Bently Nevada

Welcome to System 1

Version 21.1 [May 2021]

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Welcome

Bently Nevada is pleased to present System 1 version 21.1. This release delivers brand new capabilities to the Hydro Machine Monitoring, Emission Monitoring, and OT/IT System Integration use cases.

Hydro Machine Monitoring

- Hydro Machinery Asset Support
- Air Gap Native Channel Support
- New HMI Symbols
- Rotor Stator Plot
- Air Gap Plot

Emission Monitoring

- PEMS Integration Support

OT/IT System Integration

- OPC UA Static Data import

Users upgrading to version 21.1 will benefit from the many capability enhancements to System 1's **Connectivity**, **Analytics**, and **Visualization** pillars, which are summarized below.

Connectivity

Bently Devices
- Orbit 60 Support
- Hydro Machinery Support
  - 3500/46M Air Gap channel native support
  - System 1 6.X to v21.1 migration with native support for Air Gap Channel
  - Hydro Turbine Generator Asset Configuration
- vbOnline Pro Enhancements
  - Software States
  - vbOnline Pro as Modbus Client
- Ranger Pro Enhancements
  - Order Ranger Pros by Name in Hierarchy
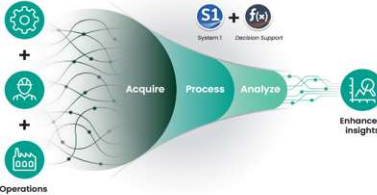 - Import Progress Feedback

Interfaces
- OPC UA Static Data Import

Data Management
- Create Audit files of Multiple Machines/Groups

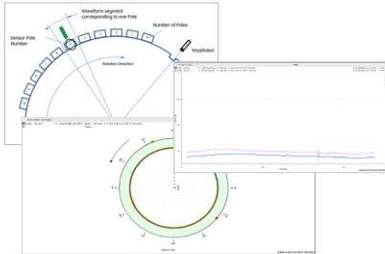### Analytics

Core Alarming
- 2300 Alarm Data Capture

Emission Monitoring
- PEMS Integration Support

Decision Support
- *Refer to Decision Support Roadmap*

Visualization

HMI Builder
- Hydro Machinery Symbols
- General Machine Symbols

Plots
- Rotor Stator Plot
- Air Gap Plot

Reports
- Route Report Enhancement

Bently Nevada remains focused on delivering the world's premier plant-wide machinery management software through bi-annual product releases. For a detailed overview of System 1, please visit the website.

Thank you,

Chris Kramm – System 1 Product Manager

On behalf of your System 1 Leadership and Development Teams

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1. SYSTEM 1 V21.1 FEATURE OVERVIEW

ALL 21.1 FEATURES ARE ONLY SUPPORTED WITH POSTGRESQL AS THE DATA HISTORIAN.

Table 1: System 1 v21.1 – Connectivity Capabilities

Connectivity		
Bently Devices		
Orbit 60 Support ***Orbit 60 release to follow System 1 21.1***	System 1 v21.1 supports connection to the new Orbit 60 Series platform and the advanced processing capabilities of the Condition Monitoring Module (CMM). This includes Offline Diagnostic File import, Protection Configuration synchronization, Alarm & Transient Data collection, Alarm and System Health Events import, Software State-Based Alarming, Static Data Historization, and CM Waveform support.	3.1.1
Hydro Machinery Support	System 1 enables monitoring of Hydroelectric Turbines and Generators using the data provided by 3500/46M Air Gap channels. These channels can be mapped to new Hydro Asset Models to support the Hydro Monitoring Use Case.	3.1.2
Bently Devices		
vbOnline Pro Software States	System 1 now supports software states for machines mapped with vbOnline Pro channels.	3.1.3
vbOnline Pro as Modbus Client	The vbOnline Pro device can be configured as a Modbus Client, allowing the device to connect to and historize data from third-party systems. This data can drive Device states on the vbOnline Pro.	3.1.3
SCOUT Enhancements	To connect to SCOUT devices, users now have the option to manually enter the device IP address (rather than relying on UDP Browse).	3.1.4
Ranger Pro Enhancements	Configuration enhancements to the Ranger Pro include: • Order Ranger Pro device by name • Improved progress indicator when importing devices	3.1.5
Interfaces		
OPC UA Static Data Import	System 1 supports the import of static data from third-party systems via the OPC UA Protocol.	3.2.1
Data Management		
Audit Files Enhancement	System 1 allows users to create audit files that consist of multiple groups and/or machine trains.	3.3.1

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Table 2: System 1 v21.1 – Analytics Capabilities

Analytics		
Core Alarming		
2300 Alarm Capture	System 1 now supports trigger-based alarm data capture for 2300.	4.1.1
Emission Monitoring		
PEMS Integration	System 1 Predictive Emissions Monitoring System (PEMS) is specifically designed for gas turbines. It can predict with high accuracy the level of emissions generated by gas turbines based on ambient conditions, fuel composition, and machine operating conditions, while also considering real-time degradations.	4.2.1
Decision Support		
Decision Support	*Refer to the Decision Support Roadmap for more details.*	-

Table 3: System 1 v21.1 - Visualization Capabilities

Visualization		
HMI Builder		
HMI Enhancements	The HMI library now includes new symbols for hydro machinery and other general machines.	5.1.1
Plots		
Rotor Stator Plot	The Rotor Stator Plot compares data from multiple Air Gap sensors, displays the stator shape relative to the rotor shape, and displays the overall rotor shape.	5.2.1
Air Gap Plot	The Air Gap Plot is specifically designed to display data from hydro generator machines and is an XY Plot of rotor poles versus air gap.	5.2.2
Reports		
Support Route Report – Machine Summary	System 1 v21.1 adds a new route report, *Route Report – Machine Summary*, which provides a summary of all routes and machines within a Database or Route Folder.	5.3.1

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2. VERSION SUPPORT & OPERATING SYSTEM COMPATIBILITY

System 1 follows a semi-annual release cadence with targeted releases in May and November of each year. Versions are fully supported for a minimum of two years from the published date of availability (Table 4).

New Versions of System 1 benefit from:

- Compatibility with the latest Microsoft Client & Server Operating Systems
- Client backwards compatibility to previous versions under support (21.1 Client to 19.2 Server DB)
- Database upgrade from previous versions released within last 3 years (18.2→21.1)
- Security patch & update testing for the latest available version
- Bug fixes included in the latest available version
- Standard technical support with escalation to engineering as required

Versions no longer supported:

- Standard support is provided for common FAQ type questions, but users are encouraged to update software to latest version to benefit from new features, OS compatibility, and bug fixes.

Table 4: System 1 Version Support & OS Compatibility Matrix

System 1 Versions & Support			Windows Server OS					Windows Client OS (64bit)		
Version	Available	End of Support	2019	2016	2012 R2	2012	2008 R2	10**	8.1 U1	7 SP1
21.1	May 2021	May 2023	✔	✔	✔			✔	✔	
20.2	Nov 2020	Nov 2022	✔	✔	✔			✔	✔	
20.1	May 2020	May 2022	✔	✔	✔	✔		✔	✔	
19.2	Nov 2019	Nov 2021	✔	✔	✔	✔	✔	✔	✔	✔
19.1	May 2019	May 2021	✔	✔	✔	✔	✔	✔	✔	✔
18.2	Dec 2018	Dec 2020		✔	✔	✔	✔	✔	✔	✔
18.1	Jul 2018	Jul 2020		✔	✔	✔	✔	✔	✔	✔

Windows 10 version compatibility will track Microsoft's published release and support model. System 1 will be tested and supported on all versions of Windows 10 under support at the time of release.

System 1 v21.1 (Windows 10 v20H2, 2004, 1909)   System 1 v19.2 (Windows 10 v1903, 1809, 1803)
System 1 v20.2 (Windows 10 v1903, 1909, 2004)   System 1 v19.1 (Windows 10 v1809, 1803)
System 1 v20.1 (Windows 10 v1903, 1809, 1803)   System 1 v18.2 (Windows 10 v1803, 1709)

3. CONNECTIVITY

3.1 Bently Devices

3.1.1 Orbit 60 Support

Orbit 60 Support video located in Bently Nevada Tech Support Training Library
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Orbit 60 release to follow System 1 21.1

In System 1 v21.1, users with a valid security certificate and Import Protection Configuration (read only) User Rights can add an Orbit 60 device and view data and events from the device. Once an Orbit 60 device has been added to System 1, users will be able to:

- Synchronize the protection configuration changes in System 1. System 1 will then retrieve and store data and events (Alarm and System) in real-time from the Orbit 60 device.
- Configure alarm and transient data capture settings and send them to the Condition Monitoring Module (CMM). System 1 will trigger alarm and transient data collection from the CMM based on the event triggered on the machine train.
- Add and configure synchronous and asynchronous waveforms on Orbit 60 device vibration and thrust position channels and send them to the CMM. Based on waveform properties configured by the user, the CMM will calculate the waveforms and transmit live data back to System 1.
- Add Trended Variables, such as Wf pk-pk, Spectral Bands, and Bearing Fault Bands to Orbit 60 vibration channels. System 1 will compute and store the values in its database.
- Configure software states and use Orbit 60 points to trigger the state (when Orbit 60 points are mapped to machine trains)
- Utilize the System 1 Display workspace to manage the health of machines monitored by the Orbit 60 Device, as well as the Instrumentation health of the device itself (Figure 1).

Under Devices Hierarchy, users will also be able to import the Offline Diagnostic File (ODF) generated from the CMM installed on the Orbit 60 device. The ODF contains protection configuration, events (Alarm & System), and alarm and transient data stored in the CMM. Once the ODF is imported successfully in System 1, diagnostic experts can leverage System 1 features to troubleshoot machine related issues.
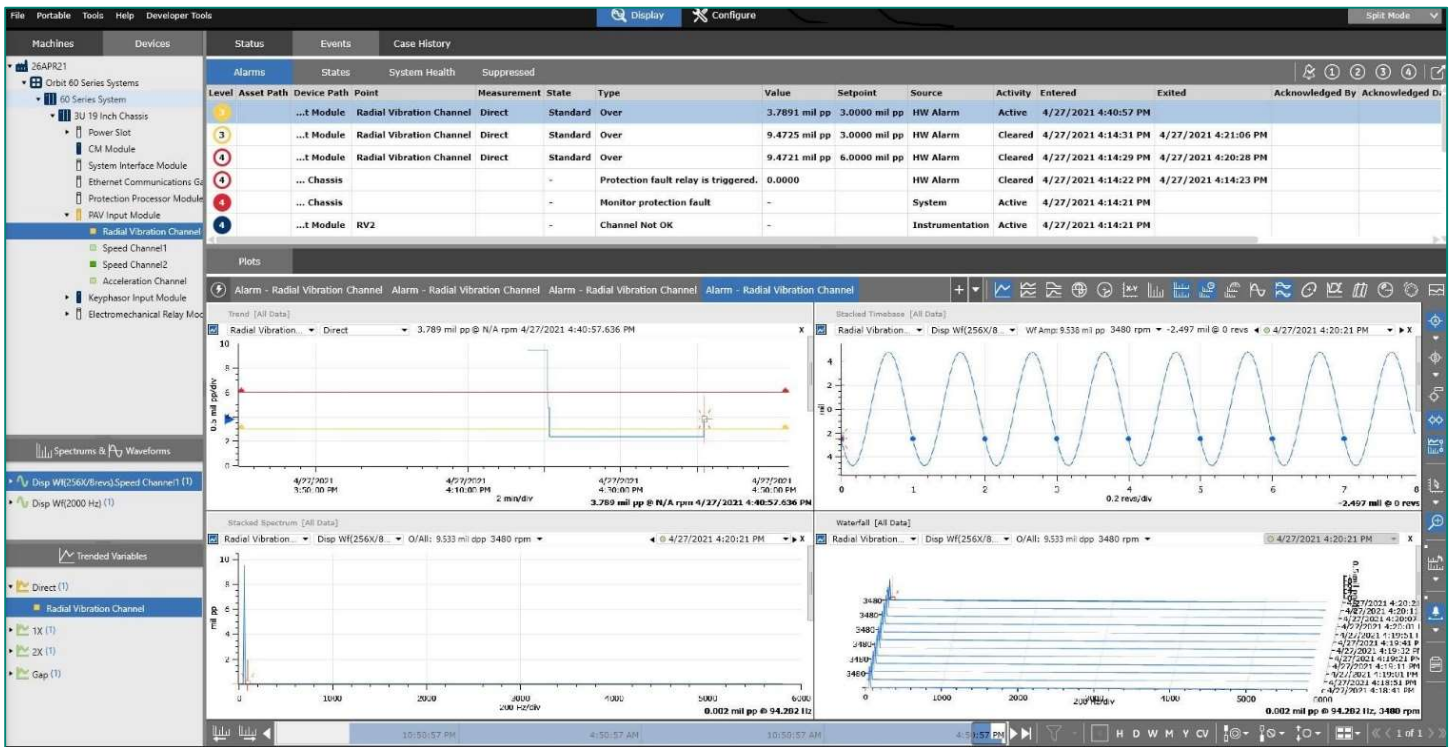
Figure 1: Orbit 60 Series Device and Data in Display Workspace of System 1

3.1.2 Hydro Machinery Support

Hydro Machinery Support video located in Bently Nevada Tech Support Training Library

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System 1 supports comprehensive monitoring of hydroelectric turbines and generators, with extensive configuration and display-based capabilities.

Configuration Capabilities

- One of the key capabilities of the Bently Nevada solution is the ability to monitor Air Gap, which is a measure of the distance between rotor (a part of the generator that has a rim) and poles. The Air Gap measurement is taken from a 3500/46M Hydro monitor. System 1 v21.1 supports the import of 3500/46M Hydro and Multimode Hydro Air Gap Channels as native channels. All properties that exist for these channels in 3500 can now be viewed within System 1.

- Along with 3500 Device Import, System 1 also supports migration of these channels from System 1 6.x through the Database Migration tool. (NOTE: In versions prior to v21.1, these channels were migrated from System 1 6.x and supported as Custom Channels).

- Users can map these channels to the newly added Hydro Turbine Generator Machine available within the Asset Library.

Display Capabilities

- Hydro Machinery health can be viewed within the Status workspace, with a standard Machine Train diagram (Figure 2) or customized HMI views (see Section 5.1.1)

- System 1 provides diagnostic capabilities for Hydro Machinery with the addition of two plots:

1. Rotor Stator Plot (see Section 5.2.1)
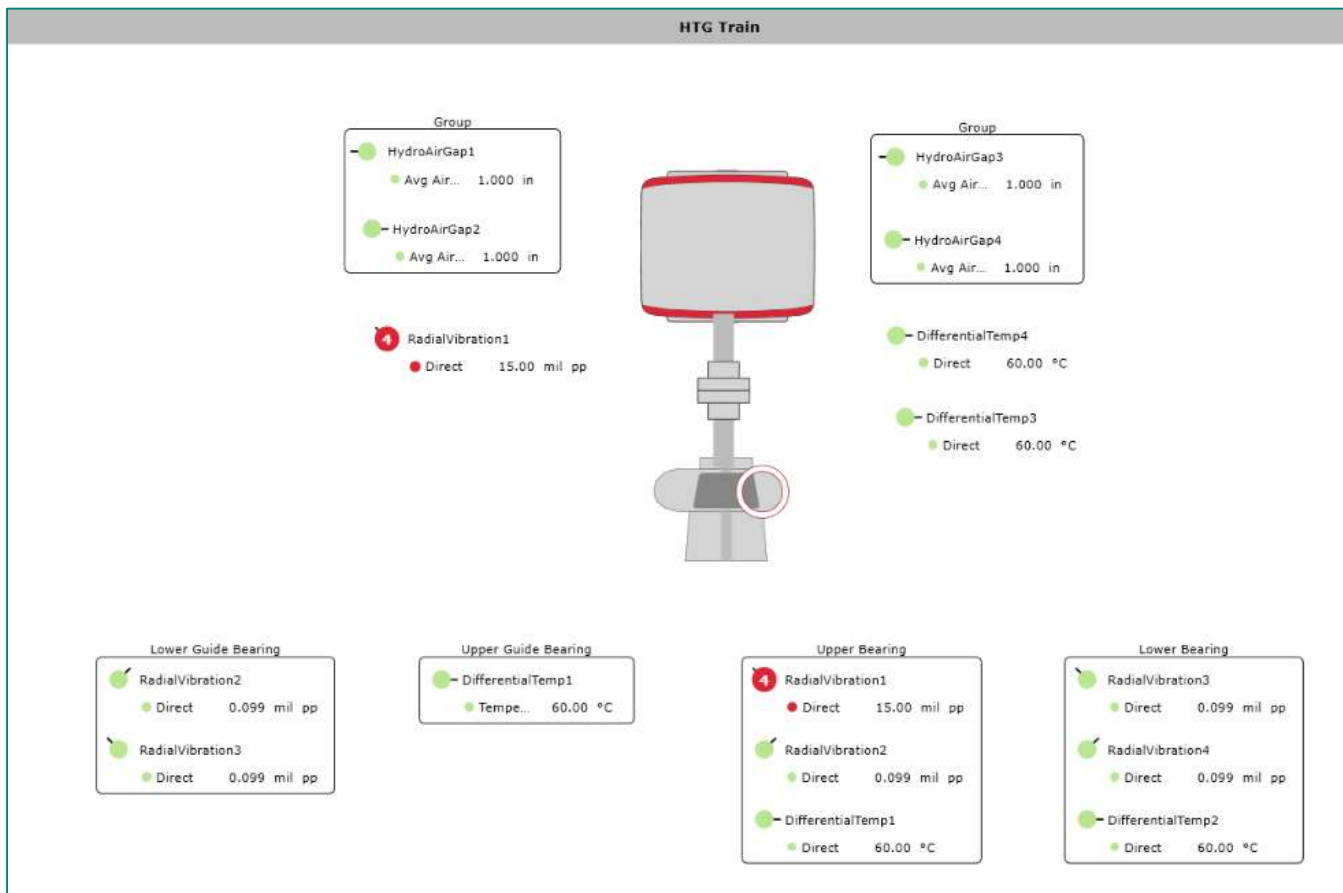
2. Air Gap Plot (see Section 5.2.2)

Figure 2: Machine Train Overview of Hydro Turbine Generator

3.1.3   vbOnline Pro Enhancements

vbOnline Pro enhancement video located in Bently Nevada Tech Support Training Library

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Software State Support

In prior versions of System 1, vbOnline Pro device users could configure Device States, which have the limitation of only including device calculated measurements as part of the trigger definition (e.g., Speed, Direct). With System 1 v21.1, Software States are also supported. These states allow users to create trigger

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definitions that combine measurements available in System 1 (e.g., OPC or Modbus process measurements) with those collected directly by the vbOnline Pro device. In addition, Software States enable state-based setpoint support for vbOnline Pro measurements (Figure 3).

Figure 3: Condition Monitoring State-Based Setpoints for vbOnline Pro Device

<u>vbOnline Pro as Modbus Client</u>

To import data directly into vbOnline Pro devices from third-party systems, Modbus over Ethernet protocol is now supported, with vbOnline Pro acting as the Client/Master and the Modbus device acting as the Server.

With the vbOnline Pro Premium+ license, the user can connect to 5 Modbus Servers, each with 15 points, for a total of 75 measurements. In addition, these measurements can be used to trigger Device States.

To connect to a Modbus TCP device:

1. Select a vbOnline Pro Device in the Devices hierarchy and navigate to the General tab
2. Select the number of Modbus servers from the "Add Modbus Servers" dropdown (Figure 4)

Figure 4 Add Modbus Servers Property in Configure Workspace

3. Select the added Modbus Server under the vbOnline Pro Device in the Devices hierarchy and enter the Modbus Server properties (Figure 5)
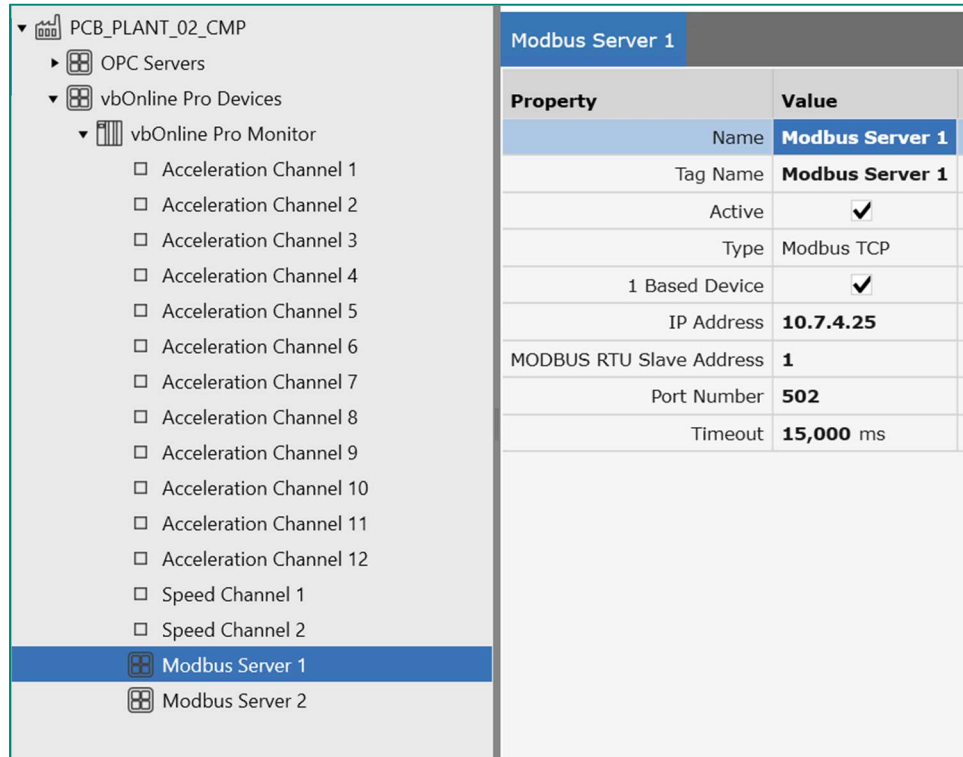

Figure 5 Modbus Server Properties in Configure Workspace

4. To efficiently create and modify Modbus points, export the "Modbus Items" csv file from System 1. Modify the points in the template and import the template file back into the database (Figure 6).

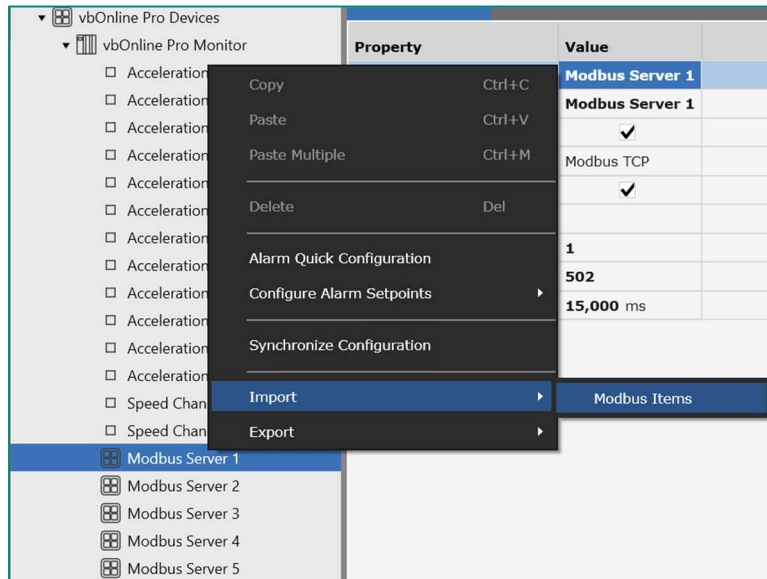5. Synchronize the device to update the device configuration

Figure 6: Import Modbus Points

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3.1.4   Portable Enhancements

Portable Enhancements video located in Bently Nevada Tech Support Training Library

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In the Portables Send/Receive dialog, the user now has the option to connect to a SCOUT device by manually entering its IP Address. Previously System 1 relied on searching the network, which was limited to the same subnet and was sometime unreliable on busy networks. When clicking on the "Select Instrument" dropdown within the Send Configuration dialog, simply choose "Enter IP Address manually" (Figure 7). The IP address is conveniently displayed in the SCOUT200 app (Figure 8). Upon successful connection, the IP address is visible in the "Select Instrument" dropdown menu (Figure 9).
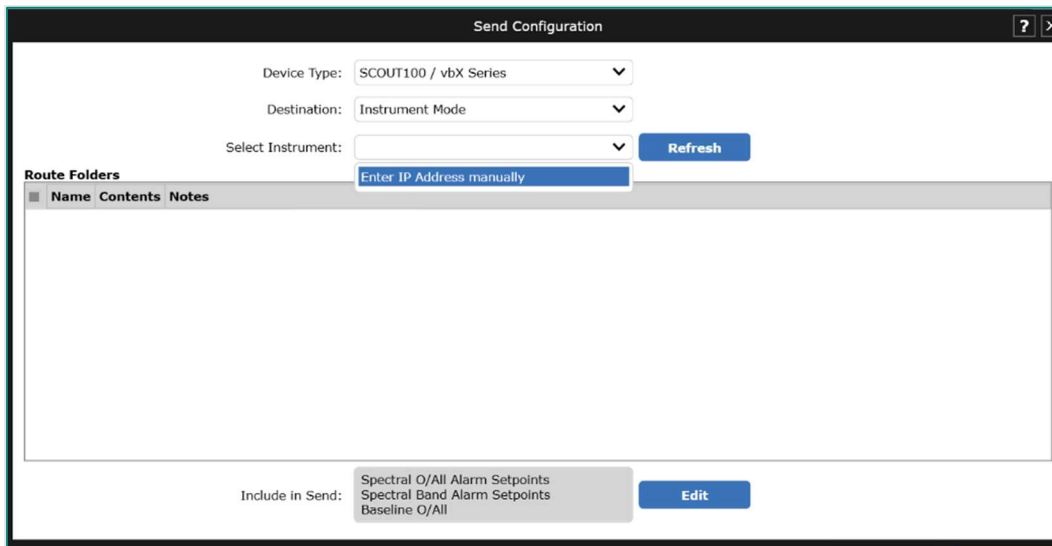

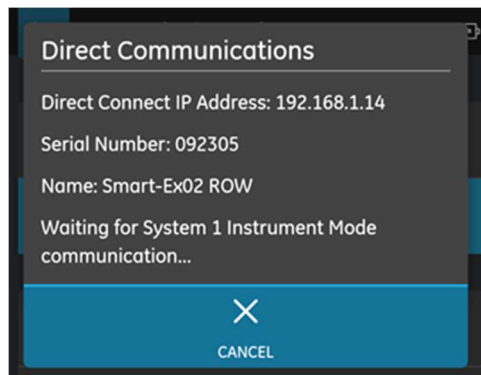*Figure 7: Enter IP Address manually option in Send/Receive Dialog*

Figure 8: IP Address is displayed in the SCOUT200 app

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Figure 9: Device Serial Number and IP Address

Other enhancements specifically for Portables can be found a

- Route Report - Machine Summary, in the Reports section at the end of this document
- Ability to receive data into System 1 when Config is locked by another user.
- Four other SCOUT200 app-specific enhancements, in the separate "SCOUT200_WhatsNew_21.1" document.

3.1.5 Ranger Pro Enhancements

In System 1 v21.1, users are provided with additional feedback of the import status of their Ranger Pro devices. The original progress bar now displays a secondary progress bar during the "Processing Configuration" step, further updating users on the state of this step (Figure 8). This enhancement helps notify the user that the process has not stalled, as this step can be time-consuming based on the number of devices being imported.
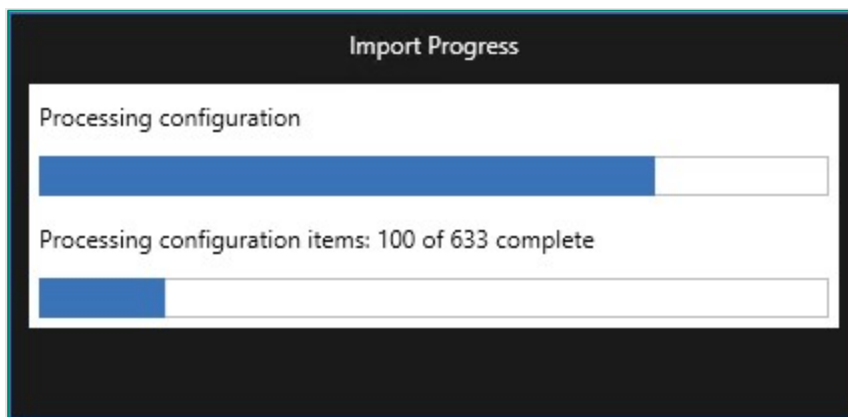
Figure 8: Secondary progress bar for Ranger Pro device import

Additionally, v21.1 now automatically sorts Ranger Pro devices in the Devices Hierarchy in ascending alphanumeric order based on the device name. This action updates when users make any edits to the name of a device, whether from within System 1 itself or externally from a gateway. Since many Ranger Pro devices are first identified by their serial number, this makes finding a specific device in the Devices Hierarchy much more efficient.

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3.2 Interfaces

3.2.1   OPC UA Static Data Import

OPC UA Static Data Import video located in Bently Nevada Tech Support Training Library

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System 1 now supports the import of static data from third-party hardware using the OPC UA protocol. A third-party OPC UA server can be added to System 1 and connected through secured modes of authentication.

Users can export the OPC UA server address space in a csv file (Figure 9) and, using the address space information from the csv file, bulk import the OPC UA static tags in System 1 through the OPC UA import csv template (Figure 10). Then, users can modify the data storage details within the OPC UA Process Group properties.

Data collected through OPC UA is stored in the System 1 Database and is available for trending and alarming, if setpoints are configured.
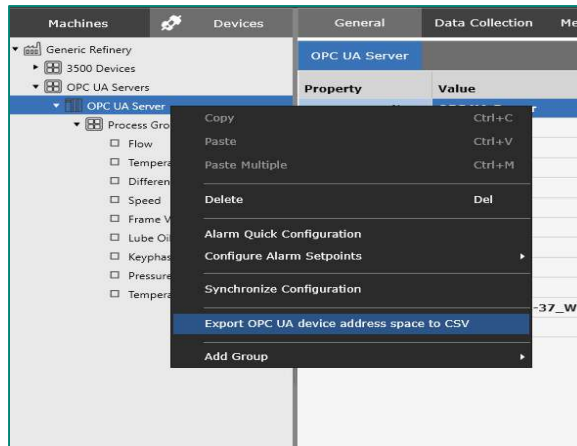

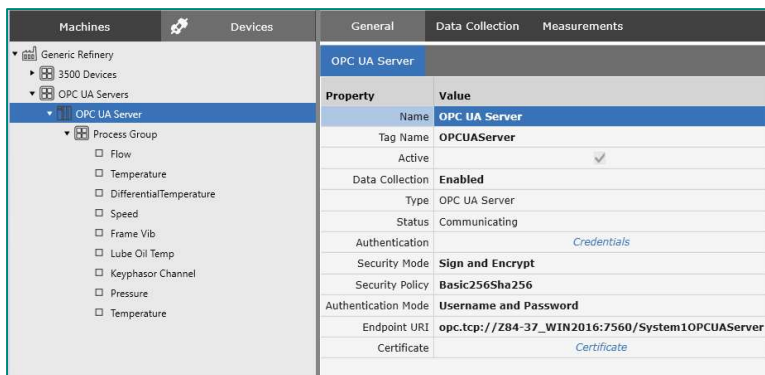*Figure 9: Export OPC UA Device Address Space Option*

Figure 10: OPC UA Server with Tags in System 1

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3.3 Database Management

3.3.1   Audit Files Enhancement

NOTE: This is only supported for databases with PostgreSQL as the data historian

<div align="center">Audit Files Enhancement video located in Bently Nevada Tech Support Training Library

Valid M&S Agreement Required</div>

System 1 v21.1 allows users to select multiple locations in a database to create an audit file, by following the below steps:

- Launch the "Machine Audit File" dialog on a hierarchy location by selecting "Create Audit File from Group, Machine, or Machine-Train"
- Click the "Select Locations" option within the Machine Audit File dialog (Figure 11) to select the Groups, Machine Trains, or Devices from the Hierarchy view (Figure 12)
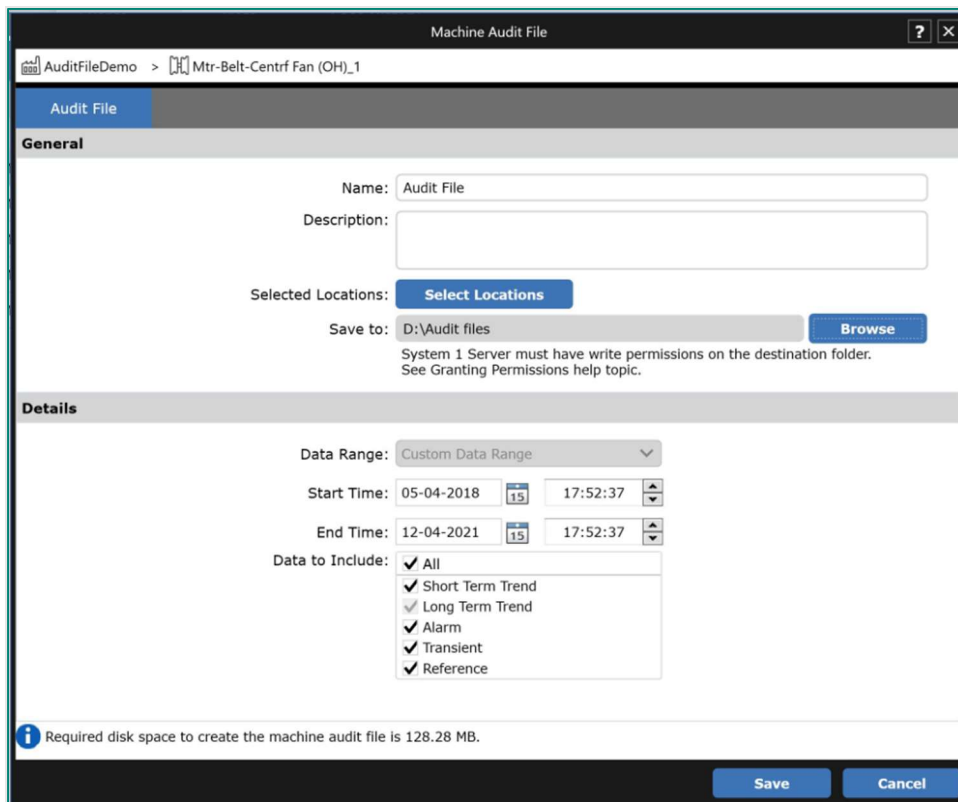

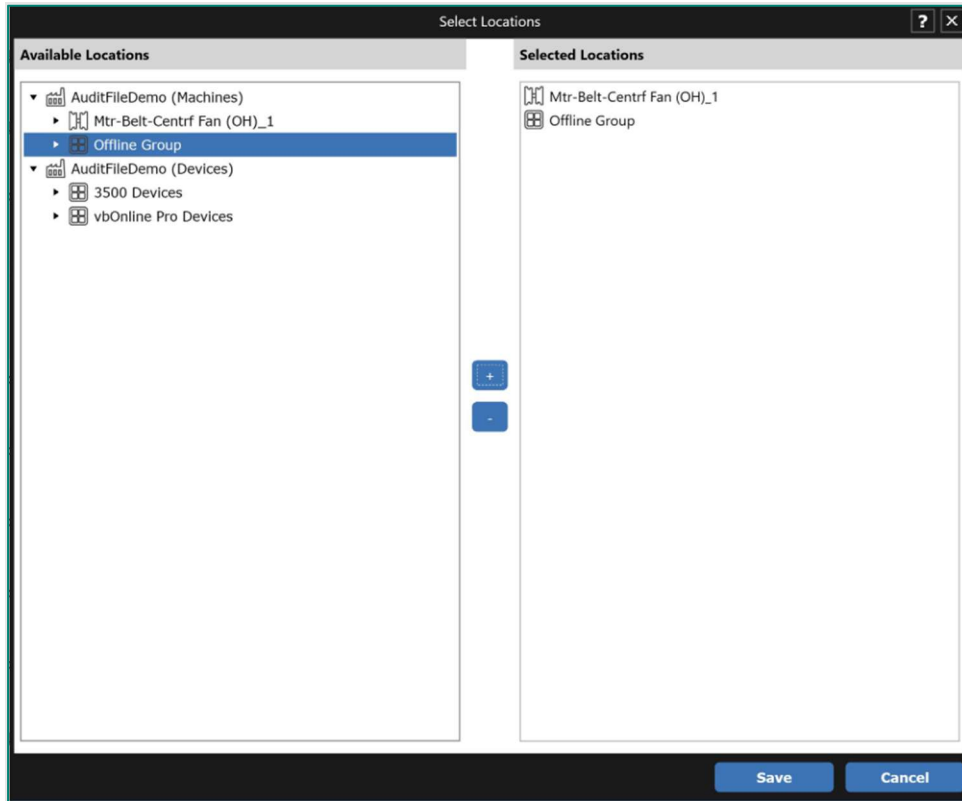*Figure 11: Select Locations Option in Machine Audit File Dialog*

Figure 12: Select Locations Screen, Launched from Machine Audit Files Dialog

4. ANALYTICS

4.1 Core Alarming

4.1.1 2300 Alarm Data Capture

2300 Alarm Data Capture video located in Bently Nevada Tech Support Training Library

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The latest 2300 Device Firmware (v3.2) supports alarm data capture. This firmware supports a single collection group, with alarm data captured for all measurements and channels. Alarm events are captured when:

- A Protection (Level 4 or Level 3) alarm is triggered on a 2300 Device point
- A Condition Monitoring (software) alarm is triggered on a 2300 Device point
- A Condition Monitoring or Protection alarm is triggered on 3500, 3701, or OPC points on a machine train with a mapped 2300 Device point

High resolution alarm data is collected for trend and waveform variables.

4.2 Emission Monitoring

4.2.1 PEMS Integration

PEMS Integration video located in Bently Nevada Tech Support Training Library

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The System 1 Predictive Emissions Monitoring System (PEMS) is specifically designed for gas turbines and predicts the level of emissions based on ambient conditions, fuel composition, and machine operating conditions while considering real-time degradations.

The PEMS solution requires the System 1 and Bently Performance software applications. Together, these two packages provide an accurate estimate of cumulative CO_2 generated over user-specified time periods, such as consecutive monthly time intervals.

To configure PEMS, check "Enable PEMS Points" in the machine Configure workspace (Figure 13) and utilize Mapping Mode to map performance inputs (collected via OPC or Modbus) and outputs (provided by the PEMS template package). Like all other System 1 data sources, PEMS measurements can be viewed in the Display workspace within the HMI, trigger alarm events, and be correlated with other asset data for enhanced diagnostic insights (Figure 14).
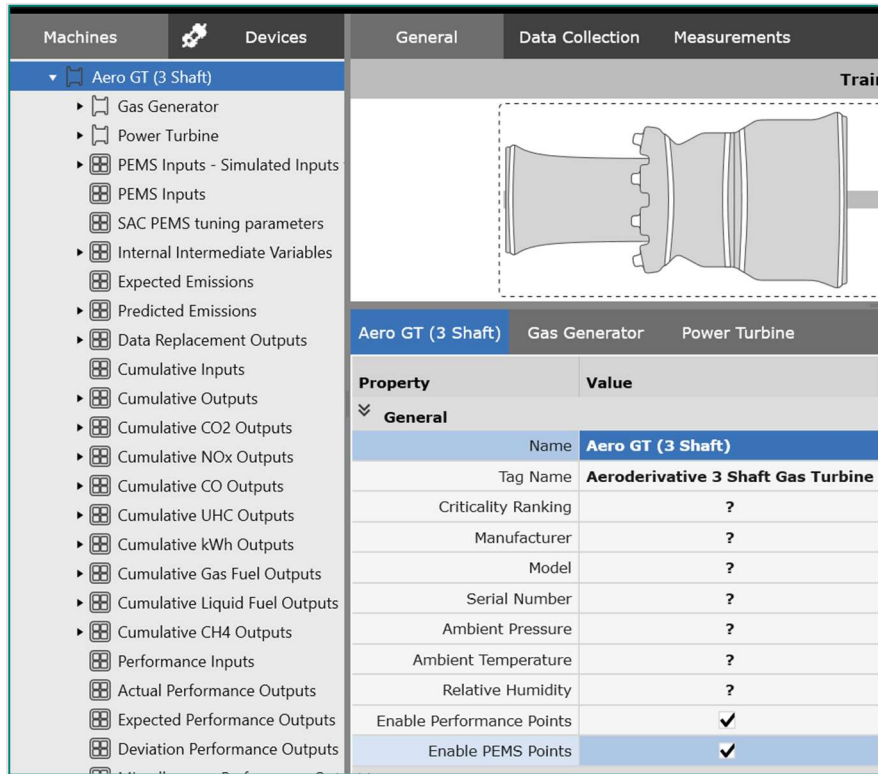
Figure 13: Enable PEMS Points Property in General Workspace of Configure
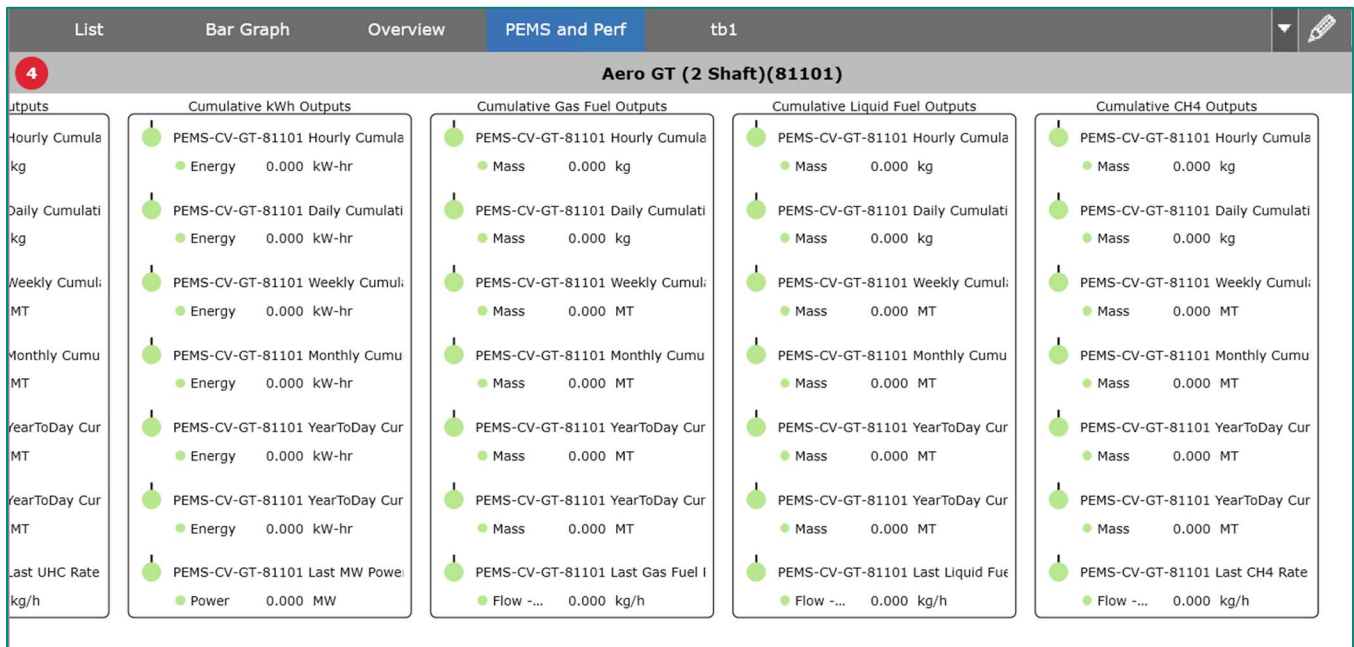
Figure 14: PEMS Data in the HMI Display Workspace

5. VISUALIZATION

5.1 HMI Builder

Hydro Machinery Support video located in Bently Nevada Tech Support Training Library

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5.1.1 HMI Enhancements

New HMI symbols have been added for the Hydro and General Machinery use cases (Figure 15). These symbols can be used to create Mechanical, Process, and Lube Oil HMI views for Hydro Monitoring (Figure 16).

Figure 15: Hydro and General Machinery Symbols

Figure 16: Hydro Turbine Lube Oil HMI View

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5.2 Plots

5.2.1 Rotor Stator Plot
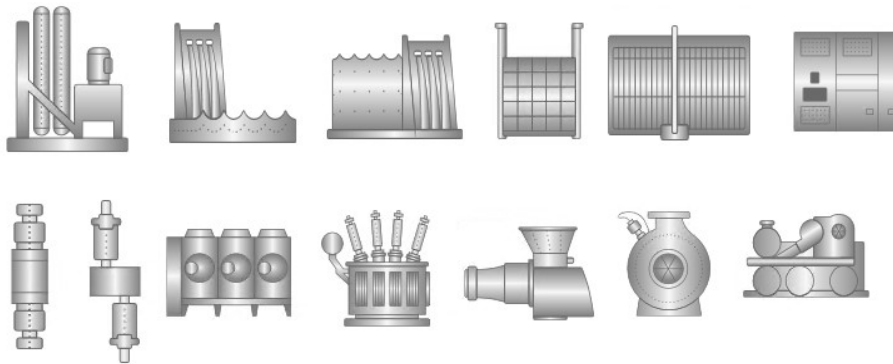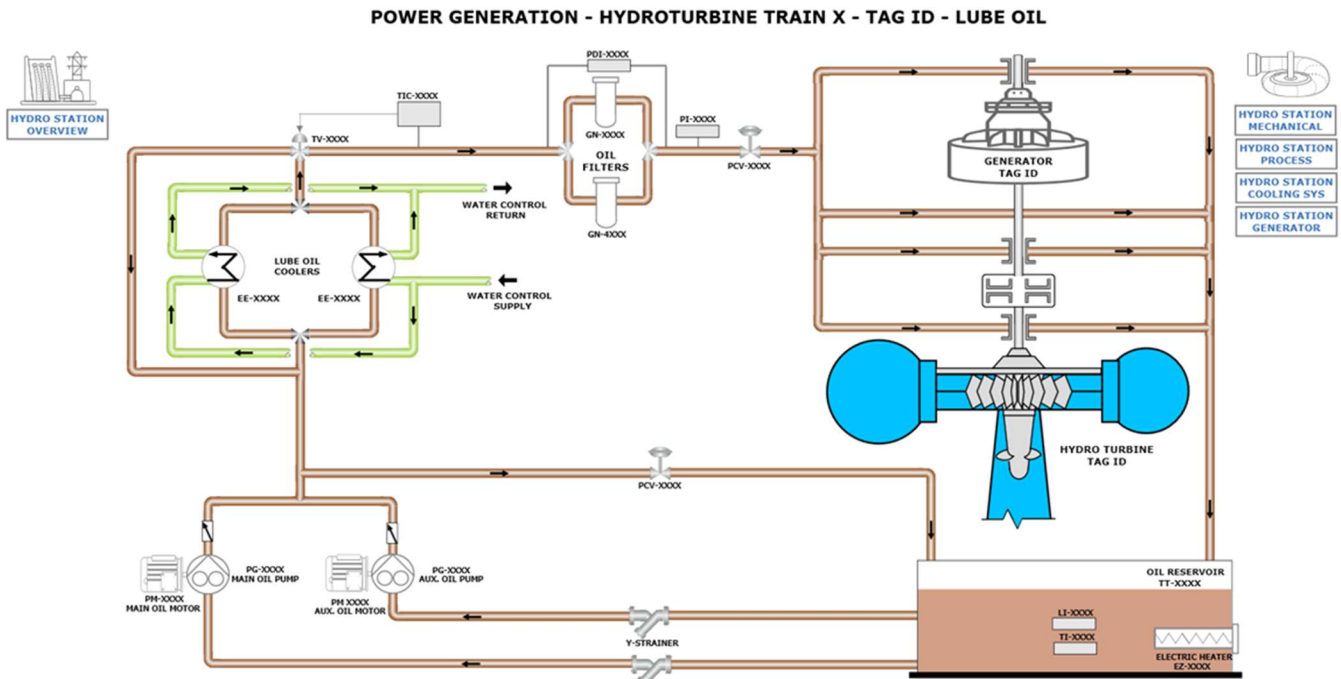
The Rotor Stator Plot is designed to display data from Hydro Generator machines. It is a multiple channel plot that displays:

1. Stator shape relative to Rotor shape in case of Profile Sets
2. Individual Stator and Rotor shapes from one or more sensors or from the average of all sensors

The Rotor Stator Plot also displays the minimum, maximum, and average Air Gap with corresponding Pole and Tooth number, with the green area representing the Nominal Air Gap. The locations of all sensors are visible on the plot, represented by triangles in the same color as the curve (Figure 17).

NOTE: There must be an even number of stator mounted probes to use this plot, with a minimum of four probes required.
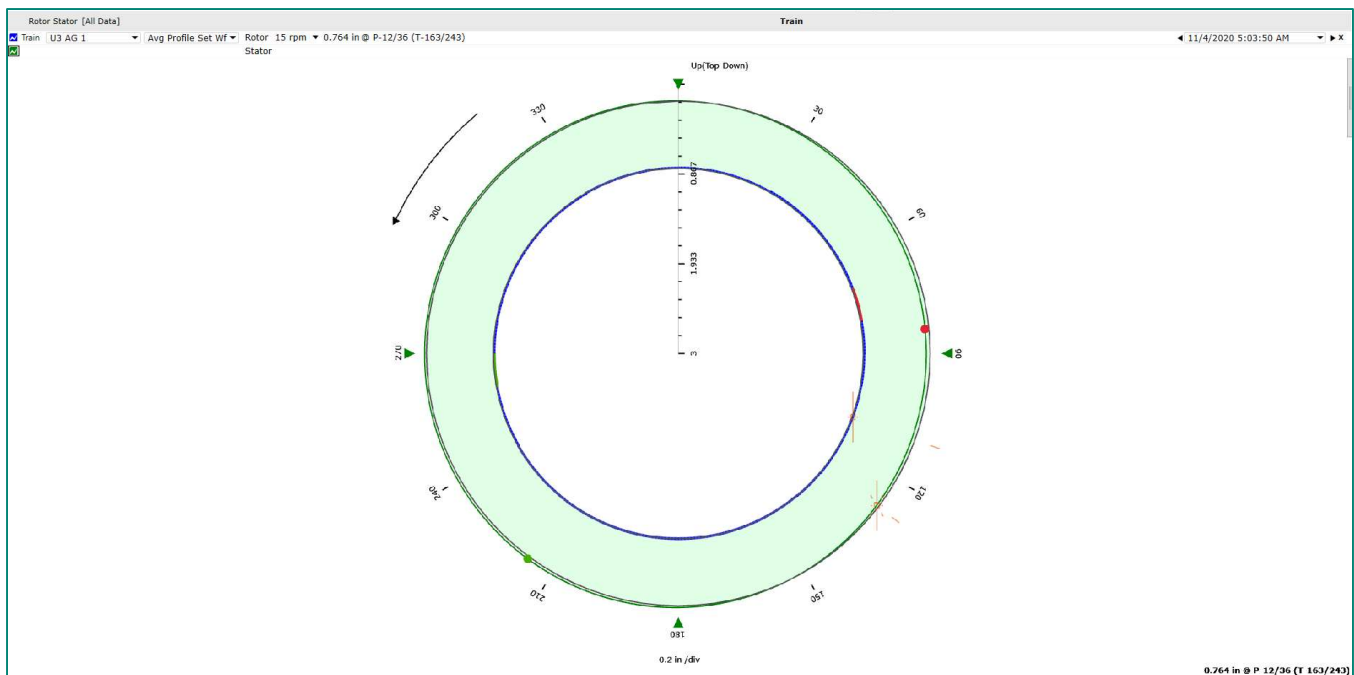

Figure 17: Rotor Stator Plot

5.2.2 Air Gap Plot

The Air Gap Plot displays data from Hydro Generator machines. It displays the rotor poles versus the air gap for a single channel or the rotor poles versus the minimum air gap on all channels. This plot uses a synchronous waveform measurement from Hydro Air Gap or Multimode Hydro Air Gap Channels (Figure 18).
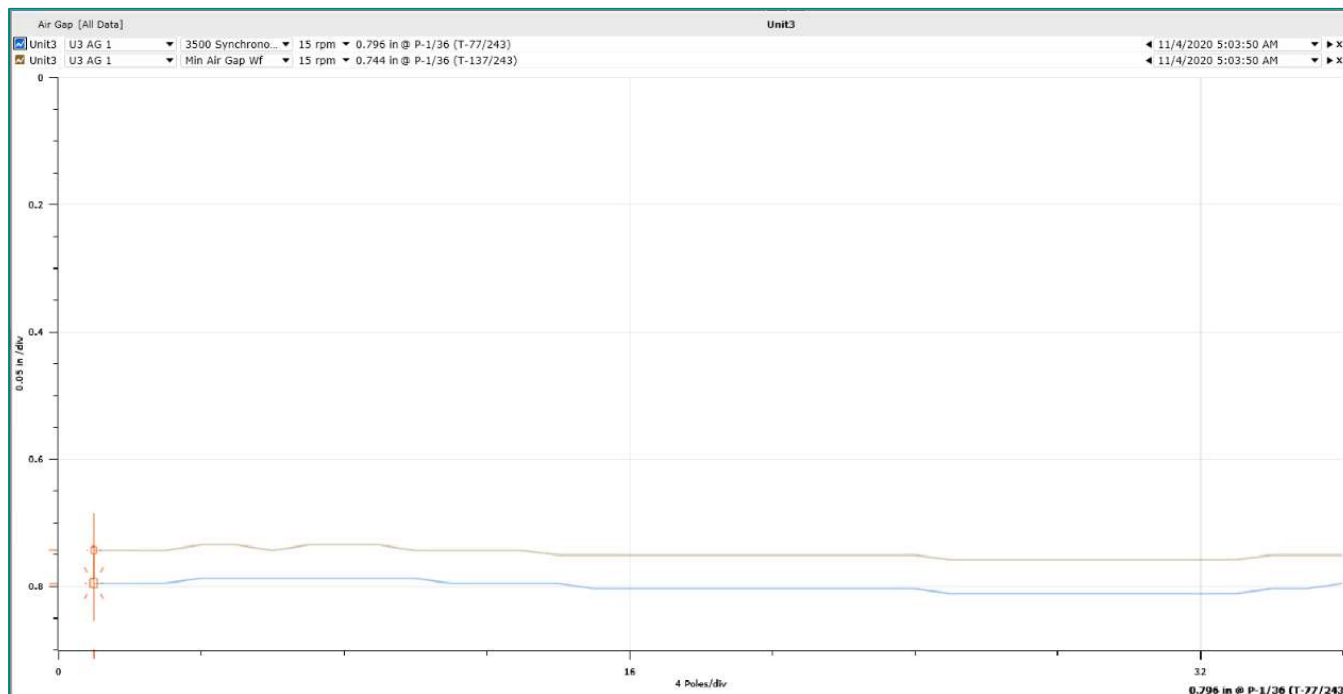
Figure 18: Air Gap Plot

5.3 Reports

5.3.1 Route Report -Machine Summary

Portable Enhancements video located in Bently Nevada Tech Support Training Library

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System 1 v21.1 adds a new report, *Route Report – Machine Summary* (Figure 20). This report summarizes the collection status of all routes and machines within a Database or Route Folder, highlighting the machines which are overdue for collection. It can be generated at the Database or Route Folder node of the hierarchy, in Config > Route mode.

NOTE: The existing Route Report is still available, renamed as *Route Report – Point Details*. It can be generated at the Route node and provides a detailed Route Status including a list of all missed points.

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System 1 Route Report - Machine Summary

Enterprise: Final Reports DB   **Work Request No.:**   **Work Order No.:**

17 May 2021

Folder: Fans Route Folder   Route: Fans Route 1

Interval [Days]: 10   Tolerance [Days]: 2

Total Machines: 4

Machine Name	Tag Name	Collection Status	Last Collection	Next Due	Alarm Status
1E-1201-M01 Lean Solvent Cooler Fan 1	MotorFanSetBeltDriven	Due	06 May 2021	26 May 2021	🟧 2
OC-2401A-E02-M01A BOG Comp LO Clr Fan	GenericMotorFanSet	Scheduled	15 May 2021	26 May 2021	🟥 4
1PK-3701A-E01A-C01 Refrigerant Condensor Fan A-A1	MotorFanSetBeltDriven	Scheduled	15 May 2021	26 May 2021	🟥 4
0DG-3101-E04-C03A-F01A Dsl Gen 1 Rad Fan A	MotorFanSetBeltDriven			26 May 2021	

Figure 19: Route Report – Machine Summary

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ONLY APPLICABLE WHEN UPGRADING FROM VERSIONS PRIOR TO 20.2

Installation

Before installing System 1 21.1, you must <u>uninstall</u> the version prior to 20.2 of System 1.

! Change to Program ID impacting OPC Data Collection

As part of the Baker Hughes separation from General Electric (GE), OPC DA import settings have been renamed. To <u>maintain data collection from OPC connections</u>, please take the following actions:

Property	Prior Versions	Version 20.2 and above	Required Action
Program ID	GE.BentlyNevada.Sys1OPCServer.2	System1OPCServer.1	Change Program ID in client to "System1OPCserver.1"
DCOM Config Name	System 1 OPC Server	System 1 OPC DA Service	**Before Uninstalling System 1** 1. Take a screenshot of DCOM setting for "System 1 OPC Server" for the following tabs: • General • Security (Launch and Activation/Access/Configuration permissions) • Identity **After Installing System 1 v20.2 and above** Reapply the DCOM settings to "System 1 OPC DA Service"

For Bently Performance (BP) installations, open the BP template key and change the Program ID from "Input OPC Server" to "System1OPCServer.1" (as shown in below image).

Bently Performance	Performance 0.6.0
Input OPC Server	System1OPCServer.1
Auto Start	TRUE
Cycle Time	30000
Status	Ok
Input Cell Range	A10:A200
Output Cell Range	V11:V200

For more details, please refer to System 1 Help.

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1631 Bently Parkway South, Minden, Nevada USA 89423

Phone: 1.775.782.3611 (US) or Bently.com/support

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