



DASHBOARD USER MANUAL

Introduction

Welcome to the comprehensive manual of the Nanoprecise Dashboard, designed to provide a complete understanding of the platform's functionalities and features. As a dynamic maintenance professional, your journey through this manual will familiarize you with the intricacies and capabilities of the cutting-edge platform developed by Nanoprecise Sci Corp.

This manual will offer a clear and detailed explanation of each element and feature present on the dashboard. By thoroughly exploring the contents within, you will gain a deep insight into the diverse functionalities available, empowering you to leverage the platform's full potential.

Whether you are a seasoned professional or a novice user, this guide will serve as your key companion, enabling you to navigate through the dashboard with confidence and efficiency. We are confident that this manual will provide you with the necessary tools and knowledge to maximize your experience and drive your productivity to new heights.



Table of Contents

Login	03
Introduction to the Home Page	05
Component Health Summary	14
Navigation and Functionality	15
Vibration	19
Sound	23
Magnetic Flux, Temperature, Humidity, Speed	26
Device Metrics	27
Multi View Dashboard	28
NRG Dashboard	30
Appendix A	36
Appendix B	37
Appendix C	40

Login

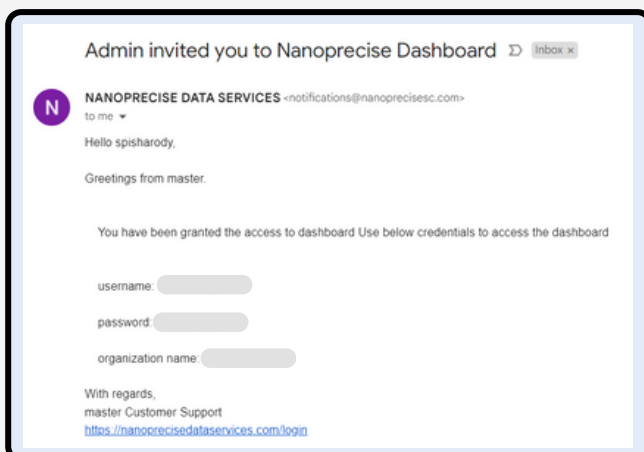
Nanoprecise Users

Access the website through the following link:
<https://nds.nanoprecisedataservices.com/login>



The screenshot shows the Nanoprecise login interface. At the top is the Nanoprecise logo. Below it are three input fields: 'Username/Email', 'Password', and 'Organization Name'. There are also checkboxes for 'Remember Me' and a link for 'Forgot Password?'. A prominent orange 'Sign In' button is located below the input fields. At the bottom, there is a link 'or Sign in with' followed by an orange 'SSO' button.

Enter the Username, Password, and Organization Name, received via email from notifications@nanoprecisesc.com, then click on "Sign In."



The screenshot shows an email notification titled 'Admin invited you to Nanoprecise Dashboard'. The sender is 'NANOPRECISE DATA SERVICES <notifications@nanoprecisesc.com>'. The email content includes a greeting 'Hello spisharody,' and a message: 'You have been granted the access to dashboard Use below credentials to access the dashboard'. Below this message are three input fields for 'username:', 'password:', and 'organization name:'. The email concludes with 'With regards, master Customer Support' and a link to the login page: <https://nanoprecisedataservices.com/login>.

Sample email with Credentials

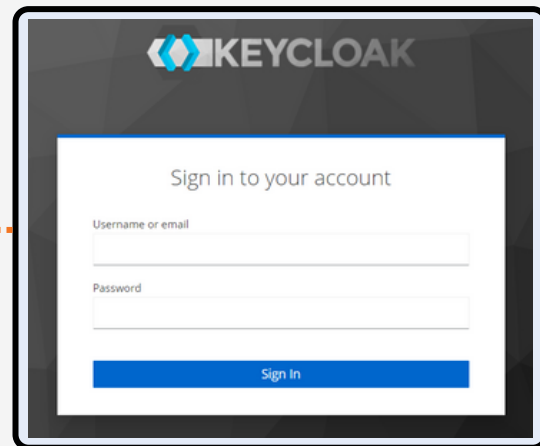
Login

SSO Users

Enter the “Organization Name” of the Company you are trying to access. If Organization is setup for SSO, it will redirect you to the “Sign In” page of your company SSO



The screenshot shows the Nanoprecise Single Sign On page. It features the Nanoprecise logo at the top, followed by the text "Single Sign On". Below this is a text input field labeled "Organization Name". There is a checkbox labeled "Remember Me" and a prominent orange "Submit" button. At the bottom right, there is a link that says "Back to Login".



The screenshot shows the Keycloak Sign In page. It features the Keycloak logo at the top. Below the logo is the text "Sign in to your account". There are two text input fields: "Username or email" and "Password". At the bottom, there is a blue "Sign In" button.

Upon successful sign-in, you will be automatically redirected to the Nanoprecise Homepage. If you would like to setup SSO for your company, please contact your Nanoprecise representative or customer-success@nanoprecise.io

Homepage

The screenshot shows the Nanoprecise homepage interface. It features a top navigation bar with a 'DEMO' dropdown and user icons. A left sidebar contains navigation links for Sensor Health Summary, Enterprise Health Summary, Equipment List, Documents, Notes, Manual, and Equipment Reports. The main content area is divided into three sections: Plant, Equipment, and Notification Logs. The Plant section shows a table with columns for Plant, Health Score, Health Status, Equipment Affected, Plant Reports, Notes, Estimated Weekly Energy Loss, and Estimated Weekly CO2 Emissions. The Equipment section shows a table with columns for Equipment, Health Status, Remaining Useful Life, History, Utilization Factor, Idle Time, Equipment Reports, Notes, Estimated Weekly Energy Loss, and Estimated Weekly CO2 Emissions. The Notification Logs section shows a table with columns for Plant, Equipment, Component, Date & Time, Graph, Subject, Acknowledgement Status, Feedback, Maintenance Type, Feedback Duration, and User. A right sidebar displays the Company Health Summary, including a 97% Health Score gauge and a list of health categories: Healthy (16), Needs Maintenance (1), Needs Attention (1), Needs Immediate Attention (0), Anomaly Detection Only (0), No Data (0), and Learning (0).

Navigation

Company Selection

Settings & Help

Equipment

Notification Management

Company Health Summary

Navigation

Facilitates rapid access to various sections of the dashboard, with available options contingent upon user privileges and activated features.

Company Selection

Enables users with access to multiple companies to make selections from a dropdown menu.

Company Health Summary

Displays the total number of equipment under each health status for the currently selected plant/s.

Plant

This section furnishes an inclusive health assessment and status overview for each of the company's plants. The presentation is structured based on the health score, with the lowest scores taking precedence. By default, the first plant on the list is automatically selected, although the option to select multiple plants is available. The chosen plant's details will be displayed in the machine/equipment tab below, along with a concise "Plant Health Summary" on the right-hand side.

Features



Plant List: Encompasses a comprehensive listing of all company plants, each accompanied by a checkbox for selecting the desired plant(s) to populate the equipment list.



Health Score: Represents a computed value reflecting the overall health of a specific plant, derived from the collective health status of the respective equipment under that plant. (Refer to Appendix C for detailed information)



Health Status: Indicates the current health status of the most compromised equipment within the plant.



Equipment Affected: Displays the count of equipment exhibiting an increased health status within the plant.



Plant Report: Serves as a centralized repository for storing supplementary findings and reports specific to individual plants.



Notes: Facilitates the addition of remarks at various levels of the hierarchy.



Action: Enables users to rename both the equipment and plant names as needed.

Equipment

Based on the selected plant(s) (which can be multiple), the equipment will be listed in order of priority, with the lowest health score ranked first.

Features



Equipment List: Displays all equipment corresponding to the selected plant(s) from the Plant section.



Health Status: Determined by the active Fault Severity/stage (2/3/4) and the Remaining Useful Life (RUL). (Refer to Appendix C for detailed information)



Remaining Useful Life (RUL): Represents the remaining useful life of the most critical or degraded component in an equipment. Presented as a percentage up to 750 hours (+- 30 days), after which it is displayed in hours.



Utilization Factor: Indicates the percentage of running measurement points relative to the total measurement points.



Idle Time: Provides an indication if the equipment has not operated for a specific number of days. (Refer to notifications settings for details)



Image: Displays an image of the equipment.



Equipment Report: Serves as a central repository for analysis reports and additional findings.

Notifications

Notifications from the selected plant(s) (accessible to the user) will be exhibited for the previous 2 weeks, with the most recent appearing first.

Features



Plant/Equipment/Component: Indicates the location where the notification was triggered.



Date & Time: Displays the exact moment when the notification was triggered.



Graph: Provides a hyperlink redirecting to the component page that initiated the notification.



Subject: Specifies the subject of the notification.



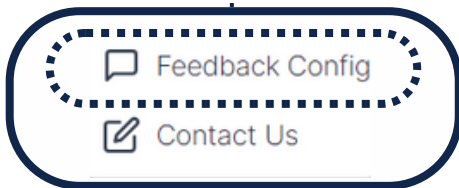
Acknowledgement Status: Allows for the acknowledgment of notifications, signifying that they have been reviewed. Users can hover over to view which user acknowledged it.



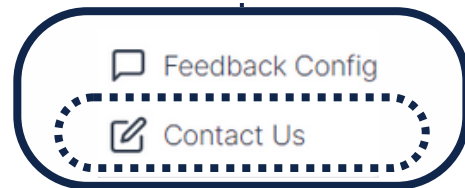
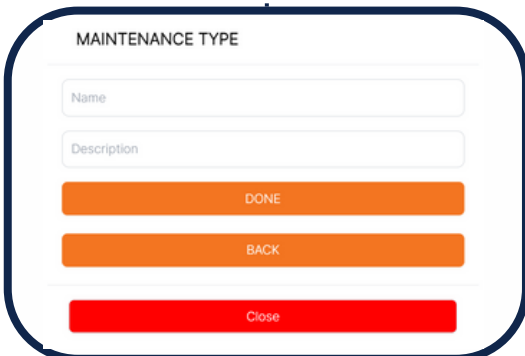
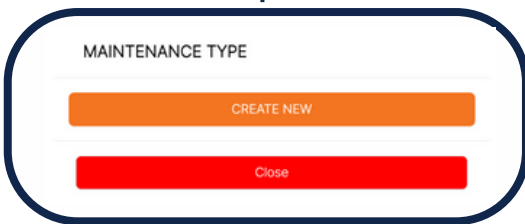
Feedback: Enables users to log follow-up actions resulting from a notification. Users can select a predefined maintenance type, provide a description, specify the time range, and allocate resources. Once saved, the entry will be visible in the notification log, facilitating the closure of the loop and ensuring a comprehensive record of actions taken and by whom.

Settings

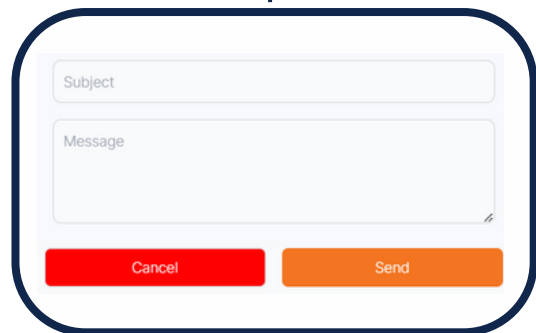
Provides access to various user and company settings, along with pertinent information concerning health statuses and notification types.



Customize Maintenance Types and Actions



Reach out to customer-success@nanoprecise.io



Notifications

Enable and Control Pop-Up Notifications



NOTIFICATION ALERT SETTINGS X

Show pop-ups for new alerts :

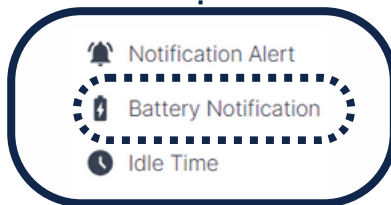
Play sound when new alert received :

Notifications Scan Interval : 5 Minutes v

Notifications Sound : Message Alert v

Submit
Test

Configure notifications for battery levels below a specific threshold



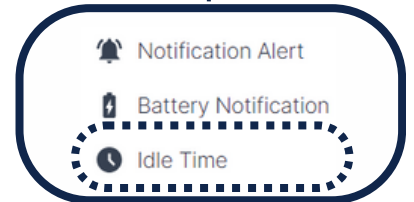
BATTERY NOTIFICATION SETTINGS X

Enable Battery Notification

2.5V 2.6V 2.7V 2.8V 2.9V 3V

Save

Establish configuration for displaying idle time indications in the equipment overview for a specified number of days

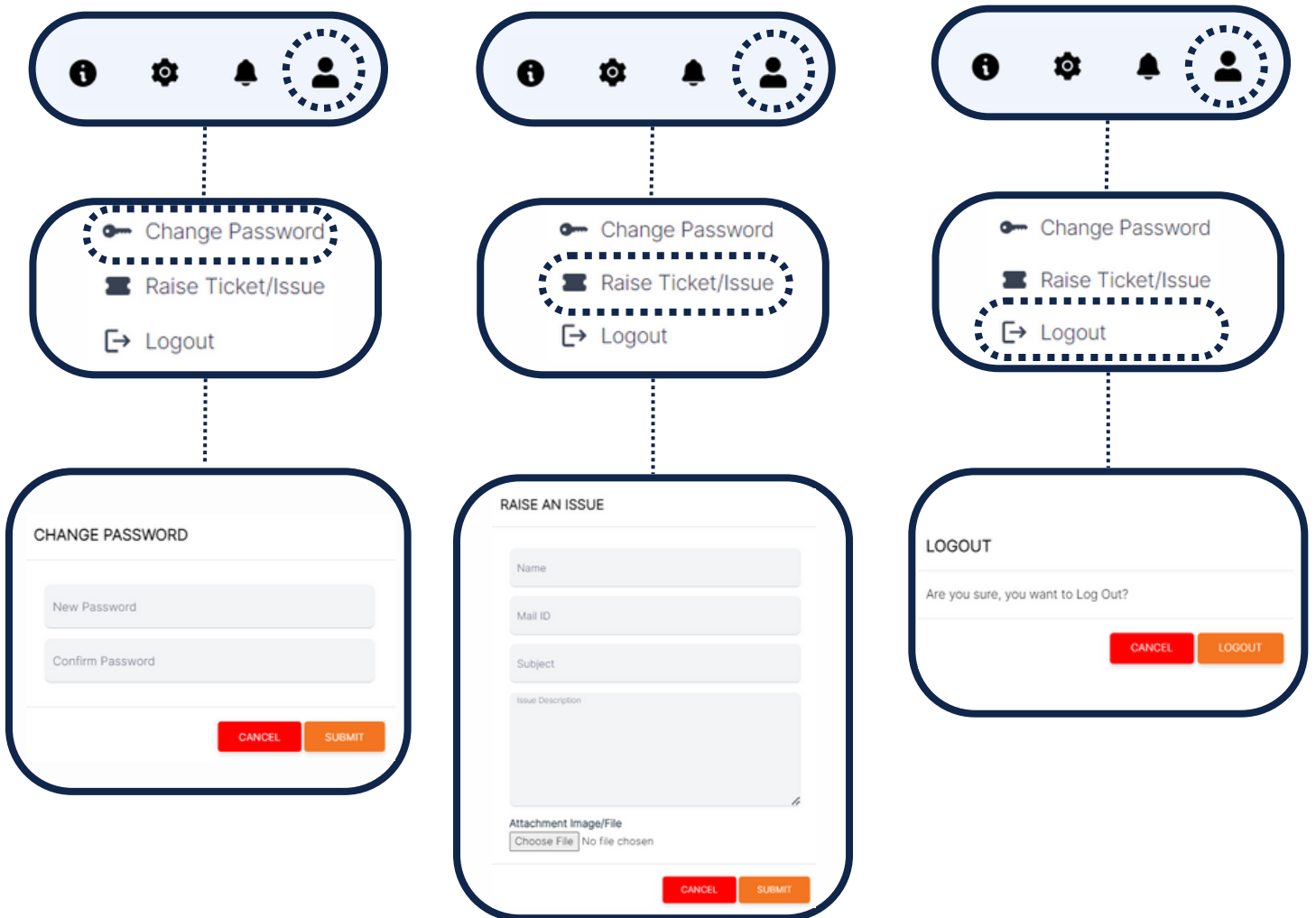


IDLE TIME SETTINGS

	Min	Max
<div style="width: 15px; height: 10px; background-color: #f1c40f; margin-right: 5px;"></div> Yellow	<input type="text" value="31"/>	<input type="text" value="60"/>
<div style="width: 15px; height: 10px; background-color: #e67e22; margin-right: 5px;"></div> Orange	<input type="text" value="61"/>	<input type="text" value="90"/>
<div style="width: 15px; height: 10px; background-color: #e74c3c; margin-right: 5px;"></div> Red	<input type="text" value="91"/>	

User Settings

Access password modification, ticket submission, and logout functionalities



Info

The info button shows details on different notification types and what triggers each and also how we define health status based on Fault Severity and RUL

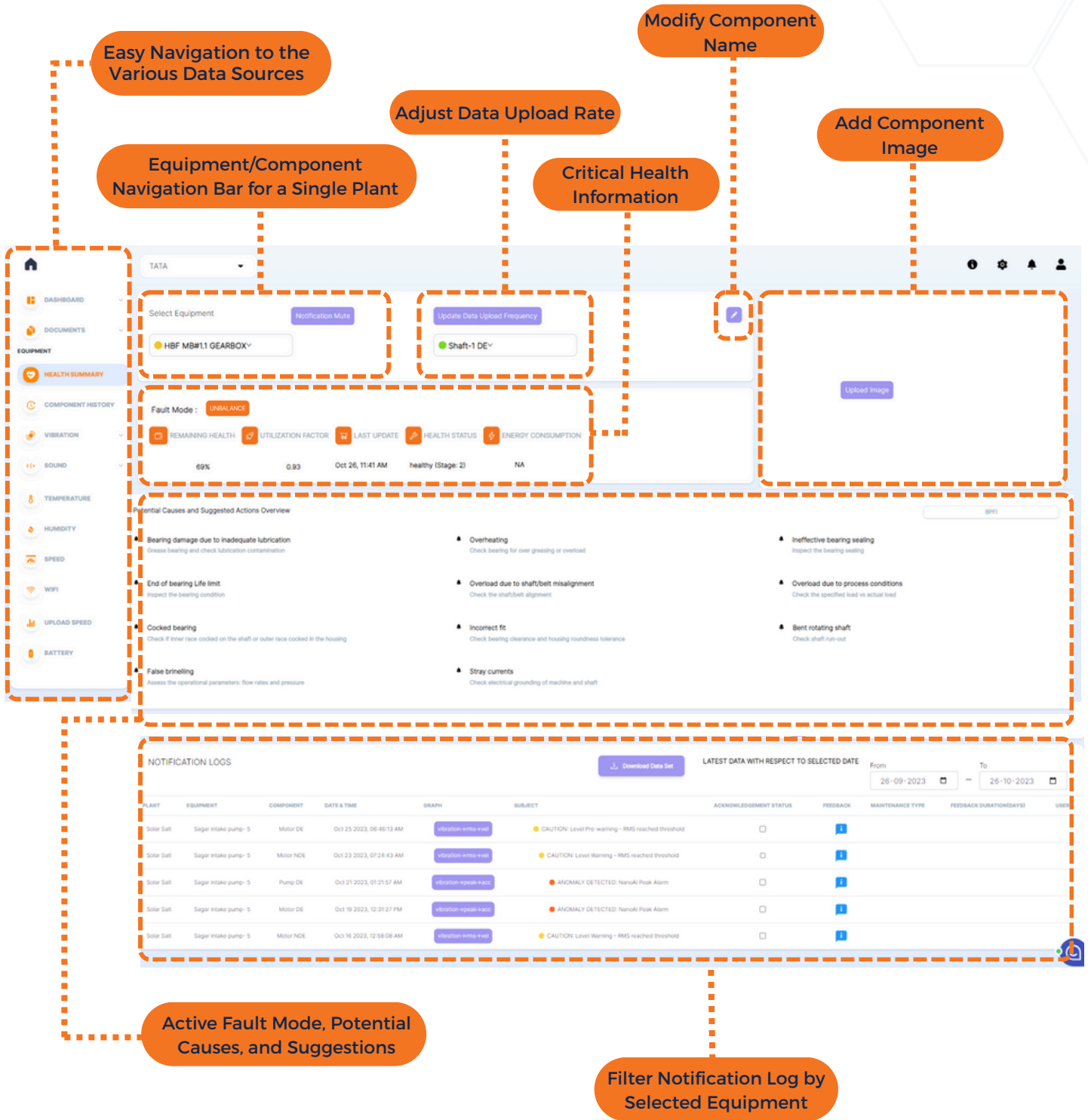


Summary on notification type and notification email subject:

Notification Source	Notification Type	Notification Email Subject
	Notifications on Health Status Summary and Remaining Useful Life (RUL)	● LATE-STAGE FAULT: Attention is required for your equipment
	Notification by NanoAI Alarm	● EARLY-STAGE Amplitude Alarm ● ANOMALY DETECTED: NanoAI RMS Alarm ● ANOMALY DETECTED: NanoAI Peak Alarm
Notifications from Cloud Computation	Notification by Email alarm	● ANOMALY DETECTED: Sound RMS Alarm ● CAUTION: Level Alarm - Peak /RMS reached threshold

[Close](#)

Component Health Summary



The screenshot displays the 'Component Health Summary' interface for a 'TATA' plant. The interface includes a sidebar with navigation options like Dashboard, Documents, Equipment, Health Summary, Component History, Vibration, Sound, Temperature, Humidity, Speed, WiFi, Upload Speed, and Battery. The main content area shows the selected equipment 'HBF MB#11 GEARBOX' and 'Shaft-1 DE'. It features a 'Fault Mode' section with 'UNBALANCE' and various metrics like Remaining Health (69%), Utilization Factor (0.93), Last Update (Oct 26, 11:41 AM), Health Status (healthy (Stage: 2)), and Energy Consumption (NA). Below this is a 'Potential Causes and Suggested Actions Overview' section with a grid of fault types and their descriptions. At the bottom, there is a 'NOTIFICATION LOGS' table with a date filter and a 'Download Data Set' button.

Easy Navigation to the Various Data Sources

Equipment/Component Navigation Bar for a Single Plant

Adjust Data Upload Rate

Critical Health Information

Modify Component Name

Add Component Image

Active Fault Mode, Potential Causes, and Suggestions

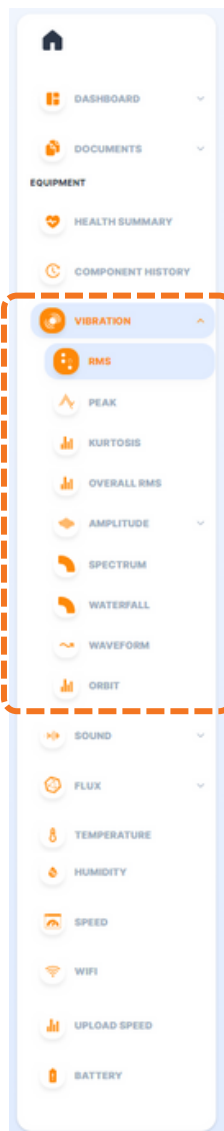
Filter Notification Log by Selected Equipment

Navigation and General Functionality

Navigation

The data sources are individually selectable, and the navigation tree expands accordingly to display all available options within each data type.

Navigate seamlessly and explore the diverse functionalities available within the platform. Familiarize yourself with the comprehensive and user-friendly features that facilitate an enhanced user experience and streamlined operations.



Vibration Parameters

Trending Graph Functionality

The screenshot displays the trending graph functionality with several key features highlighted by callouts:

- Select Direction (Z-Y-X), Comparison, Resultant:** Callout pointing to the top navigation bar with options: Vib-Z Horizontal, Vib-Y Axial, Vib-X Vertical, Comparison, and Resultant $\sqrt{X^2+Y^2+Z^2}$.
- Equipment, Component, and Unit Selectors:** Callout pointing to the configuration section where 'Flash Exhaust Blower' is selected for Equipment, 'FAN NDE' for Component, and 'Velocity (mm/sec)' for Unit.
- Download Data:** Callout pointing to the '+ RMS Data' button.
- Set user defined thresholds that will trigger notifications:** Callout pointing to the 'Email Alarm' button.
- Plot Time Axis to True Scale:** Callout pointing to the 'Turn ON Distribution' button.
- Time Scaler for Swift Data Access within a Defined Period; Select Dates to Display Corresponding Data:** Callout pointing to the time scale buttons: Day, Week, Month, 6 Month, and Year.

The graph itself shows 'Velocity (mm/sec)' on the y-axis (0 to 15) and time on the x-axis (from 26-09-2023 to 26-10-2023). It includes a legend for NanoA1 Threshold (red dot), Non Running RMS (black dot), RMS (green dot), and Smooth RMS (yellow line). A threshold update timestamp of 'October 24 2023 3:29:44 PM' is also visible.

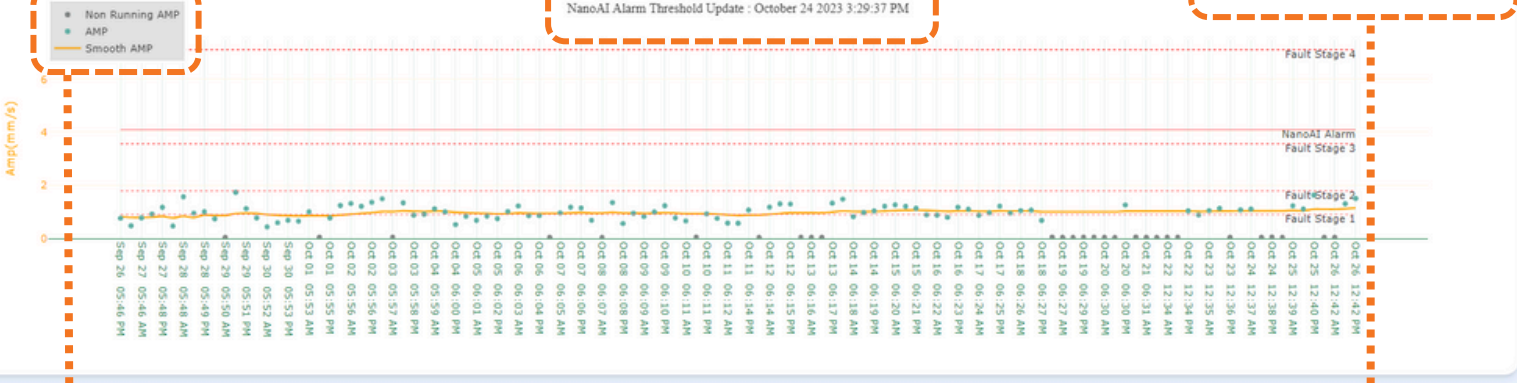
Amplitude Graph

Title and when NanoAI was last updated time

BEARING OUTER RACE
NanoAI Alarm Threshold Update : October 24 2023 3:29:37 PM



Legend for Amplitude Graphs



Zoom and other graph options

Legend for Amplitude Graphs

- Non Running AMP
- AMP
- Smooth AMP

Legend for Vibration Graphs

- NanoAI Threshold
- Non Running RMS
- RMS
- Smooth RMS

Spectrum & Time Waveform Graph

Equipment, Component, Units and domain Selector

The screenshot shows the software interface with several key elements:

- Mount Type:** Horizontal (Vib-Z)
- Equipment:** Flash Exhaust Blower
- Component:** FAN NDE
- Unit:** Velocity (mm/sec)
- Domain:** Frequency Domain
- Date/Time:** Oct 26 2023, 12:42:51 PM
- Graph Area:** Shows a spectrum plot with Velocity (mm/sec) on the y-axis (0 to 5) and Frequency (Hz) on the x-axis (0 to 7000). Vertical grid lines are present at 1000 Hz intervals. A 'Turn On Range' button is set to 1000.
- Legend:** Frequency

Last 30 days data (Grey = Not Running). Last running speed is selected by Default

Turn On Frequency Axis Zoom Range

Frequency Markers

Vibration

RMS, Peak, Kurtosis, Overall RMS

RMS

Vibration RMS is the root mean square of the entire frequency range of the vibration waveform. It describes the energy emitted by the machine, the higher the energy, the higher the RMS value is.

PEAK

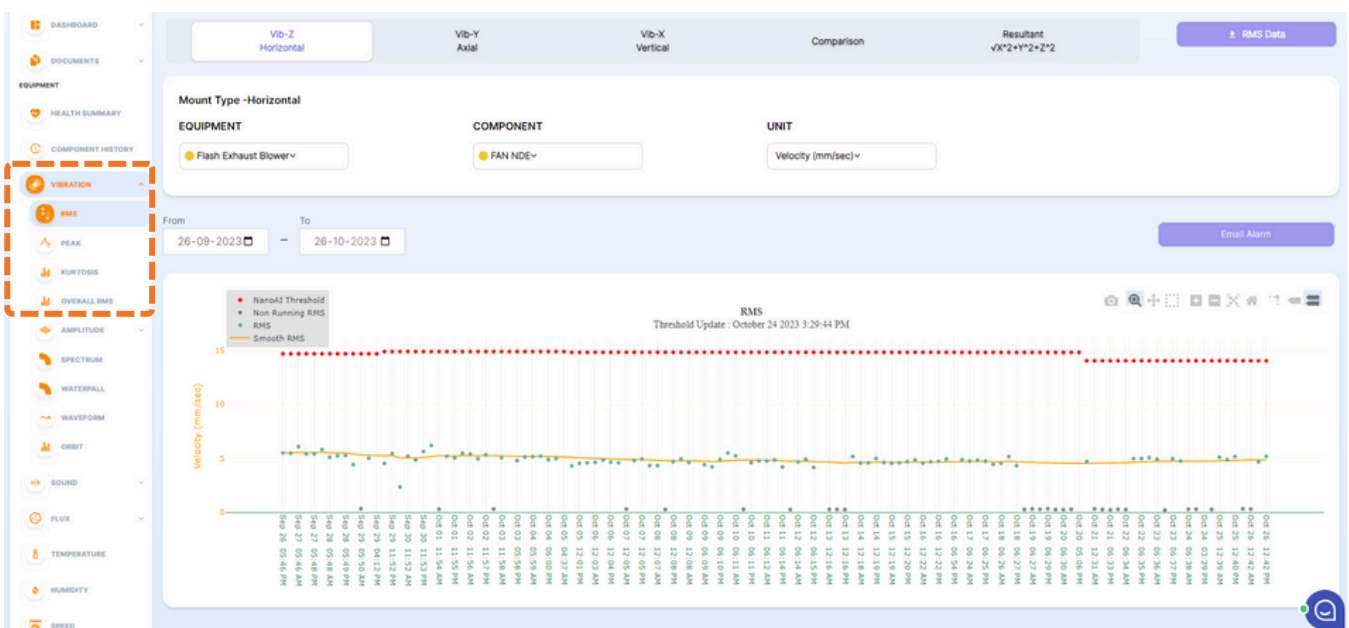
Vibration peak refers to the maximum excursion of the time wave from the zero point. The amplitude describes the severity of a specific fault mode.

KURTOSIS

Kurtosis provides a measure of the peak intensity within a vibration signal. Signals that have a higher kurtosis value have more peaks that are greater than three times the RMS value.

OVERALL RMS

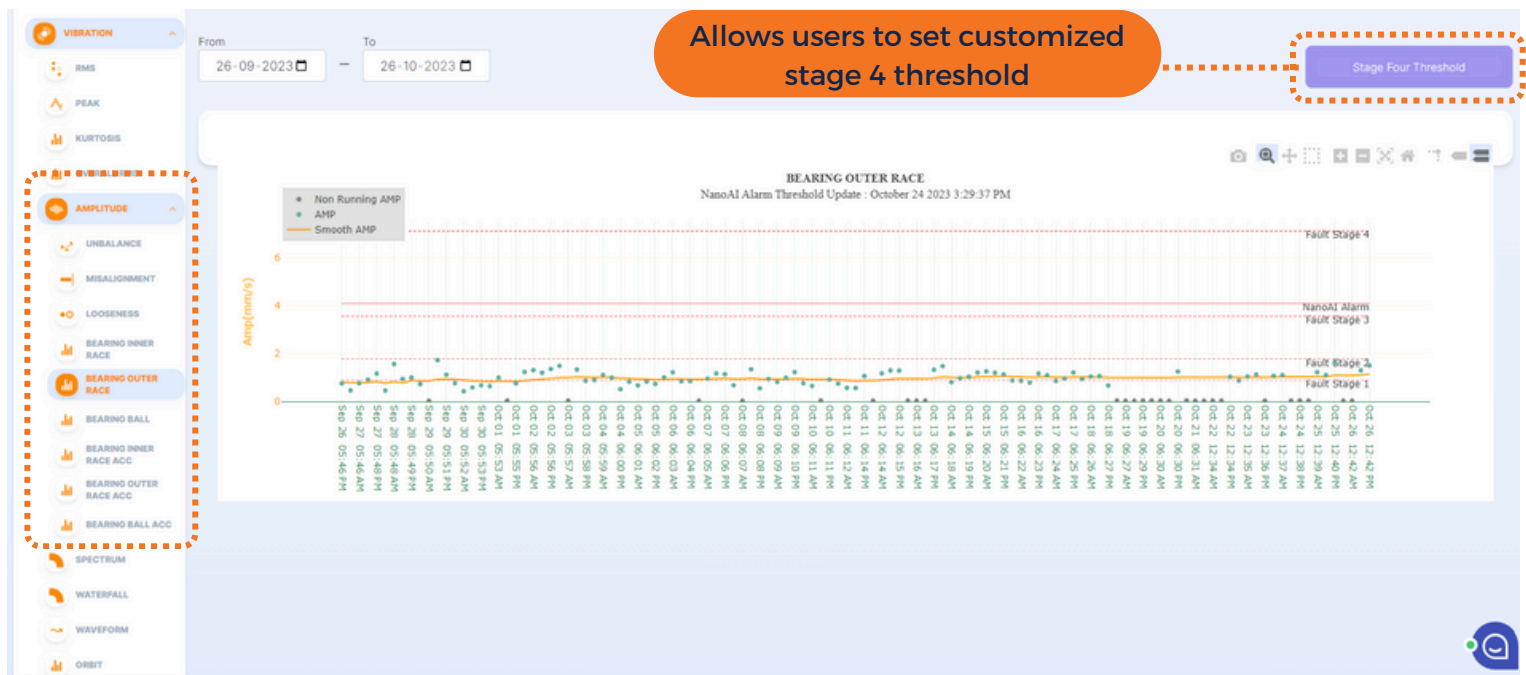
Overall RMS is the root mean square of the vibration waveform from 2-1000 Hz as of ISO10816. It describes the energy emitted by the machine, the higher the energy, the higher the RMS value is.



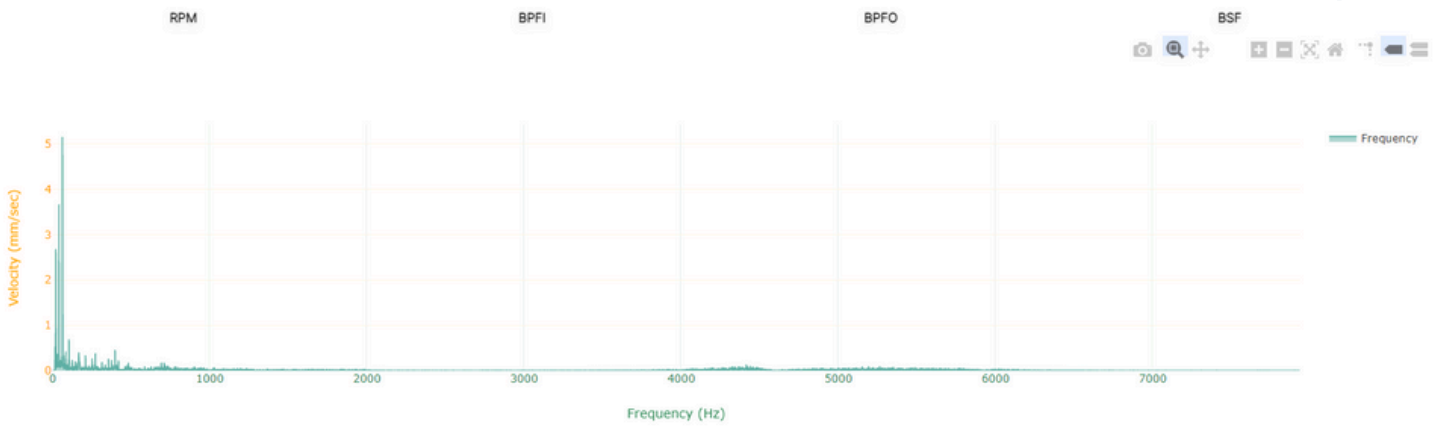
Amplitude

The amplitude graphs correspond to the monitored component, with each sensor configured to cover relevant fault modes based on its specific location. For instance, antifriction bearing faults are addressed through graphs for Bearing Inner Race, Bearing Outer Race, and Bearing Ball, while options for shaft faults encompass unbalance, misalignment, and looseness.

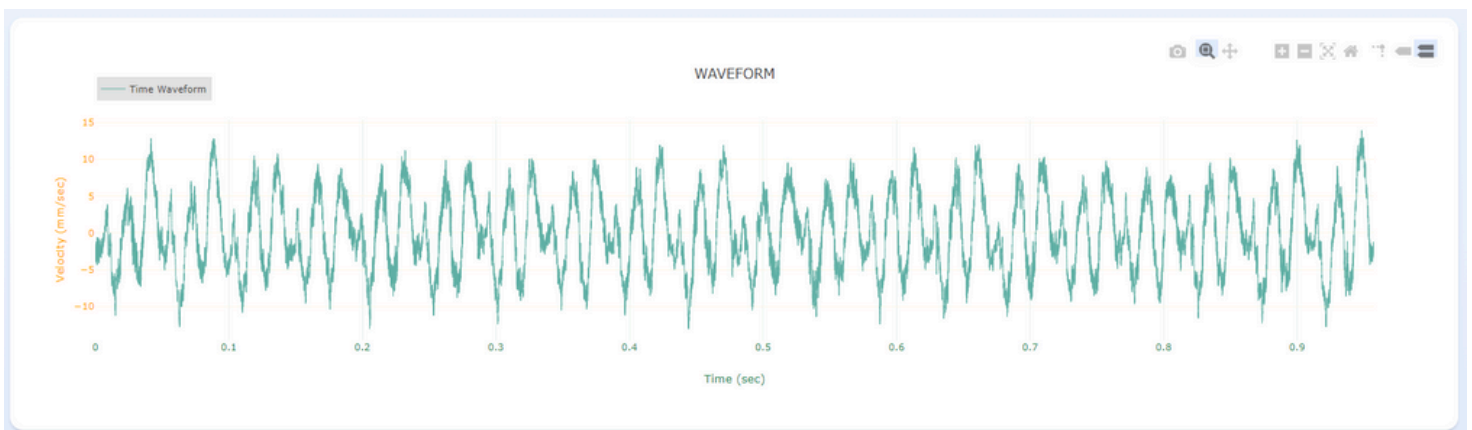
These graphs play a crucial role in determining the Remaining Useful Life (RUL) of a component, with each fault categorized into four stages. RUL is calculated as the time taken to reach Fault Stage 4, with the equipment deemed unstable upon crossing the Fault Stage 4 threshold. Appendix D provides additional insights into the initial setting of the Stage 4 threshold during the learning phase and its subsequent self-adaptive behavior.



Spectrum



Waveform



Waterfall Spectrum

EQUIPMENT

Flash Exhaust Blower

COMPONENT

FAN NDE

UNIT

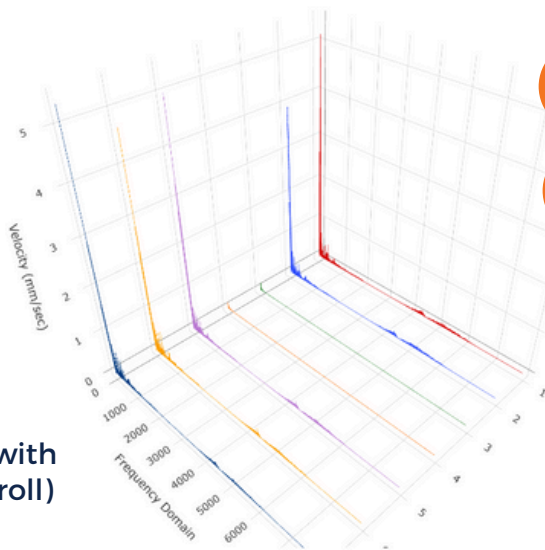
Velocity (mm/sec)

DOMAIN

Frequency Domain

- Oct 26 2023, 12:42:51 PM ✕
- Oct 26 2023, 06:42:27 AM ✕
- Oct 26 2023, 12:42:01 AM ✕
- Oct 25 2023, 06:41:37 PM ✕
- Oct 25 2023, 12:40:43 PM ✕
- Oct 25 2023, 06:40:09 AM ✕

Oct 25 2023, 12:39:10 AM ✕



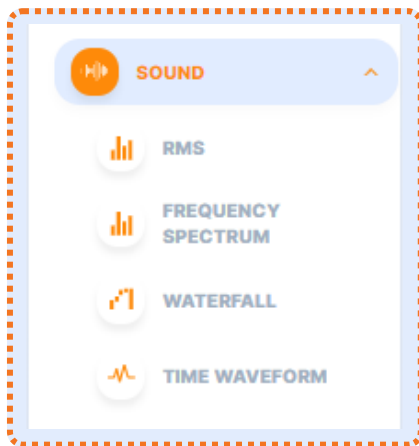
Allows to select up to 7 timestamps to plot in waterfall

Last 7 days running data is selected by default

Can be moved in 3D with mouse and zoom (scroll)

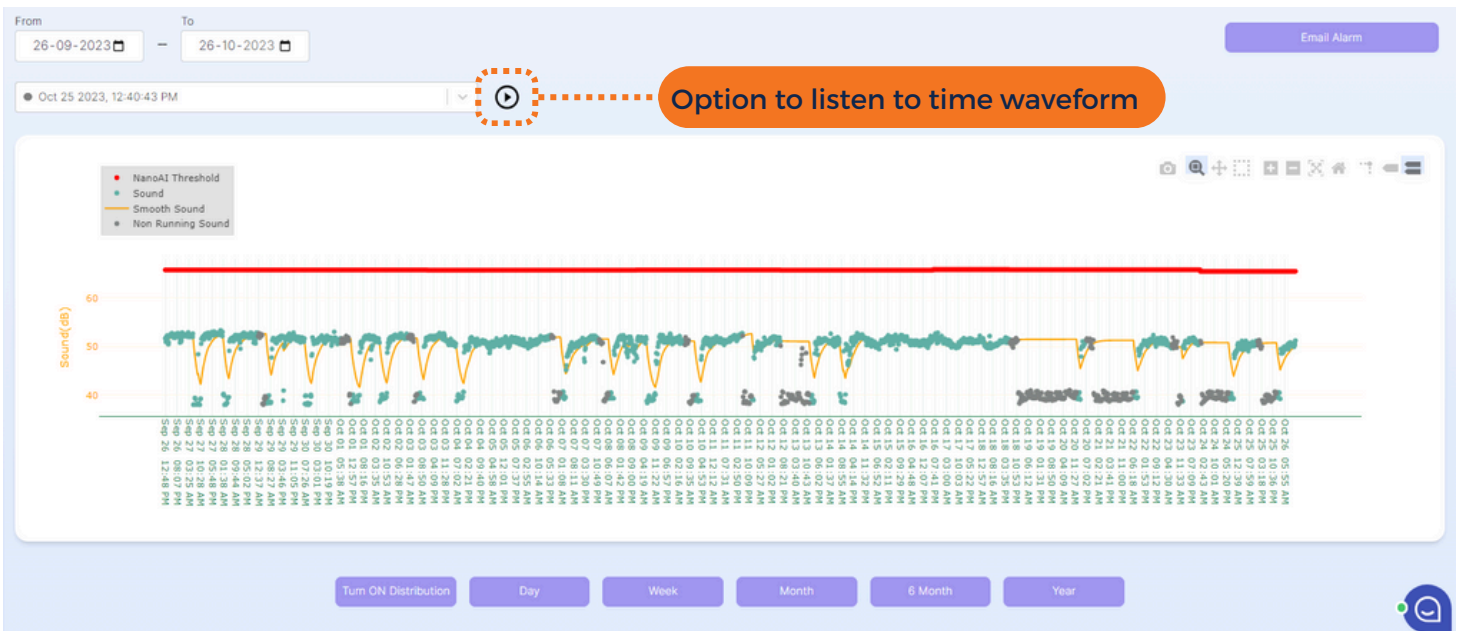
- 1->2023-10-26 12:42:51 PM
- 2->2023-10-26 06:42:27 AM
- 3->2023-10-26 12:42:01 AM
- 4->2023-10-25 06:41:37 PM
- 5->2023-10-25 12:40:43 PM
- 6->2023-10-25 06:40:09 AM
- 7->2023-10-25 12:39:10 AM

Sound

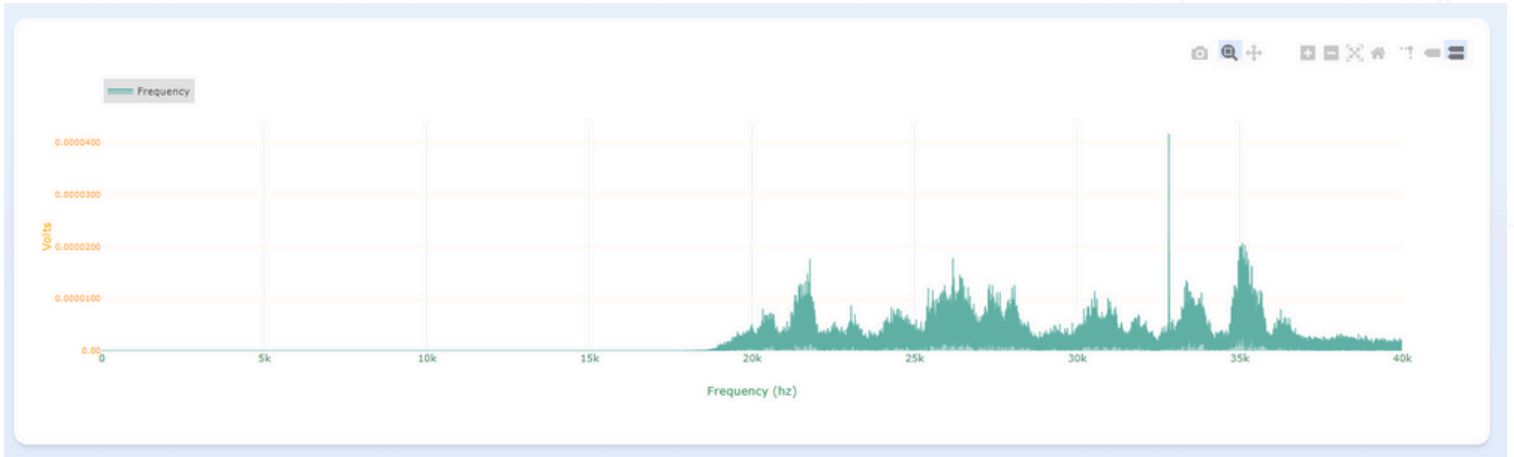


The acoustic emission data has a set frequency range of 20kHz - 40 or 80 kHz to capture the maximum amount of useful data, which is beyond human hearing range.

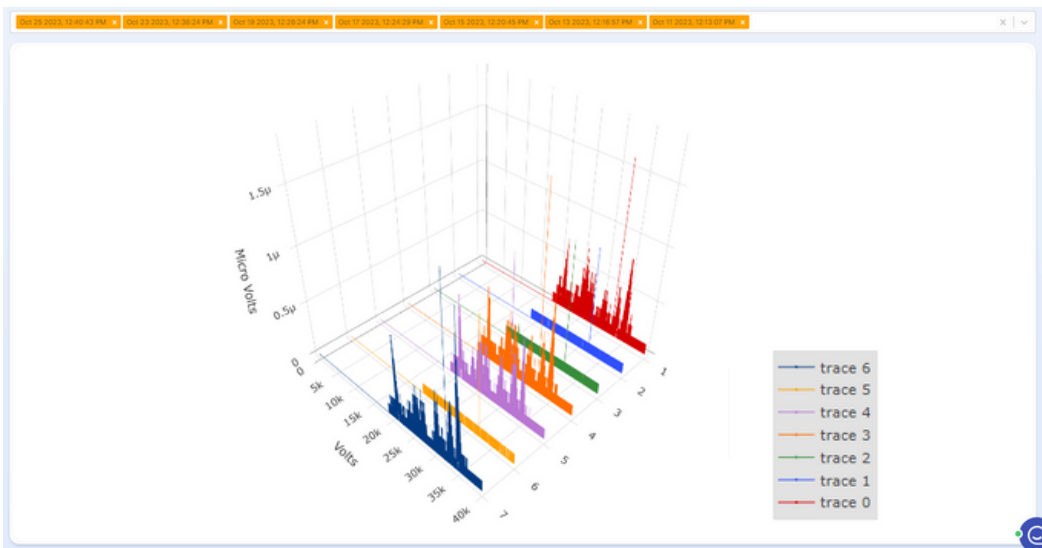
RMS



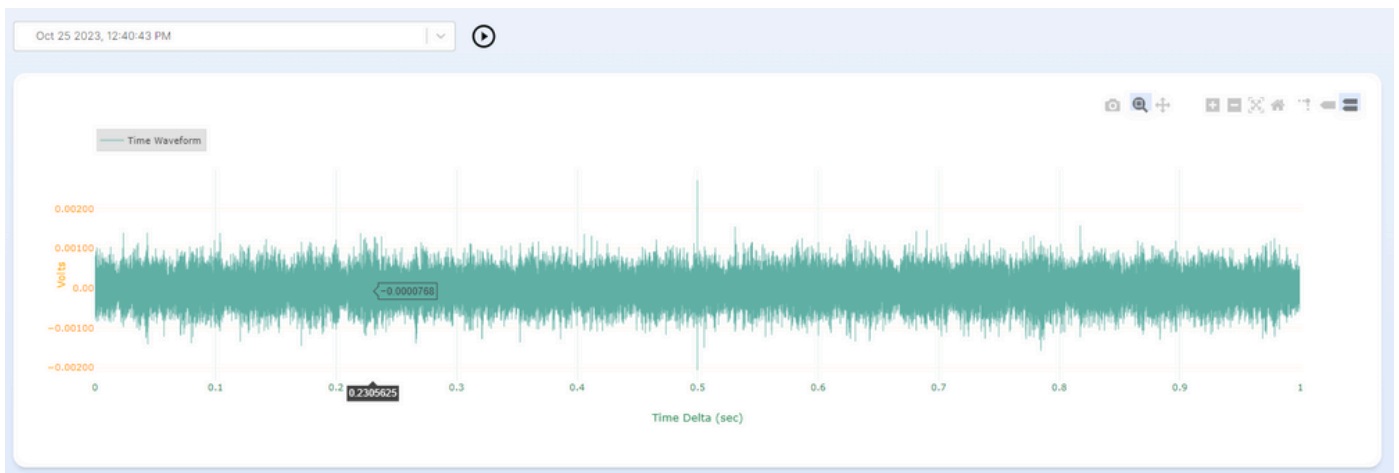
Spectrum



Waterfall Spectrum



Time Waveform



Magnetic Flux

The graph represents magnetic flux near the sensor mounting position. It displayed in RMS, Spectrum and Time Waveform.

Temperature

Temperature graph represents surface temperature of each location on which the sensor is mounted.

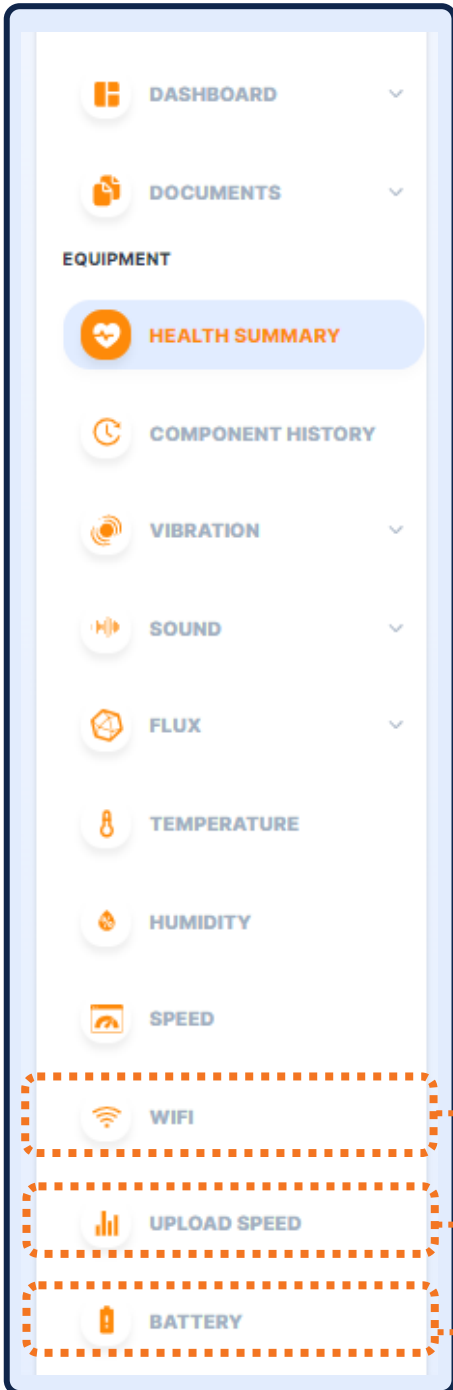
Humidity

The humidity graph represents the atmospheric humidity value near the sensor.

Speed

The speed graph provides RPM of the equipment, which is extracted from the vibration or flux signal.

Device Metrics



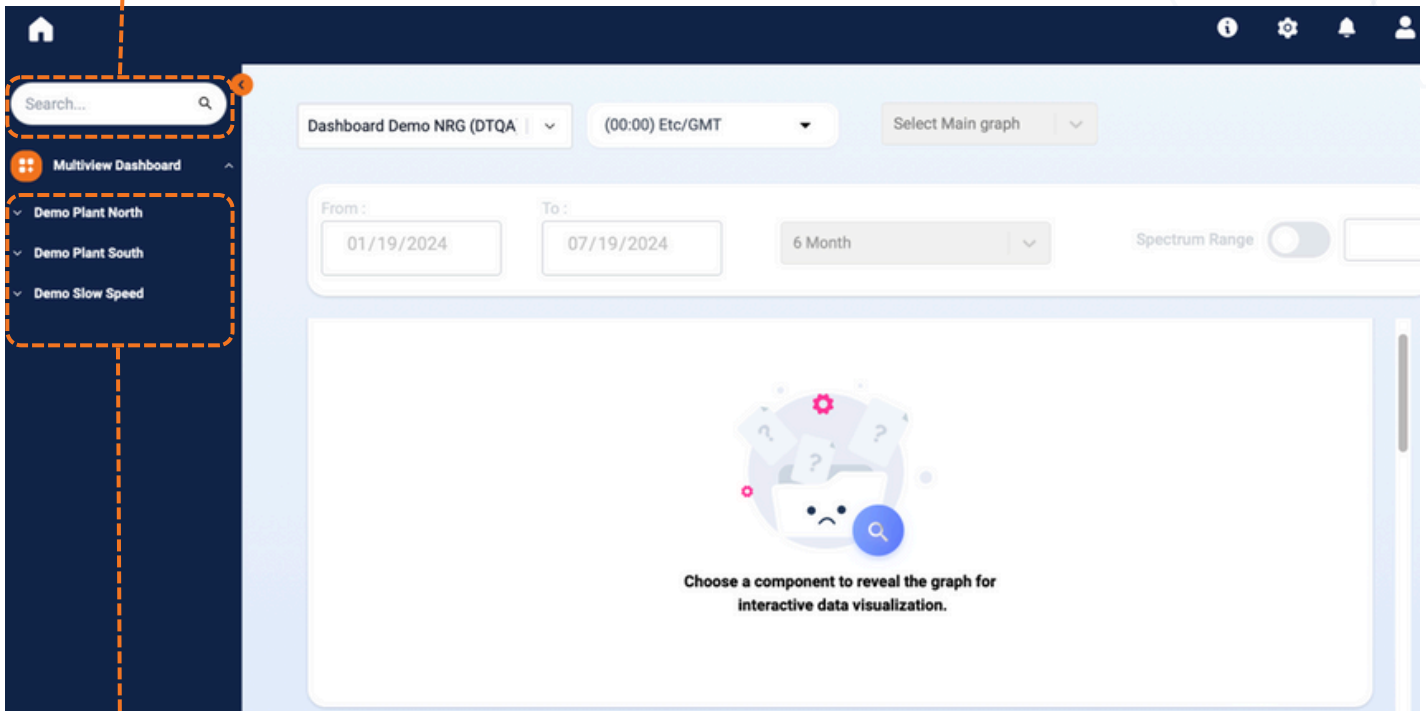
The Wi-Fi graph provides the strength of the network. Higher values (greater than -70dBm) represent good connectivity.

Upload speed is measured and displayed in trend with every data upload.

The battery graph indicates the current status of battery life.

Multi View Dashboard

Search Filter



Machine Tree

Getting Started

To populate Multiview dashboard, use the Machine Tree in the navigation pane to view the graphs for those component(s). Use the Search Filter to quickly identify plants, equipment, and components.

Select and compare charts across different components and data types.

If only one component is selected, RMS & Peak vibration, sound, and temperature charts will be shown. Vibration RMS will be the default chart for more than one component selected. Default chart is changed via the selector.

Multi View Settings

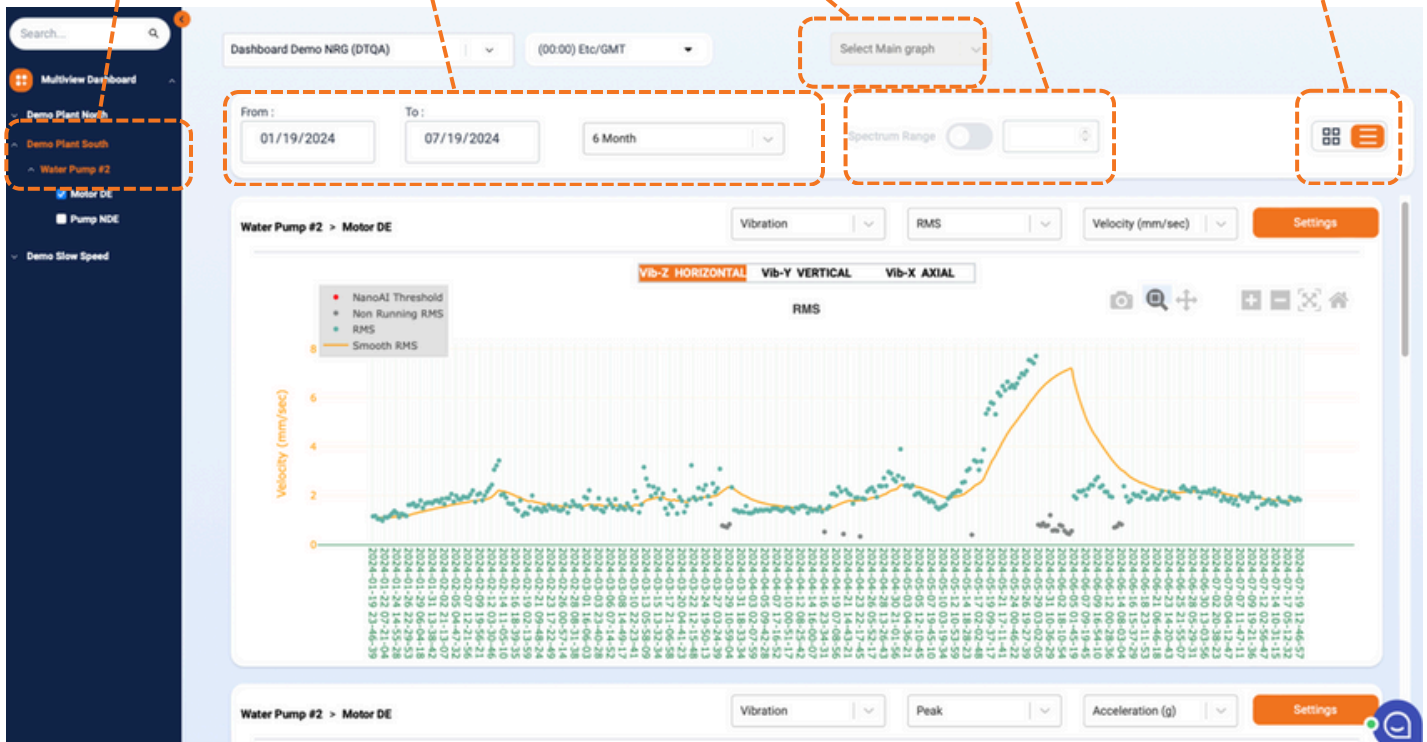
Highlighted Selections

Chart Period

Default Graph

Spectrum Frequency

Switch Between Quad View & List View



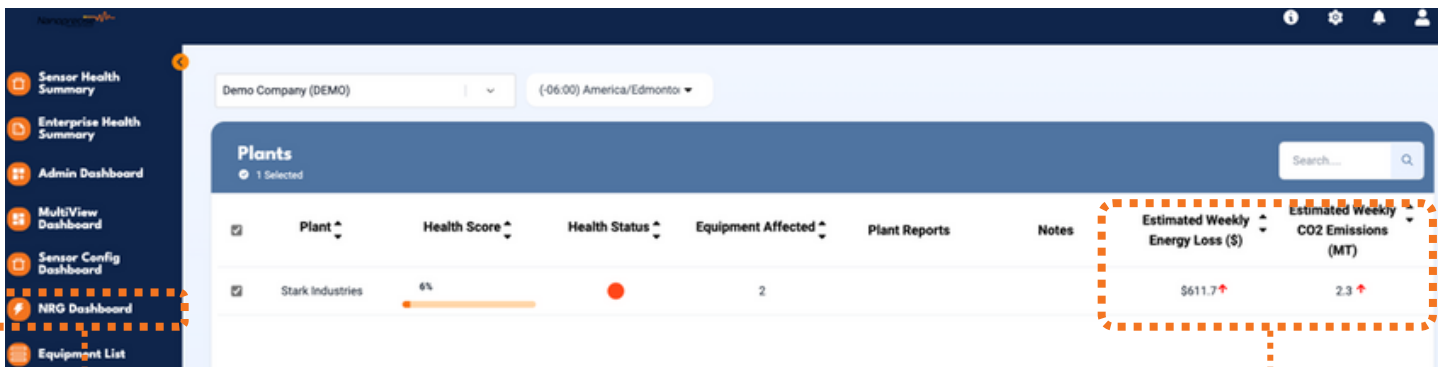
NRG Dashboard

Nanoprecise’s NRG Dashboard revolutionizes maintenance strategies by focusing on energy optimization and sustainability. Through predictive analytics, it anticipates energy consumption changes and enables early fault detection to reduce energy waste and lower operating expenses.

Where to find

Access your NRG Dashboard via the left navigation pane upon logging into the Nanoprecise platform.

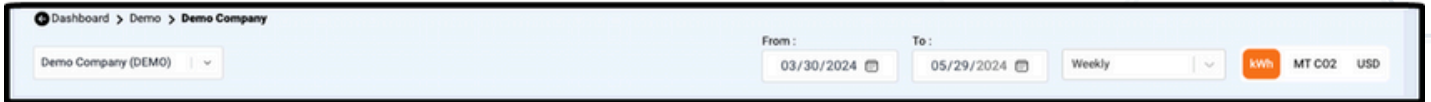
Login:



[Click here to access the NRG Dashboard!](#)

[NRG Monitor plant summary information](#)

Settings



Company Selection

If applicable, and with the appropriate user credentials, users may view the NRG Dashboards for individual organizations and companies.
Note: Click home to return to the main landing page.

Chart Period

Use the “From” and “To” date selectors to set the time window when viewing the Historical Increased Energy Consumption chart. This helps observe the change over time. Toggle between: Daily, Weekly, Monthly and Quarterly intervals.

Chart Units

Toggle between units across Δ Energy Consumed (kWh), Δ Emissions Generated (MTCO₂) and Cost of Δ Energy Consumed (Using currency based on user’s region).

Note: This setting affects both the Total Change in Energy Consumption and Historical Change in Energy Consumption charts.

Total Change in Energy Consumption

Here is the aggregate change in power consumption across all equipment type classes. This delta (change) in power consumption is indicated as it relates to the baseline performance of individual equipment.

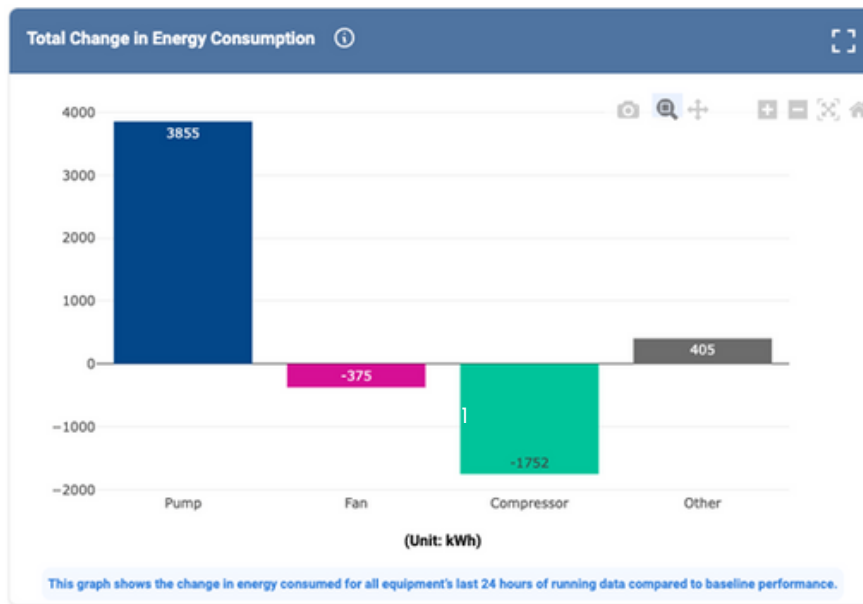


Chart Features



Equipment Type: Depending on the different types of equipment being monitored, they will show up as individual color-coded columns in this chart.



Total kWh Increase (or Decrease): For each equipment type column, the numerical value indicates the total kWh increase (negative value for decrease) of power consumption for all equipment of that equipment type.



Chart Viewer Controls: On top of the chart are the viewer controls. Users can download (screenshot), zoom, pan, and autoscale (reset zoom). Users can also enlarge the chart via the maximize icon on the top right.



Units Adjustment: The units selector on the top right of NRG Dashboard toggles Δ energy consumption metrics in the form of energy (kWh), emissions (MT CO₂), or currency (region-based). All metrics are equivalent estimates.

Total Power Rating for All Monitored Equipment

Here is the distribution of a plant/organization's equipment types and the total power rating across all their equipment (in Horsepower). This is for latest data shown today.

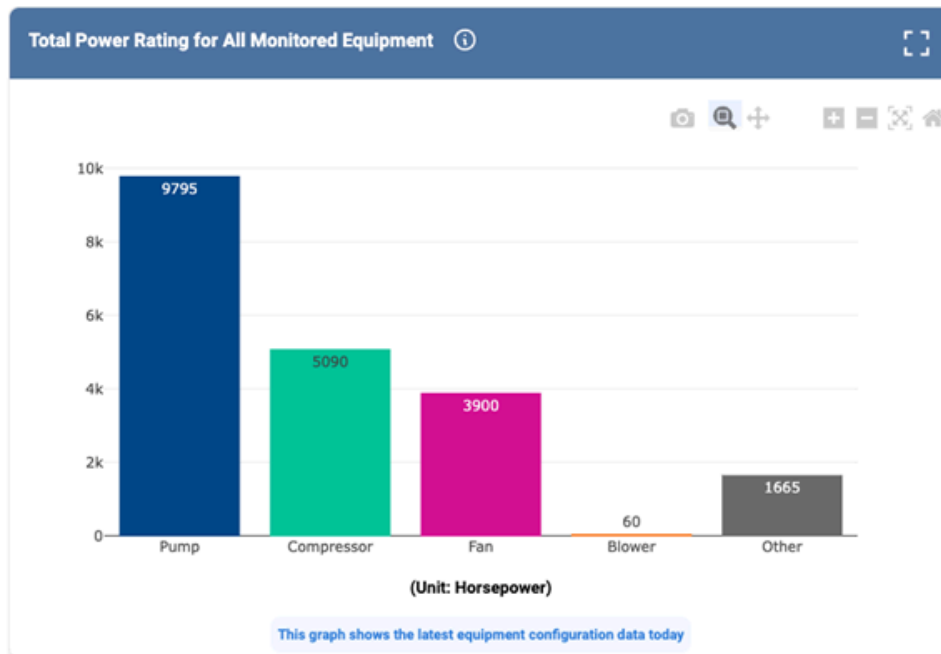


Chart Features



Equipment Type: Depending on the different types of equipment being monitored, they will show up as individual color-coded columns in this chart.



Total Horsepower Rating: For each equipment type column, the numerical value indicates the total horsepower of all equipment of that type. This data is static and unaffected by NRG Dashboard period or unit settings.



Chart Viewer Controls: On top of the chart are the viewer controls. Users can download (screenshot), zoom, pan, and autoscale (reset zoom). Users can also enlarge the chart via the maximize icon on the top right.

Historical Change in Energy Consumption

Here is a pareto chart on the trend for changes in power consumption for all an organization's equipment. This delta (change) in power consumption is indicated as it relates to the baseline performance¹ of individual equipment.

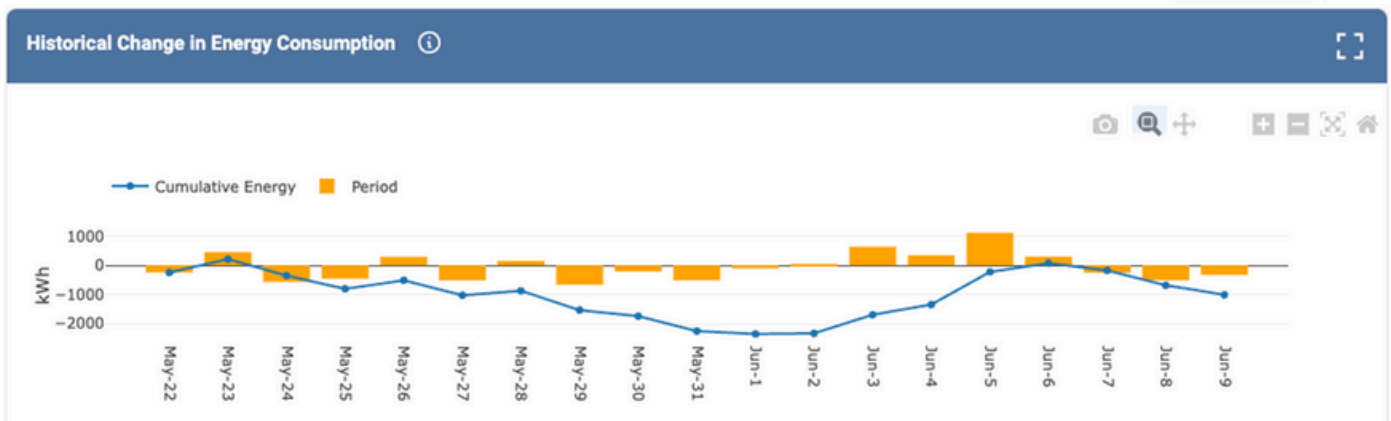


Chart Features



Total kWh Increase (or Decrease): For timestamp columns, the numerical value indicates the total kWh increase (negative value for decrease) of power consumption compared to baseline.¹ This is for all the company's equipment.



Cumulative Energy Losses (or Savings): The cumulative line shows the aggregate energy losses (negative value for savings) as time has passed.



Chart Viewer Controls: On top of the chart are the viewer controls. Users can download (screenshot), zoom, pan, and autoscale (reset zoom). Users can also enlarge the chart via the maximize icon on the top right.



Units Adjustment: The units selector on the top right of NRG Dashboard toggles Δ energy consumption metrics in the form of energy (kWh), emissions (MT CO₂), or currency (region-based). All metrics are equivalent estimates.



Period Adjustment: The period selector on the top right of NRG Dashboard can change the time interval (select window between two dates) and frequency (daily, weekly, monthly or quarterly) of the trend data.

¹Baseline performance as analyzed by Nanoprecise NRGMonitor™

Energy Intensity Last 24h

Here is the measured energy intensity for all a company's plants over the past 24 hours. This is a ratio of the change in power consumption for all equipment to the total rated power for all equipment. Higher values indicate more inefficiency when compared to baseline.¹

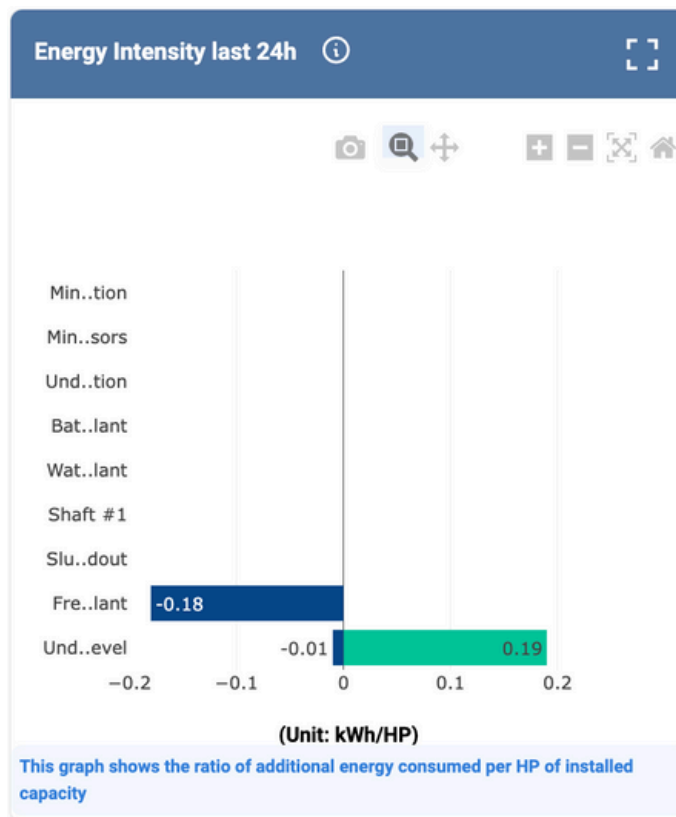


Chart Features



Plant: Depending on the user's access credentials, the rows of this chart will show the various companies/plants of the organization.



Energy Intensity: For each row, the numerical value indicates the energy intensity across all a plant's equipment for the past 24 hours. Higher values indicate increasing inefficiency while negative values suggest improvements.



Chart Viewer Controls: On top of the chart are the viewer controls. Users can download (screenshot), zoom, pan, and autoscale (reset zoom). Users can also enlarge the chart via the maximize icon on the top right.

Appendix A

NanoAI Alarm & Adaptive Fault Amplitude Threshold

- Threshold is automatically updated every 30 days based on the data of the last 30 days
- AI trained model is used to capture the features of data
- Threshold is set/modified to adapt to the features
- No prior knowledge is required from customer
- Alarms will be automatically sent to customer if RMS/Peak hits the threshold
- Applies to RMS/Peak of vibration signals (acceleration & velocity) and RMS of ultrasonic signals
- It can also be applied to Amplitude fault trends

Appendix B

Vibration

Waveform

A plot of amplitude versus time. The waveform illustrates how the vibration signal (i.e., acc., vel., and dis.) appears when graphed as amplitude over time.

Spectrum

- A plot of amplitude versus frequency.
- The Spectrum is obtained by applying a Fast Fourier Transform (FFT) on Waveform, which breaks the signal down into specific amplitudes at various component frequencies
- If a machinery problem exists, FFT Spectrum provides information to help determine the location of the problem, the cause of the problem, and, with trending, how long until the problem becomes critical
- Because we know that certain machinery problems occur at certain frequencies, we analyze the FFT spectrum by looking for amplitude changes in certain frequency ranges

Frequency Spectrum Waterfall

- A three-dimensional plot in which multiple vibration spectra curves are displayed simultaneously
- On the Nanoprecise Dashboard, vibration frequency spectrum waterfall plot covers multiple spectra for the last 7 days
- By using the frequency spectrum waterfall plot, it can show how the frequency spectral structure changes over time

Amplitude

The maximum amplitude for the fault characteristic frequencies and its harmonics up to 10th order. This amplitude describes the severity of a specific fault mode. Nanoprecise uses such amplitudes for RUL calculation.

Vibration

Peak

Peak value in time domain. The maximum excursion of the time wave from the zero or equilibrium point in the time domain.

Kurtosis

Kurtosis is a statistical parameter used to characterize a signal. Kurtosis provides a measure of the peak of a vibration signal. Signals that have a higher kurtosis value have more peaks that are greater than three times the RMS value, which are, for mechanical vibration signals, the impulses introduced by the mechanical impacts, indicating the potential mechanical fault.

RMS

Root Mean Square is the square root of the average of the squared values of the vibration waveform. RMS describes the vibration energy in the machine. The higher the vibration energy, the higher the vibration RMS is.

Magnetic Flux

Time Waveform

The time waveform illustrates how the magnetic flux appears when graphed as amplitude over time.

Frequency Spectrum

A plot of amplitude in micro voltage versus frequency. The Flux spectrum describes the amplitude at each frequency component.

RMS

Root Mean Square is computed from the spectrum to quantify the magnetic flux energy emitted by the machine.

Sound

Time Waveform

The Acoustic Emission (AE) waveform illustrates how the AE signal appears when graphed as amplitude over time.

Frequency Spectrum

A plot of amplitude in micro voltage versus frequency. The AE spectrum describes the amplitude at each frequency component.

Frequency Spectrum Waterfall

- A three-dimensional plot in which multiple AE spectra curves are displayed simultaneously
- On Nanoprecise Dashboard, AE frequency spectrum waterfall plot covers multiple spectra for the last 7 days
- By using the frequency spectrum waterfall plot, it can show how the frequency spectral structure changes over time

RMS

Root Mean Square (RMS) is the square root of the average of squared values within the AE waveform. RMS characterizes the acoustic emission (AE) energy emitted by the machine. A higher AE energy level corresponds to an elevated AE RMS value.

Appendix C

Health Status

Health Status is defined by a combination of Fault Severity of the worst condition Fault Amplitude of that component and the Remaining Useful Life.

HELP INFORMATION

Based on the comprehensive signal processing and transfer learning techniques, fault severity is analyzed and trended subject to ASNT standards with proper severity stage categorization by our algorithm. Various health summary metrics in the dashboard are linked to the fault severity as mentioned in the following table:

Fault Severity	Remaining Useful Life	Health Status	Fault	Suggestion
lower than stage 2	>75%	Healthy	Not Available	None
stage 2	>50%	Healthy	Not Available	None
stage 2 & fault anomaly detected*	>50%	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	>750 hours	Needs maintenance review	Applicable fault	Review maintenance plan and parts availability
stage 3	251-750 hours	Needs attention	Applicable fault	Schedule maintenance activity
stage 3	<250 hours	Needs immediate attention	Applicable fault	Repair immediately
stage 4	0	Needs immediate attention	Applicable fault	Repair immediately

*fault anomaly detected: fault amplitude data exceeds NanoAI Amplitude threshold

Health Score

Health score on Plant level is the average rating of each equipment health status under the plant. Assuming Plant A has 4 different equipment in it. Each equipment has 4 health modes with following health modes and associated score of ranking.

- Healthy - 3
- Needs Maintenance Review - 2
- Needs Attention - 1
- Needs Immediate Attention - 0

If two equipment are in the Healthy mode, 1 is in Needs Maintenance Review mode and 1 is in Needs Attention mode then the health score will be calculated by averaging the total score. In this case, it will be calculated as $3 + 3 + 2 + 1 / 12 = 0.75 = 75$ is the health score

Remaining Useful Life

The Remaining Useful Life (RUL) in the notification is given either in percentage or in hours, by considering both the absolute amplitude values and the relative amplitude trend.

- **Absolute Amplitude Values:** Determining whether it is above or below Stage 3
- **Relative Amplitude Trend:** Determining whether it is increasing or not
 - If the trend is flat, even though its absolute value is beyond Stage 3, the predicted RUL to reach Stage 4 would still be very large
 - Otherwise, the increasing trend would lead to a short-predicted RUL to reach Stage 4.

Fault Stage	Predicted RUL in hours	RUL Representation on Dashboard
Stage 1	NA	Percentage
Stage 2	NA	Percentage
Stage 3	>750	Hours
	<750	Hours
Stage 4	>750	Hours
	<750	Hours
Note 2	Two factors are taken into consideration for RUL calculation: Absolute Amplitude and Relative Amplitude Increasing Trend.	
Note 1	By NA for Stage 1 and Stage 2, it means the RUL will be represented in percentage regardless of the value of predicted RUL in hours.	
Note 3	750 hours is around one month, being treated as the boundary to have RUL in percentage or in hours.	
Note 4	When the Remaining Useful Life (RUL) is expressed in hours, immediate action accompanied by a field check is necessary, as the escalating trend in detected fault amplitude would be substantial.	
Note 5	When the Remaining Useful Life (RUL) is presented as a percentage, continuous monitoring is required without immediate action, as the detected fault amplitude would likely remain relatively consistent.	

Global Presence



North America

Nanoprecise Sci Corp
 Suite #122 - Advanced
 Technology Centre
 9650 20 Avenue, Edmonton,
 Alberta T6N 1G1,
 Canada

Asia

Nanoprecise Data Services Pvt. Ltd.
 IndiQube- Edge Service Centre
 Khatha No. 571/630/6/4,
 (Sy No.6/4), Ambalipura Village,
 Outer Ring Road, Varthur Hobli,
 Bangalore-560103