

SIEMENS

MindSphere

Asset Performance Monitoring

System Manual

<u>Introduction</u>	1
<u>Getting started</u>	2
<u>Data model</u>	3
<u>User rights and permissions</u>	4
<u>User Interface of "Asset Performance Monitoring"</u>	5
<u>Sites Management</u>	6
<u>High Value Asset Management</u>	7
<u>Rules Management</u>	8
<u>Event Management</u>	9
<u>Key Performance Indicator (KPI) Calculations</u>	10
<u>Settings</u>	11

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.
⚠ WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.
⚠ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.
NOTICE
indicates that property damage can result if proper precautions are not taken.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Table of contents

1	Introduction	5
1.1	Features	5
1.2	Overview	5
1.3	Prerequisites	6
2	Getting started	7
3	Data model	9
4	User rights and permissions	13
5	User Interface of "Asset Performance Monitoring"	15
5.1	Home screen	15
5.2	Site dashboard	15
5.3	Rules view	17
5.4	Events view	17
5.5	KPI summary view	18
6	Sites Management	19
6.1	Site settings.....	20
6.2	Adding site for monitoring	21
6.3	Turning-off monitoring	22
6.4	Removing site	22
7	High Value Asset Management	25
7.1	Adding High Value Asset	25
7.2	Editing High Value Asset.....	26
7.3	Removing High Value Asset	27
7.4	Status map definition.....	28
8	Rules Management	29
8.1	Creating rule.....	29
8.2	Example for Single Condition Rule	30
8.3	Example for Multi-Condition Rule.....	31
8.4	Hysteresis	32
8.5	Creating rules in bulk using a reference rule.....	32
8.6	Editing rule	34
8.7	Activating or deactivating rule	34

8.8	Deleting rule	34
9	Event Management	35
9.1	Event management workflow	36
9.2	Updating state of events	36
9.3	Filtering and sorting events	39
10	Key Performance Indicator (KPI) Calculations	41
10.1	Monitoring KPI calculations	41
10.2	KPI calculation settings	42
10.3	Adding KPI calculations	43
10.4	Configuring maintenance schedule	45
10.5	Removing KPI	46
11	Settings.....	47
11.1	Site settings.....	47
11.2	General settings	48

Introduction

Asset Performance Monitoring is a MindSphere application that enables performance and condition monitoring of connected assets without the overhead and personnel requirements of proprietary applications. It is designed to work with minimum configuration and to provide an intuitive user experience.

1.1 Features

MindSphere Asset Performance Monitoring application offers the following functions and features:

- Use data from machines to maximize up-time and availability of machines as well as to increase operational transparency across machines, systems, and sites.
- Track key operating parameters of industrial assets in order to detect and receive alerts about deviations from normal operation conditions on configurable and intuitive multi-site dashboard.
- Monitor status of critical assets in near real time to minimize downtime.
- Coordinate maintenance and service activities through the application using workflow built into event management.
- Outline industrial procurement and operating characteristics of assets using out-of-the-box KPI calculations.

1.2 Overview

Definitions

The following table contains definitions that are common in the document.

Definition	Description
Asset	An asset is the logical representation of a thing which can be a machine or an automation system with a single unit. An asset can be for example a PLC or CNC-Controller or even a factory site. Assets are defined using an asset type.
High Value Assets	High Value Assets are those assets the operation of which is critical for your business.
Site	A site is a single logical grouping of one or more than one building or factory.

Module

The following table contains the descriptions of the modules of the application.

Module	Description
High Value Assets	Configure and monitor the status of High Value Assets for business and operational reasons. This enables you to: <ul style="list-style-type: none"> • Monitor health status of High Value Assets on the dashboard. • Maximize up-time and availability of High Value Assets.
Events	Event management includes event workflow, event views with filter and sort capabilities. This enables you to: <ul style="list-style-type: none"> • View events from multiple sites on the dashboard. • Use event workflow to make operations of maintenance service transparent and traceable.
Rules	Define, activate, and manage Single Condition Rule and Multiple Condition Rule based on IoT time series data from assets. This enables you to: <ul style="list-style-type: none"> • Detect a pattern of anomalies from normal operating conditions from multiple assets. • Change from reactive to proactive maintenance practices that lead to reduction in cost of repairs or replacement.
KPI Asset	Configure assets to view pre-defined KPI Values-Hours and KPI Values-Factors on the dashboard. This enables you to: <ul style="list-style-type: none"> • View out of the box KPI Calculation on the dashboard. • Outline industrial procurement for reliability, availability and maintainability, as well as operating characteristics of an asset.

1.3 Prerequisites

The following technical information is required.

Technical data	Details
Subscription	A valid MindAccess IoT Value Plan (Small/Medium/Large) subscription is required.
Web browser	An HTML5 capable Internet browser is required (for example Firefox, Edge, and Google Chrome). The recommended screen resolution is 1024x768 or higher. Mobile devices are supported through the use of HTML5 capable Internet browser.

Read more about subscription plan and offering structure in the product sheet of the application

Getting started

MindSphere Asset Performance Monitoring application uses Sites, which are the digital representations of assets on which machinery or facilities are operated. To easily use the Asset Performance Monitoring application to monitor sites, some configurations are required in advance.

1. Assign all application users and administrators to their roles.
Read more about this in the Settings document.
2. Create the data model of your industrial environment in the Asset Management component, using assets, types, and aspects.
Read more about this in the Asset Manager document.
3. Add assets representing the Sites into the Asset Performance Monitoring application to enable remote monitoring.
Read more about this in the chapter Site Management (Page 19).
4. Define Rules for events and notifications.
Read more about this in the chapter Rules Management (Page 29).

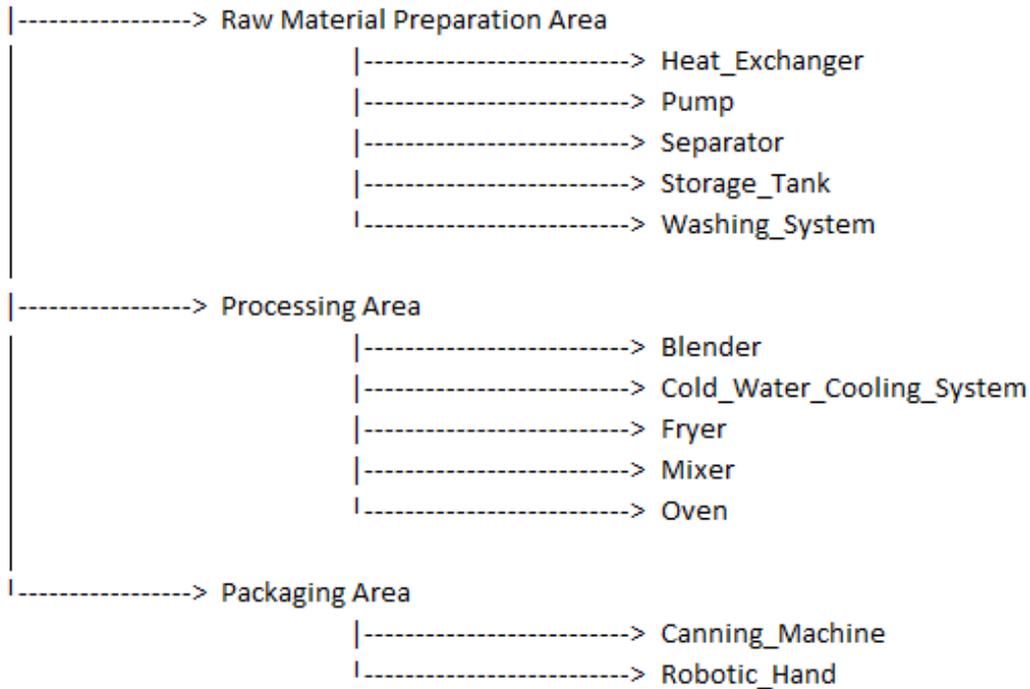
Data model

First, create the digital representation of your industrial facility in MindSphere. For this purpose, MindSphere provides Asset Manager component or Asset Manager Services. Assets, types, and aspects can be used to create hierarchies that represent machines or automation systems at Sites. This representation is called a data model for the tenant.

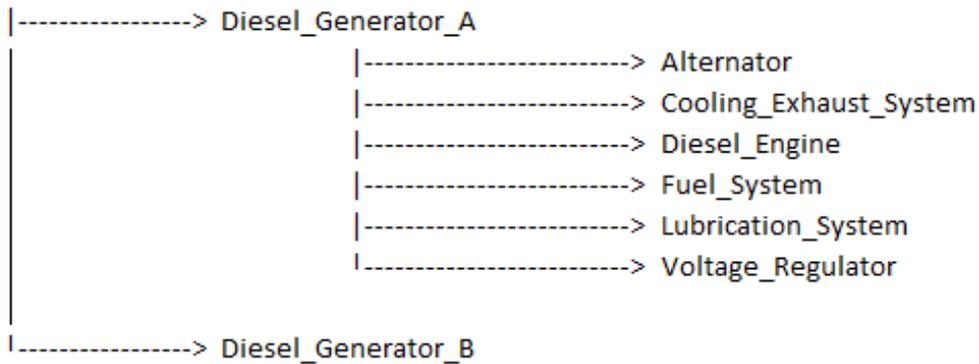
Read more about creating the data model in the Asset Manager documentation of MindSphere.

The following graphic shows you a possible hierarchy of a data model.

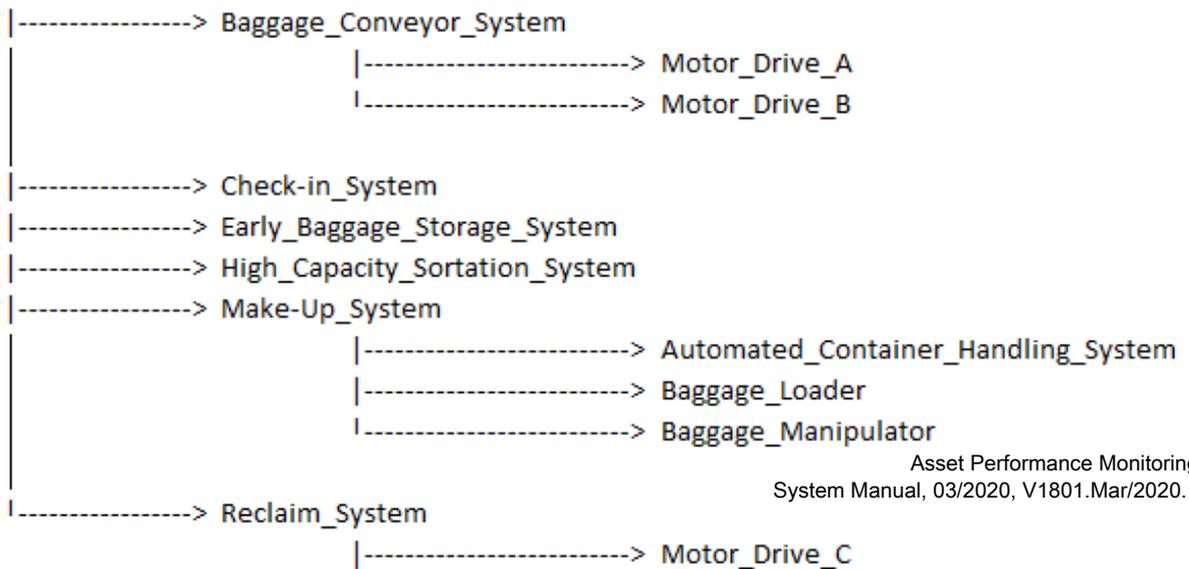
Food Manufacturing Plant



Forward Operating Base



International Airport



In the next chapters the following data model will be used.

Bad Neustadt

Production facility for potato chips and snacks

```

|-----> Diesel_Generator_Set_A
|
|-----> Diesel_Generator_Set_B
|-----> Line_1_Cumberland_Drive_Roller
|-----> Line_1_Cutter_Feeder
|-----> Line_1_Dryer_A_Exhaust_Fan
|-----> Line_1_Dryer_A_Fan
|-----> Line_1_Dryer_Outfeed_Conveyor
|-----> Line_1_Hoist_Mixer
|-----> Line_1_Oven_Dryer_A
|-----> Line_1_Packaging_Robot
|-----> Line_1_Picker_Robot
|-----> Line_1_PLC
|-----> Line_2_Cumberland_Drive_Roller
|-----> Line_2_Cutter_Feeder
|-----> Line_2_Dryer_B_Exhaust_Fan
|-----> Line_2_Dryer_B_Fan
|-----> Line_2_Dryer_Outfeed_Conveyor
|-----> Line_2_Hoist_Mixer
|-----> Line_2_Oven_Dryer_B
|-----> Line_2_PLC
|-----> Line_2_Robot_3
|-----> Line_2_Robot_4
|-----> Mixtruder_Water_Pump
|
|-----> Power_Meter_A
|-----> Power_Meter_B
|-----> Pre_Line_Boiler_A
|-----> Pre_Line_Boiler_B
|-----> GenSet_Power_Meter
|-----> Water_Pump_Power_Meter

```

Amberg

The electronic equipment factory (Contractors, Circuit board assembly, Push buttons and signal columns, Production metal parts)

```

|-----> Line_2_Pump
|-----> Processing Area
|-----> Test Oven

```

Karlsruhe

Water and soft drink bottling plant

```

|-----> Conditioner_Inclined_Roller_Motor_Conveyor
|-----> Mixtruder_Cyclone_Blower

```


User rights and permissions

The user rights depend on the following user roles:

- Application admin
- Application user

The following table shows the permissions.

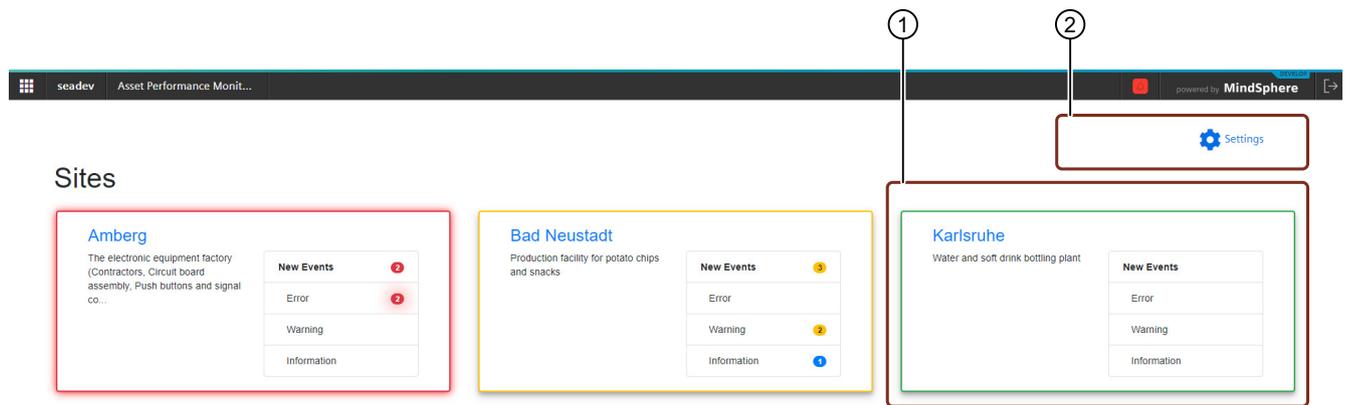
User right	Role	
	Application admin	Application user
View Main Dashboard	✓	
View User Dashboard		✓
Update General Settings	✓	
Update Site Settings	✓	
Add Site	✓	
Remove Site	✓	
Add High Value Asset	✓	
Remove High Value Asset	✓	
Edit High Value Asset	✓	
Monitor High Value Asset	✓	
Create Rule	✓	
Activate Rule	✓	
Deactivate Rule	✓	
Edit Rule	✓	
Delete Rule	✓	
Add KPI Calculation	✓	
Remove KPI Calculation	✓	
Edit KPI Calculation	✓	
Monitor KPI Calculation	✓	
Assign Event	✓	
Update Event Status	✓	✓

User Interface of "Asset Performance Monitoring"

5.1 Home screen

When Sites are configured and you start the application, the Sites Summary Dashboard appears first. It displays Site Cards that represent monitored Sites.

The following graphic shows the Sites Summary Dashboard.



- ① Site Card: Each Site Card displays a summary of new events from assets at the Site. The color of the outline of the Site Card corresponds to the priority of the new events. If the color of the outline is red, there is an error. If the color is yellow, there is a warning. If the color of the outline is green, the asset runs without incidents.
- ② Settings: In the Settings you can configure site-specific and general settings.

To see the details of a Site Card, click on the site name. The Site dashboard will be shown.

5.2 Site dashboard

Configurable intuitive Site dashboard enables remote monitoring of assets.

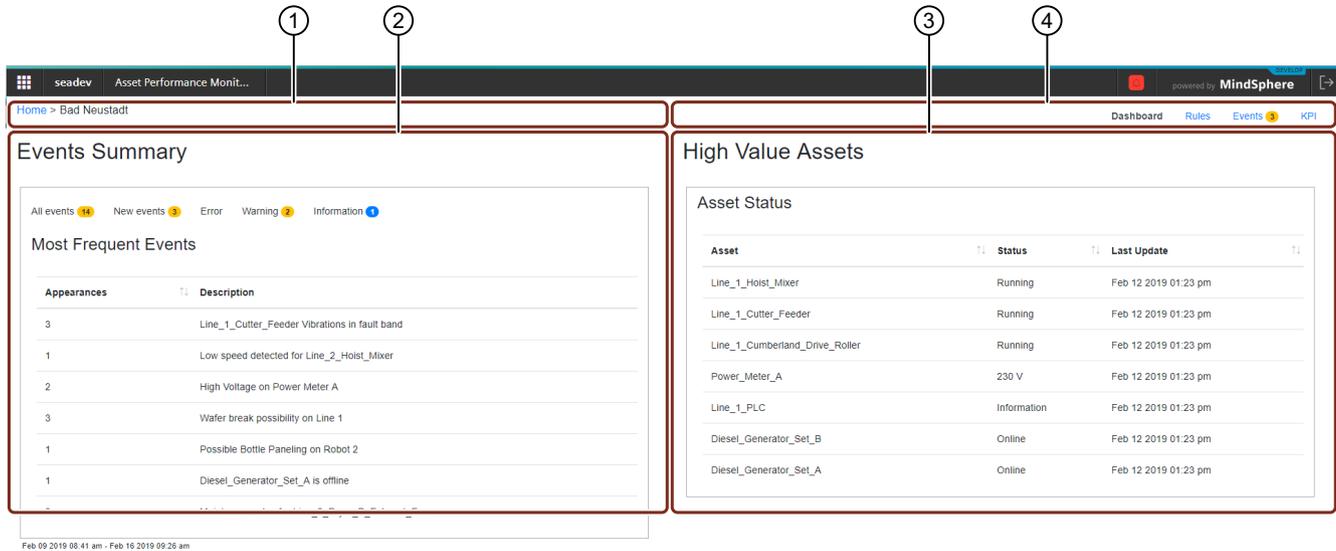
5.2 Site dashboard

This enables you to:

- Increase operational transparency across machines, systems and Sites.
- Monitor warning signs from connected assets based on occurrence of multiple operating conditions and their sequences.
- Quickly identify frequently occurring events on Site.

To open a Site Dashboard, go to the home screen and click on the site name you want to view.

The following graphic shows the Site Dashboard Bad Neustadt.



- ① Navigate by clicking the links.
- ② Events Summary
- ③ High Value Assets: Shows the latest available status of assets configured as High Value Assets.
- ④ Switch the view by clicking the tabs.

Events summary

The following table shows two kinds of Events data displayed in the Events Summary.

Events data	Description
Breakup of Events in New state	A Summary of new events from the assets at the Site. The new event count is also displayed on the Events tab.
Most Frequent Events	A List of frequently occurring events at the Site. The calculations based on Rule ID in the event definition.

The period for the summary is configurable and can be defined in the General Settings. Read more about this in the chapter General Settings (Page 48).

High Value Assets

The High Value Assets table shows the latest available status of assets configured as High Value Assets. The frequency at which the application updates the status of the assets is configurable and can be defined in the General Settings. For more information, refer to the chapter General Settings (Page 48).

5.3 Rules view

To open the Rules view, click the Rules tab on the Site Dashboard.

The following graphic shows the Rules view containing a list of all available Rules of the Site.

Rule	Asset(s)	Description	Event Severity	Additional Action	Active
(heat.temperature > 120)&(speed.vibration > 30)	Line_1_Oven_Dryer_A Line_1_Dryer_Outfeed_Conveyor	Water break possibility on Line 1	warning	EMAIL	✓
am_pressure.pressure > 0.025	Line_1_Packaging_Robot	Bottle paneling possibility on Line 1	warning	EMAIL	
power_out.voltage < 230	Power_Meter_A	Generator A low Voltage	error	EMAIL	✓

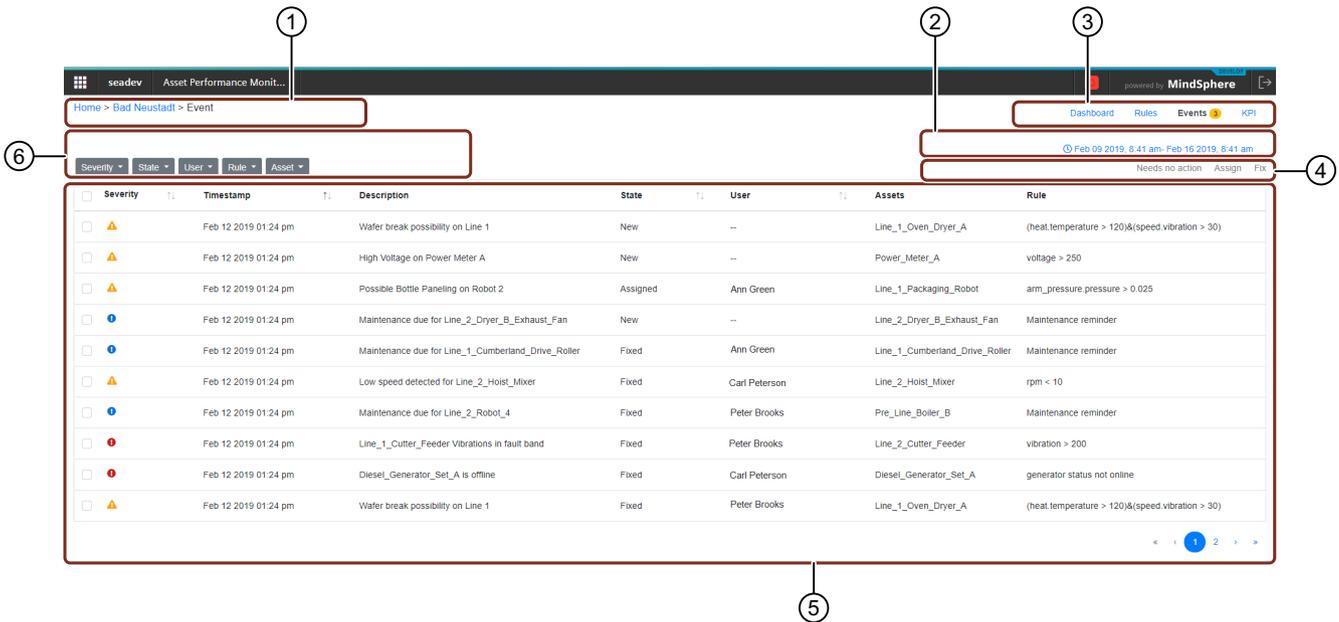
- ① Navigate by clicking the links
- ② Create new Rule
- ③ Rules Summary
- ④ Management tools: First select a rule to enable the tools.
- ⑤ Switch the view by clicking the tabs

5.4 Events view

To open the Events view, click the Events tab on the Site Dashboard.

The following graphic shows the Events view containing a list of all available Events of the Site.

5.5 KPI summary view

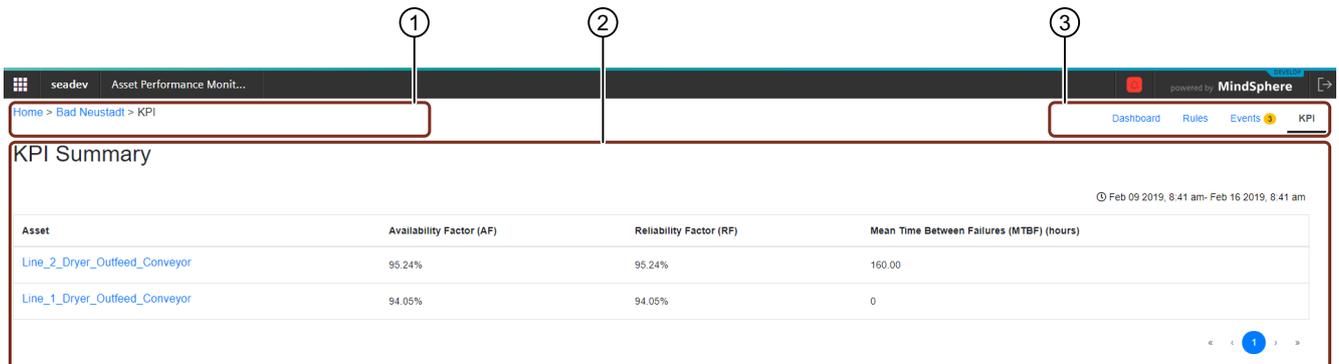


- ① Navigate by clicking the links.
- ② Filter events
- ③ Events Summary
- ④ Management tools: First select an event to enable the tools.
- ⑤ Selected period: limit or extend the time span of events
- ⑥ Switch the view by clicking the tabs.

5.5 KPI summary view

To open the KPI Summary view, which summarizes the results of the KPI calculations for the configured assets, click the KPI tab on the Site Dashboard.

The following graphic shows the KPI Summary view.



- ① Navigate by clicking the links.
- ② KPI Summary: Click on the asset name to view the details.
- ③ Switch the view by clicking the tabs.

Sites Management

Launch the Asset Performance Monitoring application from the MindSphere Launchpad. If there are no Sites added into the application, the landing page will show an empty view.

- To add new Sites, refer to chapter Adding Site for Monitoring (Page 21).
- To turn off monitoring, refer to chapter Turning-off Monitoring (Page 22).
- To remove a Site from configuration, refer to chapter Removing Site (Page 22).
- To configure Site settings, refer to chapter Site Settings (Page 20).

Once Sites are configured in the application, the Sites Summary Dashboard is shown on the home screen.

The screenshot shows the 'Sites' dashboard with three site cards:

- Amberg**: The electronic equipment factory (Contractors, Circuit board assembly, Push buttons and signal co...). New Events: Error (2), Warning (0), Information (0).
- Bad Neustadt**: Production facility for potato chips and snacks. New Events: Error (3), Warning (2), Information (1).
- Karlsruhe**: Water and soft drink bottling plant. New Events: Error (0), Warning (0), Information (0).

Note

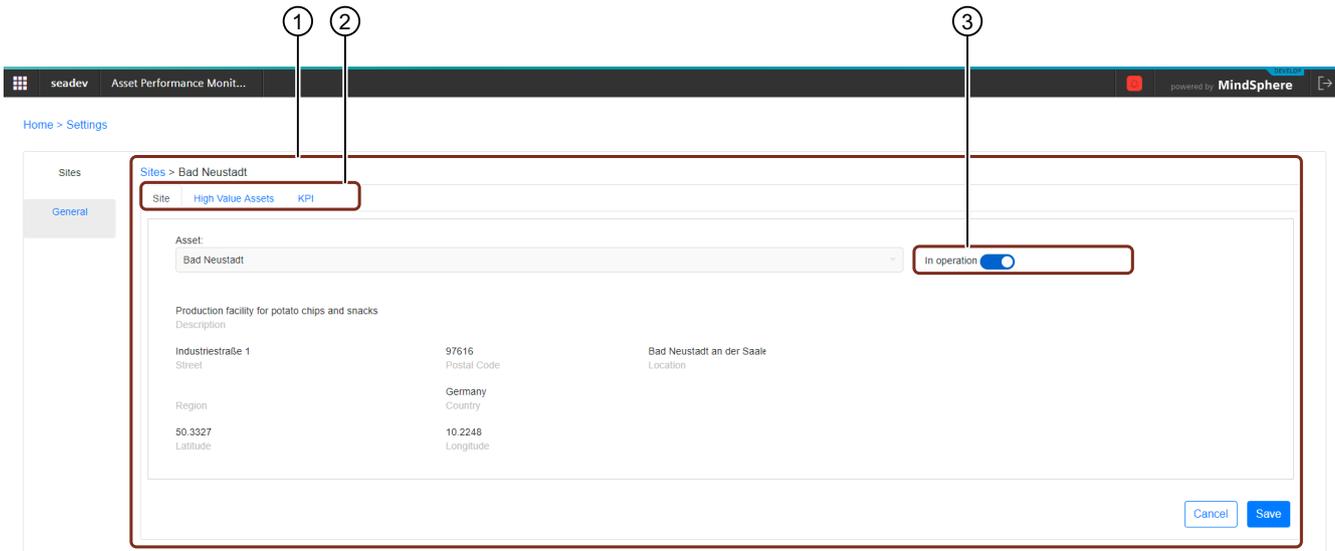
Site Management is sub tenant aware. Sub tenant users will see only the sites that belong to the subtenant on the Sites Summary Dashboard.

6.1 Site settings

You can manage the configuration of Sites you want to monitor. To show the Site Settings, proceed as follows:

1. Click Settings on the home screen.
The Site Settings view is displayed and a list with all configured Sites will be shown. Sub tenant user will see only the configured sites that belong to the user's subtenant.
2. To see the settings of a specific Site, click on the site name.
The view shows the Site Settings details.

The following graphic shows the Site Settings details of the Site Bad Neustadt.

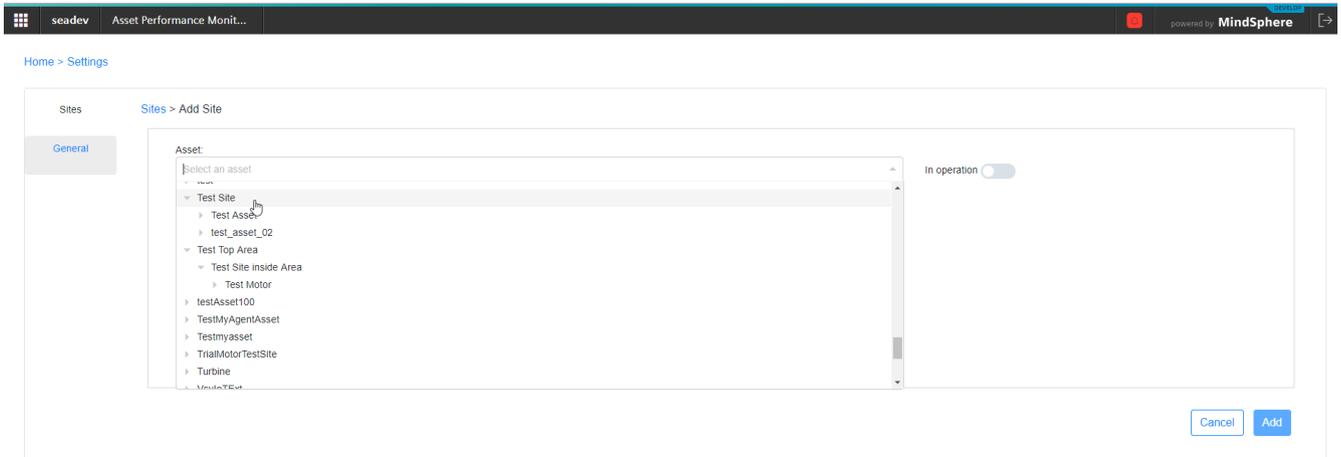


- ① Site Settings details of the Site Bad Neustadt
- ② Switch to High Value Assets or KPI Calculations by clicking the tabs
- ③ On the Site Settings, an asset can only be configured as "In Operation" or not. The configuration instructs the application to either enable or disable all monitoring for the current Site. If this option is disabled, the application does not monitor the Site and the corresponding Site Card is not available in the Site Summary Dashboard. Other settings for this tab cannot be changed. The Site Settings view imports the description and address information from the asset of the Site.

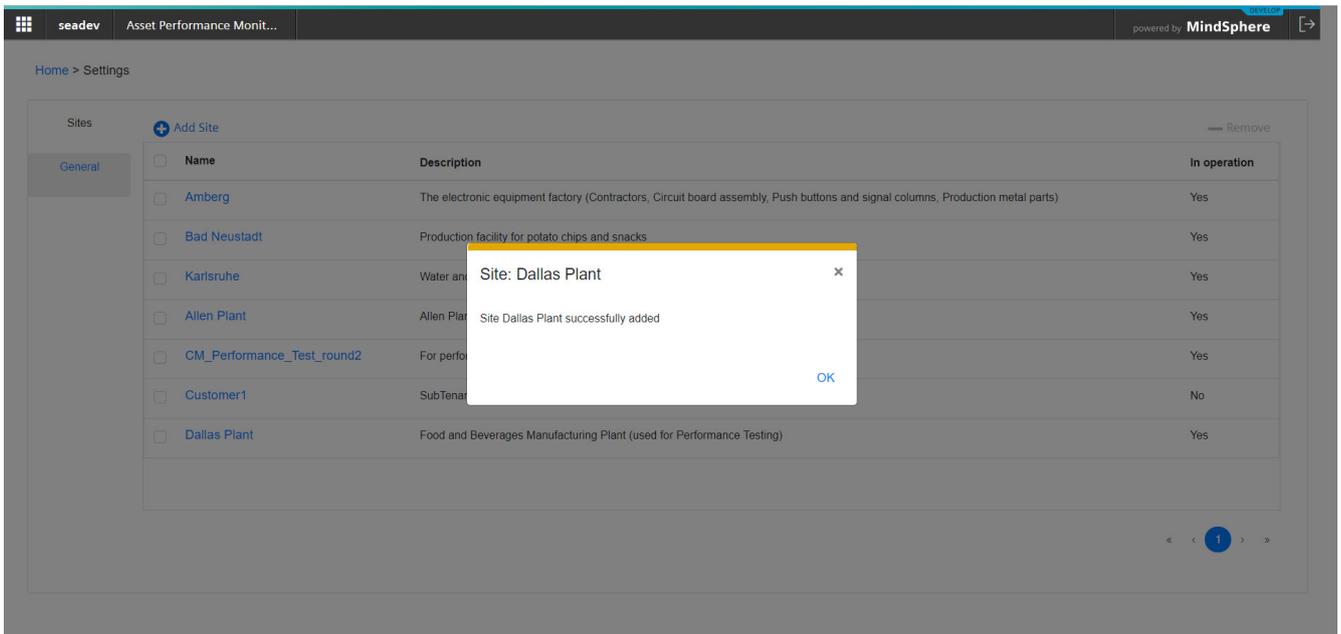
6.2 Adding site for monitoring

You can add additional Sites that represent the assets of your data model to be monitored. To add a Site, follow these steps:

1. Click Settings on the home screen.
The Site Settings view is displayed and a list with all configured Sites will be shown.
2. Click "Add Site".
A drop-down list will appear.



3. Select an asset from the drop-down list.
In operation option is enabled by default.
4. Click "Add" to save.
A message appears confirming that the new Site is successfully added.

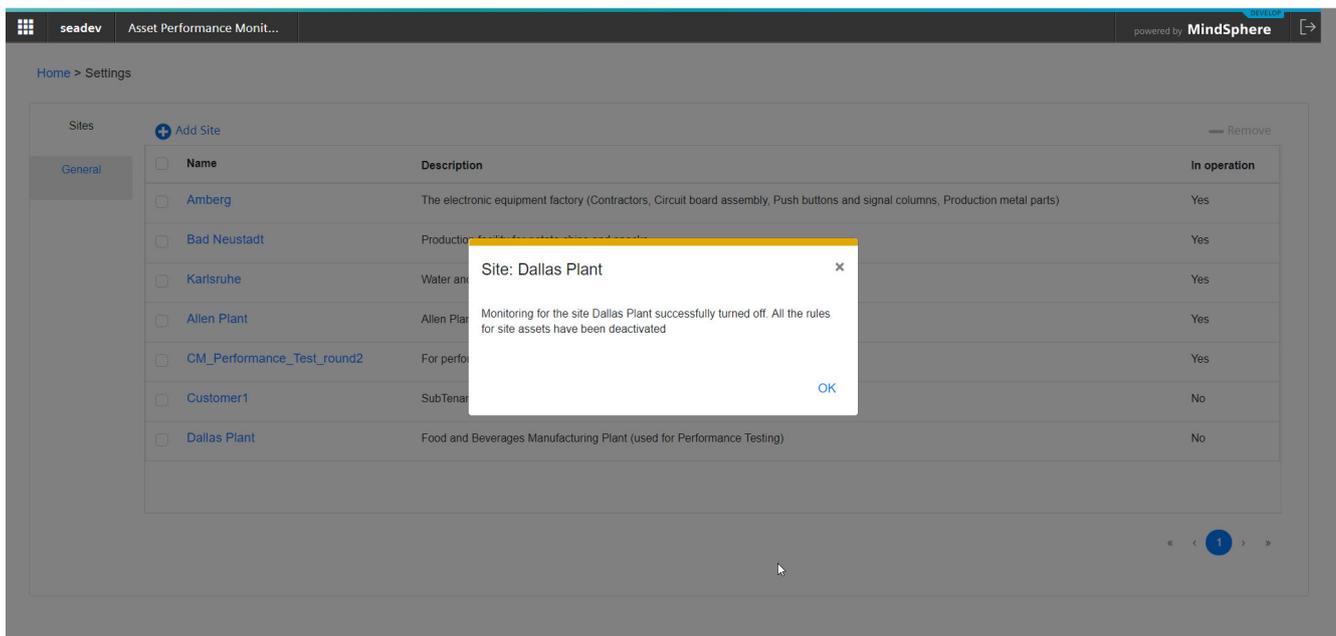


5. Click "OK".

6.3 Turning-off monitoring

To turn off the monitoring of a site, proceed as follows:

1. Click "Settings" on the home screen.
The Site Settings view is displayed and a list with all configured Sites will be shown.
2. Click on the site name that you do not want to monitor any longer.
The view shows the Site settings details.
3. Disable the option In Operation and click "Save".
A message appears confirming the deactivation of the monitoring. At the same time all rules of the site are deactivated.



4. Click "OK".

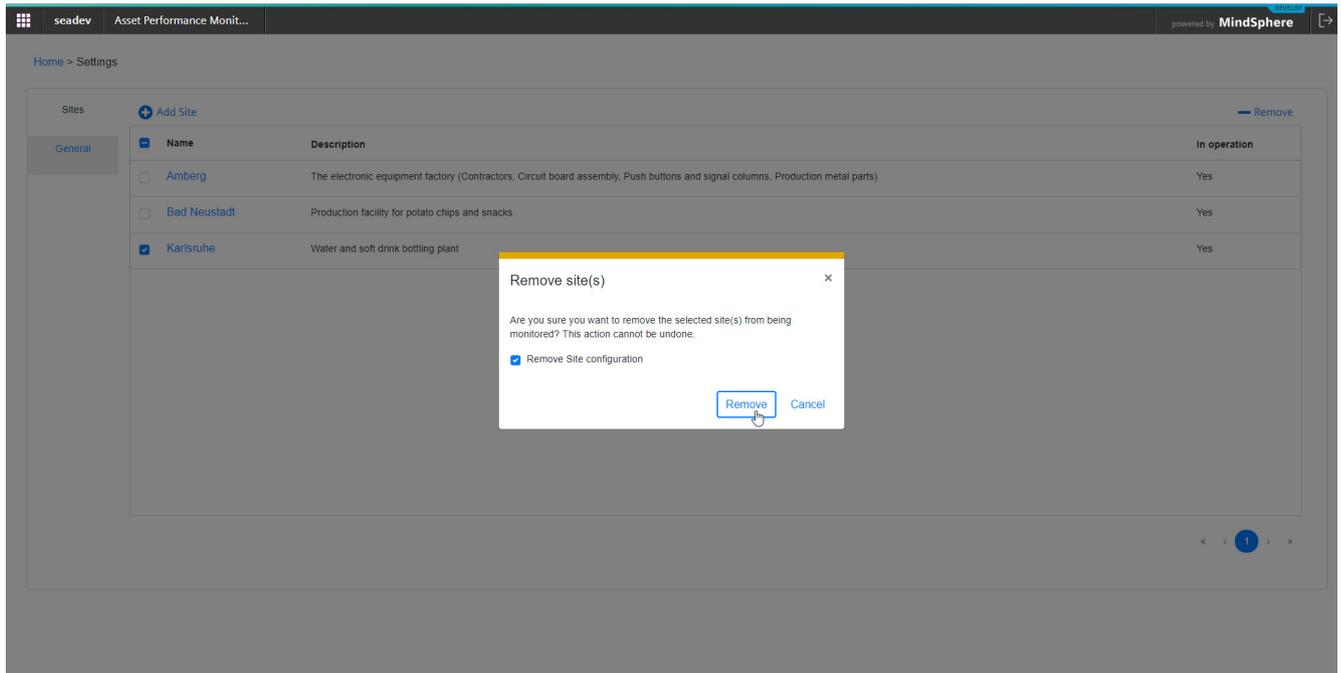
6.4 Removing site

Note

The Remove tool is disabled by default. To enable the tool, first select the Site to be removed. The configuration of a removed site can be saved. In this case, the saved configuration will be counted against feature attributes limits set according to the applicable plan and upgrades.

To remove a Site from the configuration, proceed as follows:

1. Click "Settings" on the home screen.
The Site Settings view is displayed and a list with all configured Sites will be shown.
2. Select the Site to be removed and click "Remove".
A message appears confirming the removal of this Site. The operation cannot be undone.



3. Ensure, the Remove Site configuration option is enabled. Otherwise, the saved configuration will be counted against feature attributes limits set according to the applicable plan and upgrades.
4. Click "Remove". The Site is successfully removed.

High Value Asset Management

MindSphere Asset Performance Monitoring application enables you to configure assets as High Value Assets. In the High Value Asset view, all High Value Assets are listed and can be configured.

- To add a new High Value Asset, refer to chapter Adding High Value Asset (Page 25).
- To edit an existing High Value Asset, refer to chapter Editing High Value Asset (Page 26).
- To remove High Value Assets, refer to chapter Removing High Value Asset (Page 27).

To show all High Value Assets of a site, proceed as follows:

1. Click "Settings" on the home screen.
The Site Settings view is displayed and a list with all configured Sites will be shown.
2. Click on the site name of the site whose High Value Assets you want to show.
The Site Settings details are shown.
3. Click the High Value Asset tab.
The High Value Asset view opens.

The following graphic shows the High Value Asset view of the Site Bad Neustadt.

Name	Asset Name	Status definitions
<input type="checkbox"/> Line_1_Hoist_Mixer	Line_1_Hoist_Mixer	✓
<input type="checkbox"/> Line_1_Cutter_Feeder	Line_1_Cutter_Feeder	✓
<input type="checkbox"/> Line_1_Cumberland_Drive_Roller	Line_1_Cumberland_Drive_Roller	✓
<input type="checkbox"/> Power_Meter_A	Power_Meter_A	✓
<input type="checkbox"/> Line_1_PLC	Line_1_PLC	✓
<input type="checkbox"/> Diesel_Generator_Set_B	Diesel_Generator_Set_B	✓
<input type="checkbox"/> Diesel_Generator_Set_A	Diesel_Generator_Set_A	✓

7.1 Adding High Value Asset

To configure an asset as High Value Asset, proceed as follows:

Make sure, that the Site Settings view is open.

1. Click on the site name of the site to which you want to add a High Value Asset.
The Site Settings details are shown.
2. Click the High Value Asset tab.
The High Value Asset view opens.
3. Click "Add High Value Asset".
An editor opens where you can configure the status map of the asset. An example can be found in the chapter Status Map Definition (Page 28).
4. Configure the settings and click "Save".

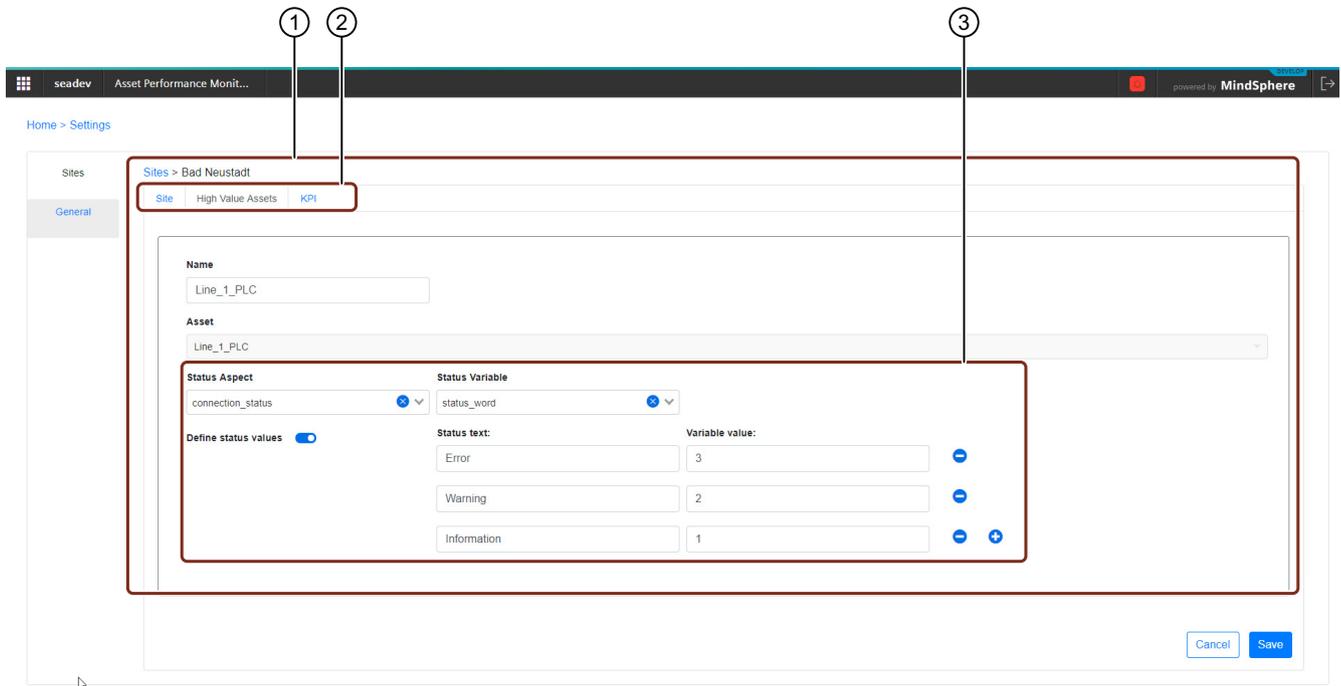
7.2 Editing High Value Asset

To edit a High Value Asset, proceed as follows:

Make sure, that the Site Settings view is open.

1. Click on the site name of the Site whose High Value Asset you want to edit.
The Site Settings details are shown.
2. Click the High Value Asset tab.
The High Value Asset view opens.

- Click on the name of the High Value Asset you want to edit.
An editor opens where you can edit the status map of the asset. Read more about this in the chapter Status Map Definition (Page 28).



- High Value Asset details
- Switch to High Value Assets or KPI Calculations by clicking the tabs.
- Status map definition

- Edit the configuration and click "Save".

7.3 Removing High Value Asset

Note

The Remove tool is disabled by default. To enable the tool, first select the High Value Asset to be removed.

To remove a High Value Asset from the configuration, proceed as follows:

The Site Settings view is open.

- Click on the site name of the site whose High Value Asset you want to remove.
The Site Settings details are shown.
- Click the High Value Asset tab.
The High Value Asset view opens.

7.4 Status map definition

- 3. Select the High Value Asset to be removed and click "Remove".
A message appears confirming the removal of the High Value Asset. The operation cannot be undone.
- 4. Click "Remove".
The High Value Asset is removed.

7.4 Status map definition

Industrial assets output status information in various formats. Some assets update bits in the status word, while some assets share the status in text form. You can use the status map in the high value asset definition to assign a significant status text to the status variable value.

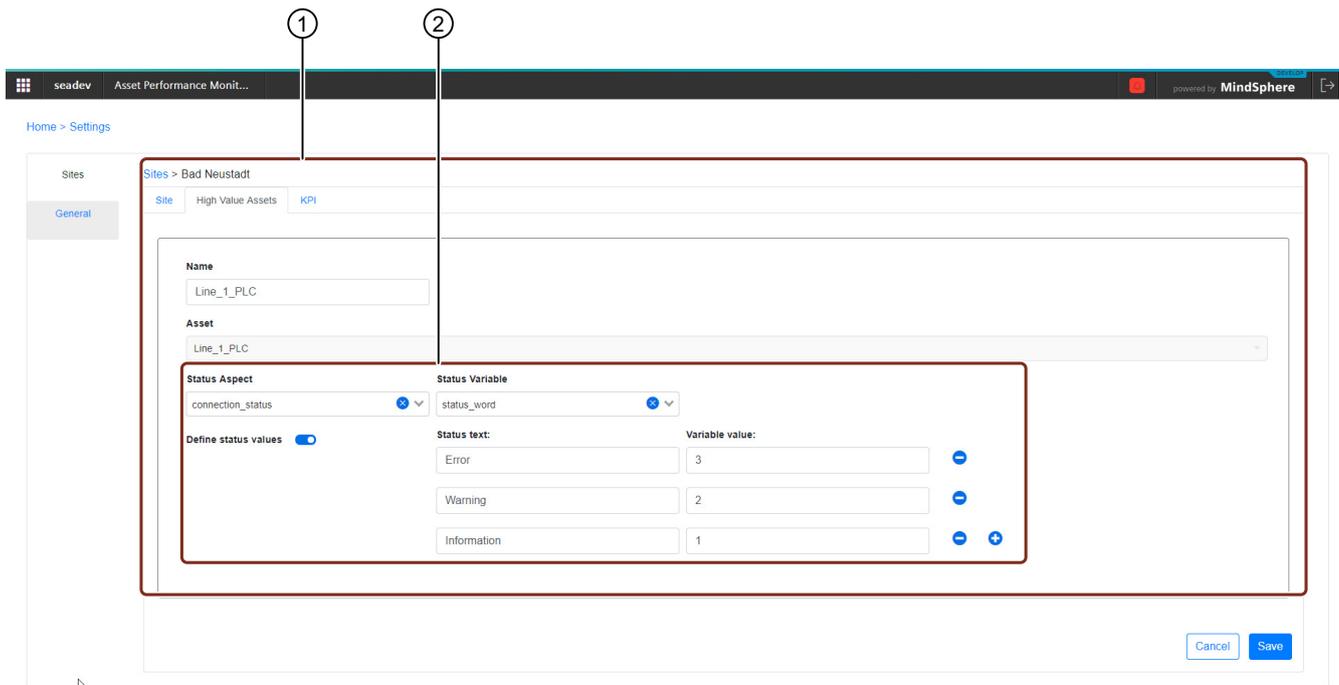
The application evaluates the value of status variable with the following expression to assign its status text.

Example

Display **Status text** WHEN [**Status Text** string] EQUALS [**Variable Value** string]

The application will display "Warning" text when the string value of "status_word" is 2.

The following graphic shows how the configuration is set in this example.



- ① High Value Asset details
- ② Status map definition

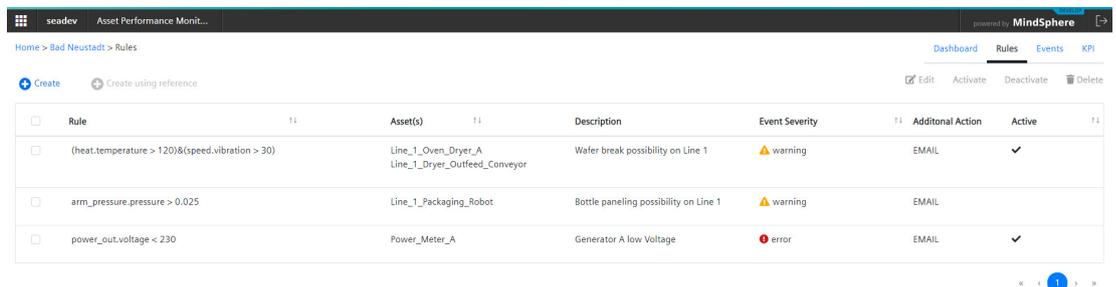
Rules Management

Asset Performance Monitoring application enables you to use Rules that monitor deviations in normal operating conditions of assets and alert you through notifications. A single rule can track the pattern of deviations from multiple heterogeneous assets.

Rules Management allows you to create and manage Rules for the Site.

- To create a new rule, refer to chapter Creating Rule (Page 29).
- To edit an existing rule, refer to chapter Editing Rule (Page 34).
- To delete a rule, refer to chapter Deleting Rule (Page 34).

To launch the Rules view of a site, click the Rules tab on the Site dashboard.



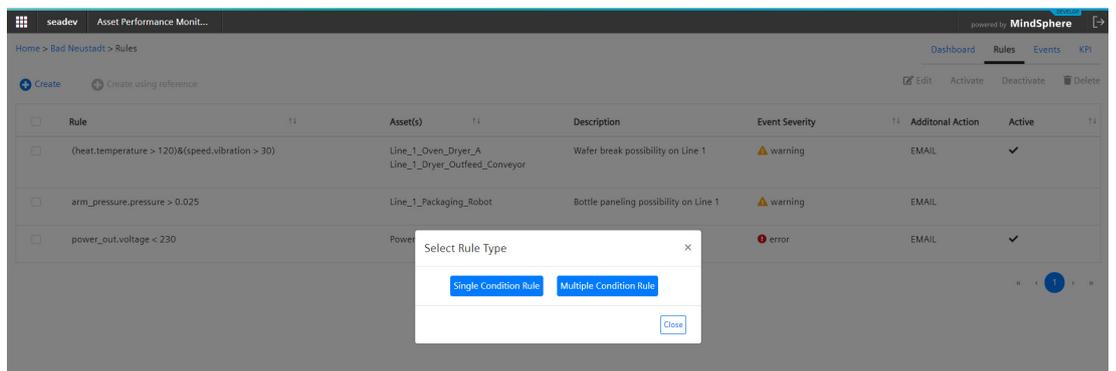
Rule	Asset(s)	Description	Event Severity	Additional Action	Active
(heat.temperature > 120)&(speed.vibration > 30)	Line_1_Oven_Dryer_A Line_1_Dryer_Outfeed_Conveyor	Wafer break possibility on Line 1	warning	EMAIL	✓
arm_pressure.pressure > 0.025	Line_1_Packaging_Robot	Bottle paneling possibility on Line 1	warning	EMAIL	
power_out.voltage < 230	Power_Meter_A	Generator A low Voltage	error	EMAIL	✓

8.1 Creating rule

Asset Performance Monitoring application enables you to create two types of Rules. While creation, you can choose between a Single Condition Rule and a Multi-Condition Rule.

To create a new Rule, proceed as follows:

1. The Rules view is open.
2. Click "Create".
A selection window opens in which you can select the Rule Type.



3. Click "Single Condition Rule" or "Multiple Condition Rule". The corresponding Rule editor opens.
4. Define the Rule settings and click "Save".

Note

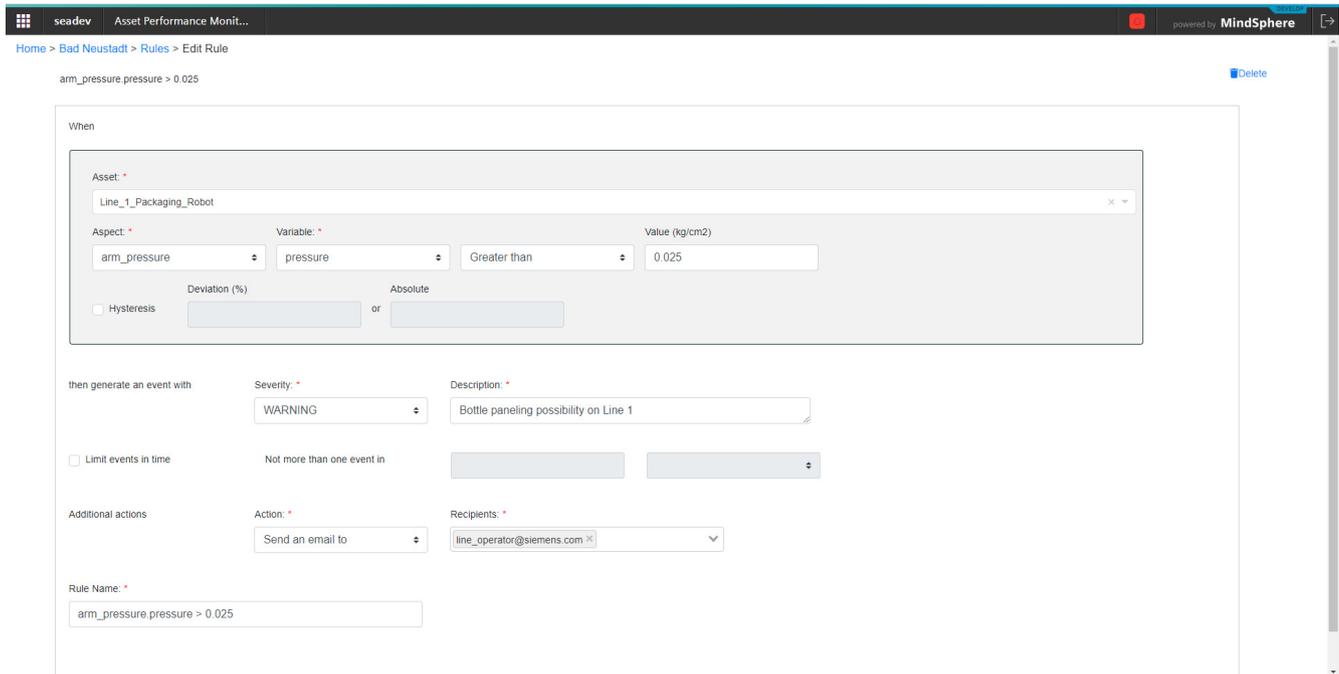
Newly created rules will be inactive. To activate the Rule, select it and click "Activate" on the Rules view.

8.2 Example for Single Condition Rule

A Single Conditional Rule can monitor the value of a variable from a single asset. Each Rule has a condition in the definition. This condition informs the application about the anomaly to be searched for in the normal operation of the asset. Then the application can notify you by generating an event and also sending an e-mail notification if that condition evaluates to true.

The following graphic shows an example of the following Single Condition Rule:

- Notify plant manager through e-mail and generate an event when value of arm pressure of the line 1 packaging robot rises above 0.025 kg/cm²



8.3 Example for Multi-Condition Rule

A Multi-Condition Rule can monitor multiple conditions consisting of values of multiple variables from single or multiple assets. These conditions inform the application about the pattern of deviations to look for in the normal operation of the assets. Then the application can alert you by generating an event and additionally by sending an e-mail notification once this pattern evaluates to true.

The following graphic shows an example of the following Multi-Condition Rule:

1. Notify plant manager through e-mail and generate an event when values of vibration and temperature of rotating parts, such as motors and gears, rise beyond thresholds within a certain period. Such a pattern of conditions is indicative of potential failure.
2. Notify diesel generator operator through e-mail about drop in generator efficiency and generate an event when values of power output and fuel intake flow are not within expected range.

seadev Asset Performance Monit... powered by MindSphere

Home > Bad Neustadt > Rules > Edit Rule

(heat.temperature > 120)&(speed.vibration > 30) Delete

When Condition 1

Asset: Line_1_Oven_Dryer_A

Aspect: heat Variable: temperature Value (deg C): 120 Operator: Greater than

Deviation (%) or Absolute

is followed by Condition 2 within 90 Seconds

Asset: Line_1_Dryer_Outfeed_Conveyor

Aspect: speed Variable: vibration Value (Hz): 30 Operator: Greater than

Deviation (%) or Absolute

Save Cancel

Patterns of deviations can be identified in data. These are based on knowledge of the initial anomaly and the subsequent sequence of anomalies.

For example, the current version of the application supports the identification of a pattern. Here, the initial deviation and the subsequent sequence of deviations within a fixed period are known.

Deviation A is followed by deviation B (before time t_1 from the occurrence of A) followed by deviation C (before time t_2 from the occurrence of B).

8.4 Hysteresis

You can instruct the rule that an error in the variable value due to a hysteresis is considered. The consideration of the hysteresis applies to the variables int, long and double type as well as to the following threshold conditions:

- Greater than
- Less than
- Greater than equal to
- Less than equal to
- equal to

When hysteresis is enabled, the rule processor usually evaluates the value of the condition according to the following logic:

- **For "greater than" and "greater than equal to" conditions**
Assuming that the threshold is set at 10 and hysteresis is set at 2. The variable value will have to drop below 8 ($10 - 2$) and then rise above 10. The value is then qualified as another instance of value crossing the threshold.
- **For "less than" and "less than equal to" conditions**
Assuming that the threshold is set at 10 and hysteresis is set at 2. The variable value will have to rise above 12 ($10 + 2$) and then drop below 10. The value is then qualified as another instance of value crossing the threshold.
- **For "equal to" condition**
Assuming that the threshold is set at 10 and hysteresis is set at 2. The variable value will have to either rise above 12 ($10 + 2$) or drop below 8 ($10 - 2$) and then equalize at 10. The value is then qualified as another instance of value crossing the threshold.

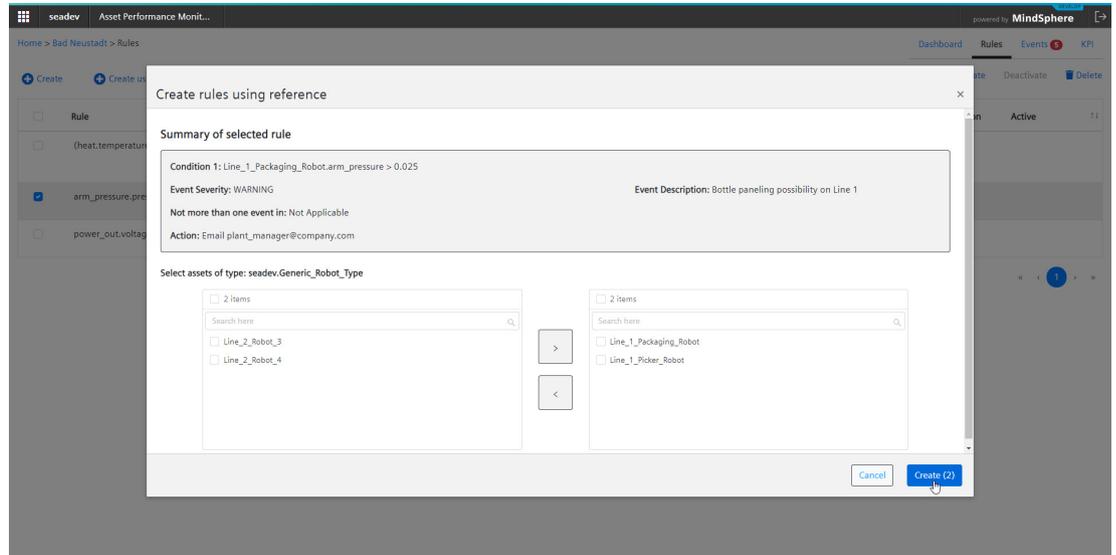
8.5 Creating rules in bulk using a reference rule

Creating single condition rules in bulk

To create new single condition rules in bulk, proceed as follows:

1. Open Rules view for a site.
2. Select existing inactive single condition rule.

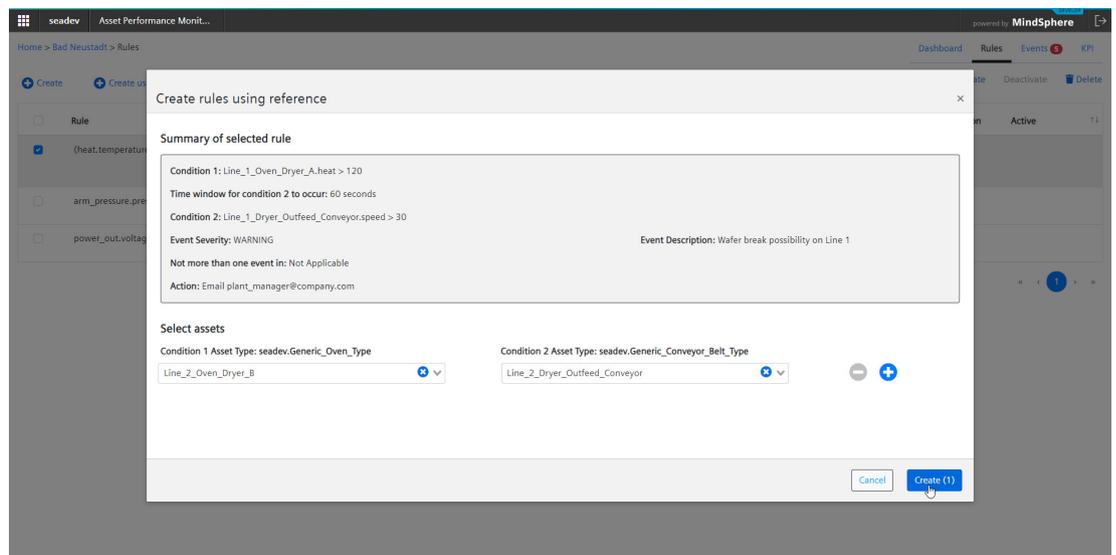
3. Click "Create using reference". This opens a popup window in which you can select multiple assets of type referenced in selected rule.
4. Click "Create". New rule will be created for each selected asset. All newly created rules will have definition same as definition of selected single condition rule.



Creating multi-condition rules in bulk

To create new multi-condition rules in bulk, proceed as follows:

1. Open Rules view for a site.
2. Select existing inactive multi-condition rule.
3. Click "Create using reference". This opens a popup window in which you can add multiple groups of assets of types referenced in selected rule.
4. Click "Create". New rule will be created for each added group of assets. All newly created rules will have definition same as definition of selected multi-condition rule.



8.6 Editing rule

Note

An active Rule has to be deactivated before edit operation.

To edit an existing rule, proceed as follows:

Make sure, that the Rules view is open.

1. Select the rule you want to edit and click "Edit".
The Rule editor opens.
2. Change the Rule settings and click "Save".

Hint: Do not forget to activate the Rule after editing.

8.7 Activating or deactivating rule

In some cases, it is necessary to deactivate rules, for example before editing.

Note

The Activate and Deactivate tools are disabled by default.

To activate or deactivate Rules, proceed as follows:

Make sure, that the Rules view is open.

1. Select rules to change their activity state.
Depending on the current activity state of selected rules, the opposite tool is enabled.
2. Click the tool to change the activity.

Hint: Repeat this process, to activate the rule after editing.

8.8 Deleting rule

Note

The Delete tool is disabled by default. To enable the tool, first select the rule to be deleted.

To delete a rule, select the rule and click "Delete" on the Rules view.

Event Management

The Event Management allows you to filter, sort, and update event state operations on asset events.

- To filter and sort events, refer to chapter Filtering and Sorting Events (Page 39).
- To update a state of an event, refer to chapter Updating State of Events (Page 36).

To launch the Events view of a site, click the Events tab on the Site Dashboard.

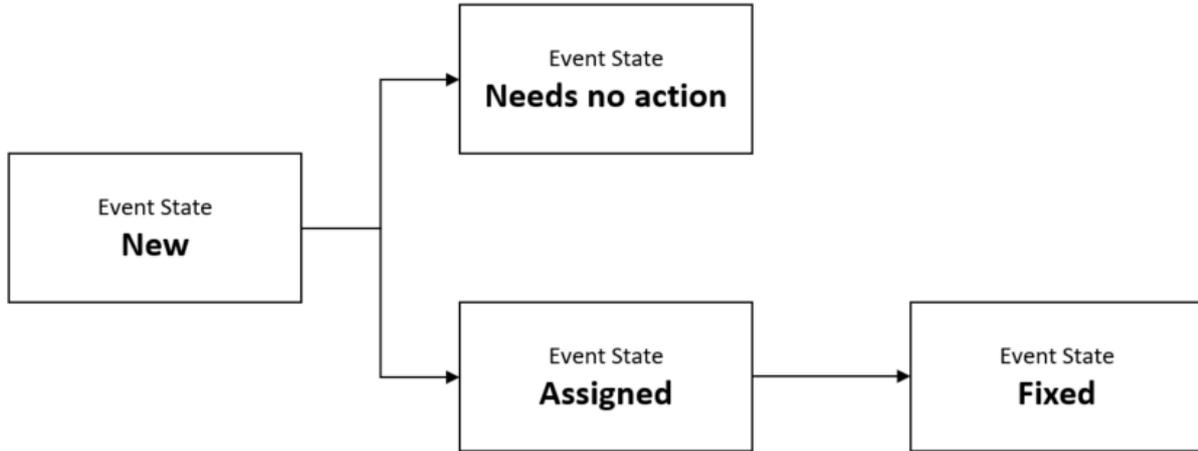
Severity	Timestamp	Description	State	User	Assets	Rule
Warning	Feb 12 2019 01:24 pm	Wafer break possibility on Line 1	New	--	Line_1_Oven_Dryer_A	(heat.temperature > 120)&(speed.vibration > 30)
Warning	Feb 12 2019 01:24 pm	High Voltage on Power Meter A	New	--	Power_Meter_A	voltage > 250
Warning	Feb 12 2019 01:24 pm	Possible Bottle Paneling on Robot 2	Assigned	Ann Green	Line_1_Packaging_Robot	arm_pressure.pressure > 0.025
Information	Feb 12 2019 01:24 pm	Maintenance due for Line_2_Dryer_B_Exhaust_Fan	New	--	Line_2_Dryer_B_Exhaust_Fan	Maintenance reminder
Information	Feb 12 2019 01:24 pm	Maintenance due for Line_1_Cumberland_Drive_Roller	Fixed	Ann Green	Line_1_Cumberland_Drive_Roller	Maintenance reminder
Warning	Feb 12 2019 01:24 pm	Low speed detected for Line_2_Hoist_Mixer	Fixed	Carl Peterson	Line_2_Hoist_Mixer	rpm < 10
Information	Feb 12 2019 01:24 pm	Maintenance due for Line_2_Robot_4	Fixed	Peter Brooks	Pri_Line_Boiler_B	Maintenance reminder
Error	Feb 12 2019 01:24 pm	Line_1_Cutter_Feeder Vibrations in fault band	Fixed	Peter Brooks	Line_2_Cutter_Feeder	vibration > 200
Error	Feb 12 2019 01:24 pm	Diesel_Generator_Set_A is offline	Fixed	Carl Peterson	Diesel_Generator_Set_A	generator status not online
Warning	Feb 12 2019 01:24 pm	Wafer break possibility on Line 1	Fixed	Peter Brooks	Line_1_Oven_Dryer_A	(heat.temperature > 120)&(speed.vibration > 30)

Parameter table

Parameter	Description
Severity	Information
	Warning
	Error
Time stamp	Time of an event
Description	Status text of the Rule
State	<ul style="list-style-type: none"> • New • Assigned • Fixed
User	Name of the user who processes the event
Assets	Assets assigned to the rule
Rule	Name of the Rule

9.1 Event management workflow

You can manage events using a simple workflow based on the state of the event. The state of a new event can be either "Needs no action" or "Assigned". Only an "Assigned" event can be "Fixed".



9.2 Updating state of events

Note

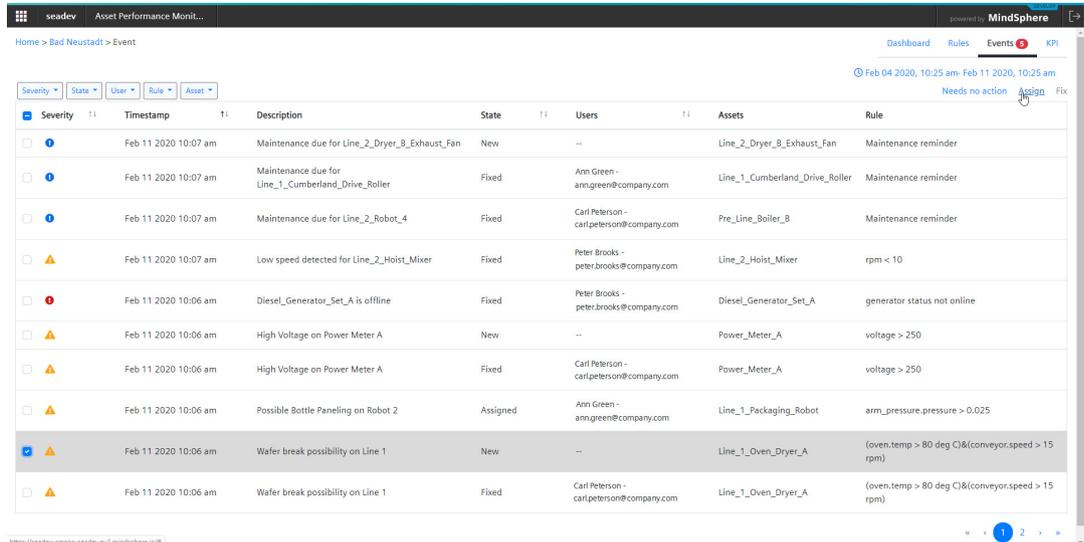
As an application user, you can only see and fix events assigned to you.

As an application administrator, you can view all available events and have the right to change the event state using all states of the workflow.

To update the state of an event, proceed as follows:

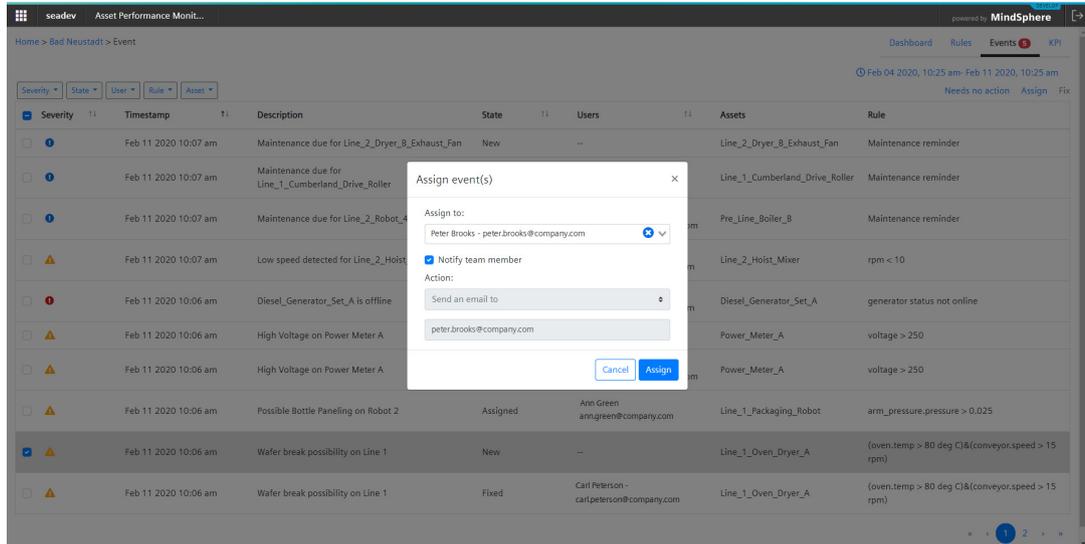
Make sure, the Events view is open.

1. Select the event.
Only the next possible states in the workflow are enabled.

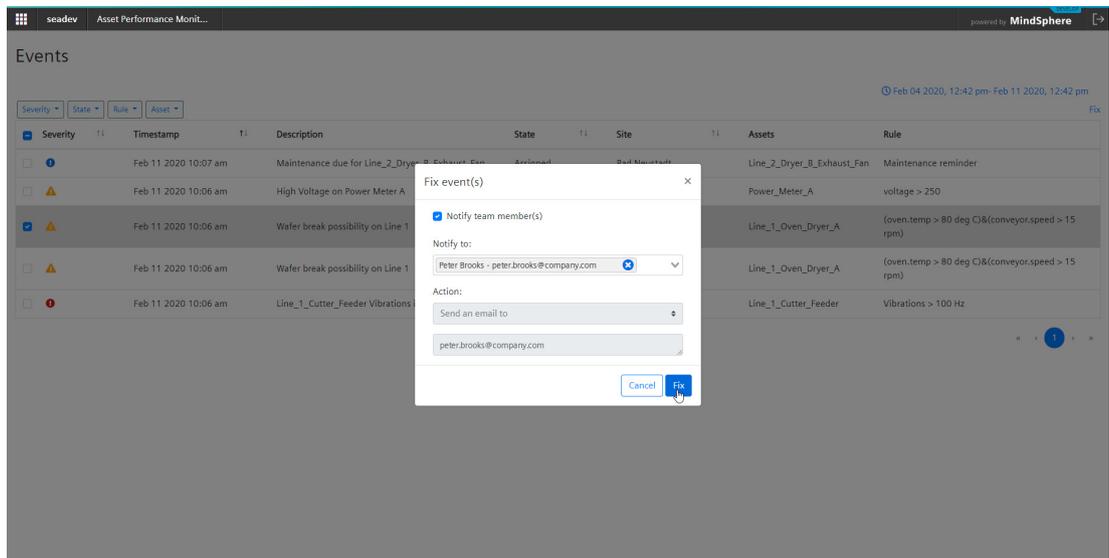


2. Click on the corresponding state. The state of the event has been updated.
or
an input window appears.

- 3. To change the state of the event to "Assigned" state, select the person to whom you want to assign the event. You can optionally send email notification to selected person's registered email id.



- 4. To change the state of the event to "Fixed" state, click on "Fix". You can optionally send email notification to multiple people at their registered email id.



9.3 Filtering and sorting events

Note

As an application user, you can only view events assigned to you and can filter and sort them by all available data types.

As an application administrator, you can view all available events with all data types.

To limit or extend the time span of events, click on the time filter. You can set a maximum of 90 days.

To sort the list according to Severity, State, User, Rule, and Asset, click on the corresponding button on top of the list.

The screenshot shows the 'Asset Performance Monitoring' interface. At the top, there are navigation links for 'Dashboard', 'Rules', 'Events', and 'KPI'. Below this, there are filter buttons for 'Severity', 'User', 'Rule', and 'Asset'. A table of events is displayed with the following columns: Severity, Timestamp, Description, State, Users, Assets, and Rule. The table contains five rows of event data.

Severity	Timestamp	Description	State	Users	Assets	Rule
	Feb 11 2020 10:07 am	Maintenance due for Line_2_Dryer_B_Exhaust_Fan	New	--	Line_2_Dryer_B_Exhaust_Fan	Maintenance reminder
	Feb 11 2020 10:06 am	High Voltage on Power Meter A	New	--	Power_Meter_A	voltage > 250
	Feb 11 2020 10:06 am	Wafer break possibility on Line 1	New	--	Line_1_Oven_Dryer_A	(oven.temp > 80 deg C)&(conveyor.speed > 15 rpm)
	Feb 11 2020 10:06 am	Wafer break possibility on Line 1	New	--	Line_1_Oven_Dryer_A	(oven.temp > 80 deg C)&(conveyor.speed > 15 rpm)
	Feb 11 2020 10:06 am	Line_1_Cutter_Feeder Vibrations in fault band	New	--	Line_1_Cutter_Feeder	Vibrations > 100 Hz

Key Performance Indicator (KPI) Calculations

This feature calculates Key Performance Indicators (KPIs) for an asset using computational procedures based on ISO 3977-9:1999.

The calculation uses the following inputs:

- Time range
- Sensor data as time series and a threshold
- Maintenance calendar data
- Initial and default unit states

KPI calculation for assets is done once in week at a predetermined time. Period of one calendar week is considered for the calculation.

10.1 Monitoring KPI calculations

To open the KPI Summary view, click the KPI tab on the Site Dashboard.

The following graphic shows Summary View displaying weekly KPI calculation values for all the configured assets in Bad Neustadt site. You can use week selector to view KPI values from the previous calendar weeks.

Asset	Availability Factor (AF)	Reliability Factor (RF)	Mean Time Between Failures (MTBF) (hours)
Line_2_Dryer_Outfeed_Conveyor	95.24%	95.24%	160.00
Line_1_Dryer_Outfeed_Conveyor	94.05%	94.05%	0

Next calculation for the period 02 Mar 2020 12:00 am UTC - 08 Mar 2020 11:59 pm UTC will be done at 09 Mar 2020 12:00 am UTC

To view the KPI details, click on an asset.

The following graphic shows the KPI detail of the asset [Line_2_Dryer_Outfeed_Conveyor](#).

Key Performance Indicator (KPI) Calculations

10.2 KPI calculation settings

The screenshot shows a web interface for 'Asset Performance Monitoring' powered by MindSphere. The page title is 'Line_2_Dryer_Outfeed_Conveyor'. It displays two tables of KPI values for the period from 10 Feb 2020 12:00 am UTC to 16 Feb 2020 11:59 pm UTC.

KPI Values - Hours		KPI Values - Factors	
KPI	Value	KPI	Value
No Data Hours (NoData)	0	Availability Factor (AF)	95.24%
Period Hours (PH)	168	Unavailability Factor (UF)	4.76%
Available Hours (AH)	160.00	Reliability Factor (RF)	100.00%
Service Hours (SH)	160.00	Service Factor (SF)	95.24%
Reserve Shutdown Hours (RSH)	0	Forced Outage Factor (FOF)	0.00%
Unavailable Hours (UH)	8.00	Mean Time Between Failures (MTBF)	160.00
Planned Outage Hours (POH)	8		
Forced Outage Hours (FOH)	0.00		

Next calculation for the period 02 Mar 2020 12:00 am UTC - 08 Mar 2020 11:59 pm UTC will be done at 09 Mar 2020 12:00 am UTC

The calculated output consists of a set of KPI time and factor values.

The following table shows the KPI states and time values.

KPI states and time values		Description
Available Hours (AH)	Service Hours (SH)	Asset is in-service.
	Reserve Shutdown Hours (RSH)	Asset is available, but not in service (default).
Unavailable Hours (UH)	Forced Outage Hours (FOH)	Asset is unavailable due to a failure.
	Planned Outage Hours (POH)	Asset is experiencing a planned outage as defined by calendar schedule.
Unknown Hours (NoData)		Not all required data is available.

The following table shows the KPI factors.

KPI factors	Description
Availability Factor	Probability that the asset will be usable (available without any outages).
Unavailability Factor	Probability that the asset will be unusable (not available due to outages).
Reliability Factor	Probability that the asset will not be in a forced outage condition.
Service Factor	Probability that the asset will be in an operating condition.
Forced Outage Factor	Probability that the asset will be in a forced outage condition.
MTBF	Mean time between failures

10.2 KPI calculation settings

You can assign assets for KPI calculations.

In the KPI tab of the Site Settings, all assets configured for KPI calculations are listed.

To show all KPI calculations of a site, proceed as follows:

1. Click "Settings" on the home screen.
The Site Settings view is displayed and a list with all configured Sites will be shown.
2. Click on the site name of the site whose High Value Assets you want to be shown.
The Site Settings details are shown.
3. Click the KPI tab.
The KPI Calculations view opens.

The screenshot shows the 'Asset Performance Monitoring' interface. The top navigation bar includes 'seadev', 'Asset Performance Monit...', and 'powered by MindSphere'. The breadcrumb trail is 'Home > Settings'. The main content area is titled 'Sites > Bad Neustadt' and has three tabs: 'Site', 'High Value Assets', and 'KPI'. The 'KPI' tab is active, displaying a table with the following data:

<input type="checkbox"/>	Name	Asset Name	Maintenance Schedule	KPI Calculations
<input type="checkbox"/>	Line_2_Dryer_Outfeed_Conveyor	Line_2_Dryer_Outfeed_Conveyor	✓	✓
<input type="checkbox"/>	Line_1_Dryer_Outfeed_Conveyor	Line_1_Dryer_Outfeed_Conveyor	✓	✓

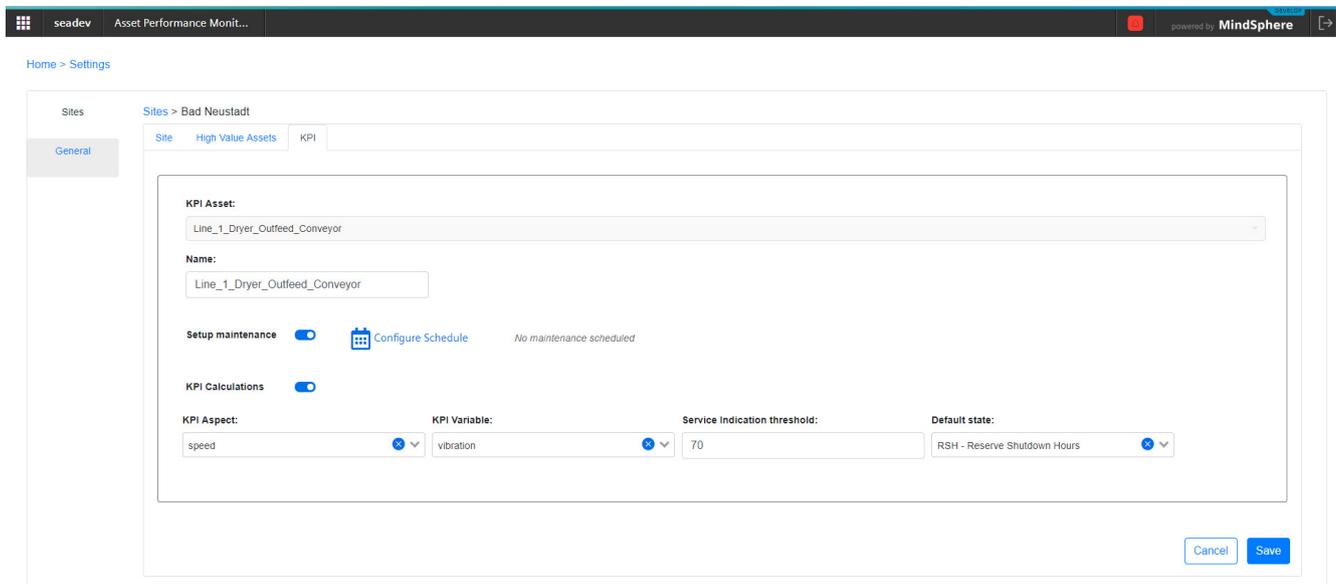
At the bottom right of the table, there is a pagination control showing '1' in a blue circle, indicating one page of results.

10.3 Adding KPI calculations

To assign an asset for KPI calculations, proceed as follows:

Make sure the KPI Calculations view is open.

1. Click "Add KPI Calculation".
A view opens.



2. Select the KPI asset. Setup maintenance option is disabled by default.
3. Enable Setup maintenance option. The KPI calculation settings are selectable.
4. Select the KPI Calculation settings.
5. Select the KPI aspect and KPI variable that will be used in KPIs calculation.
6. Inform the application about the maintenance schedule for the selected asset by clicking "Configure Schedule" and creating calendar entries.

The application calculates KPIs for an asset when

- available sensor readings can give a clear indication for service states, and
- available calendar entries define planned outage states.

Service Indication Threshold:

Asset is considered in service if the sensor value is greater than the configured value of the service indication threshold.

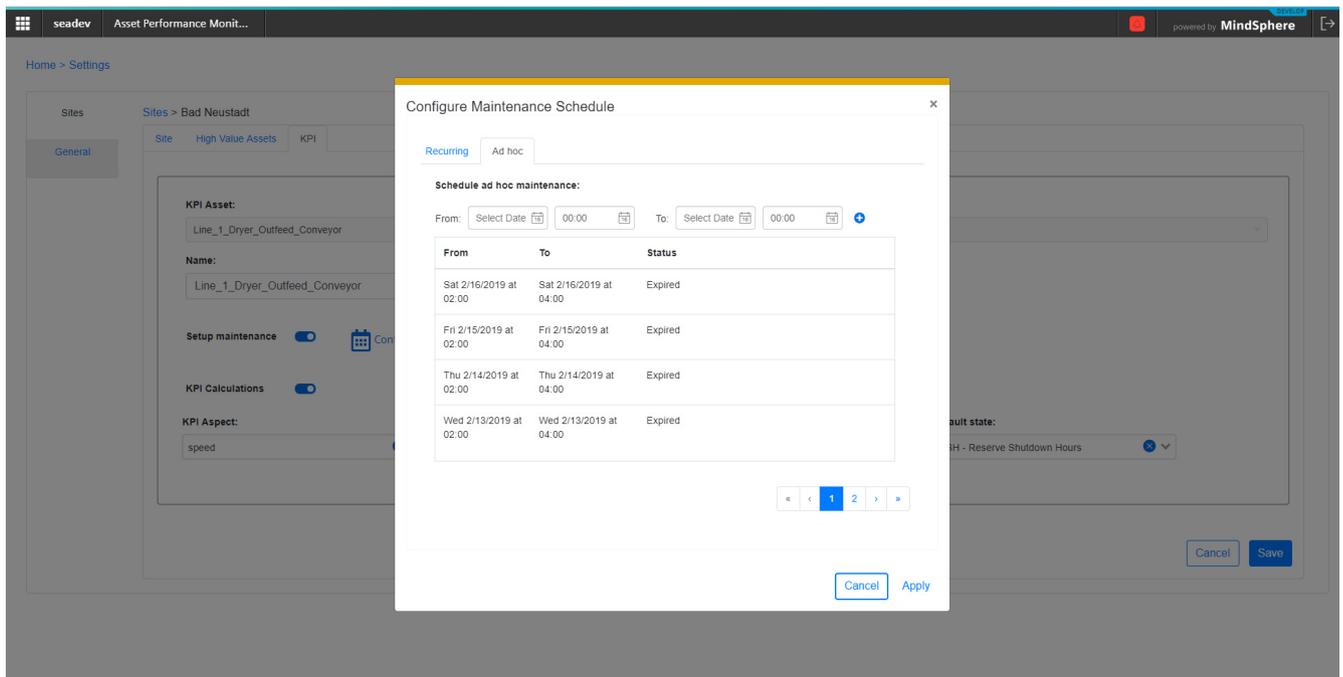
Default State:

Calculation assumes default state for the asset when the sensor and calendar do not provide enough information. Default state can be configured to be either Reserve Shutdown Hours (RSH) or Forced Outage Hours (FOH). Initial state is calculated by checking variable value. If variable value is greater than Service Indication Threshold, then service state is considered. If the sensor value is not available, then, calculation uses configured value of the default state.

10.4 Configuring maintenance schedule

To inform the application about the maintenance schedule for the selected asset, proceed as follows:

1. Click "Settings" on the home screen.
The Site Settings view is displayed.
2. Click the "KPI" tab.
The KPI Summary view opens.
3. Select a KPI Calculation or create a new KPI Calculation.
4. Enable Setup maintenance, if disabled.
5. Click "Configure Schedule".
Configure Maintenance Schedule window appears.



Click "Ad hoc" to schedule ad hoc maintenance.

6. Select date and times. For more intervals click "+".
7. Click "Apply". The schedule is saved.

Note

The Remove tool is disabled by default. To enable the tool, first select the KPI to be removed.

To remove a KPI, select the KPI and click "Remove" on the KPI Calculations view.

10.5 Removing KPI

Note

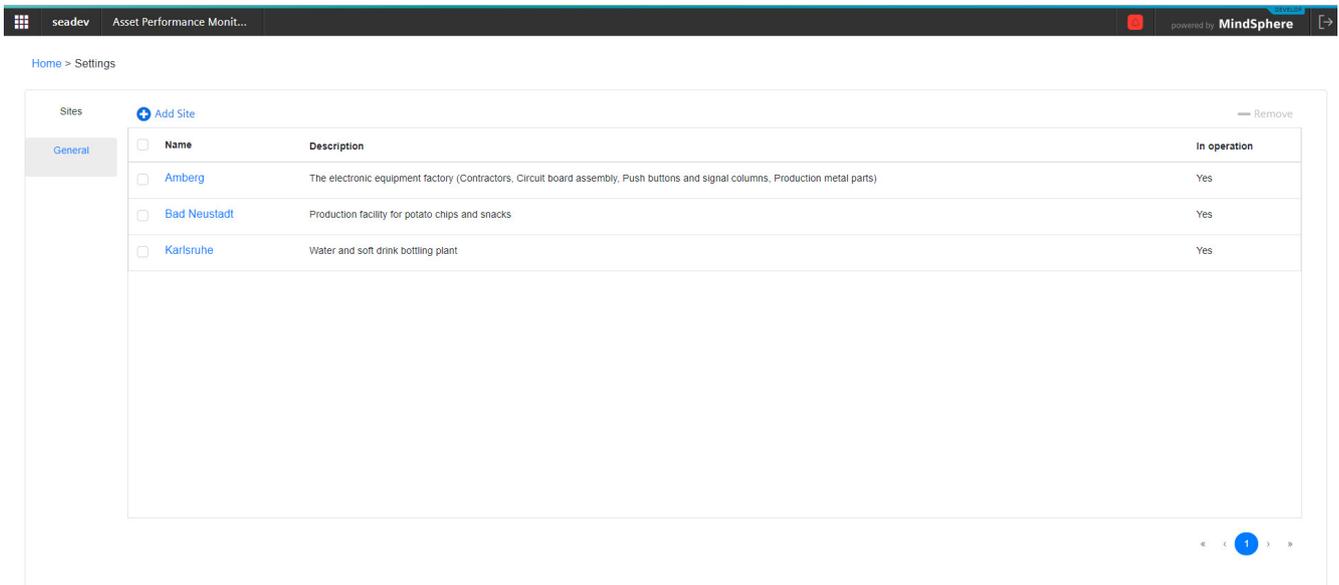
The Remove tool is disabled by default. To enable the tool, first select the KPI to be removed.

To remove a KPI, select the KPI and click "Remove" on the KPI Calculations view.

In the Settings you can manage site-specific and general configurations.

- The Site Settings allow configuring Sites in the application. Read more about this in the chapter Site Settings (Page 47).
- The General Settings allow configuring General Settings in the application. Read more about this in the chapter General Settings (Page 48).

To access the Settings, click "Settings" on the home screen. By default, the Site tab is activated. A list with all configured Sites will be shown, comparable to the following graphic.



11.1 Site settings

To access the Site settings, click "Settings" on the home screen. By default, the Site tab is activated. A list with all configured sites will be shown.

On the Site Settings view you can configure following settings:

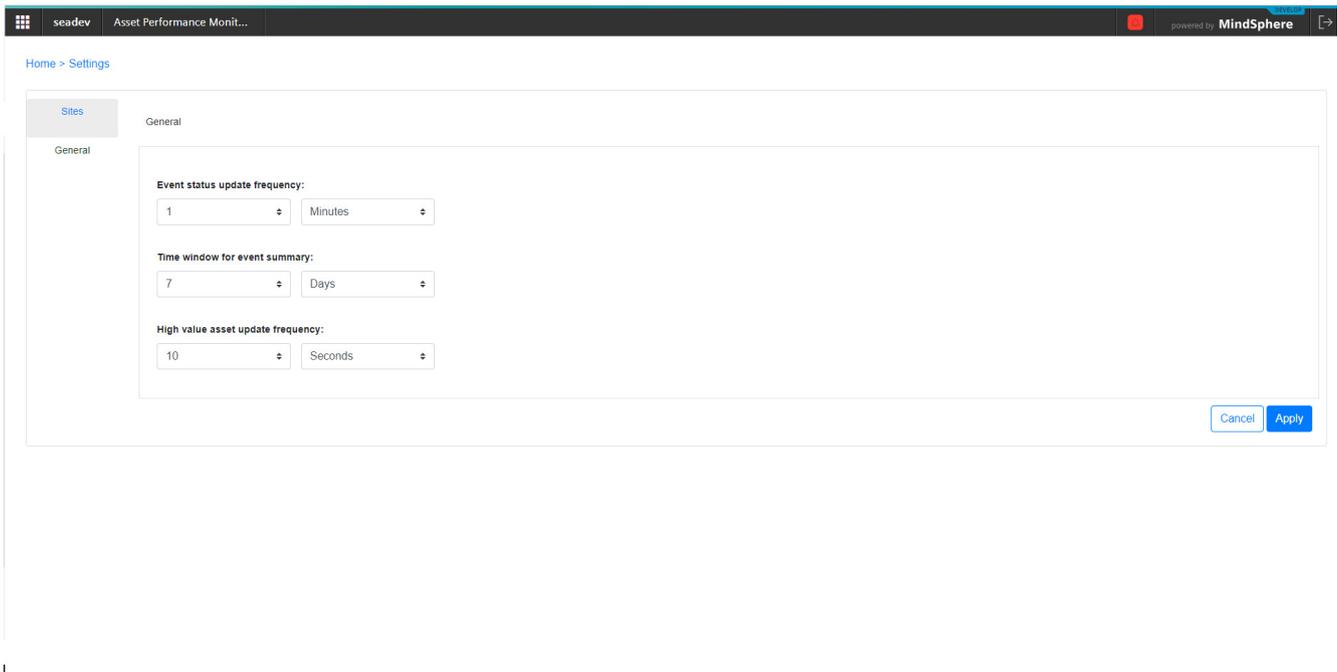
- **Site:** Displays Site Setting details.
Read more about this in the chapter Site Settings (Page 47).
- **High Value Assets:** Lists assets configured as High Value Assets.
Read more about this in the chapter High Value Asset Management (Page 25).
- **KPI:** Lists assets configured for KPI calculations.
Read more about this in the chapter KPI Calculation Settings (Page 42).

Each setting change leads to changes on the Site Dashboard.

11.2 General settings

To access the General Settings, proceed as follows:

1. Click "Settings" on the home screen.
The Site Settings view opens by default.
2. Click the General tab.
General Settings view opens.



The following table describes the parameters to be set.

Parameter	Description
Event status update frequency	Application fetches the latest events for the Sites from MindSphere at a frequency configured in this setting.
Time window for event summary	Application summarizes event information for the Site for the period configured in this setting.
High Value Asset update frequency	Application fetches the latest available status of assets from MindSphere at a frequency configured in this setting.

Example

If the value of Time window for event summary is 7 days, the application considers [current time, current time - 7 days] as the input period for summarizing events.