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# **ABB Ability™ Ellipse Asset Performance Management**

Ellipse APM User Guide

Release 5.x

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# Introduction

## Overview

Ellipse APM transforms real-time and historical asset data into strategic insights on the health of your mission critical assets. The solution can be delivered as a service via the Azure cloud (SaaS) or perpetually licensed for an on-premise installation.

## Ellipse APM Key Benefits

- Consolidates data on assets and their health across the enterprise and makes them available to key stakeholders on a dynamic and timely basis.
- Asset performance models capture and systematize subject matter expert know-how.
- Provides visibility to potential failures to support operational and maintenance decision making
- Evaluates which assets can be extended beyond their expected life and which need to be replaced.
- Focuses limited maintenance resources on the assets that need help (critical and poor health) and provides justification to defer maintenance on healthy assets.

## Ellipse APM Supported Assets

Ellipse APM contains out of the box models for the following asset types:

- Oil filled Transformers
- HV Circuit Breakers
- Station Batteries and chargers
- Transmission Lines
- Capacitor Banks
- CCVTs (Capacitance Coupled Voltage Transformers)
- Underground Cables

## How Ellipse APM Works

Ellipse APM provides predictive analytics for asset performance.

- Collects - A unified view of all asset data in a proven analytics platform.
- Predicts - Algorithms codify experience to predict and prioritize risk.
- Informs - Industry standard KPIs and expert decision support.
- Acts - Holistic asset performance management.

The Ellipse APM Reporting Module includes:

- 
- [Main Dashboard](#)
  - [Assets](#)
  - [Asset Details](#)
  - [Issues](#)

Access Ellipse APM at:

<https://ahc.enterprisesoftware.abb>

## Additional Resources

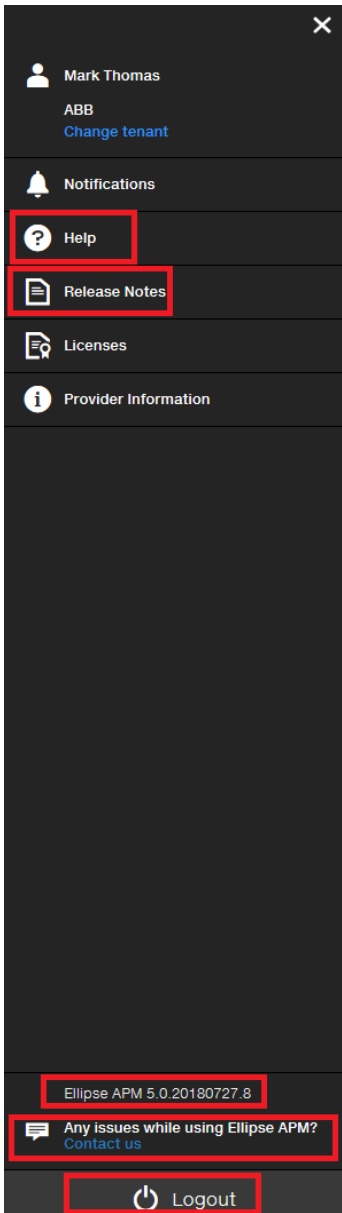
- On-Premise Installation  
See **On-Premise Installation Guide**

## Selection Pane Options

Click on the triple bar icon to open the Selection Pane.



- The User Guide in printable form is available through Help menu option on the Selection Pane.
- A compilation of Release Notes is available through the Release Notes menu option on the Selection Pane.
- Product version is available on the Selection Pane.
- A support contact link is available on the Selection Pane.
- Logout resides on the Selection Pane.

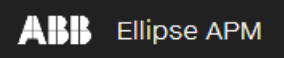


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# Main Dashboard Summary

## Navigate to the Main Dashboard

To navigate to the **Main Dashboard**, from anywhere within APM, click **ABB Ellipse APM**.



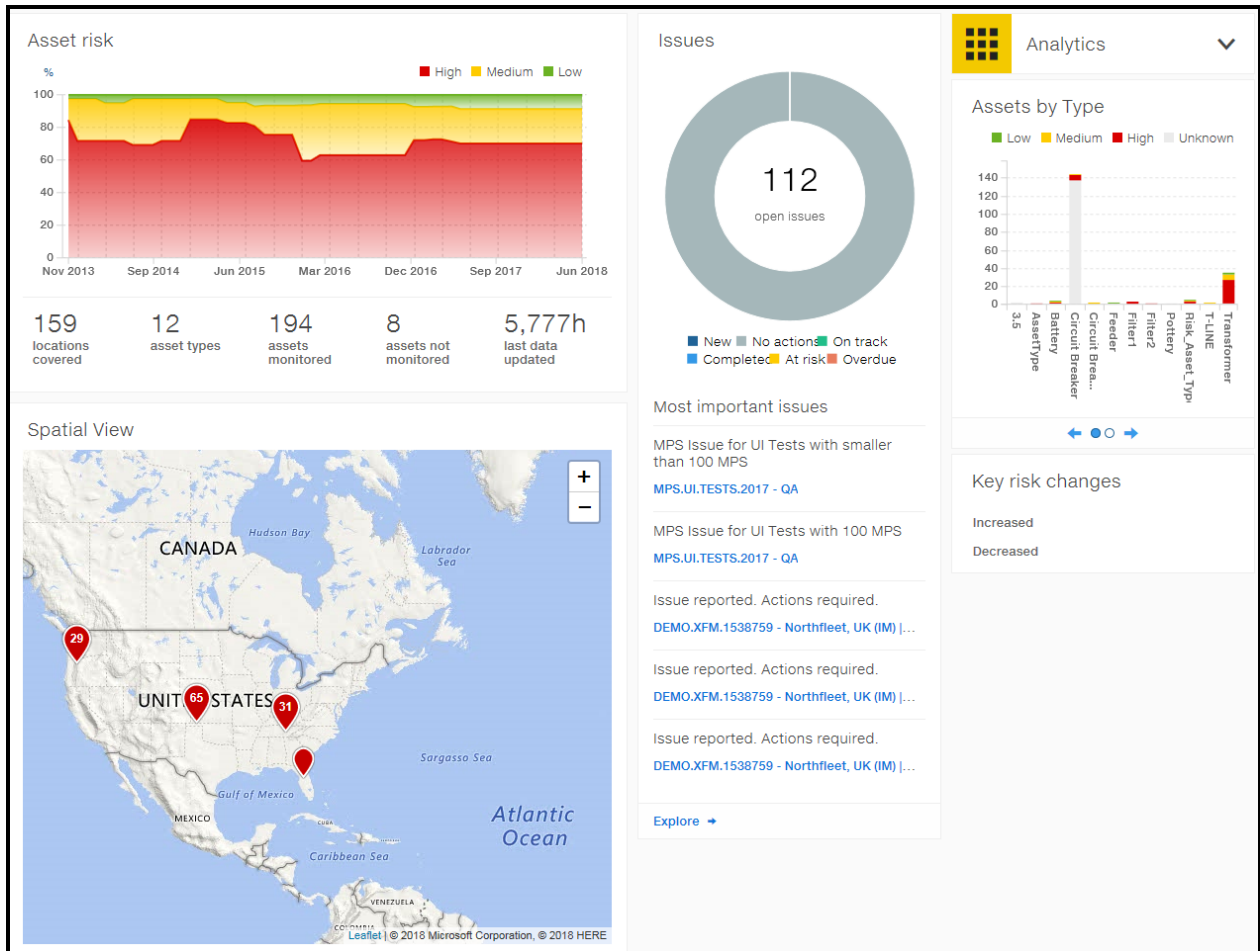
Individual widget-style components on the home page provide the user with a high level perspective of Asset Risk across the fleet with drill-downs into details.

## Dashboard

The **Dashboard** shows summary level risk information for the entire fleet of assets. Drill from the home page to Ellipse APM features including asset details, issues associated and predefined standard visualizations.

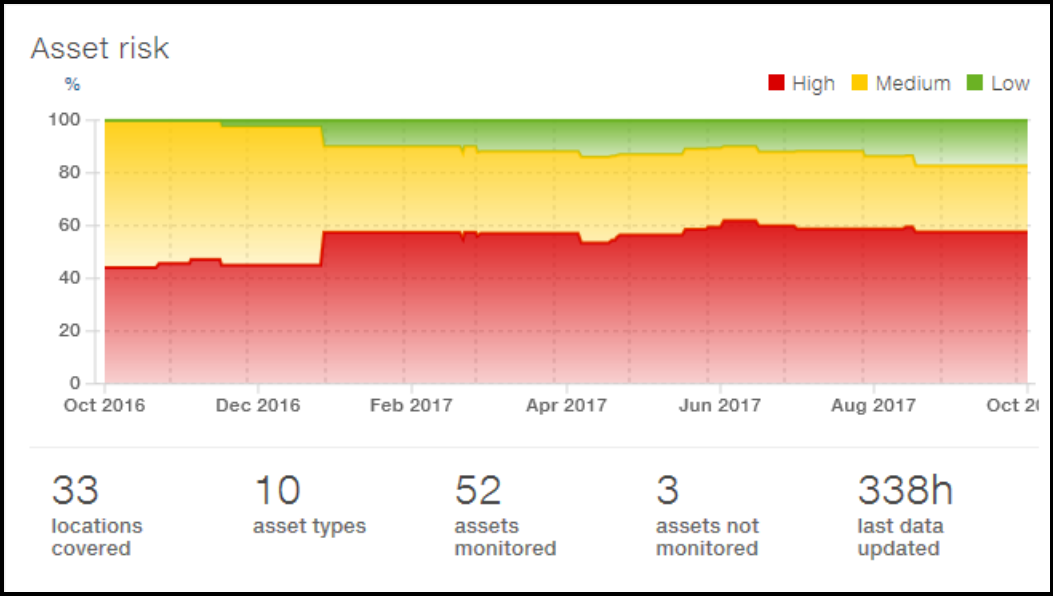
- The **Asset Risk** graph displays the share of assets by risk level over time.
- A widget displays the number of **Open Issues** by status along a list of the most important issues based on maintenance priority.
- A **Spatial View** displays asset along with risk levels by location (substation).
- A widget displays **Assets by Organization** and **Assets by Type**.
- Under the **Analytics** drop-down arrow, users can add additional reports leveraging PowerBI (SaaS only), other analytics tools, or access predefined standard visualizations.
- **Key Risk Changes** shows most significantly improved or degraded assets in the past 30 days.



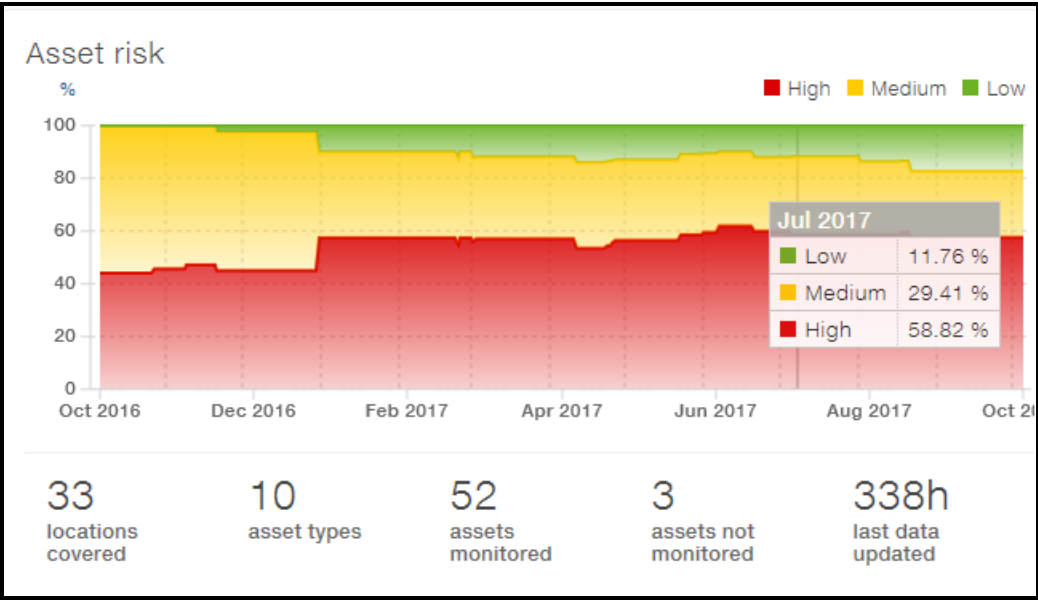


## Asset Risk

**Asset Risk** shows the distribution of assets by risk status (color) over time and further shows counts for locations covered, asset types, assets monitored, assets not monitored and last data updated.



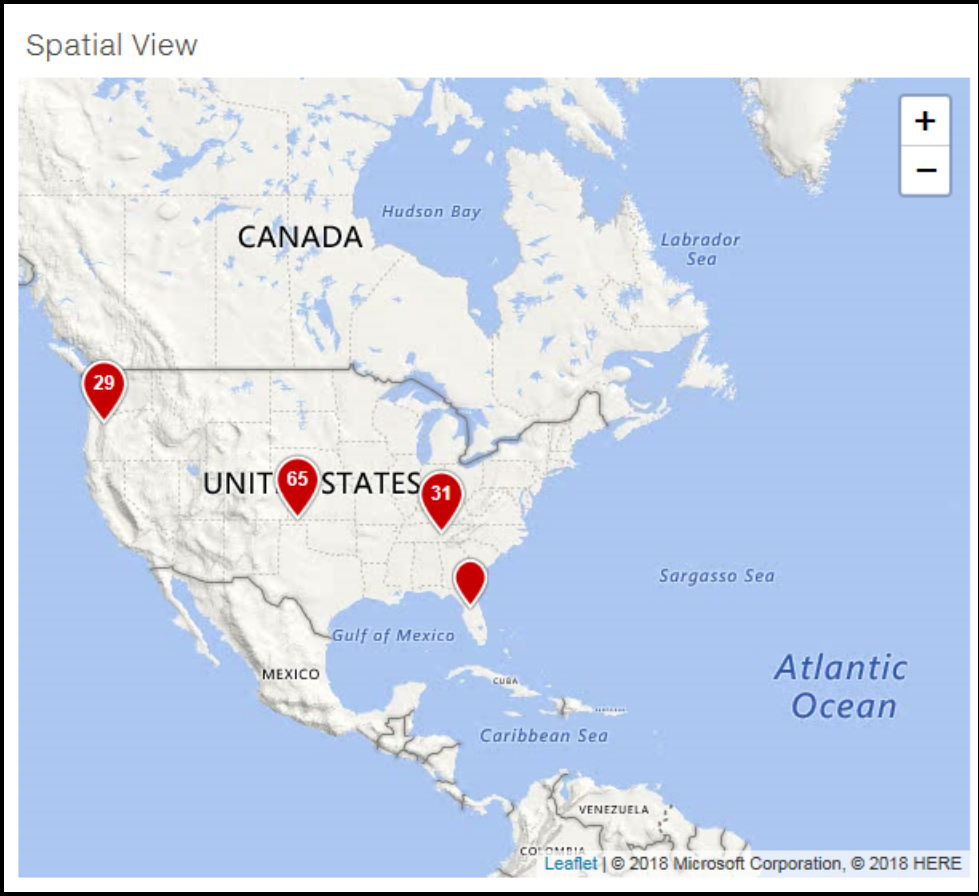
- Use the cursor to slide a line across the graph to display more detail on **Asset Risks** across time.



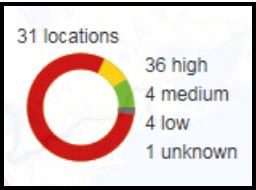
Asset Risk Chart can show up to five years of data points history (one per month) calculated to the end of each month. In case of a lack of historical data, the chart scales to fit the same size on the user interface.

### Spatial View

Spatial view shows the geographical distribution of asset locations (substations) including details related to asset risk. The color of the dot is based on the worst asset risk for the location.

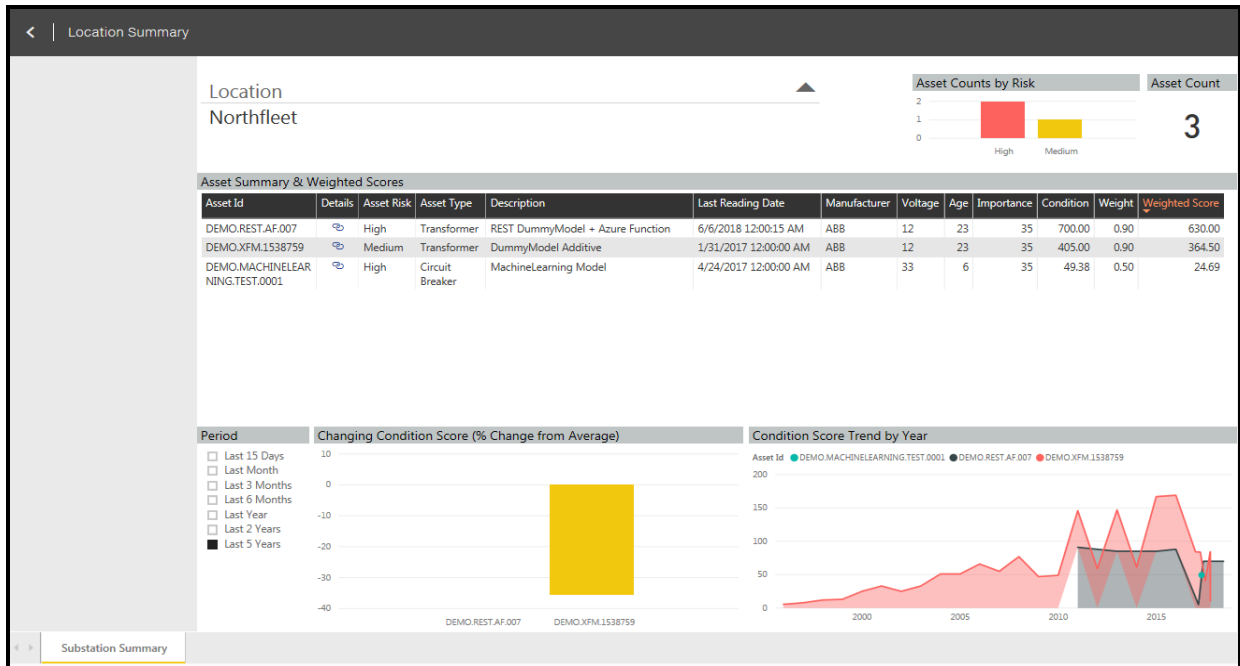


By hovering over a data point on the map, a tool tip-style pop-up displays how many assets are located within the selected location for each of the risk classes. A drill-down feature opens a report with more details for the selected, single location.



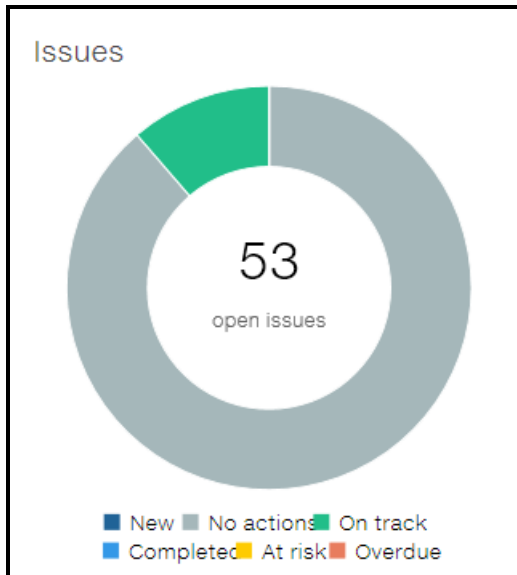
A drill-down feature on the Spatial View opens a **Location Summary** report with more details for the selected, single location.

**Note:** • **Location Summary** is available only on the spatial view widget on the main Dashboard on the cloud version.



## Issues

**Issues** displays a count of identified asset risk **issues** by resolution status. This resolution status is based on the status of work orders and work requests associated with the issue. Click on any donut chart section to drill down and see the issues corresponding to the count.

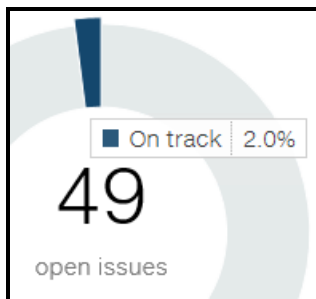


The **Issues** widget further lists the **most important issues** related to asset risks based on calculated maintenance priorities.

**Issues** displays a color coded legend delineating issues including:

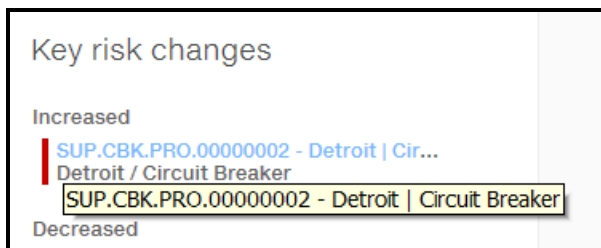
- **New** - New issue identified in the past 7 days and not yet evaluated by users.
- **No actions** - There is no work-order or work-request attached or if the work-request is cancelled or closed.
- **On track** - All work-orders attached to the issue have not exceeded Schedule Date yet (time buffer >24h ) or the Schedule Date is not specified yet. This state also refers to cases when there is a work-request In Requested and In Progress status without Schedule Date specified.
- **At risk** - At least one of the planned actions draws on to the Scheduled Date ( 0 < time buffer =< 24h), then the issue points on At risk state.
- **Overdue** - At least one of the planned actions exceeded the fixed Schedule Date of the work-order.
- **Completed** - All actions are closed.

By hovering over a data point on the chart, a tool tip-style pop-up displays the percentage of issues that are located within the selected color coded legend. The number inside (i.e., 49) refers to all open issues.



## Key Risk Changes

Key Risk Changes show assets with the most significant absolute condition improvement or the most significant condition degradation over the past 30 days. Click on the asset ID to navigate to the asset details.

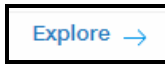
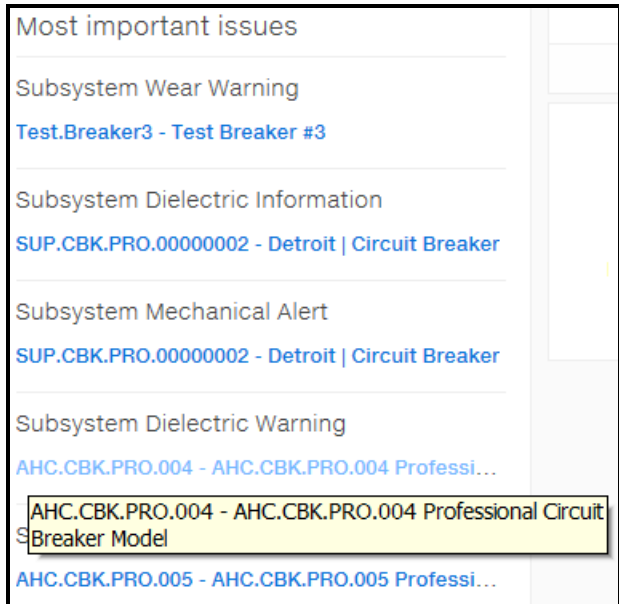


## Most Important Issues

**Most Important Issues** displays the five most significant risks or issues identified in Ellipse APM, based on the maintenance priority calculated by the application for each issue. The asset ID in blue is a link to the asset details page for each listed entry on the **Most Important Issues** list.

The Issues widget has sort rules. Issues are displayed in following order:

- Issues with New status indicated are at the top.
- Issues with Maintenance Priority Score are descending.
- When two or more issues have the same MPS, Asset Risk takes precedence.
- Sort rules on Issues widget are the same sort rules on Issues page.

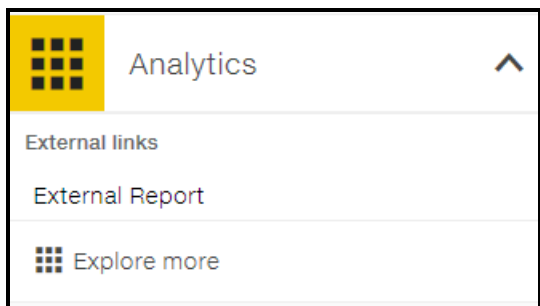


A direct link to **Issues** page to view all risks/issues is available through [Explore →](#) button.

## Analytics

**Analytics** provides access to additional reports and visualizations. Administrative users can edit this menu and add or change reports in this list. To navigate to these additional, customer-specific report, and other reports and visualizations, click on the down arrow next to **Analytics**.

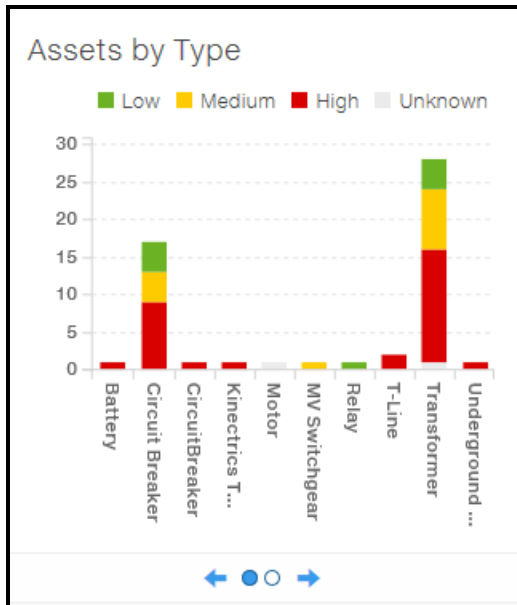
**Note:** This list can include custom embedded PowerBI content (cloud only). The list can further include hyperlinks to external content.



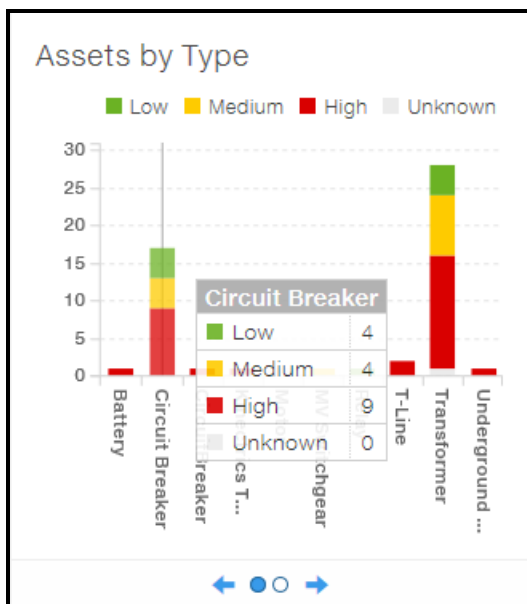
**Note:** The *Explore more* option directs users to their workspaces: <https://app.powerbi.com> (separate PowerBI license required).

## Assets by Type and Organization

**Assets by Type and Organization** provides a clear and consistent overview of the risk distribution across the asset types and organizations or operating companies.



By hovering the cursor over any bar, a tool tip-style pop-up displays how many Low, Medium, High, and Unknown assets are located within the selected organization or by asset type.



A drill-down feature on any bar opens an Assets page with the assets narrowed down to a list selected from this widget

The screenshot shows the 'Assets / 253 items' page. At the top is a filter bar with dropdown menus for Organization, Location, Asset Type, Importance, Risk, Voltage Class, Age, and Status. Below the filter bar is a table with the following columns: Asset, Description, Organization, Asset Voltage [kV], Asset Age [years], Maintenance Priority, Replacement Priority, Importance, Condition, and Risk. The table contains five rows of asset data.

Asset	Description	Organization	Asset Voltage [kV]	Asset Age [years]	Maintenance Priority	Replacement Priority	Importance	Condition	Risk
MPS.UITESTS.2017 - QA Location / AssetType	Description		13.5	18	60		100	100	<span style="color: red;">●</span>
SUP.CBK.PRO.00000002 - Detroit   Circuit Br... Detroit / Circuit Breaker	ABB.CircuitBreakerProfessional + CBK PRO Family	ABB	765	19	32.2		92	58.2	<span style="color: red;">●</span>
AHC.CBK.PRO.005 - AHC.CBK.PRO.005 Profe... Saint Louis / Circuit Breaker	AHC.CBK.PRO.005 Professional Circuit Breaker Model	ABB	1,004	2	25.6		88	48.6	<span style="color: red;">●</span>
AHC.CBK.PRO.005_pd - AHC.CBK.PRO.005 Pr... Saint Louis / Circuit Breaker	AHC.CBK.PRO.005 Professional Circuit Breaker Model	ABB	1,004	2	25.6		88	48.6	<span style="color: red;">●</span>
DEMO.CBK.PRO.00000001 - Detroit   Circuit... Detroit / Circuit Breaker	ABB.CircuitBreakerProfessional + Merged Inputs: OsPI & Nameplate & Storage	ABB	765	11	23.3		67	58	<span style="color: red;">●</span>

Independently the Assets Page is also accessible through the Assets menu button. Use the navigation tool to toggle between **Assets by Type** and **Assets by Organization**.

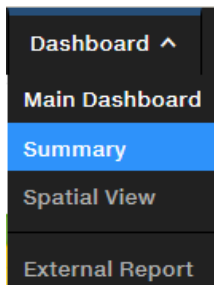


## Summary Dashboard

The following provides you with navigation to the **Summary Dashboard**, a high-level overview, and then discusses each component at a high level.

### Navigate to the Summary Dashboard

To navigate to the **Summary Dashboard** from anywhere within APM, click **Dashboard** and then **Summary**.

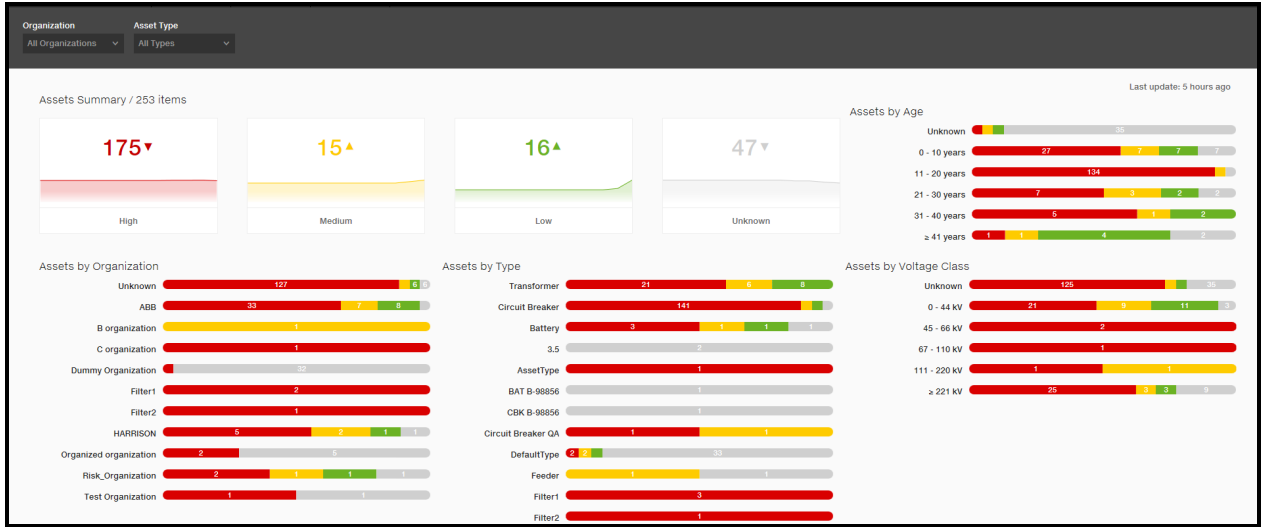




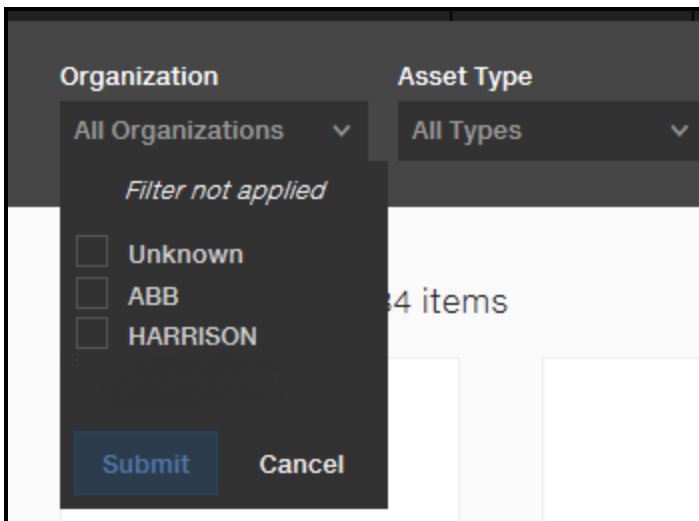
Individual widget-style components on the **Summary** page provide the user with a high level perspective of Asset Risk across the fleet with drill-downs into details.

## Summary Dashboard

The **Summary Dashboard** shows summary level risk information indicating the current status for the entire fleet of assets.



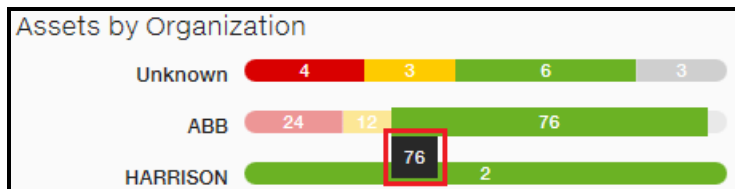
- A filtering panel implementation narrows searches by **Organization** and **Asset Type**.



- The **Asset Summary** risk graphs display color coded risk levels which are derived from an intersection of asset condition and importance.

**Unknown** is used when the application does not have information.

- Bar chart widgets display **Assets by Organization, Assets by Type, Assets by Age, Assets by Voltage Class**



- You are redirected to the assets page by clicking on each bar which keeps the filters passed (e.g. Organization, Medium risk assets).

Assets / 76 of 76 items ABB x Low x Clear Filters

Asset	Description	Organization	Asset Voltage [kV]	Asset Age [years]	Maintenance Priority ▼	Replacement Priority	Importance	Condition	Risk
AHC.CBK.PRO.002 Saint Louis / Circuit Breaker	AHC.CBK.PRO.002 Professional Circuit Breaker Model	ABB	1,001	3	6.1		20	51.0	●
TR2FC2M002 Detroit / Transformer	TRANSFORMADOR DE PODER 110KV/12KV	ABB	44	68	0.4		100	0.6	●

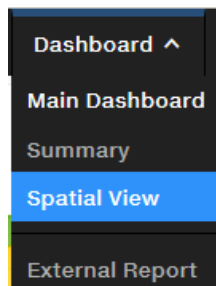
- You can drill down from the Risk counter on Assets Summary to the pre-filtered Assets Page.

## Spatial View Dashboard

The following provides you with navigation to the **Spatial View Dashboard**, a high-level overview, and then discusses each component at a high level.

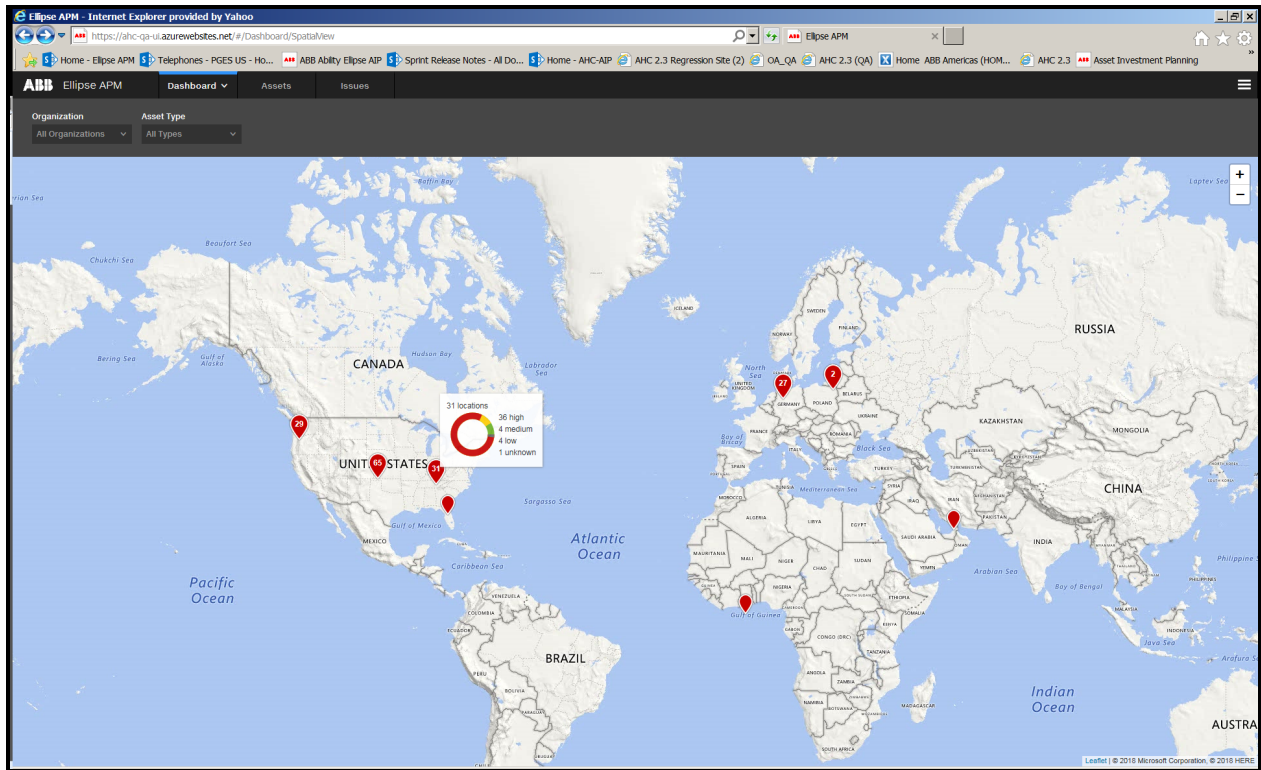
### Navigate to the Spatial View Dashboard

To navigate to the **Spatial View Dashboard** from anywhere within APM, click **Dashboard** and then **Spatial View**.



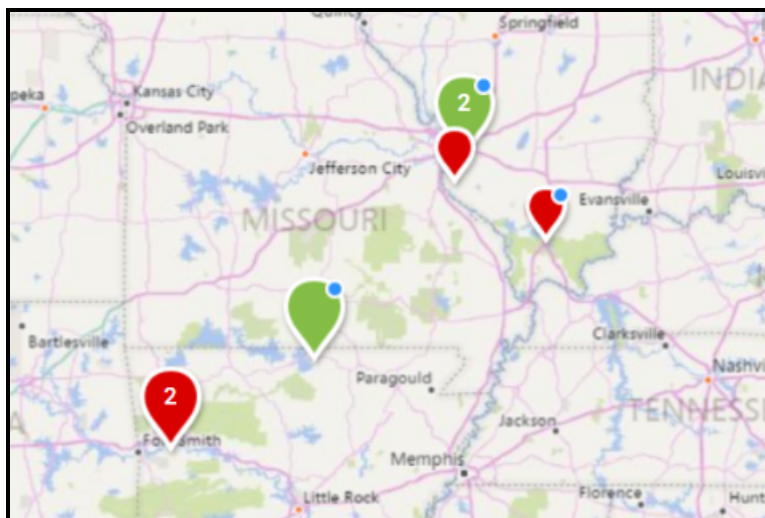
### Spatial View Dashboard

The **Spatial View** displays asset locations along with risk levels by location. The **Spatial View** shows the geographical distribution of asset locations including details related to asset health.



The color of the dot is based on the worst asset risk status for the location. Tool tips on the **Spatial View Dashboard** provide the user with a high level perspective of Asset Risk across the fleet with drill-downs into asset details.

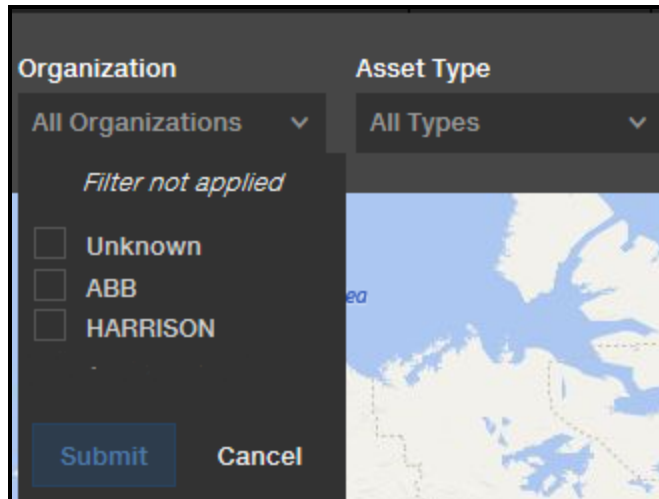
The small blue dots indicate a change to any asset in the substation from the previous work week business day.



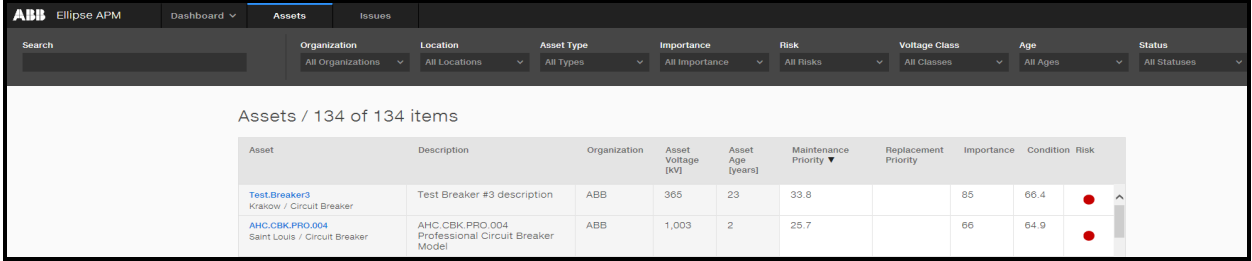
- If any asset in the substation changes color, the indicator will be there even if the substation summary does not change.

- If a substation is "blinking" today because of a change that happened overnight, this substation does not continue to blink tomorrow.
- Change indication remains for one business day, typically 24 hours, but 72 hours between Friday and Monday. Check and validation occurs every hour, no matter if any user drilled on the localization.

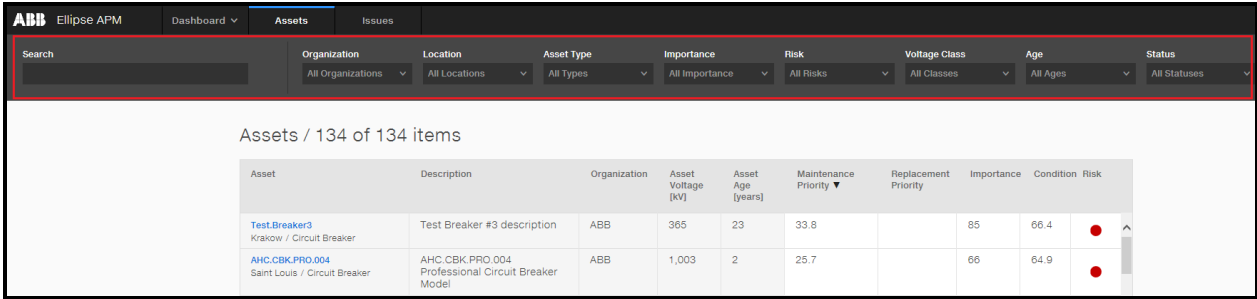
A filtering panel implementation narrows searches by **Organization** and **Asset Type**.

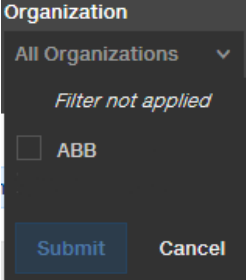


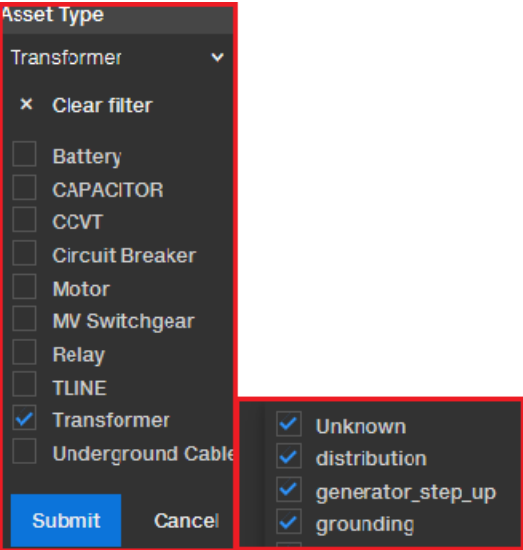
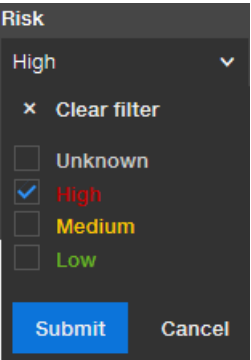
# Assets Page

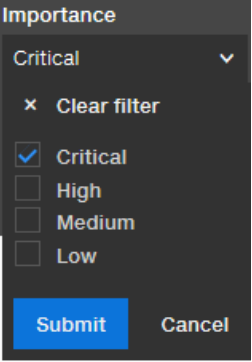
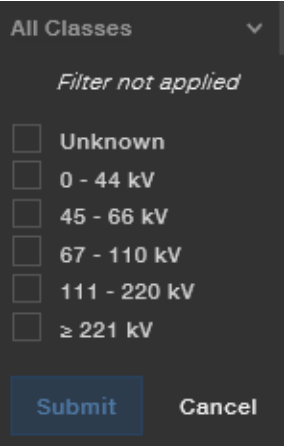



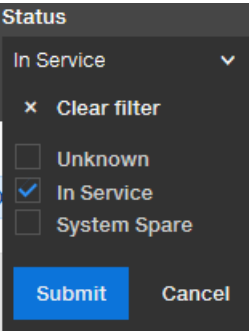
The search panel is divided into selected, predefined attributes as well as free text search box. You can easily select multiple conditions to determine filtering criteria for all assets.



Query Categories	Description
Search Box	This accepts typed-in text in order to look up, for example, an asset type.
Organization	<p>This is name of the organization filtered by assets.</p> 
Location	This is the name of the location (e.g., substation) where the asset resides.

Query Categories	Description
<p>Asset Type</p>	<p>This breaks down the type of equipment to identify ( e.g. transformer, circuit breaker, etc). Second level of filtering options are available for Asset type -Asset sub-type.</p> 
<p>Risk Level</p>	<p>This is the Risk of Failure and is designated by the colors of a "stoplight" to let you know those assets that are either OK (green), might need to be looked at (yellow), or requires attention (red).</p> 

Query Categories	Description
Importance	<p>A Unit Importance is a rating including Critical, High, Medium, and Low:</p> <ul style="list-style-type: none"> <li>■ Low (&gt;0 and &lt;= 25%)</li> <li>■ Medium (&gt;25 and &lt;=50%)</li> <li>■ High (&gt;50 and &lt;= 75%)</li> <li>■ Critical (&gt;75 and &lt;= 100%)</li> </ul> <p>A Unit Importance number is assigned to each asset. The value range is from one to 100. A distribution asset that services one customer might have a unit importance of two (2), whereas an asset that services a hospital might have a unit importance of 95.</p> 
Voltage	<p>The grid shows the actual voltage.</p> 

Query Categories	Description
Age	<p>Numeric age of the asset. Age is calculated as a difference between a current date and Manufactured Date. In case of unknown Manufacturer Date, Install Date is taken for the calculation. In case of an unknown Manufactured Date and Install Date, Asset Age is recognized as Unknown.</p> 
Status	<p>This the status of the asset (e.g., in service, spare, etc.).</p> 

**Note:** Common search panels available through other Ellipse APM pages allow an easy way to narrow down the number of visible entries by specific categories. Column headers are clickable to adjust the sort order of the results.

### Asset Report

The Asset Report displays the results of a query performed on the Asset Query search panel. The Asset Report supports sort functionality for fleet assets in Ellipse APM. Asset ID is a hyperlink which redirects the user to the **Asset Details** page.



Assets / 134 of 134 items

Asset	Description	Organization	Asset Voltage [kV]	Asset Age [years]	Maintenance Priority ▼	Replacement Priority	Importance	Condition	Risk
<a href="#">Test.Breaker3</a> Krakow / Circuit Breaker	Test Breaker #3 description	ABB	365	23	33.8		85	66.4	●
<a href="#">AHC.CBK.PRO.004</a> Saint Louis / Circuit Breaker	AHC.CBK.PRO.004 Professional Circuit Breaker Model	ABB	1,003	2	25.7		66	64.9	●

**Note:** You can easily drill down to the assets details page through a hyperlink by clicking on any available asset column available.

The Asset Report displays the following columns:

Report Categories	Description
Asset	A link to the Asset Details page resides in this field.
Description	This describes the type of asset and pertinent information about that particular asset that can be used to identify it.
Organization	This is name of the organization where the asset resides.
Location	This is name of the location where the asset resides.
Voltage	The grid shows the actual voltage.
Asset Age [years]	Numeric age of the asset.
Maintenance Priority	The highest maintenance priority score of open issues/risks against the asset. The score that helps prioritize maintenance activities. The algorithm is based primarily on model-returned data or defaults if no specific data is provided by a model. <a href="#">See Appendix A.</a>
Replacement Priority	Ellipse APM assigns an asset a Replacement Score which is calculated by an algorithm. The calculation is derived from a number of parameters which are weighted to determined the score. <a href="#">See Appendix B.</a>
Importance	A Unit Importance number is assigned to each asset. The value range is from one to 100. A higher number indicates a more important asset.
Condition	This is a value assigned to the likelihood of failure in order to provide a numerical value that will help determine the health of that asset.
Risk	This is the Risk of Failure and is designated by the colors of a "stoplight" to let you know those assets that are either OK (green), might need to be looked at (yellow), or requires attention (red). Risk is a function of both importance and condition.

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# Asset Details Summary

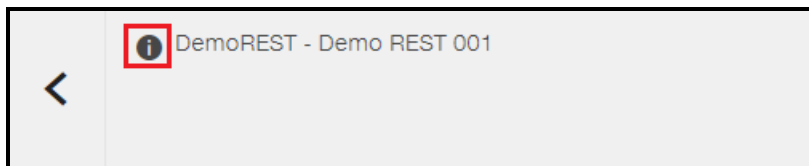
After drilling down to an asset, the **Asset Details** page appears and contains the following tabs:

- [Risk](#)
- [Parameters](#)
- [Messages](#)
- [Analytics](#)

The Asset Details page provides crucial information like asset condition history and emphasizes risk related to the particular asset.

## Name Plate Detail

To view detail about the asset including description, organization, location, asset type, install date, manufacturer and manufacturer details, click the information icon.



Asset details appear.

Nameplate		
DESCRIPTION	ABB.CircuitBreakerProfessional + CBK PRO Family	
ORGANIZATION	ABB	REGION -
ASSET SUBTYPE	-	RATED POWER 60 W
INSTALL DATE	4/24/2007	ASSET VOLTAGE 765 kV
MANUFACTURER	ABB	MANUFACTURED DATE 6/30/1999
LATITUDE	41.523	IS OBSOLETE No
MODEL ID	ABB.CircuitBreakerProfessional	STATUS -
MANUFACTURER MODEL	800PM50-30	EAM EQUIPMENT NUMBER 00000000110
		ASSET TYPE Circuit Breaker
		LOCATION Detroit
		LONGITUDE -86.36
		IMPORTANCE 92
		MANUFACTURER EXPECTED LIFE 7
		SERIAL NUMBER CB-44553216678
		MECHANISM TYPE Gas

## Risk Matrix

The primary goal is to provide a clear and meaningful view of the risk as a function of importance and asset condition. The **Risk Matrix** as a part of the asset details page shows current risk placement of the asset compared to other similar assets of the same type and at the same location.

## Risk Trend

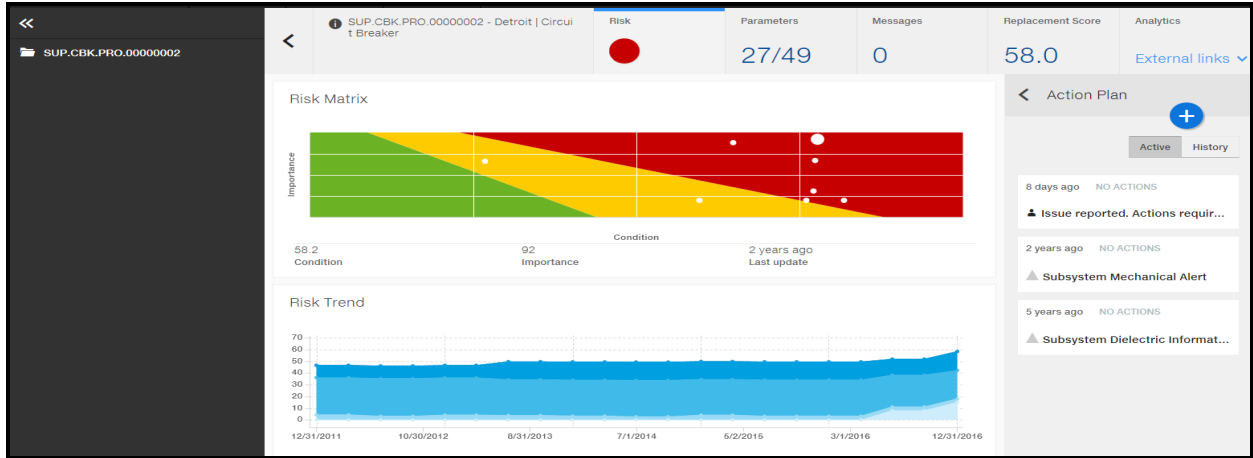
Along with the **Risk Matrix**, the **Risk Trend** are one of two widgets that together show the distribution of asset risks and aggregates. The trend chart shows the covered systems over time including the last data update.

Sub-scores available on the right side may be additive depending on the model implementation. For some asset types like ABB Transformer and ABB Breaker they sum up to the main asset condition score. Additionally, if available by the model, all sub-condition parameters are easily available when hovering over selected sub-score.



## Extended Asset Details Page

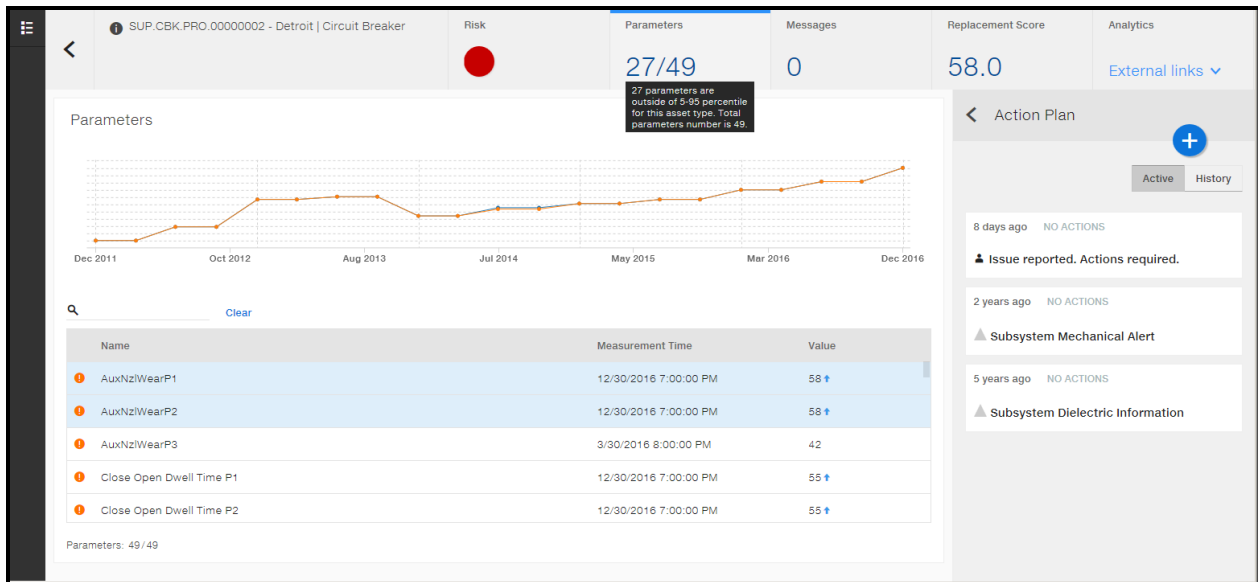
The left side panel is folded in case there is no component associated under the asset. Unfold the left panel to see asset level issues only and list of components. The left side shows all subcomponents, for example, transmission lines, in a tree structure. The user can click on each subcomponent to navigate to more details. The left side panel is not accessible in case Action Plan is in edit mode.



## Parameters

The **Parameters** tab displays asset input parameters for a specific asset. You can see model-fed data, including description, value, units if applicable, that impact overall asset health condition.

The entire list of numeric input parameters is provided to the user. Each row represents one parameter used in calculation of the Asset Condition and all Subscores.



The arrow on the table below the trend chart indicates the trend since the previous measurement. Select the indicator from the list to show a trend chart. Or, select two to see the correlation.

**Note:** The y-axis units are not available if more than one parameter selected.



- Total count of messages is displayed on the tab in 3 colors and icons:
  - Blue - no warning and no alert messages
  - Orange + icon - at least one alert and at least one warning
  - Yellow + icon - no alert and at least one warning

Message log table consists of the following columns:

- **Type** (Supported Message types: Action, Alert, Diagnosis, Error, Informational, Predictive, Solution, Timeframe, Unknown, Verification, Urgency, Warning).

Supported Message Types		
<b>Diagnosis</b>	Alert	Critical situation requiring a timely response.
	Warning	Serious situation not requiring atimely response.
	Informational	Current status of the transformer.
	Error	Unexpected data and situations.
	Predictive	Estimates of how the situation will progress.
<b>Solution</b>	Verification	Recommendations to clarify results.
	Action	Recommendations to fix problems.
<b>Urgency</b>	Timeframe	When recommended actions should be taken.

- **Message**
- **Initially Identified** shows a date of the initial message creation in a continuous string (not the latest model run, and not the first time the message was generated if at least one run in the meantime did not generate the message) .
- **Algorithm**
  - Message log table can be sorted by Type and by Date
- There is information about the number of hours from the Last update shown.
- There is information about the number of All messages shown (including errors).

## Replacement Score

See [Appendix B](#) for more details about Replacement Score Calculations.

<	 SUP.CBK.PRO.00000002 - Detroit   Circuit Breaker	Risk 	Parameters 13/50	Data Quality 1	Replacement Score 58.0
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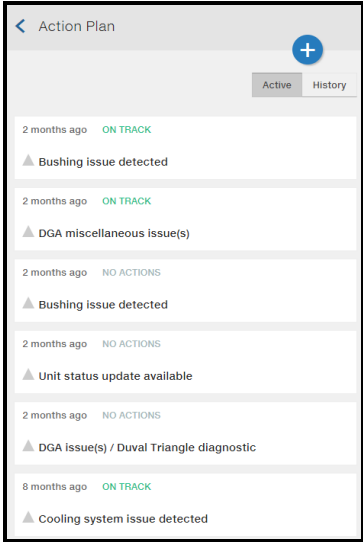
# Analytics

Click on **Analytics** tab to display visualizations. and see any embedded PowerBI reports (cloud only) or other custom links to related information.

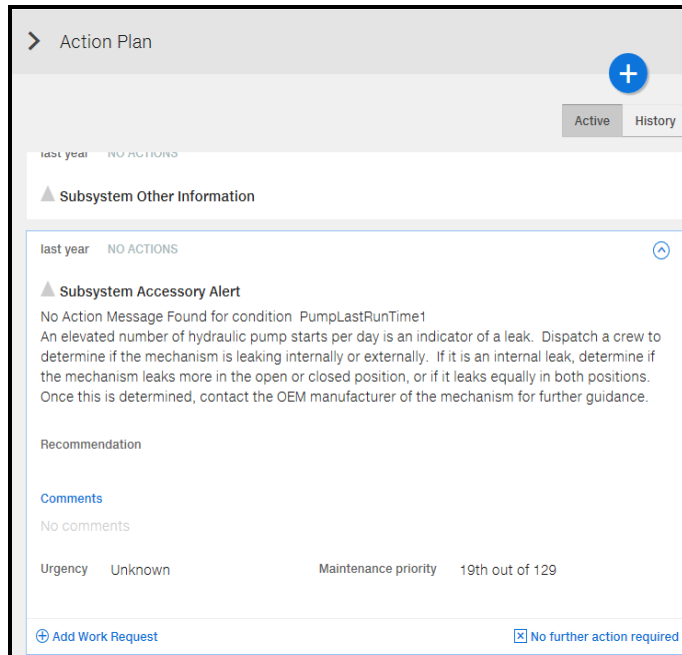
## Action Plan

Under the **Action Plan** header, the Issue Details widget displays data passed from a performance model as messages split automatically into sections: title, condition, and recommendation linked together with the timeline.

### Action Plan Collapsed



### Action Plan Expanded



There is a simple logic that determines how Ellipse APM issues are generated from the model messages.

Create a new issue when the Title level, Text ID, and Condition Text ID are newly generated by the model only and do not match Update the issue. If Title level, Text ID and Condition Text ID in a new message match the Title level, Text ID, and Condition Text ID in existing issue, other fields should be updated.

- Close the automated generated issue when:
  - No longer generated by model and
  - No open action exists on it.
- Do not close the automated Issue when:
  - Issue was generated by the latest model run OR
  - Action on the issue is open.
- Do not create/update/ close issue when the new messages/data are older than latest previously calculated scores
- Automated issues are not editable - "edit " button is removed from auto issue intentionally, so that the user does not change the text of the original message from the model.
- Alternatively, you can report your notes as a comment related to the specific issue as needed, and keep some audit information as a reference.

The number of days reported in issues should reflect the number of days since the initial generation of the issue; not the number of days since the last time it was generated. Additionally, when hovering over the Issue's header the user is informed through the tooltip of the last occurrence day.

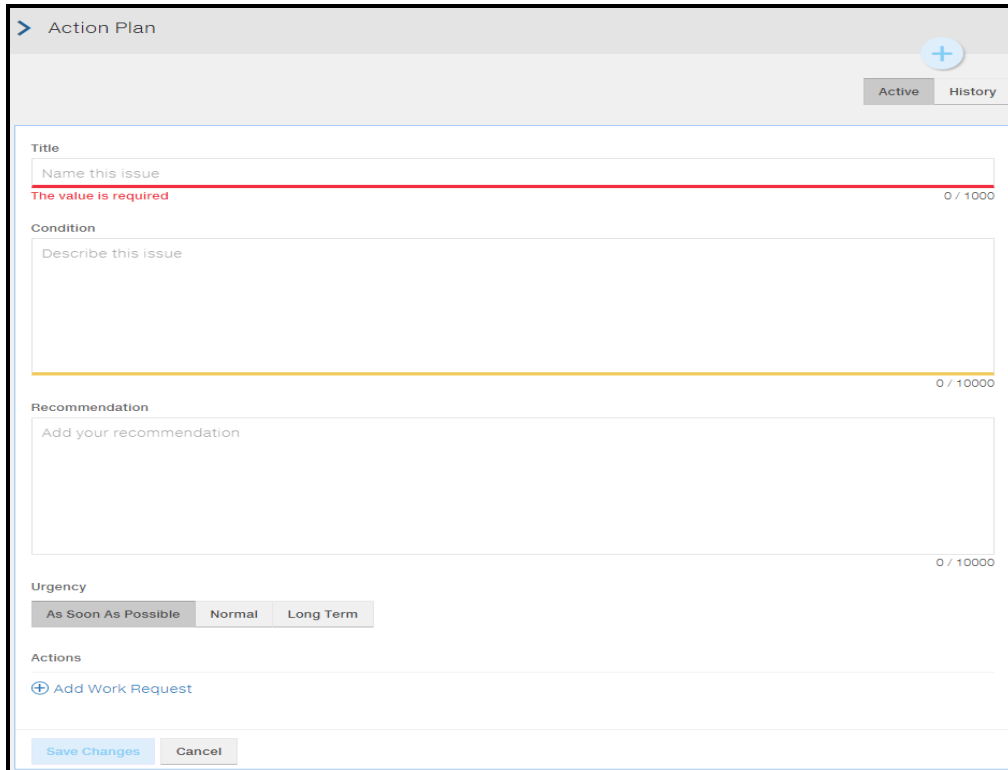
To access all closed Issues that were associated with the specific asset, click on the **History** button, next to **Active**.

**Note:** The time in the issue header, e.g., 3 weeks ago, means that the message for this issue was generated by a performance model 3 weeks ago.



## Creating a New Issue

You can manually create a new issue. Click on the plus icon to display a new issue template.



The screenshot shows a web interface for creating a new issue. At the top, there is a header 'Action Plan' with a plus icon and tabs for 'Active' and 'History'. The form consists of several sections: 'Title' with a text input field containing 'Name this issue' and a red error message 'The value is required' below it; 'Condition' with a larger text area containing 'Describe this issue'; 'Recommendation' with another text area containing 'Add your recommendation'; and 'Urgency' with three radio button options: 'As Soon As Possible', 'Normal', and 'Long Term'. Below these is an 'Actions' section with a plus icon and the text 'Add Work Request'. At the bottom, there are 'Save Changes' and 'Cancel' buttons.

Enter the following:

1. Title.
2. Condition Description.
3. Recommended action description and timeline.
4. Select an urgency level: As soon as possible, Normal or Long Term which affects the Maintenance Priority Score calculation.

**Note:** The urgency status **Unknown** is shown only if performance model does not provide a Urgency flag (default).

In case the model returns message(s) with any status within a group respectively:

- **As Soon As Possible:**
  - Immediate, AsSoonAsPossible, Urgent,
- **Normal:**
  - CanWait
- **Long Term:**

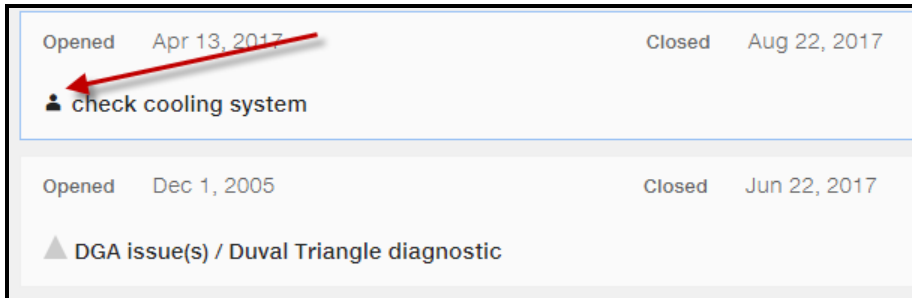
User name and comment addition/modification date are stored for reference and are displayed as a tool tip.

5. Click **New Request** to create a work request through an EAM work request.

**Note:** Integration is required.

This page opens and displays currently open work orders for the asset. So, you can check if the work order has already been created. The user can select one of these existing work orders and associate it with the issue, or create a new request by clicking the **Add** button. Also note that scheduled date which is a blue number under the scheduled date and status are from EAM and that the link takes you to the work order in the EAM system.

To indicate manually created issues, and differentiate them from automated issues, the human icon is displayed on the issue header.



The upside-down triangle preceding Issue title indicates message Impact driven by the model. Tooltip information explains exact Impact which can be

- VeryHigh or High (orange triangle)
- Medium (yellow)
- Low or Very Low (blue triangle)
- Unknown (grey triangle).



6. Click **Add**.
7. Click **Save Changes**.

## Ellipse APM and EAM Work Request Status Mapping

EAM: Undefined -> Ellipse APM: Requested

EAM: Open -> Ellipse APM: Requested

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EAM: Closed -> Ellipse APM: RequestClosed  
EAM: Estimated -> Ellipse APM: RequestInProgress  
EAM: Cancelled -> Ellipse APM: RequestCancelled  
EAM: Uncompleted -> Ellipse APM: RequestInProgress  
EAM: InWork -> Ellipse APM: RequestInProgress

## Ellipse APM and EAM Work Order Status Mapping

EAM: Authorized -> Ellipse APM: WorkOrderCreated  
EAM: Open -> Ellipse APM: WorkOrderInProgress  
EAM: Closed -> Ellipse APM: WorkOrderFinished  
Scheduled date [Ellipse APM] is Required By Date [EAM]

## More About Issues

Issues created manually are defaulted as medium impact and indicated by human icon instead of triangle. Such issues are also defaulted to No actions status if there is no action attached.

Issue status depends on several factors:

1. **New**, if creation date does not indicate the issue is older than 7 days.
2. **No actions**, if creation date is older than 7 days and no active actions are associated with the issue or actions are canceled.
3. In case all actions are completed (work order is finished or work request closed) then issue status is **Completed**.
  - If actions are not completed and action's Due date is exceeded then **Overdue**.
  - If actions are not completed and Due date is set within upcoming 24 hours then **At risk**.
  - Otherwise **On track**.

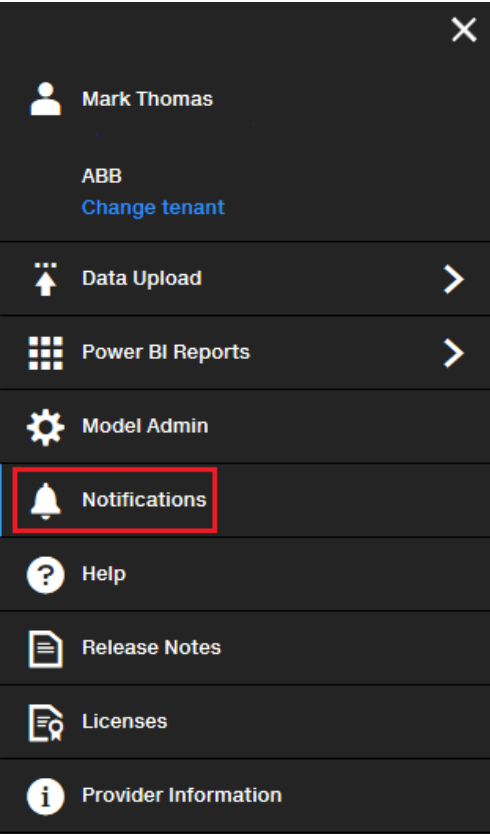
Status is set depending on the action date of the work request or order. So, the action state (or no action) impacts the issue's state.

All attributes of the issue can be edited until the issue is closed. You can close an issue by clicking **No further action required** and assuming all work orders are closed the issue will close.

The number of days reported in automatically generated issues reflects the number of days since the initial generation of the issue and not the number of days since the last time it was generated.

## Notifications

You can use a simple email preference configuration page to set preferences including organization and asset type. **Notifications** is accessible from the Selection Pane.



You can select specific notification events for example:

- When an asset degrades to red.
- When an asset degrades to yellow.
- When an asset improves to green.
- When an asset improves to yellow.

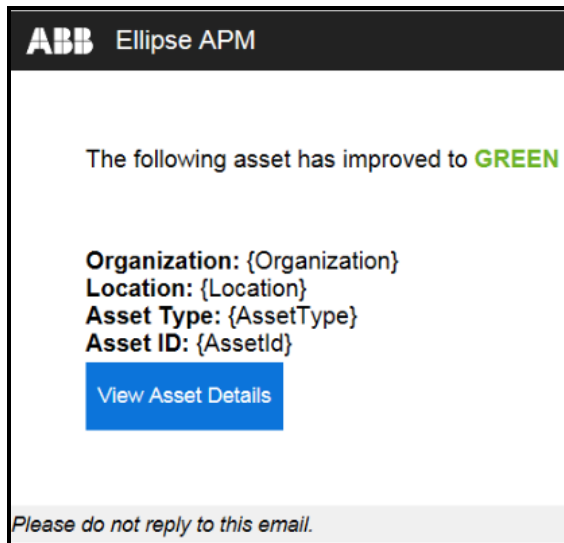
**Note:** You will only get notified once of a change.

Simple email templates exist to facilitate email notifications distribution based on the preferences defined on the configuration page.

**Note:** Organization filter works as OR condition, while combining organization and asset type works as AND condition.

E-mail template includes:

- Header with: Location- Asset ID - change (e.g. 'Boston - ABD-123 has turned RED')
- Body with Organization, Location, Asset ID and name
- Asset color

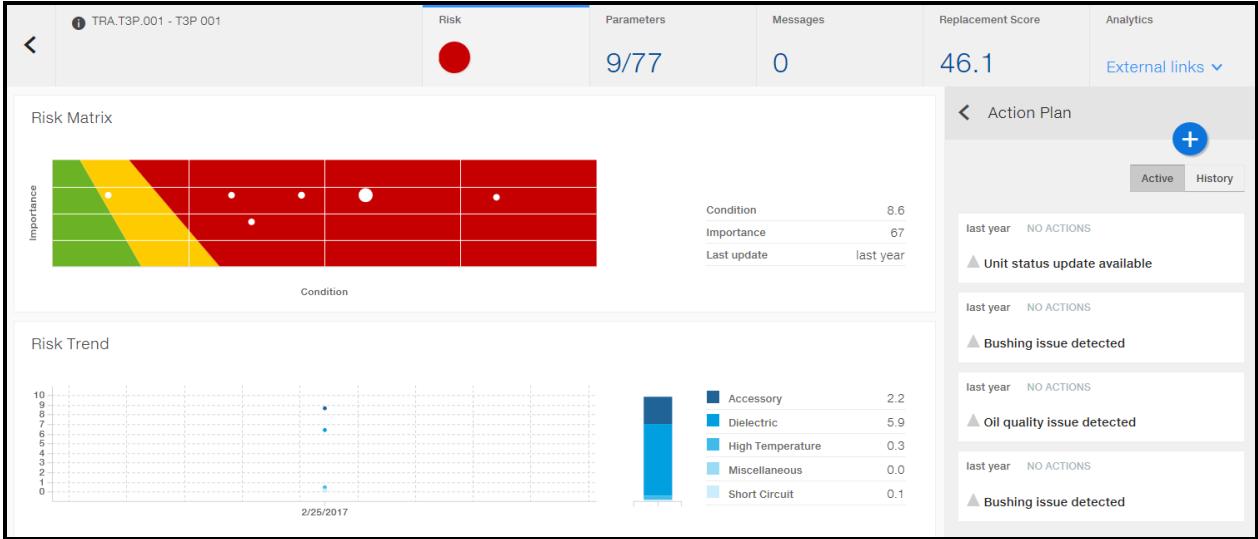


# Asset Details | Transformers | General

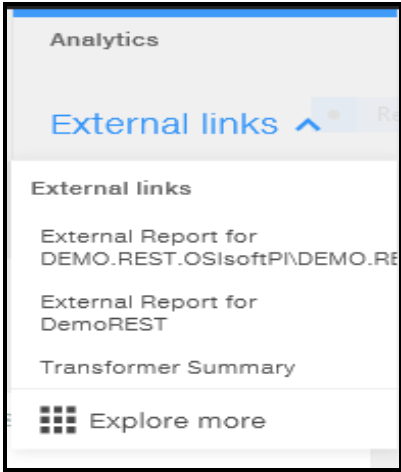
The **Asset Details** report for **Transformers** displays the selected asset's basic nameplate information, such as Asset ID, Install date, and Manufacturer. The **Asset Details** report displays a high-level view of the selected asset including details on:

- Risk Matrix
- Risk Trend
- Action Plan

In addition, a combination of "Operational" and "Trending" data using a series of navigational tabs (for example, Standard Oil Test) is available through **Analytics** menu.



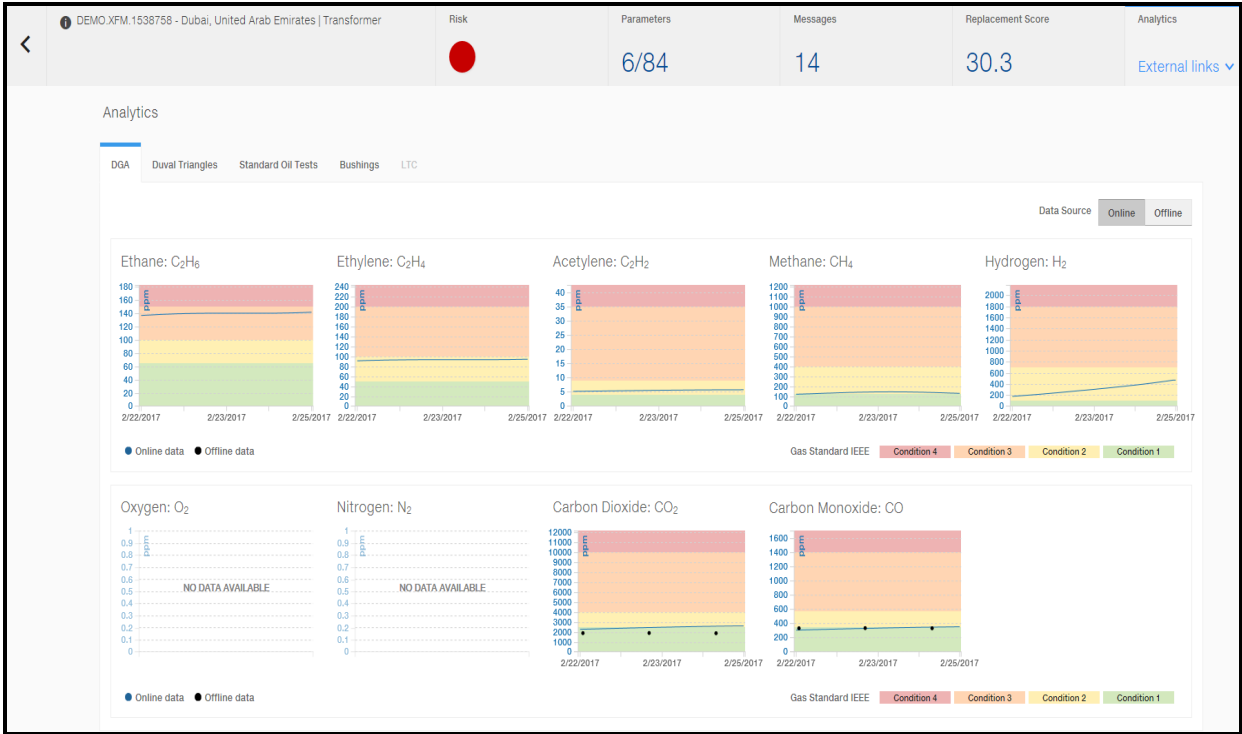
Click on **Analytics** to view tabs containing asset details.



# Asset Details | Transformers | DGA

This tab displays Transformer oil dissolved gas analysis. This is a useful, predictive, and effective way for evaluating transformer health. The breakdown of electrical insulating material and related components inside a transformer generates gases within the transformer. Therefore, the identity of these gases being generated is very important to maintenance of transformer.

## Online

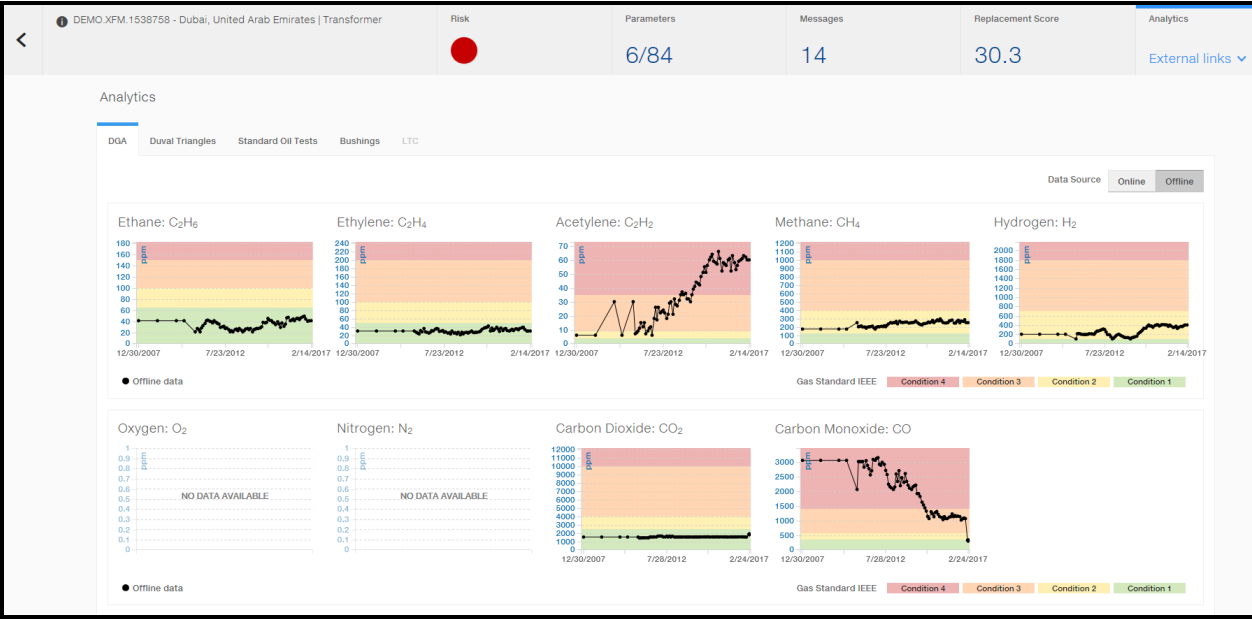


- Last 60 data points on X-axis
- Shows online and additionally offline data (as dots).

**Note:** Time range for offline data is limited to online range if displayed on same chart and same time

**Offline**

**Note:** Offline data is the default view rather than Online for transformer DGA visualizations.



- A whole data history that as has been changing over time
- Shows only offline data (dots connected with a line).

Depending on Gas Standards supported and transformer model configuration, visualizations indicate IEEE (default), IEC and Cigre ranges for gases.

Status	Hydrogen (H <sub>2</sub> )	Methane (CH <sub>4</sub> )	Acetylene (C <sub>2</sub> H <sub>2</sub> )	Ethylene (C <sub>2</sub> H <sub>4</sub> )	Ethane (C <sub>2</sub> H <sub>6</sub> )	Carbon Monoxide (CO)	Carbon Dioxide (CO <sub>2</sub> ) <sup>1</sup>	TDCG
Condition 1	100	120	4	50	65	350	2,500	720
Condition 2	101 - 700	121 - 400	1	51 - 100	66 - 100	351 - 570	2,501 - 4,000	721 - 1,920
Condition 3	701 - 1,800	401 - 1,000	2 - 9	101 - 200	101 - 150	571 - 1,400	4,001 - 10,000	1,921 - 4,630
Condition 4	>1,800	>1,000	>35	>200	>150	>1,400	>10,000	>4,630

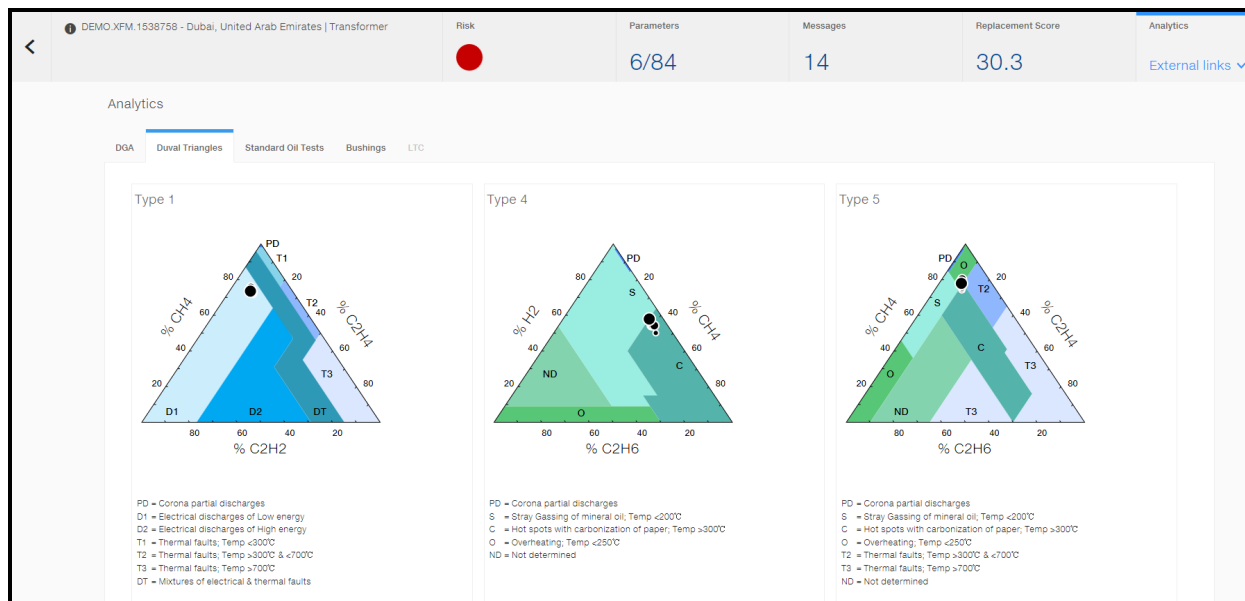
<sup>1</sup> CO<sub>2</sub> is not included in adding the numbers for TDCG because it is not a combustible gas.



# Asset Details | Transformers | Duval Triangles

The **Asset Details** screen for **Transformers** displays within the **Duval Triangles** tab "Operational" and "Trending" data. The **Duval Triangles** tab provides a high-level view of the selected asset including details on:

- Type 1
- Type 4
- Type 5



Duval triangles are a diagnostic method for oil-insulated high-voltage transformers. The tabs provide different Duval triangles that evaluate different gasses, gas levels in PPM, and shows possible causes of abnormal gas levels, trends, or both in oil insulated devices in order to evaluate the condition of a transformer.

Each of the gasses that can be produced by a transformer is associated to any one of many different colors.

For example, concentrations (ppm) of methane (CH<sub>4</sub>), ethylene (C<sub>2</sub>H<sub>4</sub>), and acetylene (C<sub>2</sub>H<sub>2</sub>) are expressed as percentages of the total (CH<sub>4</sub> + C<sub>2</sub>H<sub>4</sub> + C<sub>2</sub>H<sub>2</sub>) and plotted as a point (%CH<sub>4</sub>, %C<sub>2</sub>H<sub>4</sub>, %C<sub>2</sub>H<sub>2</sub>) in a triangular coordinate system on a triangular chart that has been subdivided into fault zones. The fault zone in which the point is located designates the likely fault type which produced that combination of gas concentrations.

The Duval Triangle method, like any other Dissolved Gas Analysis (DGA) diagnostic method, should be applied only when there is some suspicion of a fault, based on an increase in combustible gas or some other suspicious symptom. The diagnostic method itself is not a means of fault detection.

Because of the relative inaccuracy of gas-in-oil concentration measurements at low concentrations, DGA diagnostic methods, including the Duval Triangle, should not be applied unless the gas concentrations are well above the detection limit.

If reasonably stable concentrations of the gases were present before the onset of the suspected fault, it is advisable to subtract out the background concentrations, provided that the differences are large enough for interpretation. The diagnosis should be based on recently-formed gas if possible, and including pre-fault gas in the diagnostic calculations can lead to misleading results.

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## Fault Codes

The fault codes used in all Duval triangles are as follows:

### Type 1

- PD – Corona Partial discharge
- T1 – Thermal Faults;temperature > 700 Degrees Celsius
- T2 – Thermal Faults;temperature > 300 and < 700 degrees Celsius
- T3 – Thermal Faults;temperature > 700 Degrees Celsius
- D1 –Low-energy electrical discharge
- D2 –High-energy electrical discharge
- DT –Mixture of electrical and thermal faults.

### Type 4

- PD – Corona Partial discharge
- S – Stray gassing of mineral oil; temperature < 200 degrees Celsius
- C – Hot spots with carbonized of paper; temperature > 300 degrees Celsius
- O – Overheating; temperature < 250 degrees Celsius
- ND – Not Determined

### Type 5

- PD – Corona Partial discharge
- S – Stray gassing of mineral oil; temperature < 200 degrees Celsius
- C – Hot spots with carbonized of paper; temperature > 300 degrees Celsius
- O – Overheating; temperature < 250 degrees Celsius
- T2 – Thermal Faults;temperature > 300 and < 700 degrees Celsius
- T3 – Thermal Faults;temperature > 700 Degrees Celsius
- ND – Not Determined

## Using the Duval Triangle Method

In the example above, the transformer was found to show increases in PPM for CH<sub>4</sub> and C<sub>2</sub>H<sub>4</sub>. These levels are significant enough to suspect a fault and to apply the Duval Triangle method.

Plotting a point on the triangle up the CH<sub>4</sub> axis, down the C<sub>2</sub>H<sub>4</sub> axis, and across the C<sub>2</sub>H<sub>2</sub> axis, places points that represents the gas data and falls in the T3 fault zone, indicating a high-temperature thermal fault (T3), which

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is typically a "hot metal" fault. There are also points in the DT fault zone. This identifies the asset requires attention and allows you to resolve the issue before the transformer becomes defective and causes your customers to experience an outage.

## Duval Triangle Type 1

The Duval Triangle Type 1 displays a triangle that performs the same as all Duval Triangles, except it evaluates the following gasses:

- Acetylene (C<sub>2</sub>H<sub>2</sub>)
- Ethylene (C<sub>2</sub>H<sub>4</sub>)
- Methane (CH<sub>4</sub>)

The Duval Triangle 1 uses gases (CH<sub>4</sub>, C<sub>2</sub>H<sub>4</sub>, and C<sub>2</sub>H<sub>2</sub>) that are formed by faults of low to high energy (from low-temperature faults T1 and PD to high energy arcing faults D2).

## Duval Triangle Type 4

The Duval Triangle Type 4 displays a triangle that performs the same as all Duval Triangles, except it evaluates the following gasses:

- Hydrogen (H<sub>2</sub>)
- Ethane (C<sub>2</sub>H<sub>6</sub>)
- Methane (CH<sub>4</sub>)

The Duval Triangle 4 evaluates H<sub>2</sub>, CH<sub>4</sub>, and C<sub>2</sub>H<sub>6</sub> gases that are formed more specifically by faults of low energy or temperature (PD, T1, and T2). You should only use the Duval Triangle 4 for faults identified first with Triangle 1 if those faults were identified as PD, T1, or T2. You should never use it in cases where faults were identified as electrical faults D1 or D2. Duval Triangle 4 is used mostly to distinguish between:

- Stray gassing of oil at T < 200°C in zone S,
- Overheating at T < 250°C in zone O with "cooking" but no carbonization of paper,
- Potential of carbonization of paper at T > 300°C in zone C (in 80% of inspected cases used for Triangle 4 - not 100%),
- Corona partial discharges in zone PD. The boundary between zones PD and S has been changed recently from % C<sub>2</sub>H<sub>6</sub> = 1 to 0.6, based on stray gassing test results on new types of oil on the market.
- Situations in which the DGA point in service in the PD zone with a % C<sub>2</sub>H<sub>6</sub> slightly < 0.6 (for example, 0.5 or 0.3%), verify the stray gas formation of the oil used with laboratory stray gassing tests before confirming a fault PD or S.

## Duval Triangle Type 5

The Duval Triangle Type 5 displays a triangle that performs the same as all Duval Triangles, except it evaluates the following gasses:

- Ethylene (C<sub>2</sub>H<sub>4</sub>)
- Ethane (C<sub>2</sub>H<sub>6</sub>)

- 
- Methane (CH<sub>4</sub>)

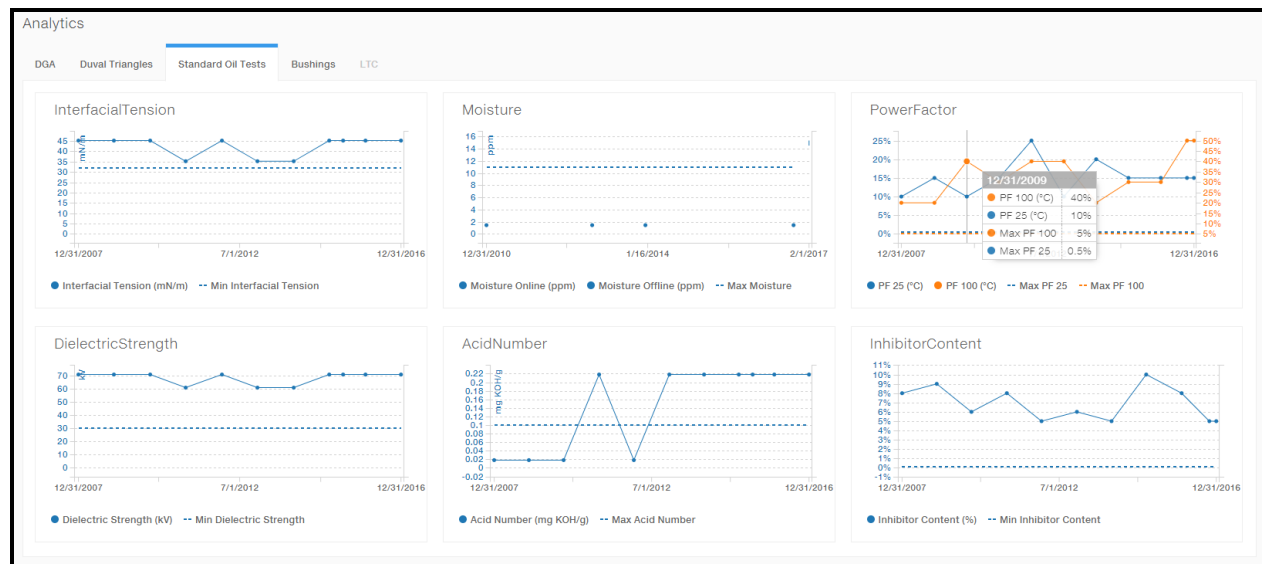
The Duval Triangle 5 uses gases (CH<sub>4</sub>, C<sub>2</sub>H<sub>4</sub>, and C<sub>2</sub>H<sub>6</sub>) that are formed more specifically by faults of high temperature. You should only use the Duval Triangle 5 for faults identified first with Triangle 1 if those faults were identified as T2 or T3. You should never use it in cases where faults were identified as electrical faults D1 or D2. Duval Triangle 5 is used mostly to distinguish between:

- Hot spots in oil only in zones T3 (> 700°C) and T2 (> 300°C),
- Potential of carbonization of paper in zone C (in 90% of inspected cases used for Triangle 5 - not 100%).

# Asset Details | Transformers | Standard Oil Test

The Standard Oil Test tab displays the results from tests performed on oil insulated transformers including

- Interfacial Tension
- Moisture
- Power Factor
- Dielectric Strength
- Acid Number
- Inhibitor Content



## Interfacial Tension

The Interfacial Tension of oil is the force in Dynes per centimeter required to rupture the oil film existing at an oil-water interface. When certain contaminants, such as soaps, paints, varnishes, and oxidation products are present in the oil, the film strength of the oil is weakened, thus requiring less force to rupture. For in-service oils, a decreasing value indicates the accumulation of contaminants, oxidation products, or both.

The **Interfacial Tension** chart displays the interfacial tension in Dynes (mN/m) that was recorded over a timeline. This helps you determine the quality of the oil. A lower number can cause more heat build-up and degrade the life expectancy of the transformer.

## Power Factor

The power factor is an indication of the amount of energy that is lost due to the heat retained within the oil. When pure oil acts as a dielectric very little energy is lost to the capacitance charging. Contaminants will increase the energy absorbed by the oil and wasted as heat. The power factor is a function of the phase angle (the angular displacement) between an AC potential applied to the oil and the resulting current.

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The **Power Factor** chart displays the power as a three digit decimal that was recorded over a timeline. This helps you determine if contaminants are present in the oil. A higher number means more energy is being retained and results in an increases amount of heat, thus reducing the life expectancy of the transformer.

Degrees Celsius is not the unit of measure for the Power Factor, but 100 degrees and 25 degrees are basically the temperatures at which the power factor is measured. So, really the “power factor when the oil is 100°C”.

## Moisture

Moisture content is very important in determining the serviceability of transformer oil. The presence of moisture (as little as 25 parts per million) will usually result in a lower dielectric strength value. Water content is especially important in transformers with fluctuating loads. As the temperature increases and decreases with the changing load, the transformer’s oil can hold varying amounts of water in solution.

Large amounts of water can be held in solution at higher temperatures. In this state (dissolved) the water has a dramatic effect on the oil’s performance so water contamination should be avoided.

The physical presence of water settled at the bottom of a transformer tank is not an indication of high water content and it is usually harmless in this state. The dissolved water content is the dangerous factor. It is usually measured by physical or chemical means. Testing for the presence of dissolved water can be performed with the use of a Karl Fischer titrating apparatus or by performing one of many tests, such as the Flashpoint, Viscosity, and Specific Gravity. They are of limited value for interpretation of the oil’s quality, but can be used for further investigation if unsatisfactory results are obtained for the tests listed above.

The **Moisture** chart displays the amount of dissolved water in PPM that was recorded over a timeline. This helps you determine if moisture has contaminated the oil. A higher number means more moisture is present and results in reducing the efficiency of the oil, which will increase the amount of heat, thus reducing the life expectancy of the transformer.

## Dielectric Strength

The dielectric breakdown is an indication of the oil’s ability to withstand electrical stress. The most popular test takes an oil sample, places it in a test cup with two electrodes placed at a specific distance apart, and then an AC voltage is applied and raised at a constant rate until an arc jumps through the oil between the two electrodes. The voltage at which the arc occurs is considered the dielectric strength of the oil.

The **Dielectric Strength** chart displays the amount of kilovolts (kV) applied to the oil to produce an arc and then recorded over a timeline. This helps you determine the condition of the oil. A lower number means the oil has less Dielectric Strength, which means it is breaking down due to moisture, contaminants, and so on, thus reducing the efficiency of the oil, increasing the amount of heat, and reducing the life expectancy of the transformer.

## Acid Number

Total Acid Number (**TAN**) is the measure of the oil’s acidity and is measured by titrating the oil with a base material (KOH) and determining the amount of the base required to neutralize the acids in the oil. The results are reported as mgKOH/g of the oil being tested. An equation was derived to model the peak absorbance and weight percent of inhibitor content (%IC) of the oil and it was verified with additional oil sample with a known weight percent of Inhibitor content.

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## **Inhibitor Content**

Monitoring and inspection of inhibitor content in transformer insulating oil has been a routine test for power utilities. Although new uninhibited transformer insulating oil contains naturally occurring inhibitors, these inhibitors could deplete over time during operation. Once the inhibitor depleted completely, the oil would start to deteriorate at a faster rate and eventually could lead to faults in transformer. The common method of determining the weight percentage of inhibitor in transformer oil. An equation was derived to model the peak absorbance and weight percent of inhibitor content (%IC) of the oil and it was verified with additional oil sample with a known weight percent of Inhibitor content.

## **Using the Standard Oil Test**

In the example below, the transformer was found to show a decrease from 39.2 to 35.2 mN/m in Interfacial Tension demonstrating the film strength of the oil has been weakened. The Power Factor rose to .022 from .015 showing more energy is being retained in the oil resulting in an increased amount of heat. The Moisture increased from 3.0 PPM to 10.0 PPM showing more moisture is present in the oil, which reduces its efficiency. The Dielectric Strength dropped from 56kV to 29 kV showing the oil has less strength due to moisture and contaminants.

Based on these factors and many other factors displayed in other reports and screens not shown in this guide, this transformer should be considered to be a candidate for a High Health Score.

# Asset Details | Transformers | Bushing

The Asset Details screen for Transformers displays within the Bushing tab "Operational" and "Trending" data. The Bushing tab provides a high-level view of the selected asset. The visualization is available on the **Analytics** tab

For bushing health monitoring there are two main categories that methods fall into – offline and online.

Offline methods, as the name implies, require that the transformer be out of service prior to testing. These methods typically require the use of an external test set that accurately measures leakage current, applied voltage, frequency, and the phase angle between the applied voltage and the leakage current. From this data, the real power loss and power factor can be calculated.

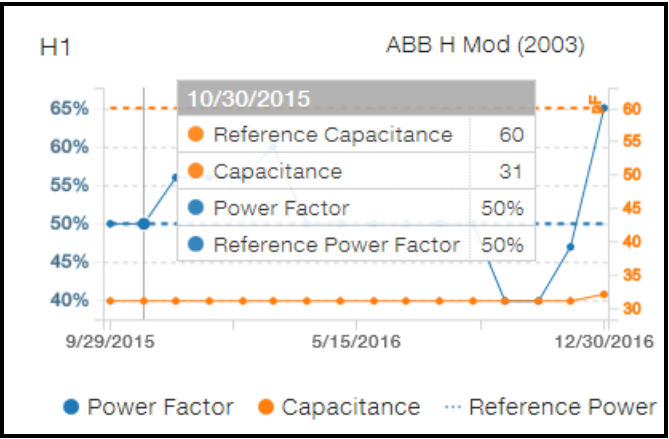


Offline bushing visualizations: Power Factor & Capacitance, are combined on one chart to indicate correlation if any. Charts can have ranges as well.

The range is available as one of the parameters (reference line) separately for each Power Factor and each Capacitance

Hover over a data point to view details. A single Bushings chart may show four values: Power Factor, Capacitance, Reference Power Factor and Reference Capacitance. Each row legend gives a possibility to operate on each row separately (turning on and off the Power Factor/Capacitance). In case Reference Capacitance and Reference Power Factor are equal, they are indicated at the same level alternately.





Each chart holds additional and useful information about the:

- Manufacturer
- Model
- Installation date (year)

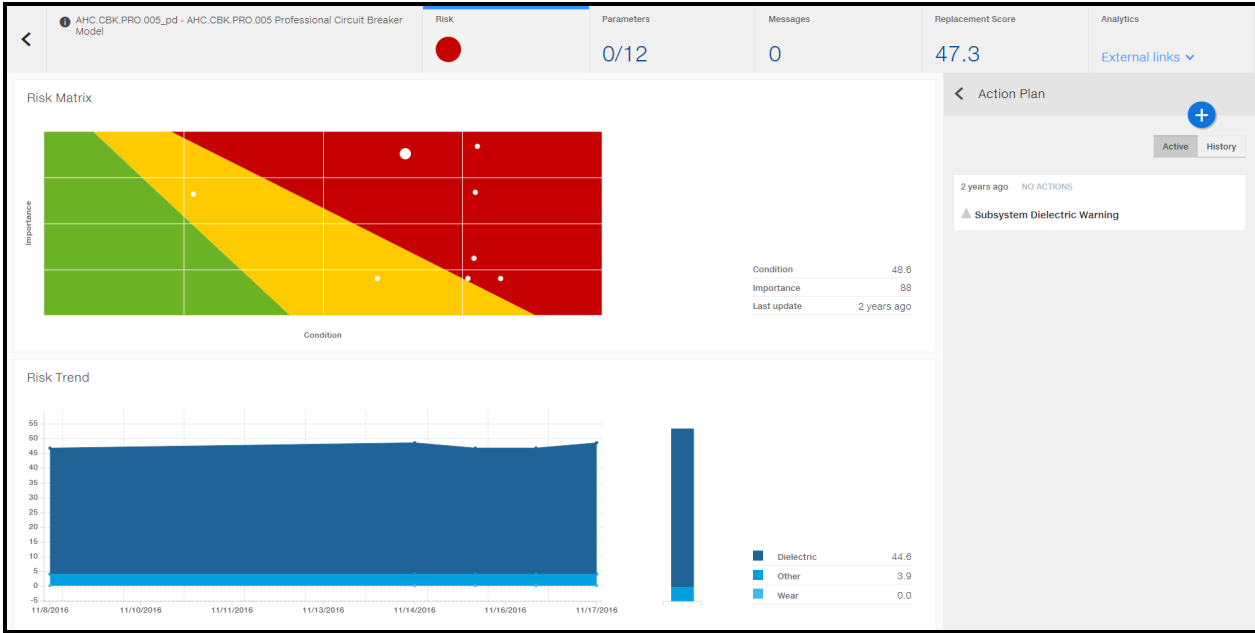
The left y-axis refers to PowerFactor (%) and is the same color as the PowerFactor trend line. The right y-axis refers to Capacitance (pF) and is the same color as the Capacitance trend line.

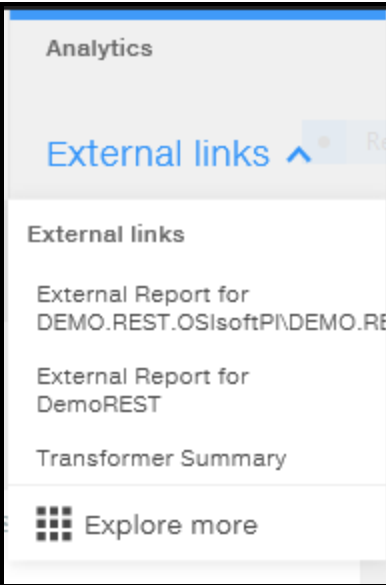
# Assets Details | Circuit Breaker | General

The **Asset Details** report for **Circuit Breaker** displays the selected asset's basic nameplate information, such as Asset ID, Install date, and Manufacturer. The **Circuit Breaker** report provides a high-level view of the selected asset including details on **Dielectric**, **Mechanical**, **Wear** and **Accessory**. This subsystem contains the parameters relating to the insulation to ground quality for that circuit breaker. The **Asset Details** report displays a high-level views including details on:

- Risk Matrix
- Risk Trend
- Action Plan

In addition, a combination of "Operational" and "Trending" data using a series of navigational tabs (for example, Accessory) is available through **Analytics** menu.





## ABB Circuit Breaker Model - Issues and Error Messages

Issues and Error Messages output from the ABB Circuit Breaker model.

- Additional error messages: In addition to error messages for full model run failures, APM displays error messages related to input data quality.
- Issues are split: Instead of merging recommendations into a single issue per sub-system, each recommendation is represented as a separate issue in the action plan. This change facilitates translation of issues into different languages (besides supported language i.e., English, Chinese, Spanish, and Portuguese). Moreover, this change allows for more descriptive issue titles and less cluttering in the issue details.

# Issues Dashboard

The Issues page is a list of all open Issues identified on the fleet's assets. This list includes the actions associated with existing issues and Maintenance Priority Score calculated for each individually according to internal application logic.

Search

Organization

All Organizations
▼

Location

All Locations
▼

Equipment Type

All Types
▼

Importance

All Importance
▼

Condition

All Conditions
▼

Status

All Statuses
▼

Issues / 119 items

Asset	Condition Risk		Issue	Maintenance Priority	Status	Actions
MPS.UITESTS.2017 <small>Location / AssetType</small>	100.0	<span style="color: red; font-size: 1.2em;">●</span>	MPS Issue for UI Tests with 100 MPS	60.0	No actions	0
SUP.CBK.PRO.00000002 <small>Detroit / Circuit Breaker</small>	58.2	<span style="color: red; font-size: 1.2em;">●</span>	Subsystem Mechanical Alert	32.2	No actions	0
SUP.CBK.PRO.00000002 <small>Detroit / Circuit Breaker</small>	58.2	<span style="color: red; font-size: 1.2em;">●</span>	Subsystem Dielectric Information	32.2	No actions	0
IED.234234 <small>SOUTHEAST CANTON / IED</small>	40.0	<span style="color: red; font-size: 1.2em;">●</span>	Current firmware version is updated. Current firmware version is 1.1.1.	26.8	No actions	0
IED.234234 <small>SOUTHEAST CANTON / IED</small>	40.0	<span style="color: red; font-size: 1.2em;">●</span>	Optional recommendations from configuration settings: there are no optional configuration parameters.	26.8	No actions	0
AHC.CBK.PRO.005_pd <small>Saint Louis / Circuit Breaker</small>	48.6	<span style="color: red; font-size: 1.2em;">●</span>	Subsystem Dielectric Warning	25.6	No actions	0
DEMO.CBK.PRO.00000001 <small>Detroit / Circuit Breaker</small>	58.0	<span style="color: red; font-size: 1.2em;">●</span>	Subsystem Mechanical Alert	23.3	No actions	0

Click on **Maintenance Priority** to see maintenance priority details. This pop-out shows the Maintenance Priority and Maintenance Score calculations and results for each.

$$MS = \frac{NC \cdot Im \cdot I}{C \cdot U}$$

$$MP = 100 \cdot \frac{MS}{\max(MS)}$$

NC - Normalized Condition:		64.9
Im - Importance:		66.0
I - Impact:	Unknown	6.0
C - Cost:	Unknown	1.0
U - Urgency:	Unknown	1.0
<hr/>		
MS - Maintenance Score:		25,718.6
MP - Maintenance Priority:		25.7

Click on the **Action** count to see action details. This pop-out will show the list of actions, and for each action: action number, status, schedule date. The action number is hyperlinked to open the action in the source tool (typically the Enterprise Asset Management system).

---

AHC.CBK.PRO.004 >

Equipment Type: Circuit Breaker

Location: Saint Louis

### Actions (1)

Status: Requested

Schedule date: -

Low SF6 purity is usually the result of filling the breaker with impure gas. In certain other cases, it is possible that the breaker has interrupted significant faults, and the gas has been broken down. Reclaim the gas, and send out for purification. Change the interrupter tank molecular sieve (desiccant) and take a look at the breaker contacts and nozzles. Refill the breaker with SF6 that is at least 98% pure. Low SF6 pressure is most likely due to a leak. Dispatch a crew to determine the source of the leak. Check all plumbing and gasket seals. Contact the OEM manufacturer for repair recommendations. Available fault current in excess of the breaker's nameplate rating can only be addressed by up-rating the interrupting rating (contact OEM manufacturer for plausibility) or replacement of the breaker.

## Issues Sorting Order

Issues are sorted and displayed in following order:

- Issues with **New** statuses are displayed at the top of the list.
- Maintenance Priority is displayed in descending order.
- When there are two or more issues with the same Maintenance Priority, Health score takes precedence, and the sort is descending.
- Sort rules on Issues widget is exactly the same as on Issues page (watchlist).

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# Glossary

This glossary contains terminology for Ellipse APM.

## A

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### **Asset Condition**

This is a value assigned to the likelihood of Failure in order to provide you with a numerical value that will help you determine the health of that asset.

### **Asset Risk**

Shows the intersection of asset count in percentages and date with a color coded graph displaying counts for locations covered, asset types, assets monitored, assets not monitored and last data updated.

### **Azure**

Microsoft Azure is a collection of integrated cloud services that developers and IT professionals use to build, deploy, and manage applications through our global network of datacenters.

## C

---

### **CCVTs**

Capacitance Coupled Voltage Transformers

## I

---

### **Issues**

Displays a count of identified asset risk issues by resolution status.

---

## M

---

### **Maintenance Priority**

A score that helps prioritizing maintenance activities. The algorithm is based primarily on model-returned data or defaults if no specific data is provided by a model.

### **Most Important Issues**

List displays up to six assets with most significant absolute changes in the health score over the past week.

## O

---

### **Open Issues**

A card displays the number of Open Issues along with a watch list of the most important issues.

## P

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### **Parameters Tab**

Displays asset input parameters for a specific asset. You can see model-fed data, including description, value, units if applicable, that impact overall asset health.

## R

---

### **Replacement Priority**

Ellipse APM assigns an asset a Replacement Score which is calculated by an algorithm. The calculation is derived from a number of parameters which are weighted to determined the score. The parameters are different for each asset type.



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**Risk**

This is the Risk of Failure and is designated by the colors of a "stoplight" to let you know those assets that are either OK (green), might need to be looked at (yellow), or requires attention (red).

**S**

---

**Scatter Plot**

A report displaying Assets by Condition and Importance

**Spatial View**

Shows the geographical distribution of fleet assets (locations) including details related to asset health.

# Appendix A: Maintenance Priority Score Calculations

Maintenance Priority Calculations:

- Normalized Condition:  $(100 * \text{Condition} / \text{NormalizationScoreFactor})$ 
  - NormalizationScoreFactor - value store in model configuration (can be changed by admin user through API for morel configuration, JSON).
- Limited ranges for i(impact), c(cost), u(urgency) as a [1..10]
  - [1..10] range; this value can be changed by admin user through API for model configuration, JSON.
- Calculation process is simplified to the equation:  $\text{MPS} = (\text{MS}(i) * 100) / 100000$  [assuming that maximum possible MS(i) would be 100000 as  $\max(\text{MS}(i))$  for entire calculation.
- Importance (not normalized because it is always between 1..100 for each asset).

Search

Organization  
All Organizations

Location  
All Locations

Asset Type  
All Types

Importance  
All Importance

Issues / 117 items No actions Clear Filters

Asset	Condition Risk	Issue
Test.Breaker3 - Test Breaker #3 <small>Krakow / Circuit Breaker</small>	66.4 <span style="color: red; font-weight: bold;">●</span>	Subsystem Wear Warning
SUP.CBK.PRO.00000002 - Detroit   Circuit Bre... <small>Detroit / Circuit Breaker</small>	58.2 <span style="color: red; font-weight: bold;">●</span>	Subsystem Dielectric Information
SUP.CBK.PRO.00000002 - Detroit   Circuit Bre... <small>Detroit / Circuit Breaker</small>	58.2 <span style="color: red; font-weight: bold;">●</span>	Subsystem Mechanical Alert

$$\text{MS} = \frac{\text{NC} \cdot \text{Im} \cdot \text{I}}{\text{C} \cdot \text{U}}$$

$$\text{MP} = 100 \cdot \frac{\text{MS}}{\max(\text{MS})}$$

NC - Normalized Condition:  
Im - Importance:  
I - Impact: Unknown  
C - Cost: Unknown  
U - Urgency: Unknown

MS - Maintenance Score:  
MP - Maintenance Priority:

**Note:** We cannot use a maintenance priority that works across asset types unless we have a correction factor. The reason for that is an asset type that is generally less important in a network would see the same 'normalized importance' values as an asset type that is generally more important. This would skew the maintenance priority results in favor of the less important assets.

## Maintenance Priority Score Ranking

The following is a list of Maintenance Priority Score (MPS) Ranking:

- the higher MPS the higher ranking
- issues with same MPS have the same ranking
- issues with no MPS have the lowest ranking
- ranking sample:
  - an issue with MPS=3 rank 1
  - an issue with MPS=2 rank 2
  - an issue with MPS=1 rank 3

- 
- an issue with MPS=1 rank 3
  - an issue with MPS=1 rank 3
  - an issue with MPS=0 rank 6
  - an issue with MPS=null rank 7
- DENSE\_RANK computes the rank of a row in an ordered group of rows and returns the rank as a number. The ranks are consecutive integers beginning with 1. The largest rank value is the number of unique values returned by the query. Rank values are not skipped in the event of ties. Rows with equal values for the ranking criteria receive the same rank. This function is useful for top-N and bottom-N reporting.

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## Appendix B: Generic Replacement Score Calculations

- All Kinectrics models and ABB Circuit Breaker models return normalized scores and those scores are used for the replacement score algorithm.
- On the other hand, ABB Transformer scores are not normalized. So the replacement score uses non-normalized condition score, as originally returned by the model (0..4).
- The REST model may return normalized or non-normalized scores, depending on design and individual preferences/requirements.

1. The calculation of the Replacement Score is the sum of the following sub-scores:

- Age Score
- Financial Score
- Health Score
- Obsolescence Score

2. Only Replacement Score, which is the main score for the asset is stored in database and so this value is shown to the user. Subscore values are not stored in the database..

- Raw Scores are determined using the following formulas:

- Raw Age Score =
  - 100 if age is greater  $m+3s$ ;
  - 80 if  $m+2s < \text{age} \leq m+3s$ ;
  - 60 if  $m+s < \text{age} \leq m+2s$ ;
  - 40 if  $m < \text{age} \leq m+s$ ;
  - 20 if  $m-s < \text{age} \leq m$ ;
  - 0 otherwise

Where age = Current Date – In-Service Date in Years; m is the mean age of the asset population and s is the standard deviation of the age of the asset population. In-Service Date is held as Install Date on the nameplate.

m - means average age for assets of the same family according to asset types

s - standard deviation of assets age or same same family according to asset types

- Raw Importance Score = Asset Importance

- Raw Financial Score =

- 0 if age is 0
- 100 if age is equal to Asset Life Age (this will be different for different types of assets)
- $\text{Age} * (100 / \text{Asset Life Age (mfg expected life)})$

---

**Age is calculated as (Current Date – Manufactured Date) in years**

**Note:** Replacement Score algorithm (Age calculation) is done based on Manufactured Date (Install Date when the Manufacturer Date is not available and current date if both Manufactured Date and Install date are not defined).

Asset Life Age means Ellipse APM Manufacturer Expected Life, and 'Age' is calculated as 'age' for Age Score (Current Date - Install Date)

- Raw Health Score = Total Condition Score
  
- Obsolescence Score = 0 or 100 depending on a customer provided obsolete indicator not attribute but IsObsolete field is used , taken from the asset's nameplate.
  - a. Set to 0 if asset is not obsolete.
  - b. Set to 100 if asset is obsolete.

4. Each Weighted Score is set using the following calculation

Weighted Score = Raw Score \* Customer Assigned Weight / Total of all Customer Assigned Weights

For example, if given the following weights:

Age Score = 50

Criticality Score = 100

Financial Score = 100

Health Score = 100

Obsolescence Score = 0

Then if the Raw Age Score is 60, the Weighted Age Score would get calculated as:

Weighted Age Score =  $60 * 50 / 350$  which comes out to 8.57 (rounded)

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