cold for the current OPS.

Pressure Tab

The **Pressure** tab (Figure 73) shows the details of the Delta_P_Hot_Operating_Point and Delta_P_Cold_Operating_Point conditions being assessed. This tab is a view of the HXAM_ST_Pressure_FE Aspect.

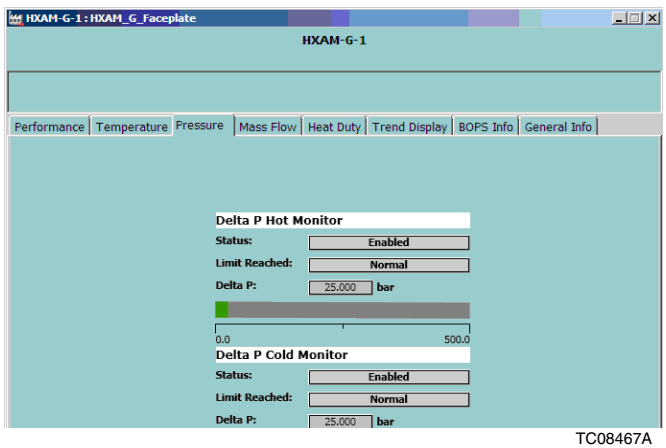


Figure 73. Pressure Tab

The Limit Reached field for both Pressure Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. Also the values of Delta P Hot

and Delta P Cold will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Pressure** tab are:

- **Delta P Hot Monitor:**
  - **Status:** This field gives the status of the Delta P Hot Monitor. The different status that one might see here are as follows:

    Enabled: If Delta P Hot Monitor is enabled.

    Not Enabled: If Delta P Hot Monitor is not enabled.

    Stale Data in Trained Set: If one or more BOPS is stale.

    Not Available: During Training.

    Data Unavailable: If Delta P Hot Monitor is but Delta P Hot data is not available.
  - **Limit Reached:** Gives the subcondition for the Delta_P_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

    Normal: Delta P Hot is within the Normal range.

    Increasing: Delta P Hot has crossed the Delta_P_ Hot _Increasing Limit.

    High: Delta P Hot has crossed the Delta_P_Hot _High Limit.

    Decreasing: Delta P Hot has crossed the Delta_P_Hot _Decreasing Limit.

    Low: Delta P Hot has crossed the Delta_P_ Hot _Low Limit.
  - **Delta P Hot:** Gives the value of Delta P Hot for the current OPS.
- **Delta P Cold Monitor:**
  - **Status:** This field gives the status of the Delta P Cold Monitor. The status values are:

    Enabled: If Delta P Cold Monitor is enabled.

    Not Enabled: If Delta P Cold Monitor is not enabled.

    Stale Data in Trained Set: If one or more BOPS is stale.

Not Available:	During Training.
Data Unavailable:	If Delta P Cold Monitor is but Delta P Cold data is not available.

– **Limit Reached:** Gives the subcondition for the Delta_ P_Cold _Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Delta P Cold is within the Normal range.
Increasing:	Delta P Cold has crossed the Delta_ P_ Cold _Increasing Limit.
High:	Delta P Cold has crossed the Delta_P_Cold _High Limit.
Decreasing:	Delta P Cold has crossed the Delta_P_Cold _Decreasing Limit.
Low:	Delta P Cold has crossed the Delta_P_Cold _Low Limit.

– **Delta P Cold:** Gives the value of Delta P Cold for the current OPS.

Mass Flow Tab

The **Mass Flow** tab (Figure 74) shows the details of the W_Hot_Operating_Point and W_Cold_Operating_Point conditions being assessed. This tab is the view of HXAM_ST_MassFlow_FE Aspect.

The Limit Reached field for both Mass Flow Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. The values of Mass Flows will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

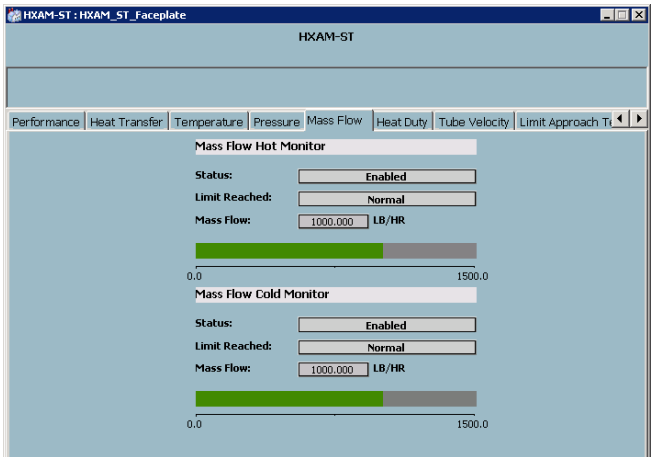


Figure 74. Mass FlowTab

The fields in the **Mass Flow** tab are:

- **Mass Flow Hot Monitor:**
  - **Status:** This field gives the status of the Mass Flow Hot Monitor. The status values are:

    Enabled: If Mass Flow Hot Monitor is enabled.

    Not Enabled: If Mass Flow Hot Monitor is not enabled.

    Stale Data in Trained Set: If one or more BOPS is stale.

    Not Available: During Training.

  - **Limit Reached:** Gives the subcondition for the W_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

    Normal: Mass Flow Hot is within the Normal range.

    Increasing: Mass Flow Hot has crossed the W_ Hot _Increasing Limit.

High: Mass Flow Hot has crossed the W_Hot _High Limit.

Decreasing: Mass Flow Hot has crossed the W_Hot _Decreasing Limit.

Low: Mass Flow Hot has crossed the W_ Hot _Low Limit.

– **Mass Flow Hot:** Gives the value of Mass Flow Hot for the current OPS.

• **Mass Flow Cold Monitor:**

– **Status:** Gives the status of the Mass Flow Cold Monitor. The status values are:

Enabled: If Mass Flow Cold Monitor is enabled.

Not Enabled: If Mass Flow Cold Monitor is not enabled.

Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

– **Limit Reached:** Gives the subcondition for the W_Cold_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal: Mass Flow Cold is within the Normal range.

Increasing: Mass Flow Cold has crossed the W_Cold_Increasing Limit.

High: Mass Flow Cold has crossed the W_Cold_High Limit.

Decreasing: Mass Flow Cold has crossed the W_Cold_Decreasing Limit.

Low: Mass Flow Cold has crossed the W_Cold_Low Limit.

– **Mass Flow Cold:** Gives the value of Mass Flow Cold for the current OPS.

Heat Duty Tab

The **Heat Duty** tab (Figure 75) shows the details of the Delta_HD_Operating_Point, HD_Hot_Operating_Point, and HD_Cold_Operating_Point conditions being assessed. This tab is a view of the HXAM_ST_HeatDuty_FE Aspect.

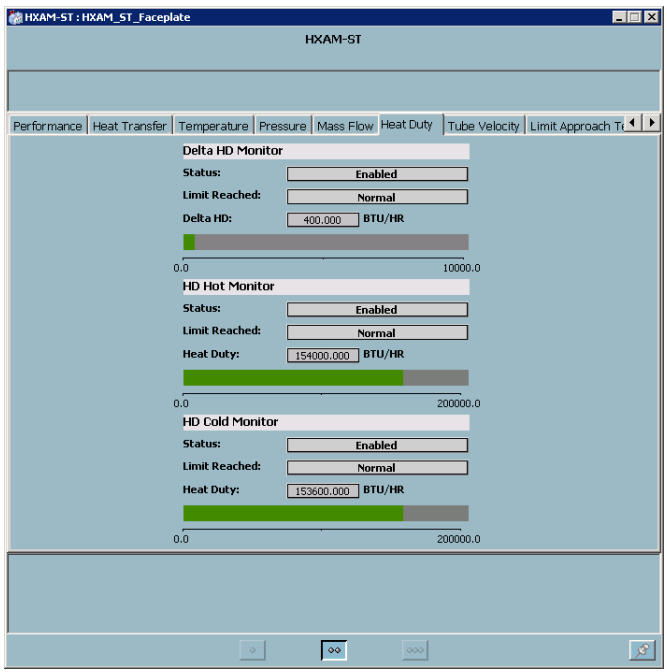


Figure 75. Heat Duty Tab

The Limit Reached field for all Heat Duty Condition Monitors will show `Normal`, when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. Also the values of Delta HD, Heat Duty Hot, and Heat Duty Cold will show `0` when the Asset Monitoring Server is not running and `-1` otherwise except when the Status field says `Enabled`.

The fields in the **Heat Duty** tab are:

- **Delta HD Monitor:**
  - **Status:** This field gives the status of the Delta HD Monitor. The different status that one might see here are as follows:

Enabled:	f Delta HD Monitor is enabled
Not Enabled:	If Delta HD Monitor is not enabled
Stale Data in Trained Set:	If one or more BOPS is stale
Not Available:	During Training

  - **Limit Reached:** Gives the subcondition for the Delta_HD_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	Delta HD is within the Normal range.
High:	Delta HD has crossed the Delta_HD_High Limit.

  - **Delta HD:** Gives the value of Delta HD for the current OPS.
- **HD Hot Monitor:**
  - **Status:** This field gives the status of the HD Hot Monitor. The different status values are:

Enabled:	If HD Hot Monitor is enabled.
Not Enabled:	If HD Hot Monitor is not enabled.
Stale Data in Trained Set:	If one or more BOPS is stale.
Not Available:	During Training.

  - **Limit Reached:** Gives the subcondition for the HD_Hot_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal:	HD Hot is within the Normal range.
High:	HD Hot has crossed the HD_Hot_High Limit.

Low: HD Hot has crossed the HD_Hot_Low Limit.

– **HD Hot:** Gives the value of HD Hot for the current OPS.

• **HD Cold Monitor:**

– **Status:** Gives the status of the HD Cold Monitor. The status values are:

Enabled: If HD Cold Monitor is enabled.

Not Enabled: If HD Cold Monitor is not enabled.

Stale Data in Trained Set: If one or more BOPS is stale.

Not Available: During Training.

– **Limit Reached:** Gives the subcondition for the HD_Cold_Operating_Point condition. The different subconditions that will be reported during Monitoring are:

Normal: HD Cold is within the Normal range.

High: HD Cold has crossed the HD_Cold _High Limit.

Low: HD Cold has crossed the HD_Cold_Low Limit.

– **HD Cold:** Gives the value of HD Cold for the current OPS.

Tube Velocity Tab

The **Tube Velocity** tab (Figure 76) shows the details of the Tube_Velocity condition being assessed. This tab is the view of HXAM_ST_Tube_Velocity_FE Aspect.

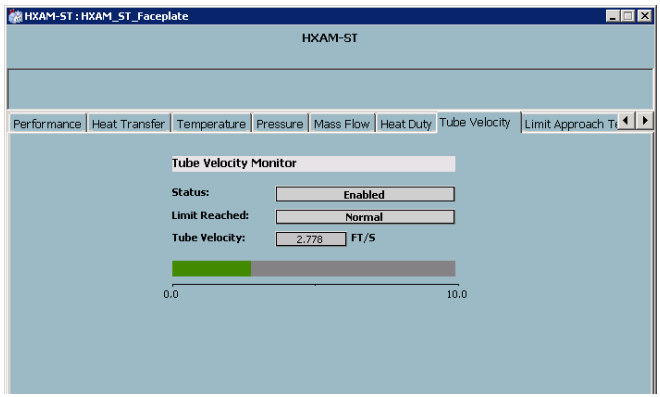


Figure 76. Tube Velocity Tab

The Limit Reached field for Tube Velocity Monitor will show `Normal` when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. Also the value of Tube Velocity will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Tube Velocity** tab are:

- **Status:** This field gives the status of the Tube Velocity Monitor. The different status values are:
  - **Enabled:** If Tube Velocity Monitor is enabled.
  - **Not Enabled:** If Tube Velocity Monitor is not enabled.
  - **Stale Data in Trained Set:** If one or more BOPS is stale.
  - **Not Available:** During Training.
- Limit Reached: Gives the subcondition for the Tube_Velocity condition. The different subconditions that will be reported during Monitoring are:

  - **Normal:** Tube Velocity is within the Normal range.
  - **High:** Tube Velocity has crossed the Tube Velocity_High Limit.
  - **Low:** Tube Velocity has crossed the Tube Velocity_Low Limit.
- **Tube Velocity:** Gives the value of Tube Velocity for the current OPS.

Limit Approach Temperature Tab

The **Limit Approach Temperature** (LAT) tab (Figure 77) shows the details of the Limit_Approach_Temperature condition being assessed. This tab is a view of the HXAM_ST_LAT_FE Aspect.

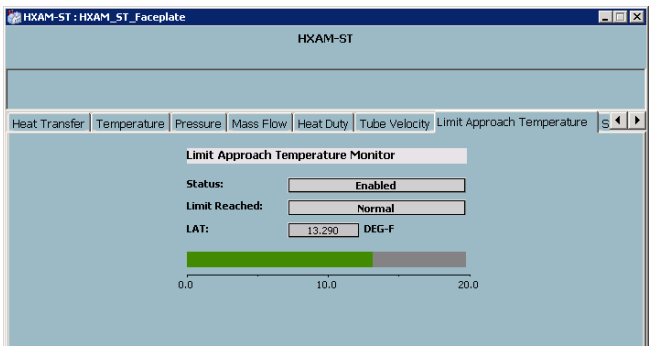


Figure 77. Limit Approach Temperature Tab

The Limit Reached field for LAT Monitor will show `Normal` when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. The value of Tube Velocity will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Limit Approach Temperature** tab are:

- **Status:** Gives the status of the LAT Monitor. The different status values are:
  - **Enabled:** If LAT Monitor is enabled.
  - **Not Enabled:** If LAT Monitor is not enabled.

  - **Stale Data in Trained Set:** If one or more BOPS is stale.
  - **Not Available:** During Training.

- Limit Reached: Gives the subcondition for the Limit_Approach_Temperature condition. The different subconditions that will be reported during Monitoring are:
  - **Normal:** LAT is within the Normal range.
  - **Low:** LAT has crossed the LAT_Low Limit.
- **LAT:** Gives the value of Limit Approach Temperature for the current OPS.

Shell Side Flow Tab

The **Shell Side Flow** tab (Figure 78) shows the details of the Shell_Side_Flow condition being assessed. This tab is the view of HXAM_ST_Shell_Side_Flow_FE Aspect.

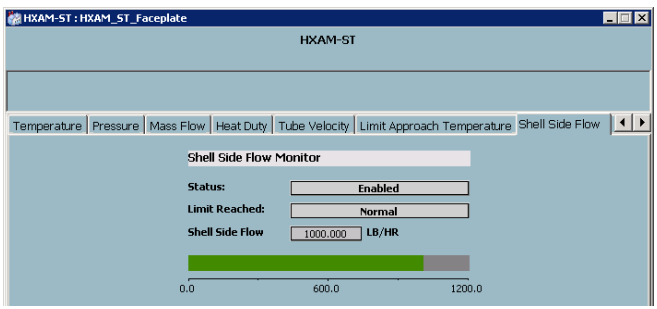


Figure 78. Shell Side Flow Tab

The Limit Reached field for Shell Side Flow Monitor will show `Normal` when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. Also the value of Shell Side Flow will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The fields in the **Shell Side Flow** tab are:

- **Status:** This field gives the status of the Shell Side Flow Monitor. The different status values are:
  - **Enabled:** If Shell Side Flow Monitor is enabled.
  - **Not Enabled:** If Shell Side Flow Monitor is not enabled.
  - **Stale Data in Trained Set:** If one or more BOPS is stale.
  - **Not Available:** During Training.
- **Limit Reached:** Gives the subcondition for the Shell Side Flow condition. The different subconditions that will be reported during Monitoring are:
  - **Normal:** Shell Side Flow is within the Normal range.
  - **Low:** Shell Side Flow has crossed the Shell_Side_Flow_Low Limit.
- **Shell Side Flow:** Gives the value of Shell Side Flow for the current OPS.

Temperature Crossover Tab

The Temperature Crossover tab in Figure 79 shows the details of the Temperature_Profile condition being assessed. This tab is a view of the HXAM_ST_TCOD_FE Aspect.

The Limit Reached field for Temperature Crossover Detection Monitor (TCOD) will show `Normal` when the Asset Monitoring Server is not running or if Status field says `Not Available`, `Stale data in Trained Set`, or `Not Enabled`. The value of Shell Side Flow will show `0` when the Asset Monitoring Server is not running and `-1` otherwise, except when the Status field says `Enabled`.

The Fields in the **Temperature Crossover** tab are:

- **Status:** This field gives the status of the TCOD Monitor. The different status values are:
  - **Enabled:** If TCOD Monitor is enabled.
  - **Not Enabled:** If TCOD Monitor is not enabled.
  - **Stale Data in Trained Set:** If one or more BOPS is stale.
  - **Not Available:** During Training.

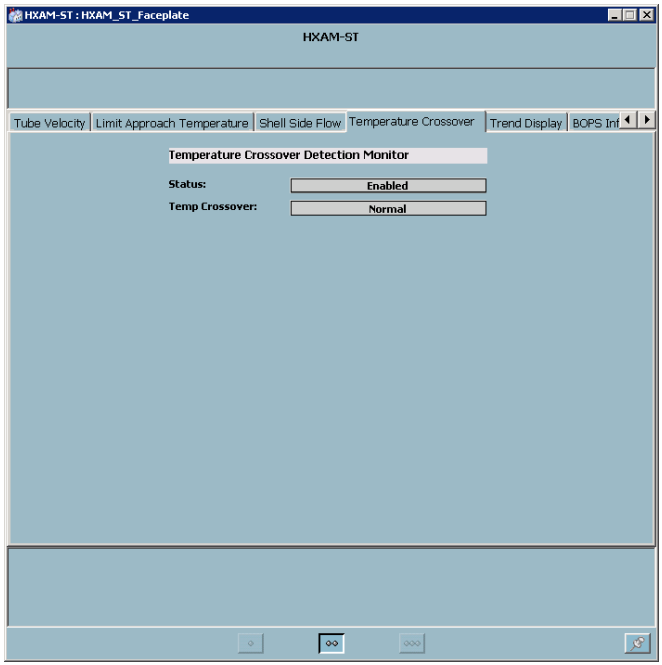


Figure 79. Temperature Crossover Tab

- **Limit Reached:** Gives the subcondition for the Temperature_Profile condition. The different subconditions that will be reported during Monitoring are:
  - **Normal:** The Heat Exchanger is not working on Temperature Crossover.
- **Crossover:** The Heat Exchanger is working on Temperature Crossover.

Trend Display Tab

The **Trend Display** tab shows the plots of the logged properties against time. This tab is the view of Trend Display Aspect. Four properties are logged and the user can configure for which logged property the trend is to be displayed. Refer to Trends and Logs on page 177 for more details.

BOPS Info Tab

The BOPS Info tab (Figure 80) gives the user information on the trained BOPS. The first text box in Figure 80 will display the same message as the text box in Figure 70 on page 156. The second text box shows the details of the trained BOPS. This field will be empty during Training. Clicking **Clear all BOPS and Retrain** gives the user the choice to retrain the Asset Monitor at any time if BOPS have not been manually entered. This tab is a view of the HXAM_ST_BOPS_Info_FE Aspect.

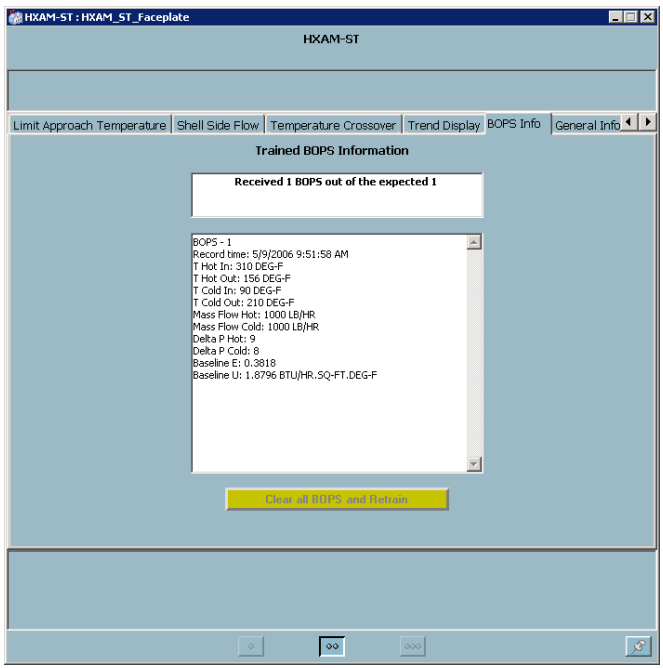


Figure 80. BOPS Info Tab

General Info Tab

The **General Info** tab (Figure 81) displays general information. For example, it will display the recommended AMSI, if the AMSI configured by the user does not match the recommended value. It also displays the default values taken for any Asset Parameters. This tab is a view of the HXAM_ST_General_Info_FE Aspect.

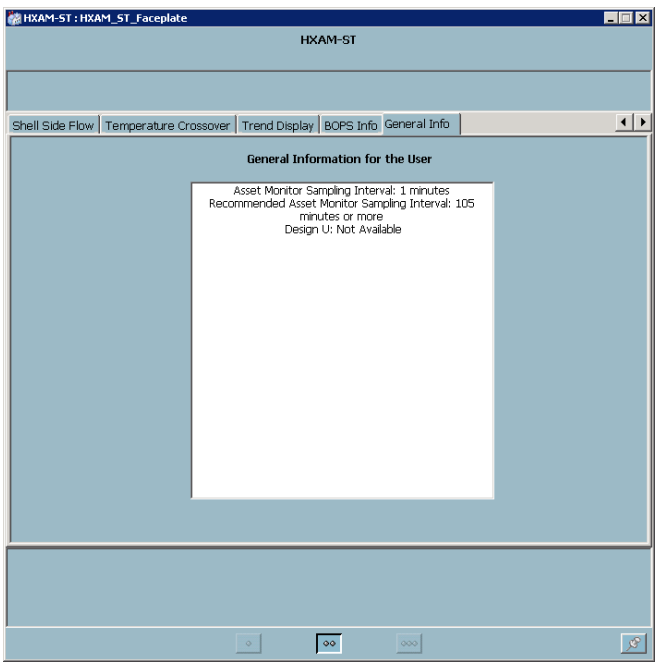


Figure 81. General Info Tab

Trends and Logs

The Trend portion is used to present object properties graphically as a function of time or as an XY-plot. To enable trending, the following seven aspects are used:

- History Source.
- Log Template.
- Log Configuration.
- Trend Template.

- Trend Display.
- AssetMonitorProperties.
- HXAM_ST_Available_Logs_FE.

HXAM_ST_Available_Logs_FE is not actually used for logging, but displays the values for which logs are configured on the default Heat Exchanger – Shell and Tube object type

Refer to *System 800xA Operations Operator Workplace Configuration (3BSE030322*)* for more details.

History Source

The History Source Aspect is used to define the Service Group that handles a subset of logs, i.e. the Log Configurations on all child objects. It should be noted that if no History Source is defined no logging will occur.

Log Template

A Log Template is a template for building logs for heat exchanger properties. Modifying the Log Template will affect existing logs that use the Log Template. The template is configured to log data for the last three years.

Log Configuration

The Log Configuration Aspect is used to configure what properties are to be logged. In the Shell and Tube Heat Exchanger Asset Monitor the following properties are configured to be logged:

- Relative Performance Factor.
- Current Performance Factor.
- Heat Transfer Efficiency.
- Hot Side Heat Duty.
- Cold Side Heat Duty.
- Current Coefficient of Heat Transfer Efficiency.

The data for these properties are read from the AssetMonitorProperties Aspect, which is populated by the Asset Monitoring Engine. The view of the Log Configuration Aspect is shown in Figure 82. The logged data for a property can be viewed by selecting the **Status** tab and clicking **Read**. A value of `-1` shows that the Asset Monitoring Server is not running or the Asset Monitor Status Quality is not **good** or not **goodlocaloverride**. Every time the Asset Monitoring Server is started or restarted, the property will take a value of `0` first and then the current value.

The green light (circle in lower left of the display) indicates that logging is working correctly. If it is not green, it means that the History Source is not configured properly.

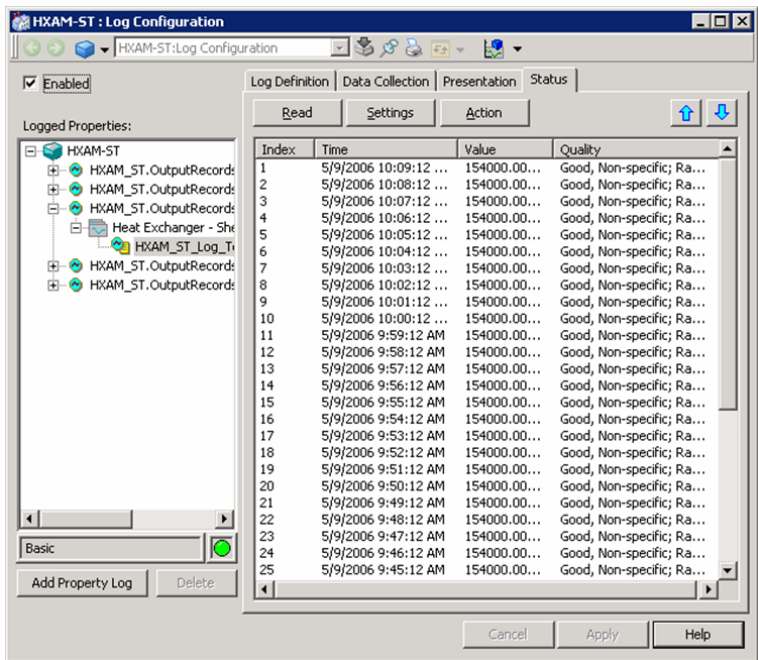


Figure 82. Log Configuration Aspect

Trend Template

A Trend Template is a template for building Trend Displays. Modifying an existing Trend Template will not automatically affect existing trends. Settings that are affected are those that can not be changed in the existing Trend Display such as number of areas and configurable rows, trace colors, and Hide/Show Table. The Trend Template is configured to take four rows in Trend Display Aspect, each row for one of the four logged properties. It also takes four traces (**Colors** tab), each trace representing the plot for the logged property.

Trend Display

The Trend Display Aspect displays the four logged heat exchanger properties graphically as a function of time.

Asset Monitor Properties

The Asset Monitor Properties Aspect displays the values of parameters defined within the HXAM-G object.

Log File Description (.csv file)

The Log File is identified by:

- **Name Of File:** .Asset.ItemGUID & .Asset.AspectGUID & "-LogFile.csv"

  Name of File is given as the combination of the Asset Item Global Unique Identifier (GUID), the Asset Aspect GUID, and "-LogFile.csv".

- **Path Name:** App.Path & "\" & “HXAM_ST_Store” & "\" & *Name Of File*

  Path name of the Log File gives the location where the Log File is stored. The Log File is stored in the same location as the Application (App.Path) under a HXAM_ST_Store folder under the file name specified by *Name Of File*.

- **Format of File:** The file contains the following information in the following order:

The data in Step 1 and Step 2 are saved only once at the time when the Log File is created. All data in Step 3 and Step 4 will be saved to the Log File for each Start or Download/Restart on the Asset Monitoring Server. All the data in Step 5 is saved to the Log File on every execution of the Asset Monitor logic.

1. Description of what data the file contains.
2. Date and time when the file was created.
3. Date and time when logging started.
4. All the Asset Parameters (With heading **Asset Parameter Name** and **Parameter Value**).
5. All the Process Data, Calculated Data, and ACDs in the order shown in Table 11 (Heading is also provided).

Table 11. Log File Headings and Explanations

Heading	Explanation
Time Stamp	The current time in local time standard when the Asset Monitor started execution.
Execution Time (ms)	The total time the Asset Monitor takes to execute logic in milliseconds, rounded to one decimal.
Phase Of Operation	Tells if the Asset Monitor is *In Training* or *Monitoring*.
BOPS	During Training, it specifies if an OPS has been accepted as a BOPS. If it is a BOPS, then it specifies if it is the first, second, etc. During monitoring the BOPS used for comparison with the COPS is logged.
T Hot In	Hot Side Inlet Temperature
T Hot Out	Hot Side Outlet Temperature
T Cold In	Cold Side Inlet Temperature
T Cold Out	Cold Side Outlet Temperature
Mass Flow Hot	Hot Side Mass Flow
Volume Flow Hot	Cold Side Volume Flow
Mass Flow Cold	Hot Side Mass Flow
Volume Flow Cold	Cold Side Volume Flow
P Hot In	Hot Side Inlet Pressure

Table 11. Log File Headings and Explanations (Continued)

Heading	Explanation
P Hot Out	Hot Side Outlet Pressure
Delta P Hot	Hot Side Pressure Difference
P Cold In	Cold Side Inlet Pressure
P Cold Out	Cold Side Outlet Pressure
Delta P Cold	Cold Side Pressure Difference
Delta T Hot	Hot Side Temperature Difference
Delta T Cold	Cold Side Temperature Difference
Delta Tx	Temperature Difference Across heat exchanger
Is Hot Side Condensing	Specifies if Hot Side is Condensing
Thc Hot Eff	Effective Delta T Hot if Hot Side is Condensing
Delta Thc_x Eff	Effective Delta Tx if Hot Side is Condensing
Is Cold Side Evaporating	Specifies if Cold Side is Evaporating.
Tce Cold Eff	Effective Delta T Hot if Cold Side is Evaporating
Delta Tce_x Eff	Effective Delta Tx if Cold Side is Evaporating.
Delta Thc_ce_x Eff	Effective Delta Tx if Hot Side is Condensing and Cold Side is Evaporating.
Performance Factor (E)	Performance Factor
Corrected LMTD	Corrected LMTD
Heat Transfer Efficiency (U)	Heat Transfer Efficiency
HD Hot	Hot Side Heat Duty
HD Cold	Cold Side Heat Duty
Delta HD	Heat Duty Difference
Performance ACD	ACD for Performance Factor

Table 11. Log File Headings and Explanations (Continued)

Heading	Explanation
Heat Transfer Performance ACD	ACD for Heat Transfer Efficiency
Staleness ACD	ACD for Staleness
Delta Tx ACD	ACD for Delta Tx
Delta T Hot ACD	ACD for Delta T Hot
Delta T Cold ACD	ACD for Delta T Cold
W Hot ACD	ACD for W Hot
W Cold ACD	ACD for W Cold
Delta P Hot ACD	ACD for Delta P Hot
Delta P Cold ACD	ACD for Delta P Cold
HD Hot ACD	ACD for HD Hot
HD Cold ACD	ACD for HD Cold
Delta HD ACD	ACD for Delta HD
Tube Velocity ACD	ACD for Tube Velocity
LAT ACD	ACD for Limit Approach Temperature
Shell Side Flow ACD	ACD for Shell Side Flow
Temperature Profile ACD	ACD for Temperature Crossover Detection
Clear BOPS	Clear_BOPS: Specifies if the Asset Monitor has to be retrained

Section 10 Asset Optimization Reporting

Introduction

The 800xA System provides two Asset Optimization Report Templates that summarize important maintenance information to provide maintenance engineers with comprehensive data to make decisions. The Asset Optimization Report Templates are:

- AO Asset Condition History Report.
- AO Running Time Report.

These reports are implemented as a Microsoft Excel (.xls) files. The templates are used in conjunction with the Inform IT Scheduler system extension. Reports are run manually and can be scheduled periodically as defined in the Scheduling Definition Aspect. Report data is retrieved through DataDirect macros or by using custom macros written in Visual BASIC. All report parameters are defined in a second configuration sheet. When data is collected and formatted, the reports can be optionally printed or historized, if Information Management is installed and appropriately configured.

The Asset Optimization Report Template implementation requires that the following 800xA System features be installed on the target Aspect System:

- Asset Optimization: required as a source for the report data.
- Scheduler: required for the report template to be triggered, run, and stored.
- DataDirect (Excel add-in): required for retrieving data from the Aspect System.
- Information Management: required if long term archiving of reports is required.

Refer to *System 800xA Asset Optimization Configuration (3BUA000118*)* for information on setting up and configuring reports.

AO Asset Condition History Report

The AO Asset Condition History Report provides, for every asset, a detailed listing of all asset maintenance conditions that have been active in a time interval. This report is based on an Alarm and Event list (Alarm type) configured to display Asset Conditions. The AO Asset Condition History Report is used to identify the repeating asset condition offenders and highlights the critical assets with high failure rates. This report can be used to define a proactive maintenance strategy.

AO Running Time Report

The AO Running Time Report lists all assets in a given structure with a Runtime Asset Monitor. It shows, per asset, the configured runtime limit value, hours of operation, indication that the runtime limit is active, and the date of the last Asset Monitor reset. Furthermore, it calculates the remaining time days of operation until the runtime limit is reached based on the current calculated average runtime rate. The AO Running Time Report allows sorting by tag, object type, runtime limit, and alarm active.

Input

The Asset Optimization Report Templates are preconfigured as Microsoft Excel spreadsheet (.xls) files. These spreadsheets are used as templates for the Asset Optimization Reports and contain logic for extracting the Alarm and Event data and properties from the specified Asset Optimization objects. After the report data is read, it is formatted in the spreadsheet using Excel functions in a tabular format.

Output

To execute the reports, the Scheduling Definition and Action aspects must be configured. The reports can be executed automatically according to a certain schedule or on demand by clicking **RUN NOW** in the Scheduler Definition Aspect.

Working with Asset Optimization Reports

Saved reports can be reviewed at a later time if the Action Aspect is configured to export to an object path (refer to *System 800xA Asset Optimization Configuration (3BUA000118*)*.

In the example shown in Figure 83, the saved reports are retained as objects under the AO Running Time Report folder found under Reports in the Scheduling Structure.

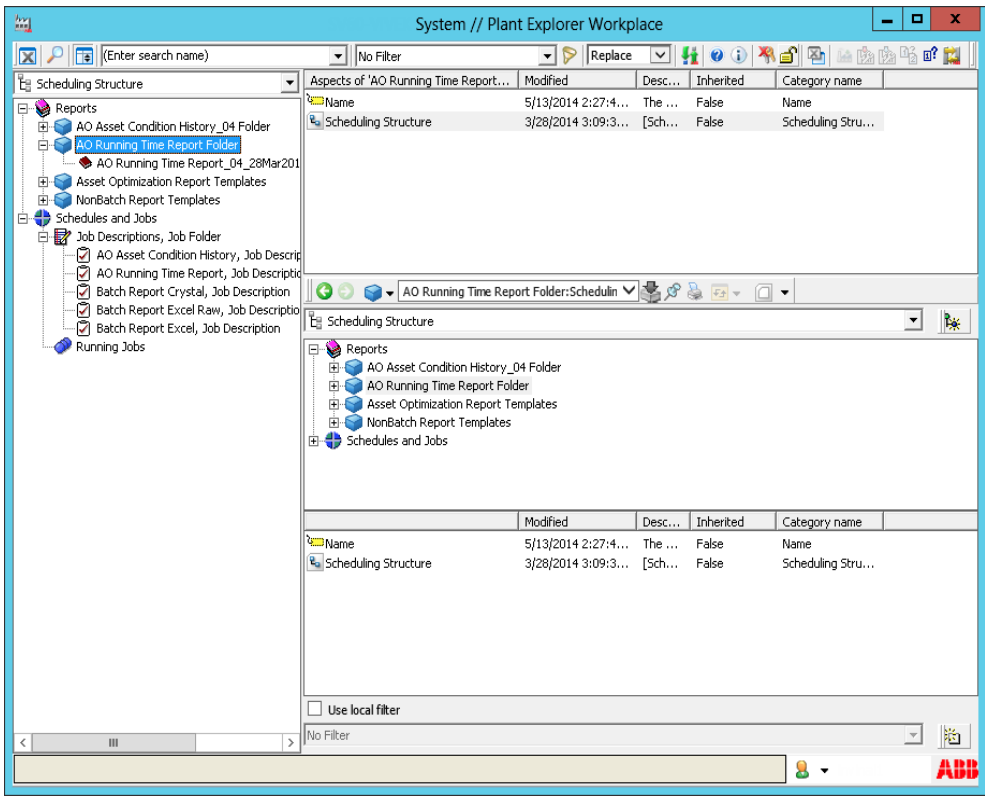


Figure 83. Saved Reports in Scheduling Structure

To review a printed report:

1. Select the completed report according to the date timestamp.
2. Select the File Viewer Aspect to display the report generated for this time trigger. The report data can then be reviewed by clicking on the **Open** button in the **File Download** dialog.

The report shall be opened in the Microsoft Excel shown in Figure 84.

{627A1B1E-32A4-43C4-AD18-FF79B59A90E9}{EFD3C39B-0407-4189-985C-ADBCD700EABF}0

	A	B	C	D	E	F
	Object Name	Hours Running Limit	Alarm Active	Asset Status	Hours Running	Adjusted Hours Runni
	Runtime asset monitor	48	Yes	good	71.48841083	83.11358236
	Runtime asset monitor 1	48	No	good	0.036114444	0.036164306
	Runtime asset monitor 2	48	No	good	0.028023889	0.028391806
	Runtime asset monitor 3	48	No	good	0.013459444	0.013505

Runtime Asset Monitor Report

Figure 84. AO Running Time Report Detailed View

3. To reprint a completed report, select the Report Printing Aspect to display files that can be printed as shown in Figure 85.

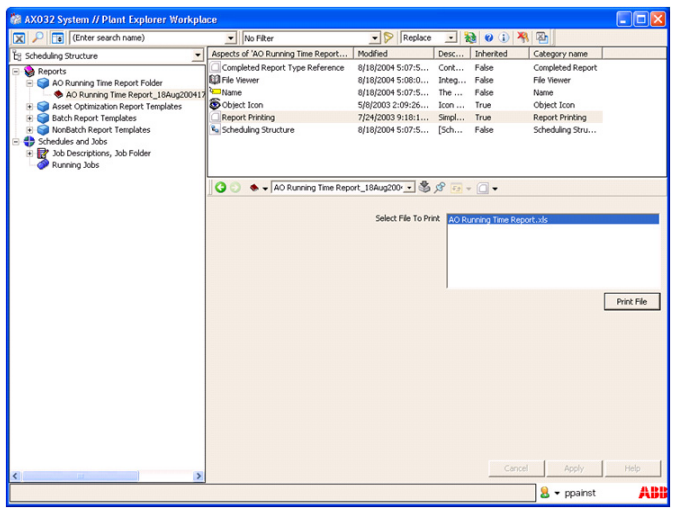


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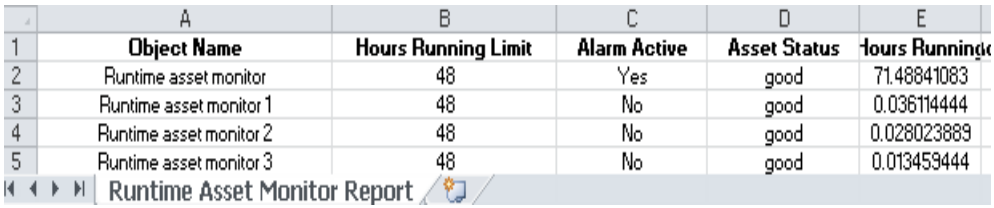
Figure 85. Saved AO Report Reprinting

4. Select the file and click Print File to reprint the report.

Example Reports

An example of the AO Running Time Report is shown in Figure 86.



	A	B	C	D	E
1	**Object Name**	**Hours Running Limit**	**Alarm Active**	**Asset Status**	**Hours Running**
2	Runtime asset monitor	48	Yes	good	71.48841083
3	Runtime asset monitor 1	48	No	good	0.036114444
4	Runtime asset monitor 2	48	No	good	0.028023889
5	Runtime asset monitor 3	48	No	good	0.013459444

Runtime Asset Monitor Report

Figure 86. AO Running Time Report (Example)

An example of the AO Asset Condition History Report is shown in Figure 87.

	A	B	
1	**ObjectName**	**Condition**	**Message**
2	Bool Check	Bool Check.State.Alarm	
3	Flow Delta AM	Flow Delta.FlowDelta.LimitExceeded	Flow delta exceeded allo
4	High Limit AM	High Limit Check.Limit.High	High limit reached
5	Runtime asset monitor	Runtime Asset Monitor.Runtime Limit Reached.Yes	RunningTime > 48 hrs.
6	XY Profile Deviation AM	XY Profile Deviation.Reference Profile Deviation.High limit exceeded	Y_Value is above higher
7	High Low Limit AM	HighLow Limit Check.LowLimit.LowOffset	Low offset limit reached
8	High Low Limit AM	HighLow Limit Check.HighLimit.HighOffset	High offset limit reached
9	Low Limit AM	Low Limit Check.Limit.Low	Low limit reached
10	System Status AM	System Status Asset Monitor.System Status.Warning	False
11	Bad Quality Check AM	Bad Quality Check.Quality.Bad	Quality value is: bad
12			

Asset Condition Report

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Figure 87. AO Asset Condition History Report (Example)

Appendix A Heat Exchanger Specific Terminology

Heat Exchanger Specific Terminology

Table 12 is a list of terms associated with heat exchangers.

Table 12. Heat Exchanger Specific Terminology

Term/Acronym	Description
AMSI	Asset Monitor Sample Interval. Time interval used by the Asset Monitor to sample heat exchanger instrumentation values. Typical values NSI/1000 or 60 seconds, whichever is greater.
BOPS	Base OPS. OPS read during the training period, which become the initial set used for all future comparisons.
COPS	Comparative OPS. OPS read during subsequent heat exchanger operation which will be used to compare against the BOPS of the heat exchanger.
Delta P Cold	Pressure difference at Cold Side (Cold-Side Inlet Pressure – Cold-Side Outlet Pressure)
Delta P Hot	Pressure difference at Hot Side (Hot-Side Inlet Pressure – Hot-Side Outlet Pressure)
Delta T Cold	Temperature difference at Cold Side (Cold-Side Inlet Temperature – Cold-Side Outlet Temperature)
Delta T Hot	Temperature difference at Hot Side (Hot-Side Inlet Temperature – Hot-Side Outlet Temperature)
Delta Tx	Temperature difference across the heat exchanger (Hot- Side Inlet Temperature – Cold-Side Inlet Temperature)

Table 12. Heat Exchanger Specific Terminology (Continued)

Term/Acronym	Description
E	Performance Factor
HD	Heat Duty
HD Cold	Cold-Side Heat Duty
HD Hot	Hot-Side Heat Duty
HeatX	Heat Exchanger
HeatX_G	Generic Heat Exchanger
HeatX_ST	Shell and Tube Heat Exchanger
HXAM-G	Generic Heat Exchanger Asset Monitor
HXAM-ST	Shell and Tube Heat Exchanger Asset Monitor.
LAT	Limit Approach Temperature
LMTD	Log Mean Temperature Difference
NBS	Number of Baseline Sets. This is the set of baseline operating point sets which will be taken during the training period.
NSI	Normal Service Interval. The time interval between heat exchanger cleanings, rebuilds, etc.
OPS	Operating Point Set. The full set of operating values read from process instrumentation relevant to the operation of the heat exchanger.
SP	Staleness Period. Maximum time interval for which a BOPS can go unreferenced. Typical value NSI/5 or 48 hours, whichever is greater.
T Hot In	Heat exchanger hot inlet temperature
T Hot Out	Heat exchanger hot outlet temperature
T Cold In	Heat exchanger cold inlet temperature
T Cold Out	Heat exchanger cold outlet temperature
TCD	Thermal Crossover Detection

Table 12. Heat Exchanger Specific Terminology (Continued)

Term/Acronym	Description
TP	Training Period. Time interval in which all operating point sets should be gathered. Typical values NSI/100 or 200 hours, whichever is smaller.
U	Heat Transfer Efficiency
W	Mass Flow
W Cold	Cold-Side Mass Flow
W Hot	Hot-Side Mass Flow

Revision History

This section provides information on the revision history of this User Manual.

Revision Index	Description	Date
-	First version published for 800xA 6.0	August 2014
A	Published for 800xA 6.0.3	September 2016

Updates in Revision Index A

The following table shows the updates made in this User Manual for 800xA 6.0.3.

Updated Section/Sub-section	Description of Update
Section 3 Condition Reporting and Monitoring	Added a new section “AM Engine Properties”.

Index

A

About this book 11
Active work orders
  Maximo 66
  SAP 71
AO asset condition history report 186
AO running time report 186
AO server operation
  Asset optimization event log 47
  Asset optimization server 50
    AO server tab 50
    Asset monitors tab 51
    Runtime statistics tab 52
AO server tab 50
Asset condition event handling 57
Asset health condition reporting 29
Asset monitoring status 29
Asset monitors
  HXAM-G
    Faceplate 125
    Log file description 144
    Logs 142
    Methodology 121
    Operation 119, 124
    Trends 142
  HXAM-ST 117
    Faceplate 155
    Log file description 180
    Logs 177
    Methodology 150
    Operation 148, 154
    Trends 177
Asset monitors tab 51
Asset Optimization event log 47
Asset optimization reporting 185
  AO asset condition history report 186
  AO running time report 186
  Inputs 186
  Output 186
Asset optimization server 50
  AO server tab 50
  Asset monitors tab 51
  Runtime statistics tab 52
Asset reporter 36
  Color scheme 37
Asset structure 19
Asset tree 30, 31, 34
  Quality indicator overlay icons 34
  Severity indicator icons 30, 31
Asset viewer 29
  Asset tree severity indicator icons 30, 31
  Quality indicator overlay icons 34
Availability of spare parts
  Maximo 70

C

CMMS views
  Maximo
    Active work orders 66
    Availability of spare parts 70
    Equipment status 69
    Preventive maintenance schedule 69
    Spare parts 70
    Work order history 68
  SAP
    Active work orders 71
    Equipment status 75
    Preventive maintenance schedule 76
    Work order history 74
Creating fault reports 61

D

DMS fault reports 57
Document
    Conventions 11
    Related 13

E

Equipment status
    Maximo 69
    SAP 75

F

Faceplate
    HXAM-G 125
    HXAM-ST 155
Fault reports
    Creating 61
    DMS only 57
    Submitting 57
Functional components 17

H

HXAM-G asset monitor
    Faceplate 125
    Log file description 144
    Logs 142
    Methodology 121
    Operation 119, 124
    Trends 142
HXAM-ST asset monitor 117
    Faceplate 155
    Log file description 180
    Logs 177
    Methodology 150
    Operation 148, 154
    Trends 177

L

Launching the maintenance workplace 19
Log file description
    HXAM-G 144
    HXAM-ST 180
Logs
    HXAM-G 142
    HXAM-ST 177

M

Maintenance filter 27
Maintenance workplace 19
    Launching 19
    Maintenance filter 27
Maximo
    Active work orders 66
    Availability of spare parts 70
    Equipment status 69
    Preventive maintenance schedule 69
    Spare parts 70
    Work order history 68
Methodology
    HXAM-G 121
    HXAM-ST 150

O

Operation
    HXAM-G 119, 124
    HXAM-ST 148, 154
Overview 15

P

Preventive maintenance schedule
    Maximo 69
    SAP 76

Q

Quality indicator overlay icons 34

R

Reporting 185

AO asset condition history report 186
AO running time report 186
Inputs 186
Output 186
Runtime statistics tab 52

S

SAP
Active work orders 71
Equipment status 75
Preventive maintenance schedule 76
Work order history 74
Severity indicator icons 30, 31
Spare parts
Maximo 70
Submitting fault reports 57
DMS only 57

T

Terminology 12, 191
Trends
HXAM-G 142
HXAM-ST 177

W

Work order history
Maximo 68
SAP 74

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