SYSTEM TECHNICAL DOCUMENTATION

ALERT ANALYTICAL DASHBOARD

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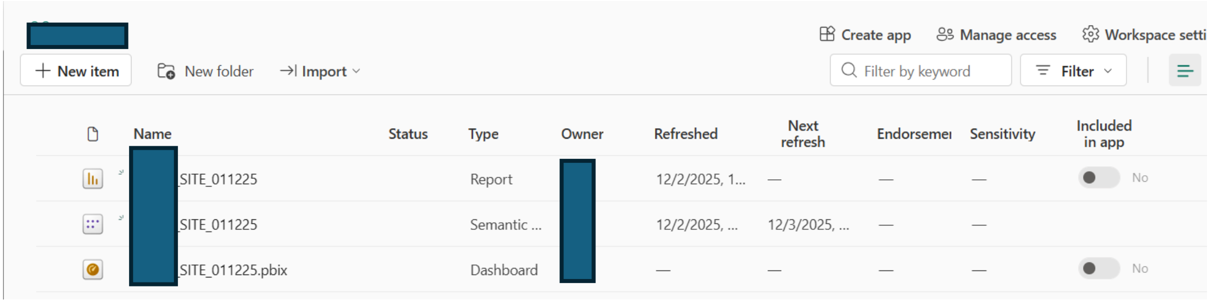
Contents

System Documentation

Purpose of the Alert Analytical Dashboard

To capture the signal processing from each equipment to identify errors or decay that can lead to equipment damage. The signal values come from a data source from API and then three monitoring graphs eventually will help the engineers to identify period of errors or decay. Eventually the system will also monitor the quality control for each site based on its compliance. Dashboards can be found in EBC (Equipment Basic Care) Workspace for PowerBI. Please let your principal know if you cannot access the workspace.

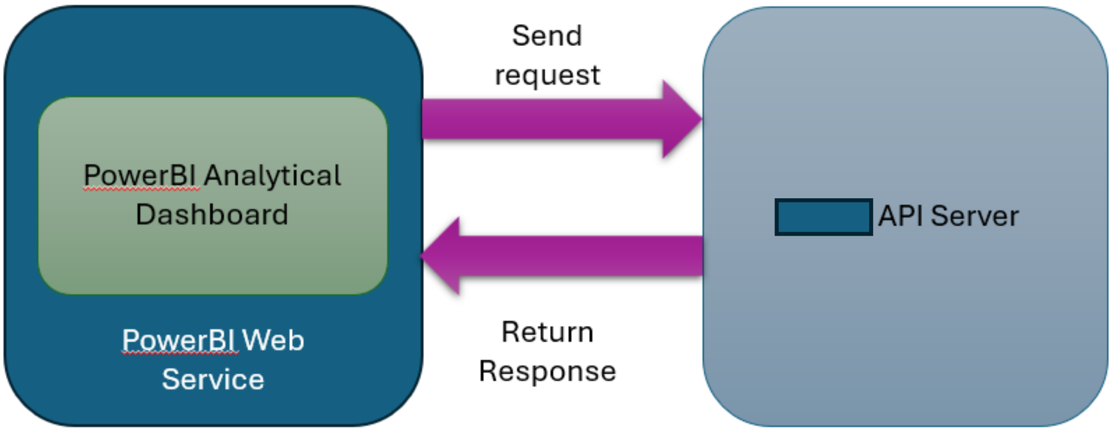


	Name	Status	Type	Owner	Refreshed	Next refresh	Endorsemen	Sensitivity	Included in app
	[redacted]SITE_011225		Report	[redacted]	12/2/2025, 1...	—	—	—	No
	[redacted]SITE_011225		Semantic ...	[redacted]	12/2/2025, ...	12/3/2025, ...	—	—	
	[redacted]SITE_011225.pbix		Dashboard	[redacted]	—	—	—	—	No

Figure 1: Workspace

System Architecture

Below describes the system architecture for the PowerBI Web Service to the analytical Dashboard.



Data source

Analytical Dashboard uses a singular data source point which is API which can be accessed from the following link:<LINK REMOVED>. Note that if there is gap in data ingestion to API, you will encounter missing data. It is recommended to ensure that if daily records are taken, the data must be made available in API DB for more accurate analysis. Dataset is taken at the range of 1.5 years from TODAY() date. If you cannot access the portal, please contact the API team to request access on Management API access. The data values are all taken from a single API URL:

<LINK REMOVED>

[redacted]

Figure 2: Contact Person for Platform Access

[redacted]

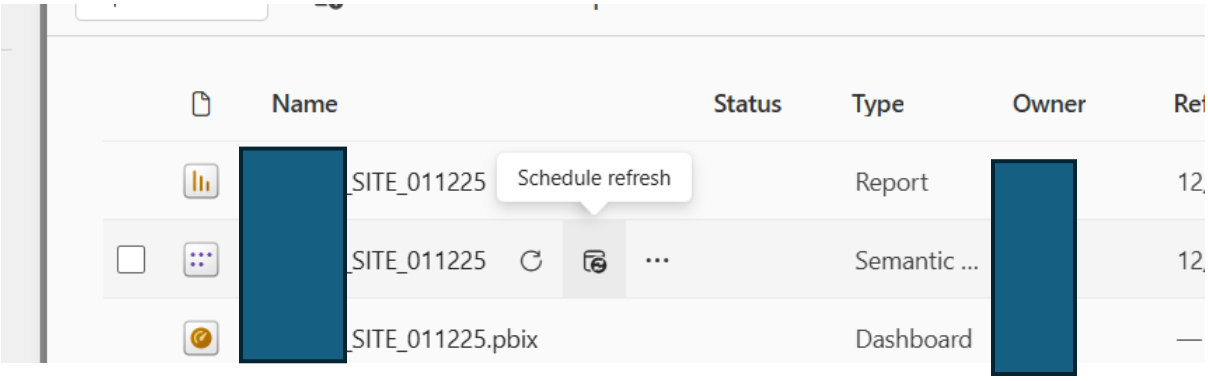
Figure 3: Lists of API access that needs to be requested

Token Generation

Token can be generated from the platform itself when using personal account. However, upon receiving the service account, you will be able to obtain the permanent token where there is no expiry.

Dashboard Refresh

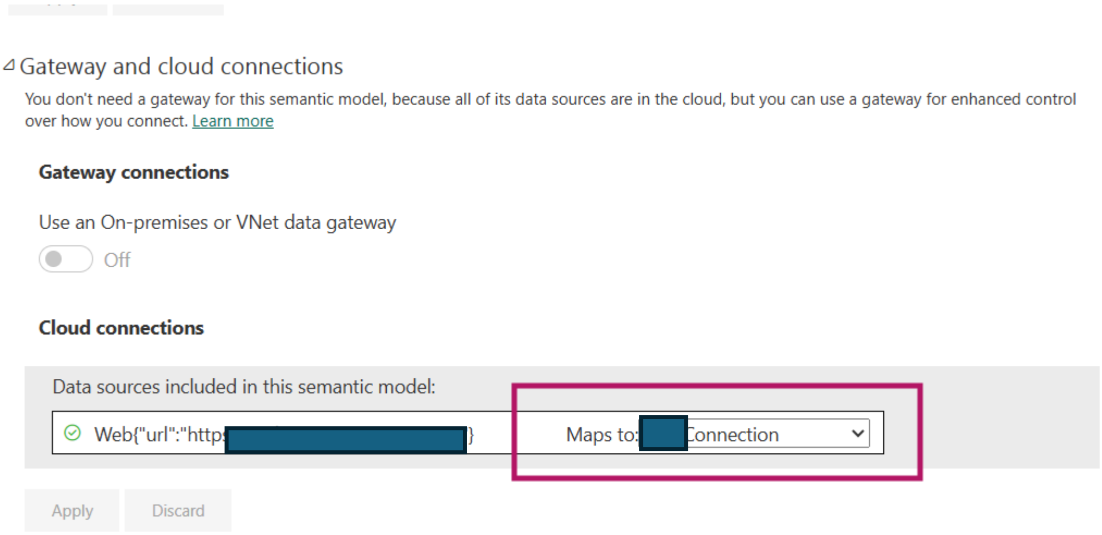
Dashboard Refresh schedule can be set through the schedule refresh after being uploaded to the EBC Workspace.



		Name	Status	Type	Owner	Re
		[redacted]_SITE_011225		Report	[redacted]	12,
☐		[redacted]_SITE_011225		Semantic ...	[redacted]	12,
		[redacted]_SITE_011225.pbix		Dashboard	[redacted]	—

Figure 4: Schedule refresh navigation button

User can select the connection to change to Connection under the Gateway and cloud connections setting.



◿ Gateway and cloud connections

You don't need a gateway for this semantic model, because all of its data sources are in the cloud, but you can use a gateway for enhanced control over how you connect. Learn more

Gateway connections

Use an On-premises or VNet data gateway

Off

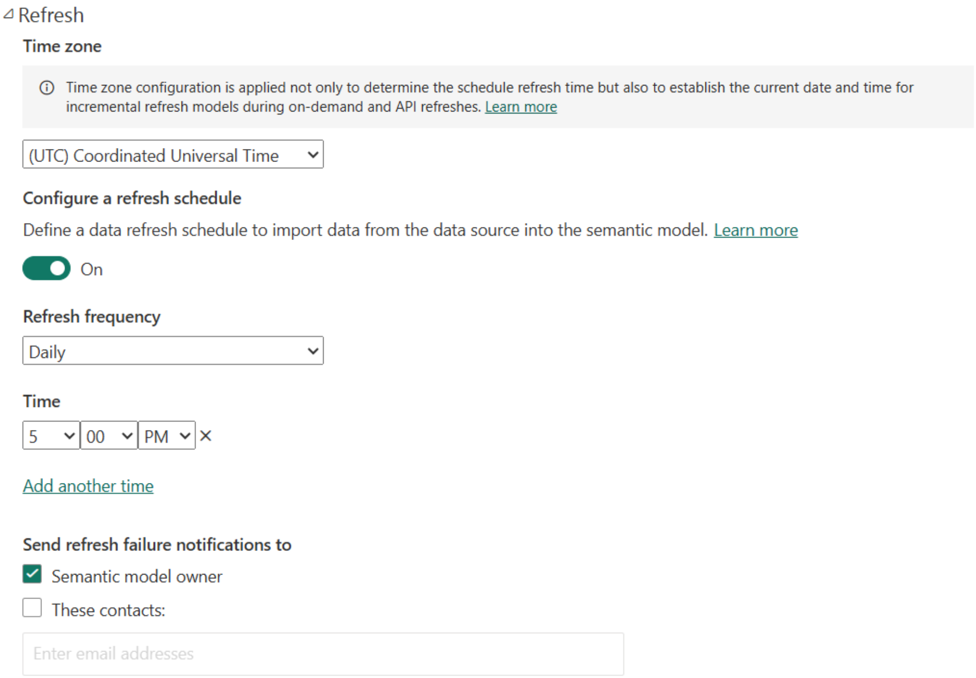
Cloud connections

Data sources included in this semantic model:

Web{"url":"http[redacted]} Maps to: [redacted]Connection

Figure 5: Gateway and cloud connections setting

Once established, user can switch on the daily refresh setting. Currently, for different sites it is set to 1 hour away from each other to resolve token conflict as well as time out issue. Refresh time for each site's dashboard can be estimated to take about 15 to 30 minutes, depending on the size of the data pulled. The refresh time is based on UTC timezone. 5 PM UTC will equal to 1 PM Malaysia time.



Refresh

Time zone

ⓘ Time zone configuration is applied not only to determine the schedule refresh time but also to establish the current date and time for incremental refresh models during on-demand and API refreshes. Learn more

(UTC) Coordinated Universal Time

Configure a refresh schedule

Define a data refresh schedule to import data from the data source into the semantic model. Learn more

● On

Refresh frequency

Daily

Time

5 | 00 | PM ✕

Add another time

Send refresh failure notifications to

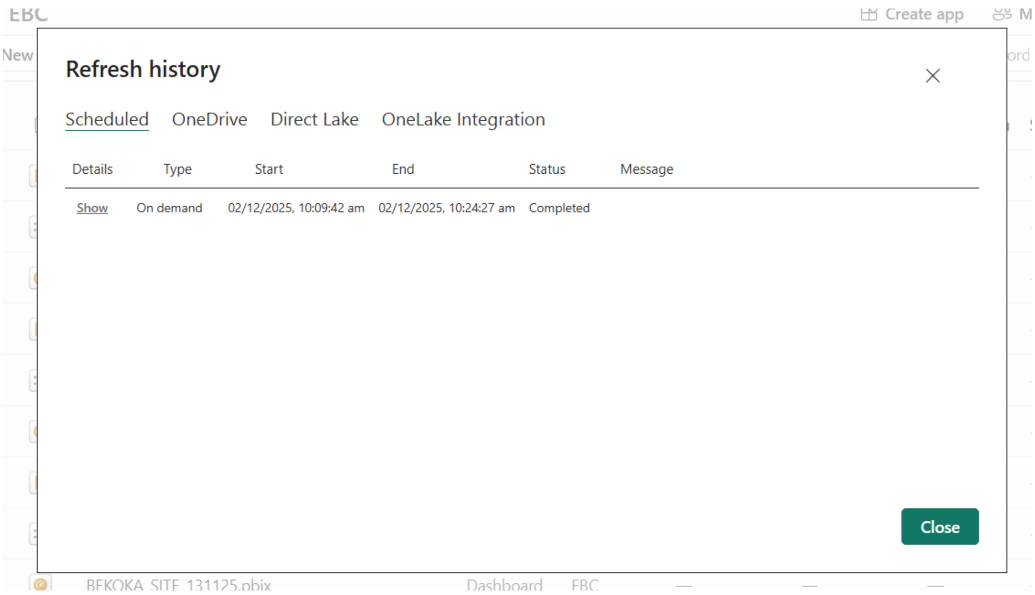
☑ Semantic model owner

□ These contacts:

Enter email addresses

Figure 6: Refresh setting for daily refresh schedule

Refresh History can be monitored to see success and how long it takes to refresh the analytic dashboard.



Refresh history

Details	Type	Start	End	Status	Message
Show	On demand	02/12/2025, 10:09:42 am	02/12/2025, 10:24:27 am	Completed	

Figure 7: Refresh history table

The table below describes the schedule in UTC and its corresponding Malaysia Time for each site's dashboard.

Site File Name	UTC Time	Malaysia Time
SITE1_011225	5:00:00 PM	1:00:00 AM
SITE2_011225	6:00:00 PM	2:00:00 AM
SITE3_011225	7:00:00 PM	3:00:00 AM
SITE4_011225	8:00:00 PM	4:00:00 AM
SITE6_011225	9:00:00 PM	5:00:00 AM
SITE7_011225	10:00:00 PM	6:00:00 AM
SITE8_011225	11:00:00 PM	7:00:00 AM

Dashboard Design

The following diagram describes how the dashboards connected to each other.

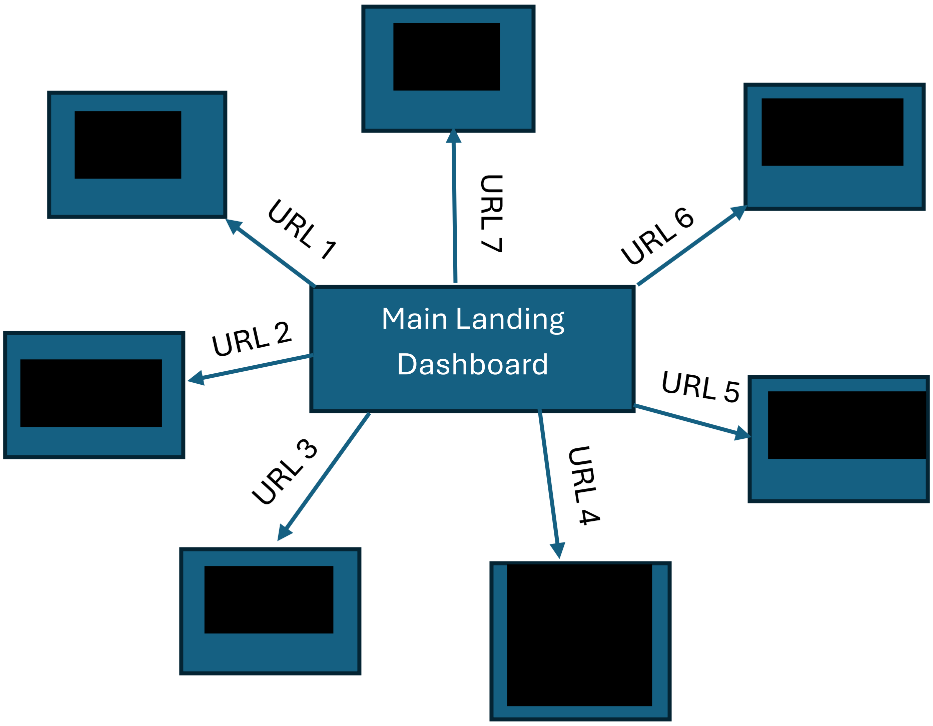


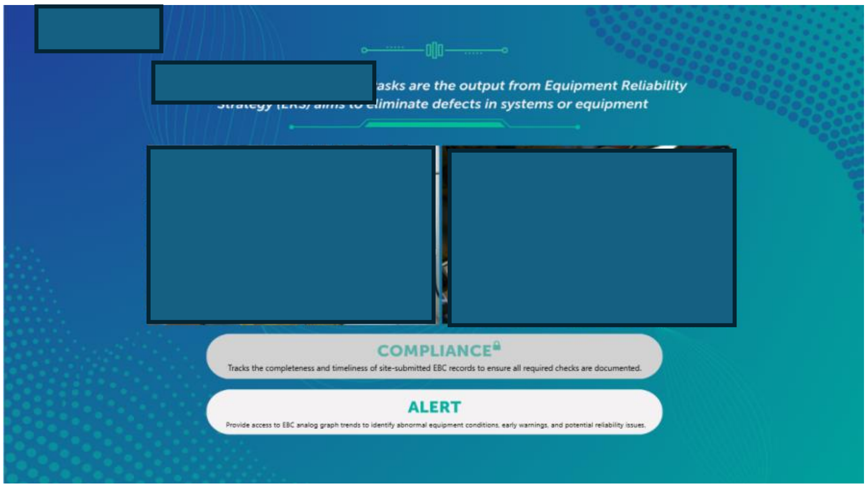
Figure 8: Dashboards linking via URLs from the main landing dashboard

Each of the dashboards has its own processing file. The reason behind this design is that the data pulled can be very huge which can cause timeout (Power BI has a maximum 2 hours refresh timespan) and minimize data losses for each site during the data pulling process because there can be many pages that consist of the data. API does not crawl the data readily and thus data crawl must be done from the analytical dashboard side.

Dashboard Pages

Main Landing Page

This is the main landing Page that can lead to Compliance pages and Alert pages. For Compliance pages, data has yet to be ingested into data source and thus, is locked as it will be continued by the next PIC as soon as data is made available in the data source platform.



[redacted]

[redacted] asks are the output from Equipment Reliability
eliminate defects in systems or equipment

[redacted]

[redacted]

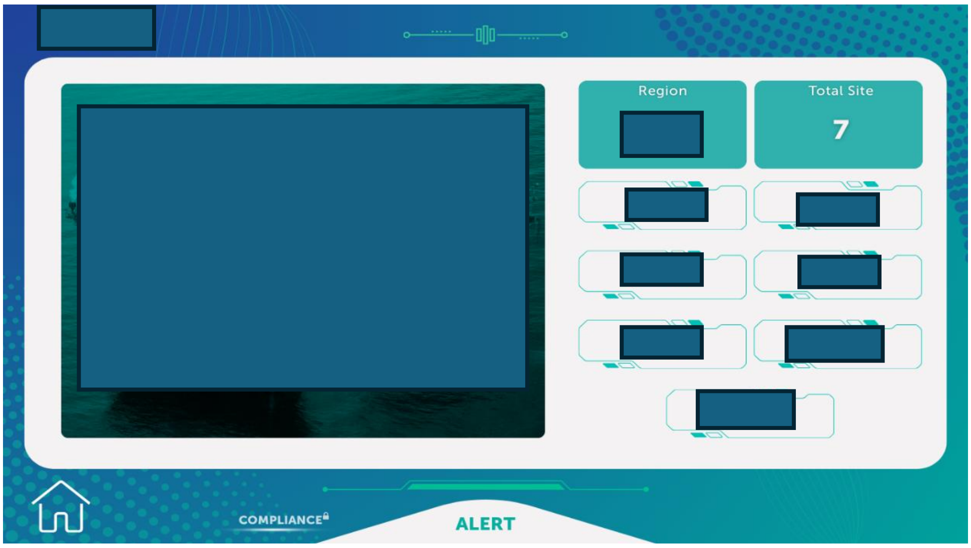
COMPLIANCE🔒
Tracks the completeness and timeliness of site-submitted EBC records to ensure all required checks are documented.

ALERT
Provide access to EBC analog graph trends to identify abnormal equipment conditions, early warnings, and potential reliability issues.

Figure 9: Main landing page

Alert Sites Navigation Page

Alert Sites Navigation Page is where user can access different links for the sites. In <REMOVED>, seven sites are included in the analytic monitoring which are SITE1, SITE2, SITE3, SITE4, SITE5, SITE6 and SITE7. When clicked on the button, a new tab will open for the sites on the web browser.



[redacted]

[redacted]

Region [redacted]

Total Site 7

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

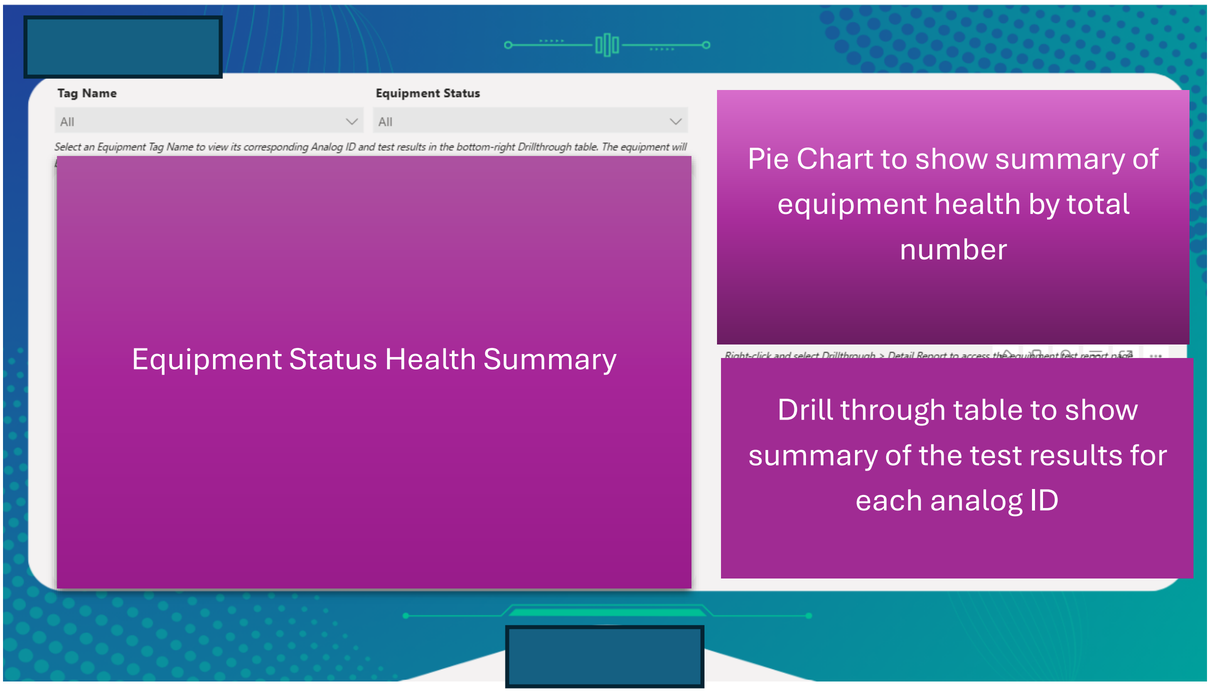
[redacted]

[redacted]

Figure 10: Alert Sites navigation page

Sites Equipment Health Summary Page

Site Equipment Health Summary Page will give a summary status of equipment's health as Pass, Concern or Fail based on tag name. A chart will be showing the ratio of health status for the sites.



Tag Name

All

Equipment Status

All

Select an Equipment Tag Name to view its corresponding Analog ID and test results in the bottom-right Drillthrough table. The equipment will

Equipment Status Health Summary

Pie Chart to show summary of equipment health by total number

Right-click and select Drillthrough > Detail Report to access the equipment test report page

Drill through table to show summary of the test results for each analog ID

Figure 11: Site Equipment Summary Page

The table below will indicate how the Equipment Status is evaluated.

Health Status	Color Code	Conditions
Pass	Green	All analog IDs overall results pass
Concern	Yellow	There is at least one analog ID concerning status or less than three fail overall result
Fail	Red	There are three or more failing overall result status analog IDs

In the drill through table, user can right click to drill through to the graphical analytics pages. It also produces a summary of overall results from different tests that take place in the processing measure. Below summarize how the overall results are evaluated.

Health Status	Color Code	Conditions
Pass	Green	At most only one Fail test result
Concern	Yellow	There are two Fail test results
Fail	Red	There are three Fail Test results

Graphical Analytics Page

Graphical Analytics Page consists of various chart tables for engineers to carry out trend examination on the fed in value from API.

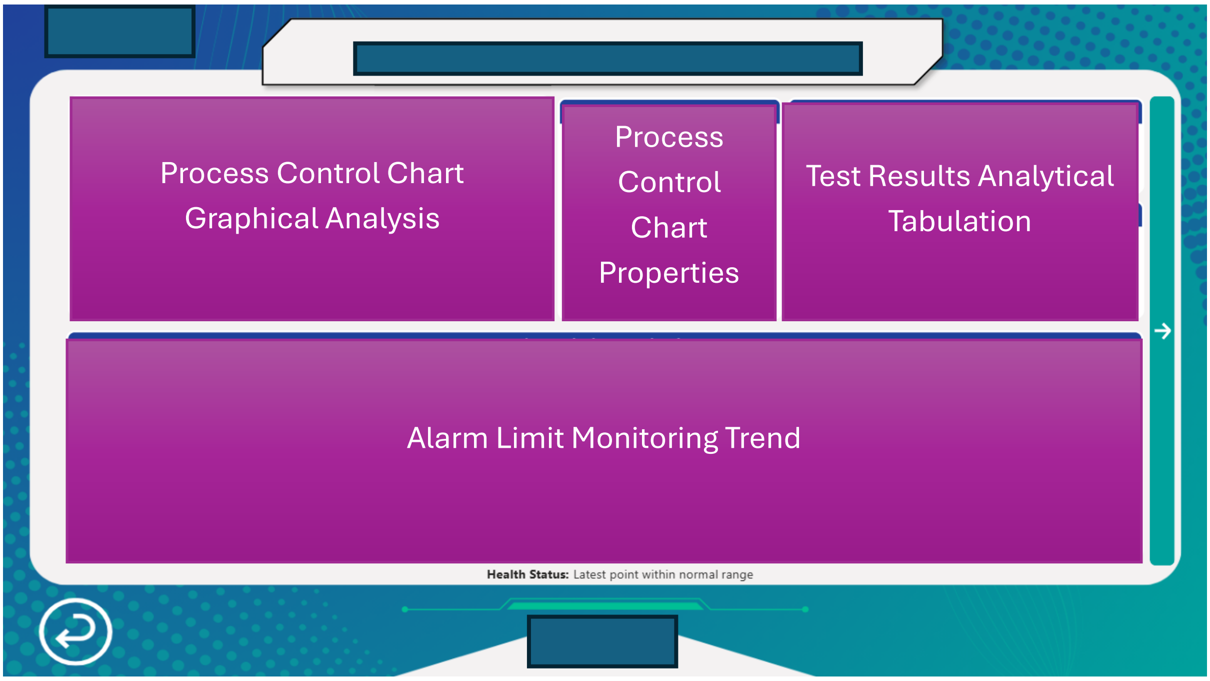

Process Control Chart Graphical Analysis
Process Control Chart Properties
Test Results Analytical Tabulation
Alarm Limit Monitoring Trend
Health Status: Latest point within normal range

Figure 12: Process Control Graphical Section

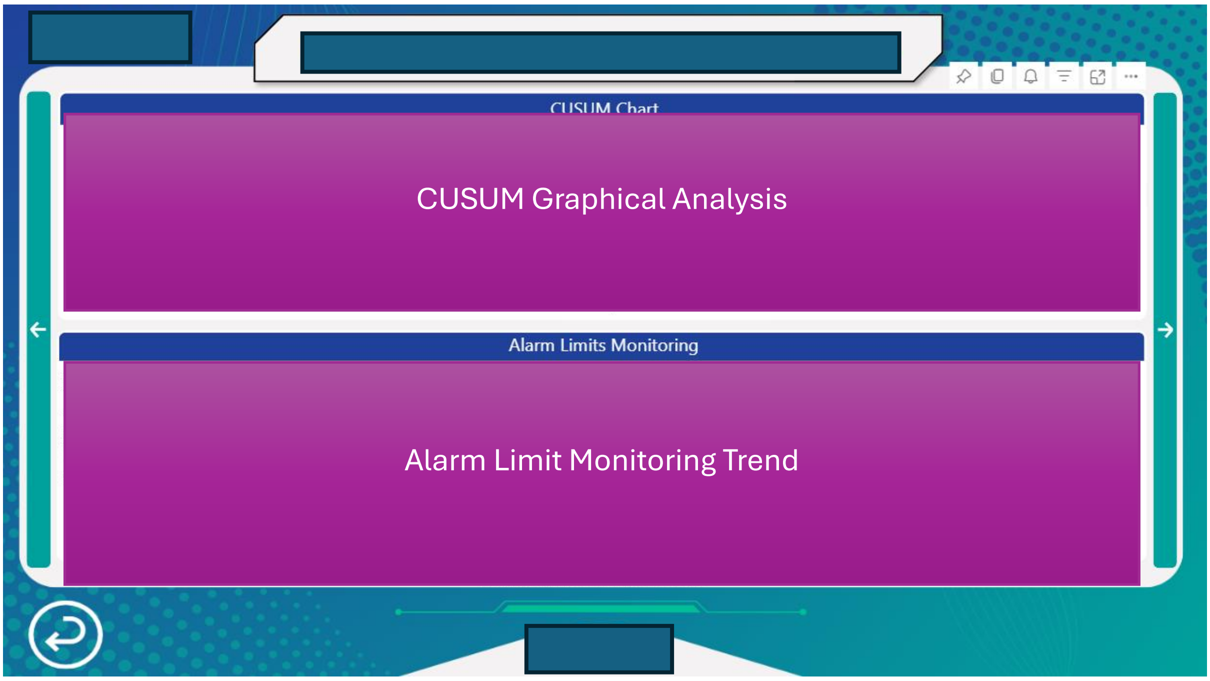


Figure 13: CUSUM Graphical Section

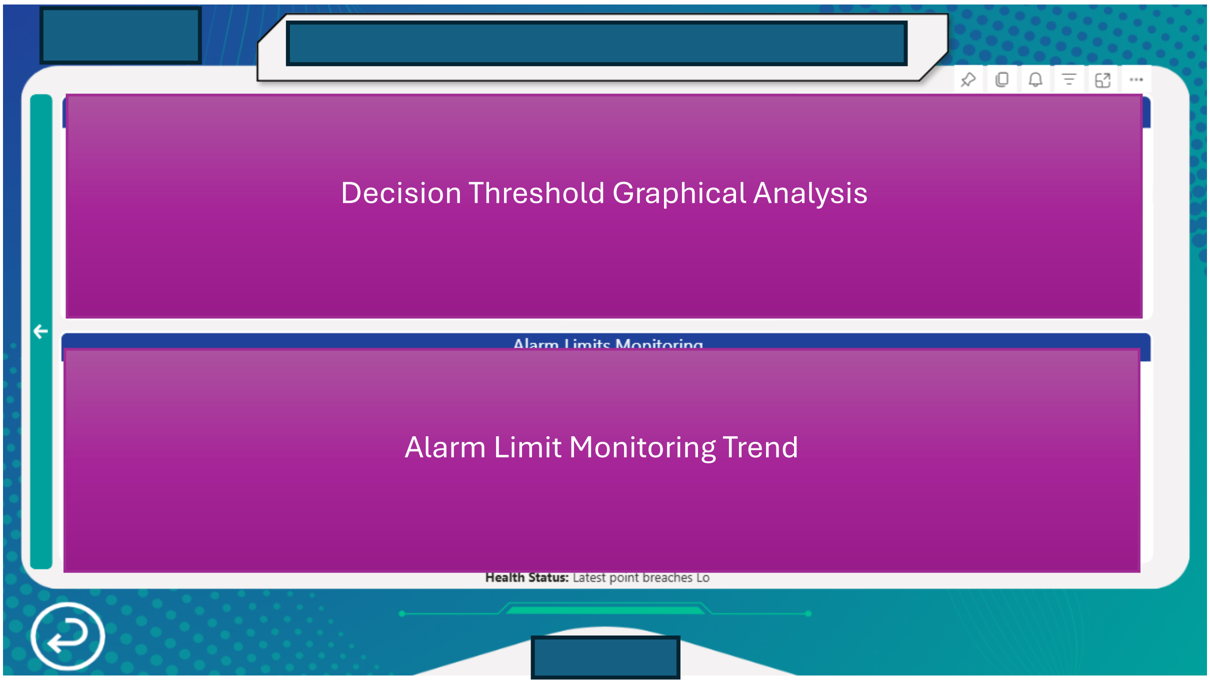

Decision Threshold Graphical Analysis
Alarm Limits Monitoring
Alarm Limit Monitoring Trend
Health Status: Latest point breaches Lo

Figure 14: Decision Threshold Graphical Analysis

Monitoring Graph Types

Process Control Chart

A Process Control Chart, often called a Shewhart Control Chart, is used to monitor how a process behaves over time.

- It tracks measurement values sequentially and compares them against statistically derived upper and lower control limits.
- Its primary purpose is to detect large, sudden shifts or variations that may indicate abnormalities or loss of control.
- It is straightforward, easy to read, and widely used for real-time process monitoring.

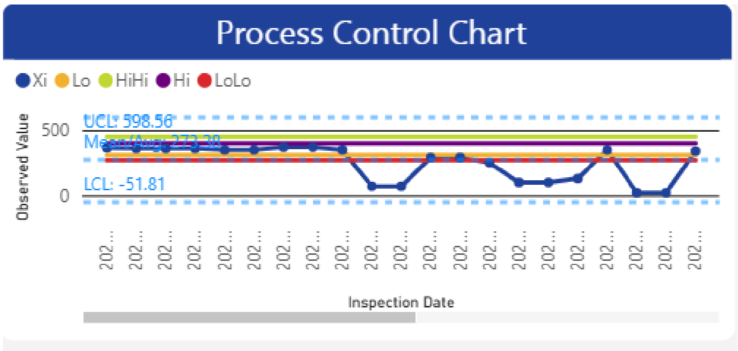


Figure 15: Process Control Chart

CUSUM Chart

A CUSUM Chart monitors the cumulative sum of deviations from a target value.

- It is more sensitive than the standard control chart, particularly for detecting small and gradual shifts in a process.
- Positive and negative cumulative sums highlight trends or drifts that might not be visible in a normal control chart.
- It is especially useful for early intervention in processes where subtle changes can lead to issues over time.

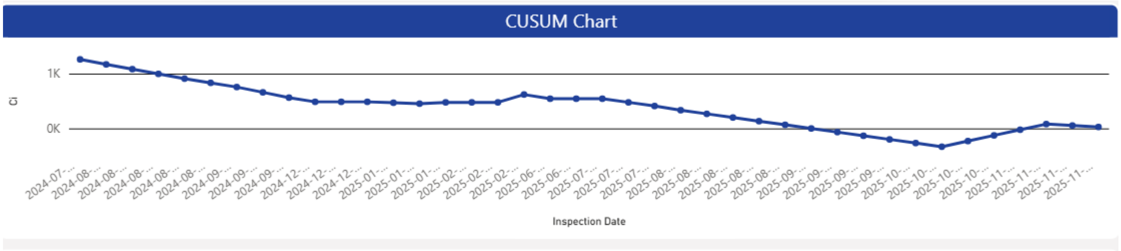


Figure 16: CUSUM Chart

Decision Threshold Chart

A Decision Threshold Chart visually compares a process measurement to predefined decision or warning thresholds.

- It highlights when a value crosses specific boundary limits that require action, such as warning, alarm, or shutdown levels.
- Often used in equipment monitoring, safety systems, and automated decision-making applications.
- Provides a clear and intuitive way to see when a process is nearing or exceeding acceptable operating boundaries.

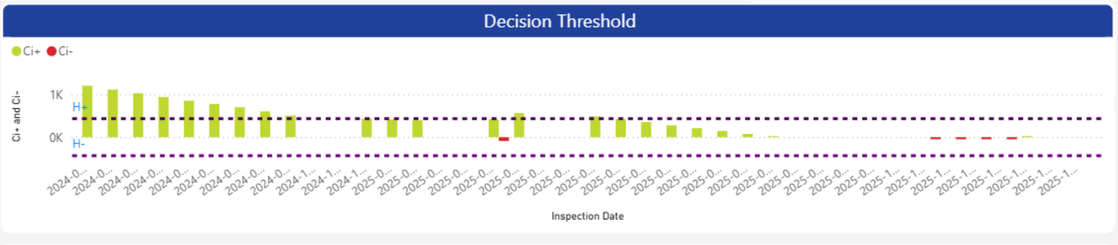
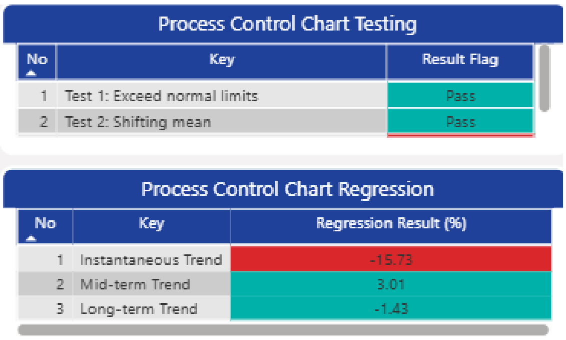


Figure 17: Decision Threshold

Test Results Analytical Tabulation

Monitoring can be done by evaluating the Process Control Chart Testing and Process Control Chart Regression. There are three tests for Process Control Chart Testing (Test 1: Exceed Normal Limits, Test 2: Shifting Mean, Test 3: Alarm Limits Monitoring) and three regression tests to see the hypotenuse trends of the graph (Instantaneous Trend, Mid-term Trend, Long-Term Trend)



Process Control Chart Testing

No	Key	Result Flag
1	Test 1: Exceed normal limits	Pass
2	Test 2: Shifting mean	Pass

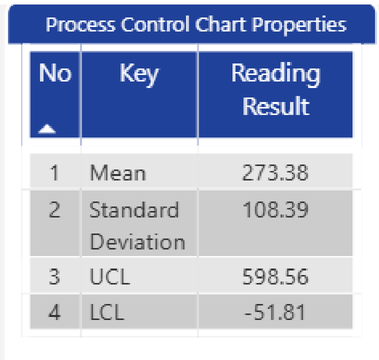
Process Control Chart Regression

No	Key	Regression Result (%)
1	Instantaneous Trend	-15.73
2	Mid-term Trend	3.01
3	Long-term Trend	-1.43

Figure 18: Process Control Chart Testing and Process Control Chart Regression

Process Control Chart Properties

Analytical calculation table displays the reading mean, standard deviation, Upper Control Limit and Lower Control Limit of the last 40 data that is available to the dashboard processing. Note that not every Analog ID has 40 data in the platform. Some are even lesser.



Process Control Chart Properties

No	Key	Reading Result
1	Mean	273.38
2	Standard Deviation	108.39
3	UCL	598.56
4	LCL	-51.81

Figure 19: Process Control Chart Properties

Technical Discussion

The following chapter will be discussing the processing logic of the system. There are two parts of the processing logic, one that takes place in the Power Query M and the other that takes place in DAX Expression format. Power Query M logic can be accessed via Power BI through “Transform Data” functionality while DAX Expression can take place through “Measures”, “Table” and “Column” at the surface level of the solution.

Power Query M Data Layer

Upon accessing the transform data processing logic, user will find two tables that are created in this layer and a single function. The first is the {SITE}_FULL_EQUIPMENT_LIST. In this table, it consists of the resultant data pulled from the API. Then, users will see the CUSUM_TABLE_CALC where in this table, cumulative and decision threshold datapoints calculations are taking place. Then, users will be able to see the fnGetAPIRecordsByPage which is a function that carries out the API data call.

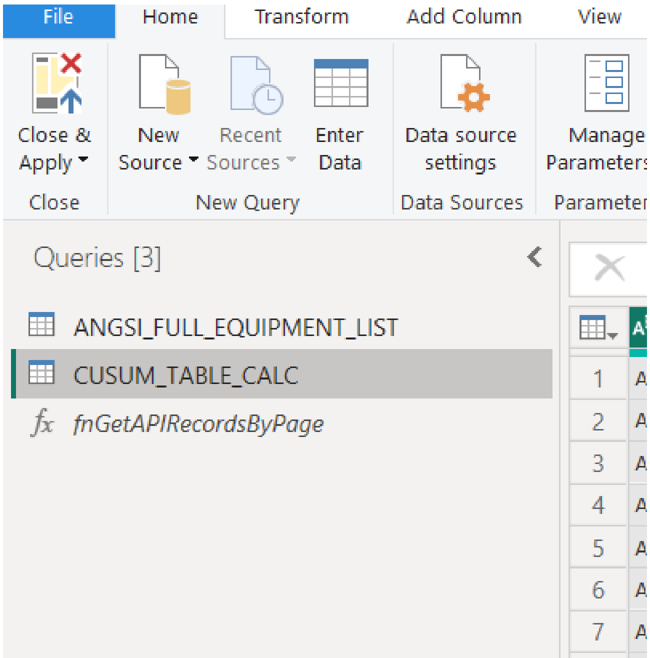


Figure 20: Power M Query Data Layer

{SITE}_FULL_EQUIPMENT_LIST

This table has 8 data steps. The following table describes the function for each data step.

Data Step Name	Description
Source	A table that keeps the parameters of region which is PM, location which is the {SITE} name and page which is how many returned pages that are returning result. The max page set is 5 for looping purposes.
Invoked Custom Function	This step will trigger the custom function called fnGetAPIRecordsByPage. The parameters from previous steps will be read by the function while it makes the API call.
Expanded FetchAPI	This step will expand all the results table to become one table
Renamed Columns	This step will change the names based on the expected names by other processing layer logic.
Removed Columns	This step will remove the repeated columns.
Custom1	This step will rank the data from latest as earliest to successive ranks after.
Custom2	This step checks for any nullable and removes the empty rows resulted from the loop. It also repairs the data types to become processable. This step also standardizes the analog name to the common entry as sometimes it is found that they can vary in string text slightly.
Custom3	Change any numeric that is kept in text to numbers

CUSUM_TABLE_CALC

This table has 9 processing steps. The following table describes all the processing steps. Reason that the CUSUM and Decision Threshold takes place in the Power Query M layer is because Power Query M can cache previous results and calculates efficiently in groupings.

Data Step Name	Description
CleanedSource	Take Reference from {SITE}_FULL_EQUIPMENT_LIST
Filtered	Removed any null tags
Sorted	Sort the table based on row index
AddCalculations	Loop through the rows and calculate the CUSUM and Decision Threshold datapoints values based on the group (Combination of tag name and Analog ID)

Expanded	This step will expand all the columns that are required for the graph plots.
ChangedType	This step ensures that all the values are in numeric
RenamedIndex	This step changes the names of RowIndex.
SafeCompositeKey_BE	This step creates unique Backend Composite Key
RemoveDuplicateCompositeKey	This step removes any duplicate rows detected from the unique Backend Composite Key

fnGetAPIRecordsByPage

This is a function that pulls data using API. The API takes three parameters from the source table which are Region, Location and page. The function will loop five times through invoking custom function data step in {SITE}_FULL_EQUIPMENT_LIST to look for data in pages 1 to 5. Each page of the data will consist of 10,000 records. Since number of records can vary for each site, the API will try to look for records in 50,000 records returned. Why the API is designed like this is to minimize loss of data. The API also calculated the start inspection date to be 1.5 years earlier than TODAY ()'s date. Segregation of sites turns the processing to lightweight so that it can finish refresh within two hours window.

DAX Query Data Layer

DAX Queries can be accessed without invoking Transform Data function. The processing is kept as "Measures", "Calculated Columns" and "Calculated Table". The following tables are designed on top of the Power Query M tables. The following are the lists of tables that are created in this layer:

- AnalogIdListTable
- EquipmentStatusSummary
- LinesLayout
- MeasureLabels
- RecordCountGroupTable
- RegressionLabels
- RegressionMeasuresTable
- TagnameListTable
- Test_Condition_Measures
- TestLabels
- Tests_EquipmentStatsTable

The following are the lists of Measures and Calculated Columns in different tables. The DAX Expression Logic can be referred to in the files.

Table Name	Measures	Calculated Column
{SITE}_FULL_EQUIPMENT_LIST	-2σ -σ +2σ +σ ANGSI Report Title DeviationPerRowMeasure Latest Hi Value Latest Hihi Value Latest Lo Value Latest Lolo Value LCL Lower Limit Value Reading Average/Mean Reading Median Reading StdDev Record Count SingleValue StdDev x 4 (H-) StdDev x 4 (H) StdDev x 5 (P) StdDev/2 (K) Top40XiMeasure UCL Upper Limit Value	CompositeKey CompositeKey_BE DataPointIndex Name/Unit
CUSUM_TABLE_CALC	CompositeKey	
EquipmentStatusSummary	ShowDetail	
LinesLayout	Latest_Threshold_Label Latest_Threshold_Line Latest_Threshold_Tooltip_Label	
MeasureLabels	-σ const +σ const AlarmColorMeasure ColumnVisibility CusumChartsDatapoints DecisionThreshold_Negative DecisionThreshold_Positive LCLBound MeanBound Reading Result Top40RecentMeasure UCLBound	
RecordCountGroupTable	EquipmentStatus GroupCountMeasure	
RegressionLabels	Regression Result (%)	
RegressionMeasuresTable	Instantaneous Regression Slope (%) - Last 5 (Drillthrough)	

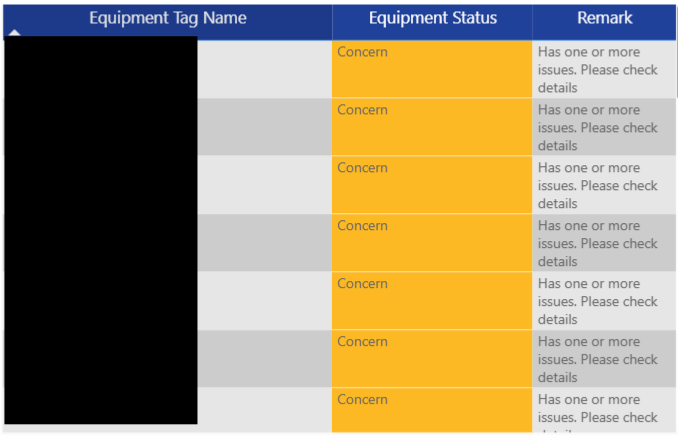
	Longterm Regression Slope (%) - Last 30 (Drillthrough) Midterm Regression Slope (%) - Last 15 (Drillthrough)	
Test_Condition_Measures	CountTop40Crossed Dynamic Tooltip Mean of latest 10 Mean of latest 15 Mean of latest 30 Mean of latest 5 MeanAfter10_Next30 PercentageOfShift StableMeanCheck Test 1 Flag Test 2 Flag Test 3 Flag Test_4_Flag	
TestLabels	Result Flag	
Tests_EquipmentStatsTable		CompositeKey Overall Result Regression Tests Test 1 Test 2 Test 3 Test 4

Need To Know Settings

The section will explain designs that are not common on this data layer for easier debugging purposes.

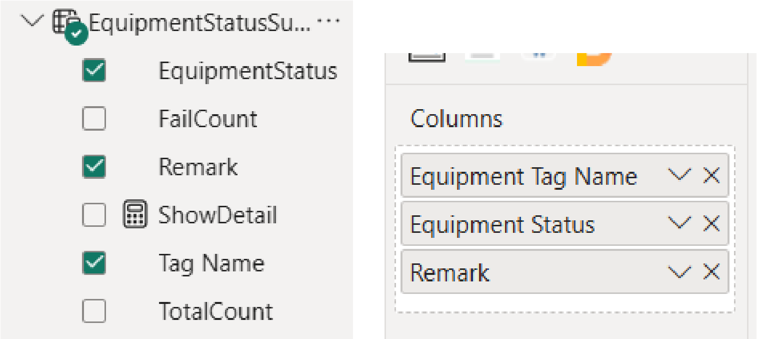
Equipment Status Visual Design

This visual is designed for its final calculation result to be taken from Equipment Status Summary.



Equipment Tag Name	Equipment Status	Remark
[redacted]	Concern	Has one or more issues. Please check details
[redacted]	Concern	Has one or more issues. Please check details
[redacted]	Concern	Has one or more issues. Please check details
[redacted]	Concern	Has one or more issues. Please check details
[redacted]	Concern	Has one or more issues. Please check details
[redacted]	Concern	Has one or more issues. Please check details
[redacted]	Concern	Has one or more issues. Please check

Figure 21: Equipment Status Table



EquipmentStatusSu... ⋯

☑ EquipmentStatus

□ FailCount

☑ Remark

□ ShowDetail

☑ Tag Name

□ TotalCount

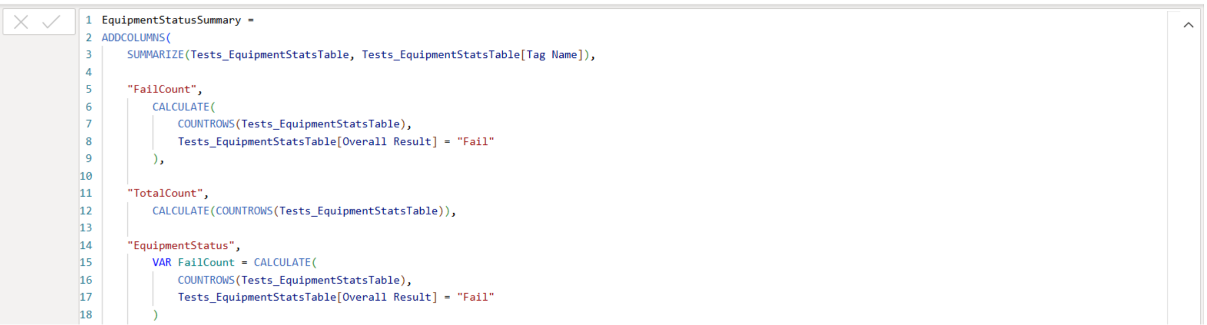
Columns

Equipment Tag Name

Equipment Status

Remark

Figure 22: Columns for the visuals



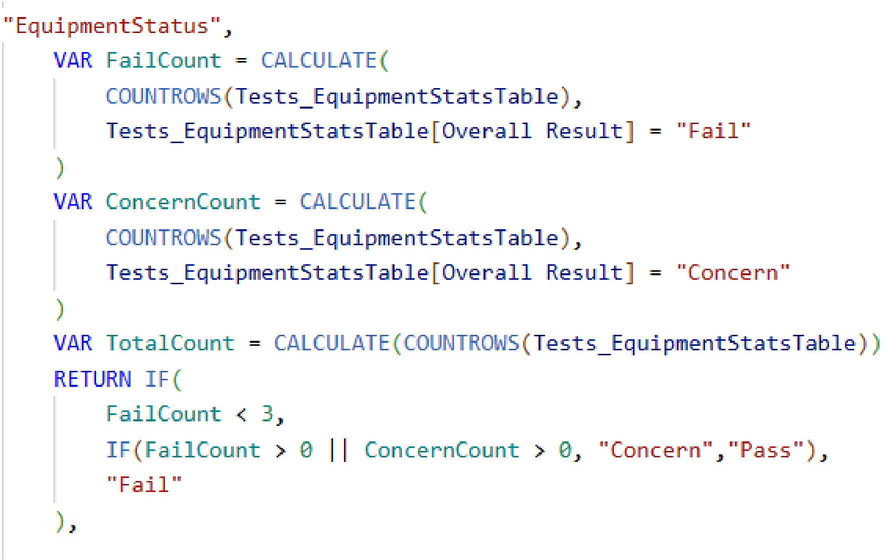
```
EquipmentStatusSummary =
ADDCOLUMNS(
    SUMMARIZE(Tests_EquipmentStatsTable, Tests_EquipmentStatsTable[Tag Name]),

    "FailCount",
        CALCULATE(
            COUNTROWS(Tests_EquipmentStatsTable),
            Tests_EquipmentStatsTable[Overall Result] = "Fail"
        ),

    "TotalCount",
        CALCULATE(COUNTROWS(Tests_EquipmentStatsTable)),

    "EquipmentStatus",
        VAR FailCount = CALCULATE(
            COUNTROWS(Tests_EquipmentStatsTable),
            Tests_EquipmentStatsTable[Overall Result] = "Fail"
        )
```

Figure 23: DAX script for EquipmentStatusSummary table creation



```
"EquipmentStatus",
    VAR FailCount = CALCULATE(
        COUNTROWS(Tests_EquipmentStatsTable),
        Tests_EquipmentStatsTable[Overall Result] = "Fail"
    )
    VAR ConcernCount = CALCULATE(
        COUNTROWS(Tests_EquipmentStatsTable),
        Tests_EquipmentStatsTable[Overall Result] = "Concern"
    )
    VAR TotalCount = CALCULATE(COUNTROWS(Tests_EquipmentStatsTable))
    RETURN IF(
        FailCount < 3,
        IF(FailCount > 0 || ConcernCount > 0, "Concern","Pass"),
        "Fail"
    ),
```

Figure 24: Equipment Status DAX Logic

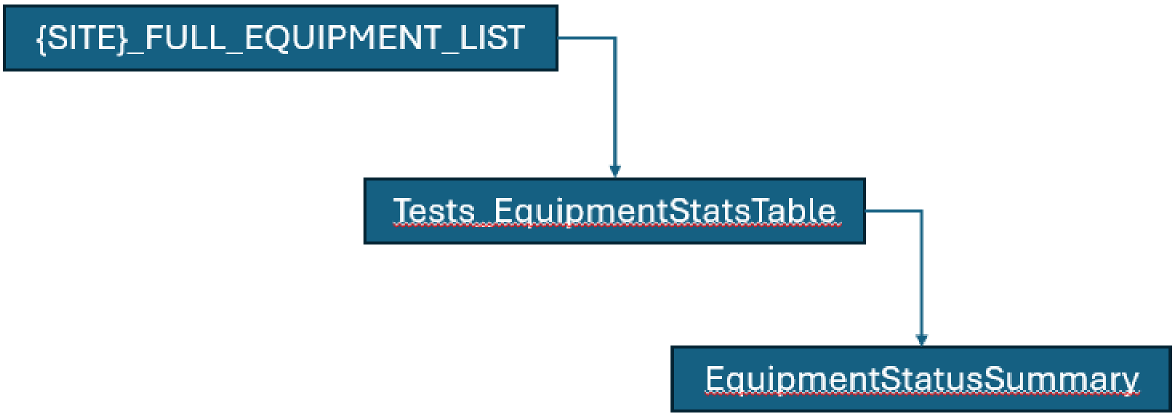
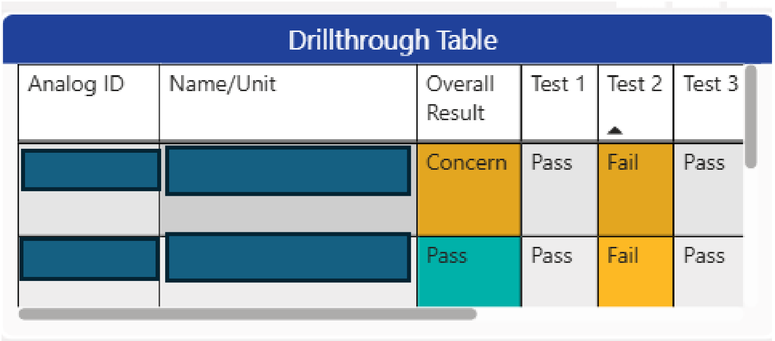


Figure 25: Equipment Status Summary Table Relationship

Drill through Table Visual Design

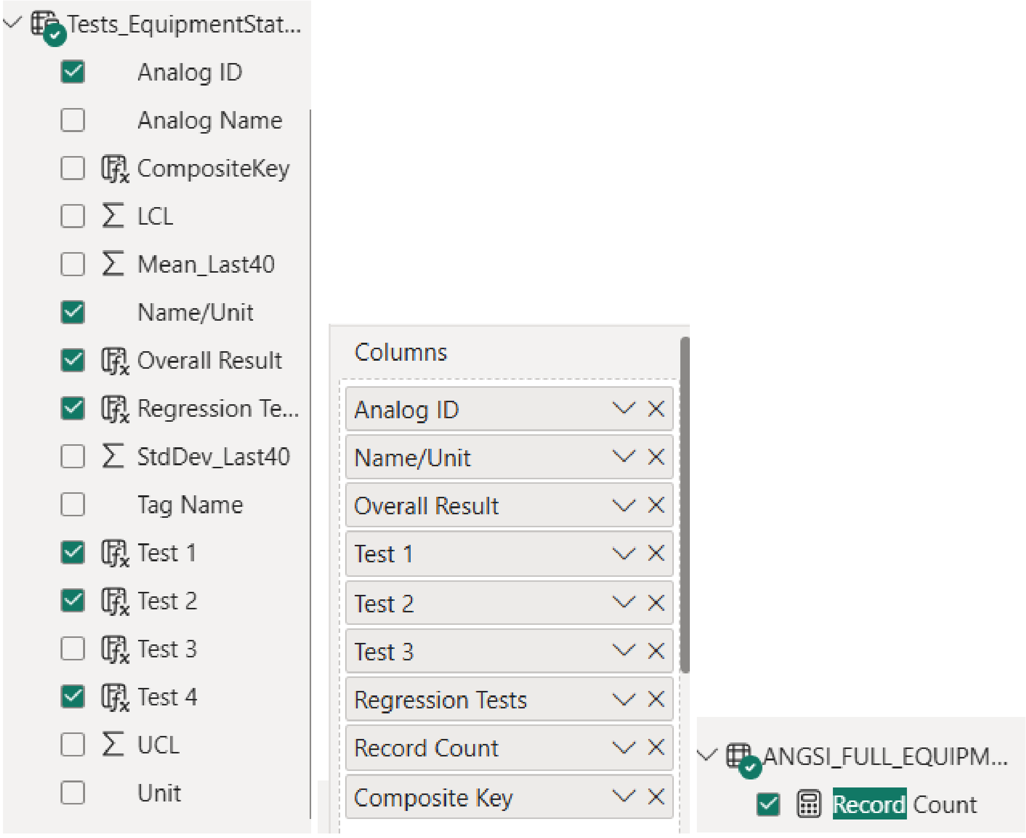
This visual is designed to be able to focus the analysis on a selected Analog ID.



Drillthrough Table

Analog ID	Name/Unit	Overall Result	Test 1	Test 2	Test 3
[redacted]	[redacted]	Concern	Pass	Fail	Pass
[redacted]	[redacted]	Pass	Pass	Fail	Pass

Figure 26: Drill through table for Analog IDs of each Equipment



Tests_EquipmentStat...

☑ Analog ID
☐ Analog Name
☐ CompositeKey
☐ LCL
☐ Mean_Last40
☑ Name/Unit
☑ Overall Result
☑ Regression Te...
☐ StdDev_Last40
☐ Tag Name
☑ Test 1
☑ Test 2
☐ Test 3
☑ Test 4
☐ UCL
☐ Unit

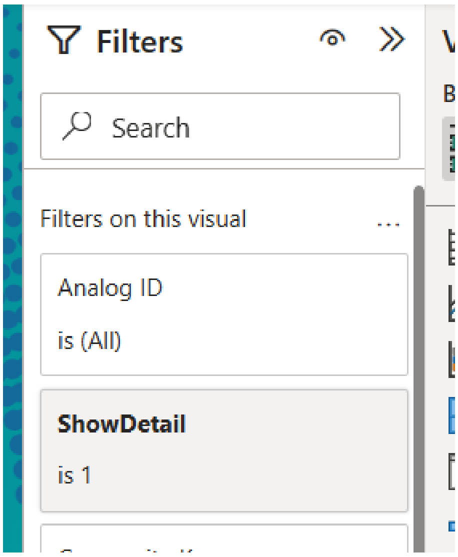
Columns

- Analog ID
- Name/Unit
- Overall Result
- Test 1
- Test 2
- Test 3
- Regression Tests
- Record Count
- Composite Key

ANGSI_FULL_EQUIPM...

☑ Record Count

Figure 27: Tests_EquipmentStatTable Setting. Test 4 is renamed as Test 3 in the visual. Record Count is from {SITE}_FULL_EQUIPMENT_LIST, linked through CompositeKey Relationship



Filters

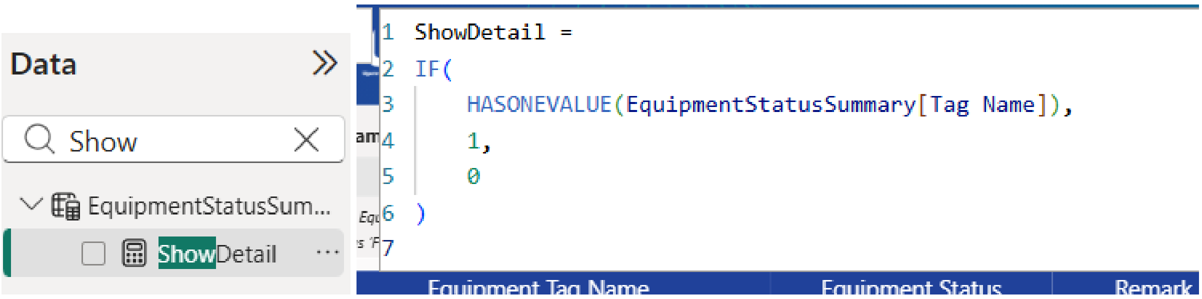
Search

Filters on this visual

Analog ID
is (All)

ShowDetail
is 1

Figure 28: In visual Filters, the columns to be appeared in the drillthrough table is controlled by ShowDetail Measure



```
ShowDetail =
IF(
    HASONEVALUE(EquipmentStatusSummary[Tag Name]),
    1,
    0
)
```

Figure 29: ShowDetail Measure checked for if Tag Name Selected is the same Tag Name in the Analog IDs , and if true, return 1 so that the flag will pick it up as items to appear in the drill through table