

PNNL-32992

Vision 0.3.2 Users Guide

Revision 0

June 2022

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Revision Log

Vision 0.3 User Guide

Rev. No.	Date	Describe Changes	Pages Changed
0	6/29/2022	Original Issued	NA

Acronyms and Abbreviations

2-D	Two-dimensional
ARR	Automatic Radionuclide Report
CSV	comma-separated value
FWHM	full width at half maximum
ID	identification
IMS	International Monitoring System
MDA	minimum detectable activity
MDC	minimum detectable concentration
PHD	pulse height data
PNNL	Pacific Northwest National Laboratory
QC	quality control
RN	radionuclide
ROI	region-of-interest
RRR	Reviewed Radionuclide Report
SAUNA	Swedish Automatic Unit for Noble gas Acquisition
SOH	state of health
sccm	standard cubic centimeters

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1.0 Vision

Vision is a research software application developed by Pacific Northwest National Laboratory (PNNL) that incorporates the scientific and operational expertise for reviewing data from treaty monitoring radionuclide stations. These stations are part of a worldwide network to monitor for nuclear explosions, and the data they produce are critical to make the determination of whether a sample is from a nuclear explosion or some other source (i.e., nuclear reactor or medical isotope production facility). Stations deliver their measurements and system status to the International Monitoring System (IMS), which forwards it via email to all subscribers. Vision provides tools for viewing and analyzing these stations' state of health data.

The term Vision is used generically throughout this document to refer to any of the various components in the software application. The user interface that is viewed with a web browser is the primary focus of this user guide. Other components include a database to store measurements and state of health (SOH) data; and the automated analysis manager (Daemon) performs analysis, and stores data for review.

1.1 Product Functions

The Vision software is a toolset for monitoring station state of health for diagnosing system problems. It also provides basic screening of radioxenon measurements. In support of this goal, the software is equipped with tools for monitoring SOH data.

The primary functions of the software are:

- Graphical display of radionuclide measurements
- Data analysis to calculate estimated concentrations and minimum-detectable-concentrations (MDCs) for radionuclides
- Ability to facilitate a review process for radionuclide measurements, including the ability to escalate
- Ability to override the station-provided energy gain calibration as part of data quality review processes for cases when the energy calibration is suspect
- SOH functionality, including ability to monitor specific status indicators of any station's health.

2.0 Viewer

2.1 Menu

Along the top of the screen is a menu, giving quick access to each of the primary views provided for utilizing and configuring the Vision ecosystem.



Figure 2-1 Top Menu Strip

2.1.1 Server LEDs

The server LEDs provide feedback to all users as to the status of the Vision ecosystem. Green LEDs are for healthy servers, orange for those that are running, but are not fully functioning, and red for those the user interface can't communicate with.

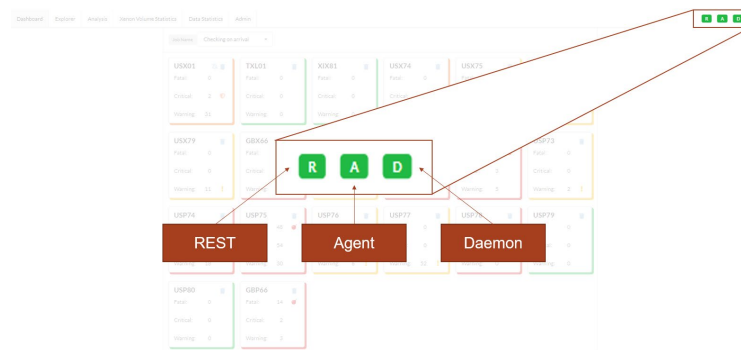


Figure 2-2 Server LEDs

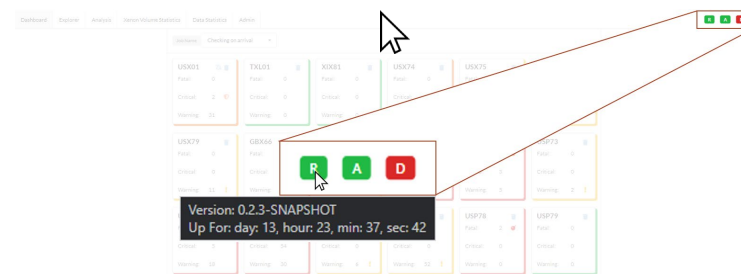


Figure 2-3 Server LED Tooltip: Health

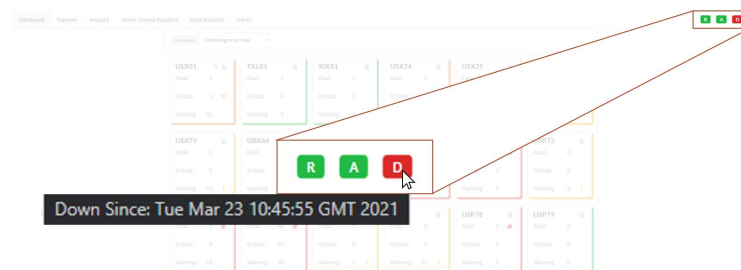


Figure 2-4 Server LED Tooltip: Unreachable

2.1.2 Settings

The settings dialog can be accessed by clicking the cog in the upper right of the menu strip.

Settings

☒ Show Sensor Names

Expanded Categories

☒ Start High sensors expanded
☒ Start Medium sensors expanded
☒ Start Low sensors expanded
☐ Start Uncategorized sensors expanded

Apply

Ok

Cancel

Figure 2-5 Settings Dialog

Selecting the “Show Sensor Names” allows users to change how sensors are displayed. Expand Categories checkboxes allow users to specify if category group boxes are collapsed or expanded on the Analysis page¹.

2.2 Dashboard

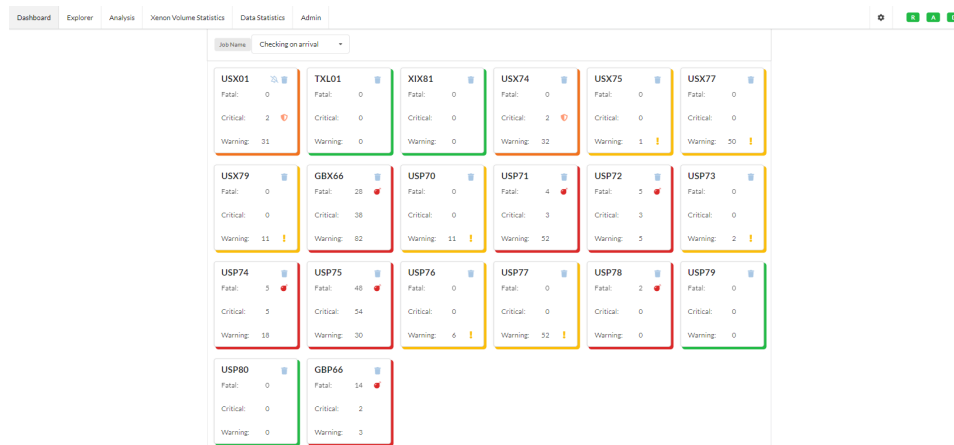


Figure 2-6 Stations displayed on Dashboard

The first screen you will see is the dashboard which gives summary of the automated analysis results for the systems of interest.

2.2.1 Stale Results

If the results are stale a colored stopwatch will be displayed giving an indication of how old the displayed results are. Yellow is longer than a single update period², orange is longer than two, and red is longer than three.

¹ This feature is not available on the Explorer page

² A yellow stale state will occasionally be shown while the Daemon is running the current job because this doesn't take into account the time it takes for the newest job to run.

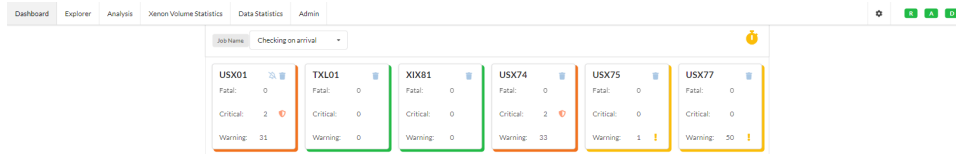


Figure 2-7 Yellow stale stopwatch indicator

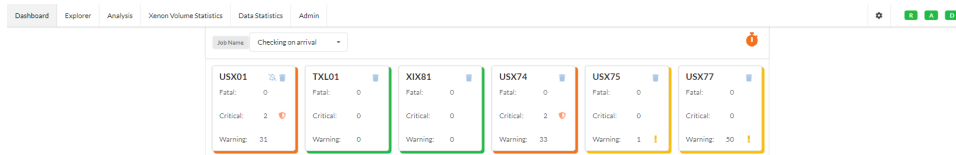


Figure 2-8 Orange stale stopwatch indicator

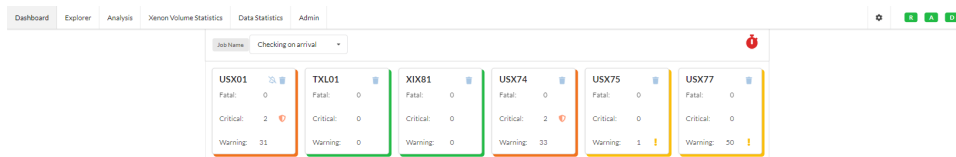


Figure 2-9 Red stale stopwatch indicator

2.2.2 Cards

Colors and icons are used to signal a station's status. Colored borders indicate the presence and severity of alerts. If no alerts are present, a station's card border will be green. If the highest alert for a station is warning, its border will be yellow. Similarly, for critical or fatal alerts, their border will be orange or red, respectively. If any sensors for a station are squelched³, and silent bell icon is added to the upper right corner of the card. If a trend is present, and plot icon is added to the upper right corner of the card. This card paradigm is also used in the Explorer view for individual sensor cards.

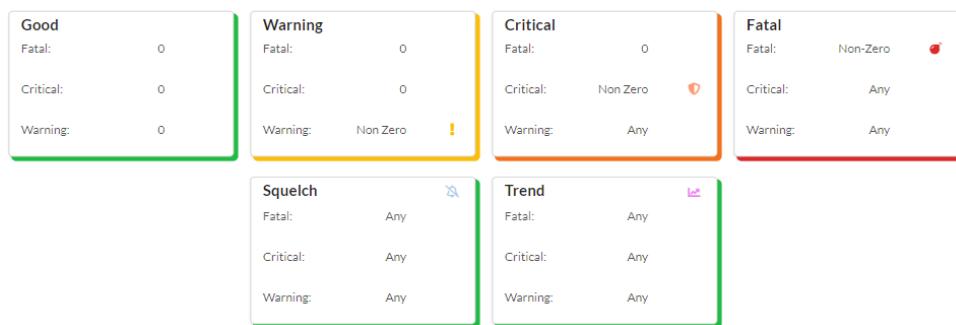


Figure 2-10 Card colors and icons

2.2.3 Dashboard Sensor List

By clicking on a station's card, a list of alerting sensors that contribute to a station's health status are populated below the cards. By clicking on the plot icon next to the station's site code, a new tab will open to the Explorer tab, with this station's tab in focus. By clicking on the plot icon in the graph column, a new tab will open to the Explorer tab, with the station's tab in focus, and the sensor plotted.

³ see 2.2.3 for details about squelching sensors

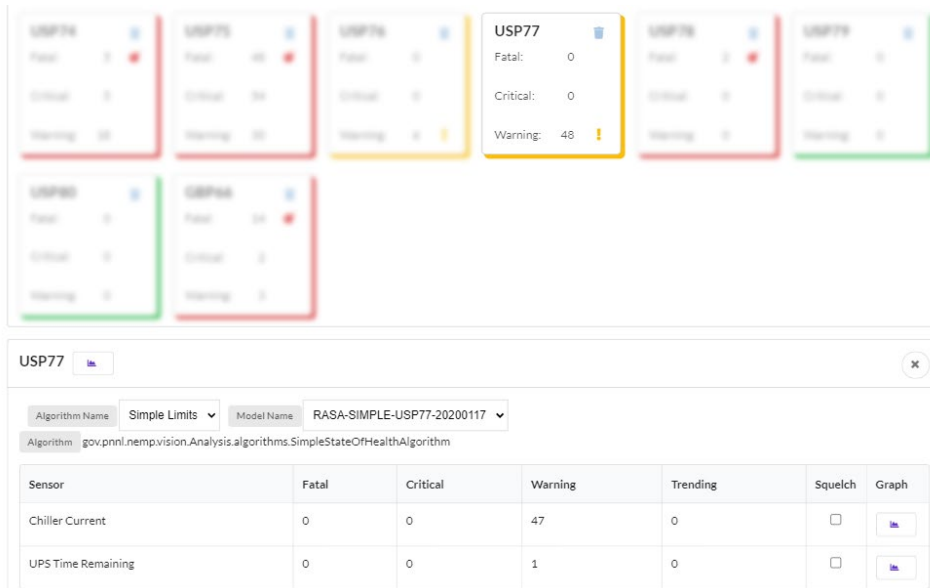


Figure 2-11 Station selected from Dashboard

2.2.3.1 Filtering Results

Sensors listed are organized by 1) the model collection and 2) the algorithm used to generate the alerts. Each column has a sum of the alerts for the previous two weeks. Alerts are stored by sensor name, start/stop times, and severity level. Start and stop times bound contiguous alerts. E.G. if a sensor alerts for 2 hours continuously, it'll be counted as a single alert rather than 12 alerts (one for each 10 minute data point that alerted).

2.2.3.2 Squelching sensors

Squelching a sensor affects the station's status. Alerts will still be recorded and reported, but if a sensor is generating Fatal alerts, while the remaining alerting sensors are generating no greater than Warning alerts, then the station's status will be set to Warning.

2.3 Explorer

The purpose of the Explorer page is to present greater detail into the results of the automated analysis for each station. Only the sensors for the currently selected Station, Job, Model, and Algorithm are displayed, by category. Sensor's categories can be adjusted on the Sensor Profile page¹.

The cards on this page are for each sensor, where the color denotes that sensor's status for the selected time-period (page defaults to the last two weeks from today). If the station isn't assigned to a job, no sensors will be offered.

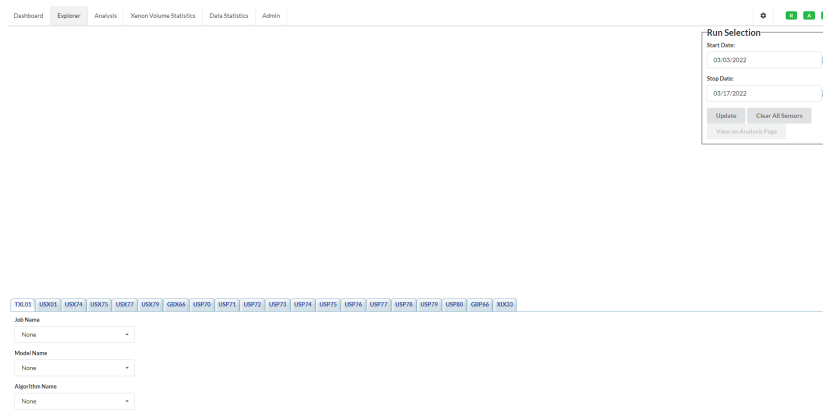


Figure 2-12 Explorer page where station has not been assigned to job analysis

Clicking the tabs with the desired station's code will load that station's sensor list, displaying the number of alerts, by severity, and the overall sensor status per the current job's results.

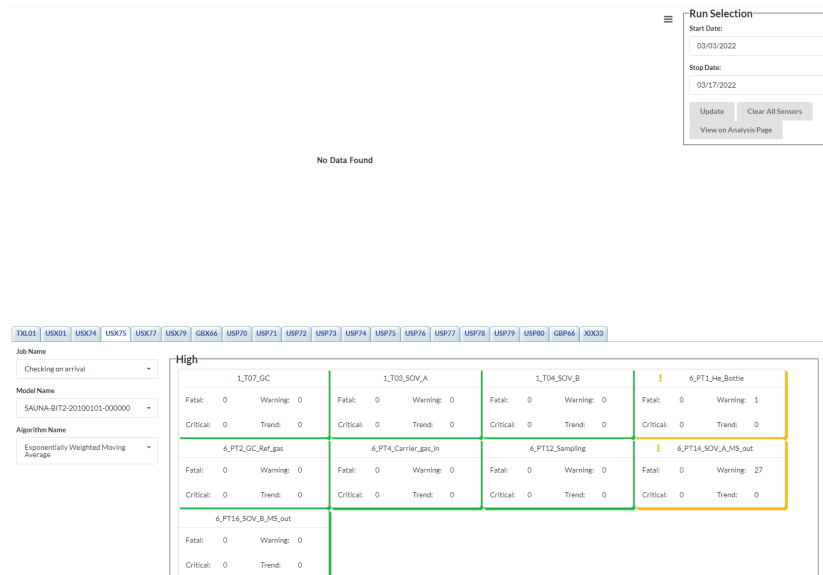


Figure 2-13 Selecting alternate station assigned to job analysis

¹ See section 7.6 for details on assigned category and adjusting sort order of sensors

To plot a sensor, click anywhere on the sensor's card. The station's name will be concatenated with an underscore ('_') to the sensor's name in the plot legend. On the Explorer page, when a singular sensor is selected, the legend will also contain Warning, Critical and Fatal Alert Region entries. These will initially be hidden (as noted by the text being greyed out).

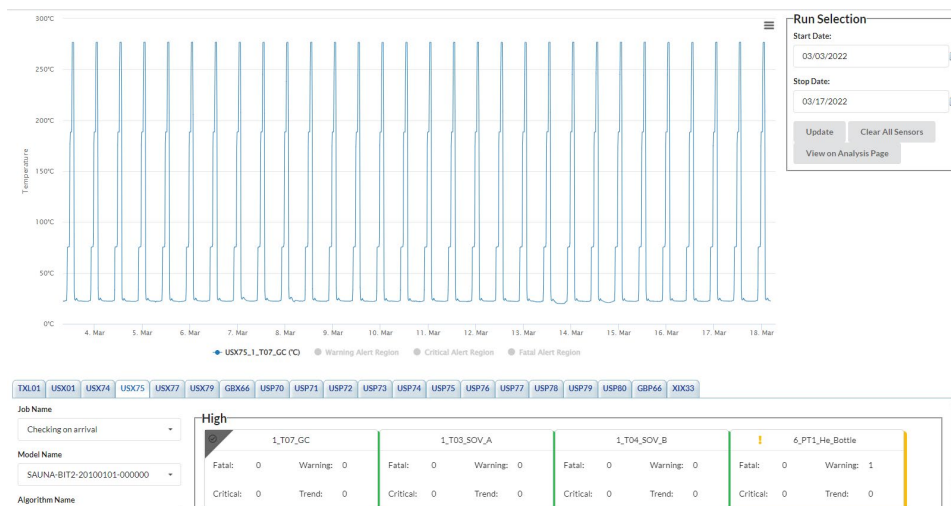


Figure 2-14 Plot of a single sensor on the Explorer page

To show the alert regions, click on the region names in the legend. Each region will have an upper and lower limit. The displayed limits denoted what values the sensor's value at each point was evaluated against at that time. This distinction is important as some limits may change if using an evolving model.²



Figure 2-15 Plot of a sensor with alert regions on the Explorer page

It's helpful to capture plots for documents or presentations. Rather than having to take a screenshot, click the dialog button in the upper right of the image, and select the download the desired image format.

² For more details on alert regions, see section 2.7.4.

From this menu, spreadsheets may also be downloaded. This is applicable to every chart in Vision, not just those on the Explorer page.

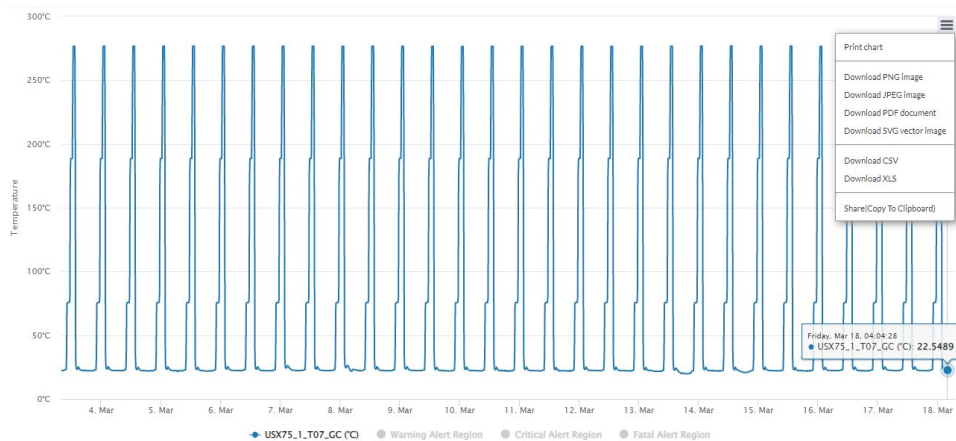


Figure 2-16 Chart download and share dialog

Additionally, there is a “Share (Copy to Clipboard)” option that will generate a URL that can be shared with other users that have access to the instance of Vision. For all pages, at the minimum it will load the same page with the same timeframe. For pages like the Explorer and Analysis pages, the URL will also include the current sensors being plotted, as well as the current stations tab in focus.

Example URL: [http\(s\)://host.name/viewer/explorer?station=USX75&startDate=20220303&stopDate=20220317&sensor=USX75;;1_T07_GC&sohModel=2&sensorModel=34](http(s)://host.name/viewer/explorer?station=USX75&startDate=20220303&stopDate=20220317&sensor=USX75;;1_T07_GC&sohModel=2&sensorModel=34)

Table 1 Explorer Share URL Breakdown

Query	Description
station=USX75	Station tab in focus (if omitted, first tab will be in focus)
startDate=20220303	Start date for plotting sensor data. At minimum, this will set the start date in the Run Selection form group.
stopDate=20220317	Stop date for plotting sensor data. At minimum, this will set the stop date in the Run Selection form group.
sensor=USX75;;1_T07_GC	List of sensors to be selected, and then plotted. Each sensor to be plotted with specify the station code and sensor name concatenated using two semi-colons. If this is omitted, then no data will be plotted upon arriving on the page. Multiple sensors are appended using the '+' character
sohModel=2	SOH Model index stored in database. This is safer than using the SOH Model name, because that can be changed
sensorModel=34	Sensor Model index stored in database. This is safer than using the Sensor Model name, because that can be changed

When multiple sensors are plotted on the Explorer page, the alert limits are removed because the plot would become overly complicated.

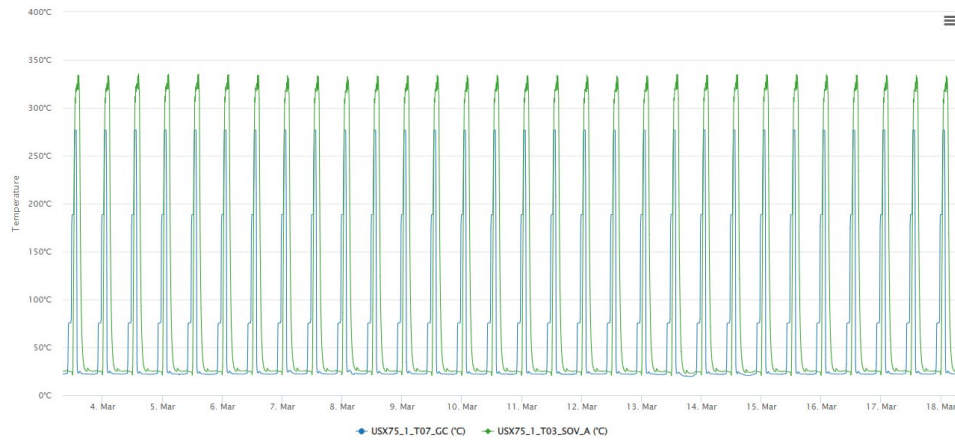


Figure 2-17 Plot of a multiple sensors on the Explorer page

As not all sensors may be visible from the Explorer page (as no sensors are required to be included in jobs for analysis), if the user clicks the “View Analysis Page” button, a new tab is opened to the Analysis page with the same selected sensors and timeframe.

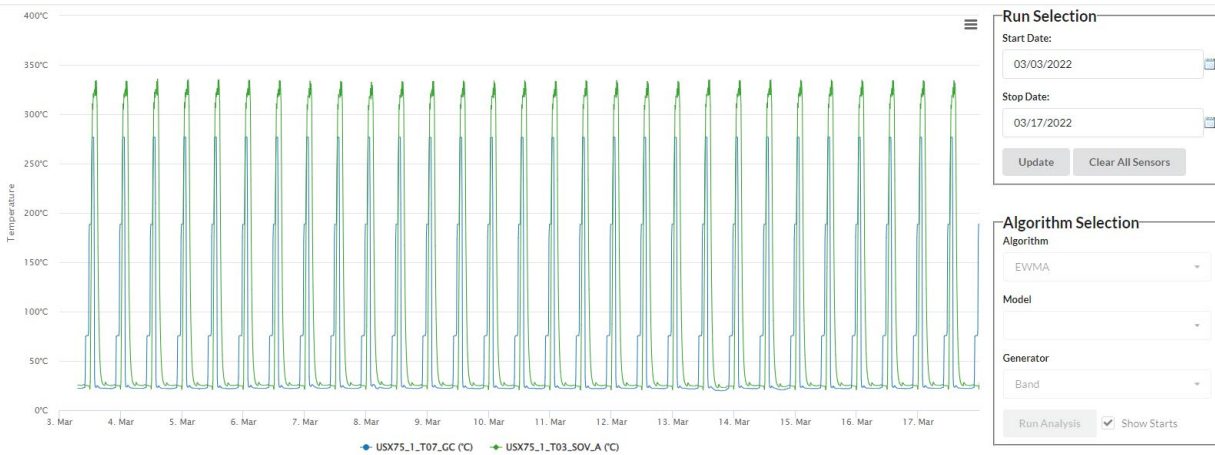


Figure 2-18 Plot of a multiple sensors after utilizing the “View Analysis Page” button

After the new tab is loaded, inspecting the address bar will show a similar query to what is generated when using the upper right dialog menu to obtain a sharable URL.

Example URL: `http(s)://host.name /viewer/analysis?station=USX75&startDate=20220303&stopDate=20220317&sensor=USX75;;1_T07_GC+USX75;;1_T03_SOV_A`

Table 2 Analysis Share URL Breakdown

Query	Description
<code>station=USX75</code>	Station tab in focus (if omitted, first tab will be in focus)
<code>startDate=20220303</code>	Start date for plotting sensor data. At minimum, this will set the start date in the Run Selection form group.
<code>stopDate=20220317</code>	Stop date for plotting sensor data. At minimum, this will set the stop date in the Run Selection form group.
<code>sensor=USX75;;1_T07_GC+USX75;;1_T03_SOV_A</code>	List of sensors to be selected, and then plotted. Each sensor to be plotted with specify the station code and sensor name concatenated using two semi-colons. If this is omitted, then no data will be plotted upon arriving on the page. Multiple sensors are appended using the '+' character

It is not required that the sensor list be limited to be source from a single station. Similarly, there is no requirement that the station tab in focus be associated with any of the plotted sensors.

2.3.1 Analysis Alerts

An alert is created once a sensor has exceeded a region's limit for 3³ contiguous data points. The alert's quality is based on the maximum limit exceeded (Warning, Critical or Failure in ascending order). The alert's span begins from the 3rd point⁴ and extends until the data points no longer exceed the region's limits. As seen in Figure 2-19, the Warning alert spans 3 data points (indicated by the yellow highlight and Warning label in the upper margin), but the tooltip from two data points prior to the alert shows that it's the first data point below the Warning region.

³ This number will be configurable in a future release

⁴ Not the first data point which exceeded the limit

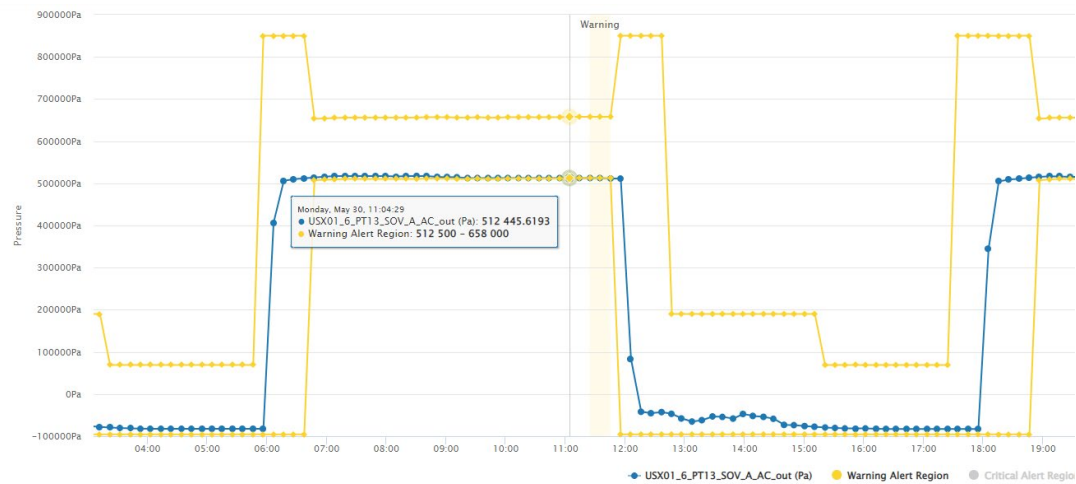


Figure 2-19 Asserting a warning alert

For the count of alerts, each contiguous set of alert points of a given severity. Above a single alert consists of three contiguous points. Below, there are two alerts, each consisting of a few dozen points each.

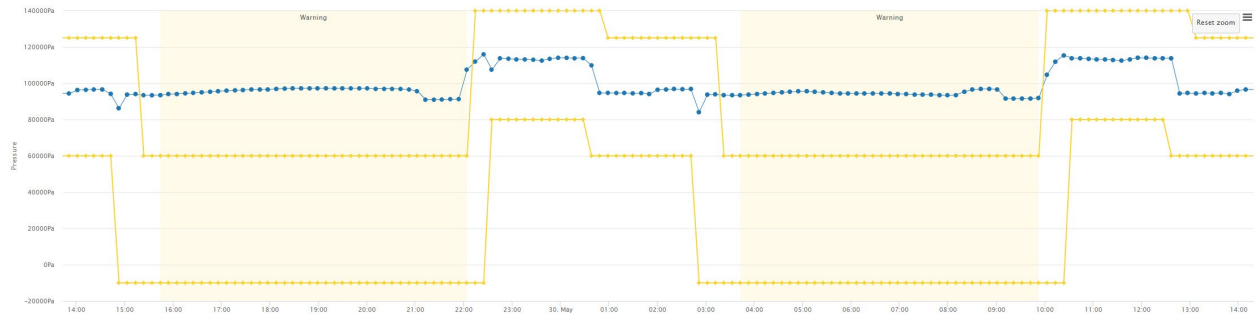


Figure 2-20 Varied alert region sizes highlighted in yellow and Warning label along upper margin

2.4 Analysis

General usage of the Analysis page is the same as the Explorer page. The biggest difference is that the Explorer show results from predefined analysis, while the analysis page allows for interactive analysis utilizing predefined models. Based on user settings, the sensor groups may initially be expanded or collapsed (see section 2.1.2).



Figure 2-21 Initial Analysis page with collapsed Uncategorized

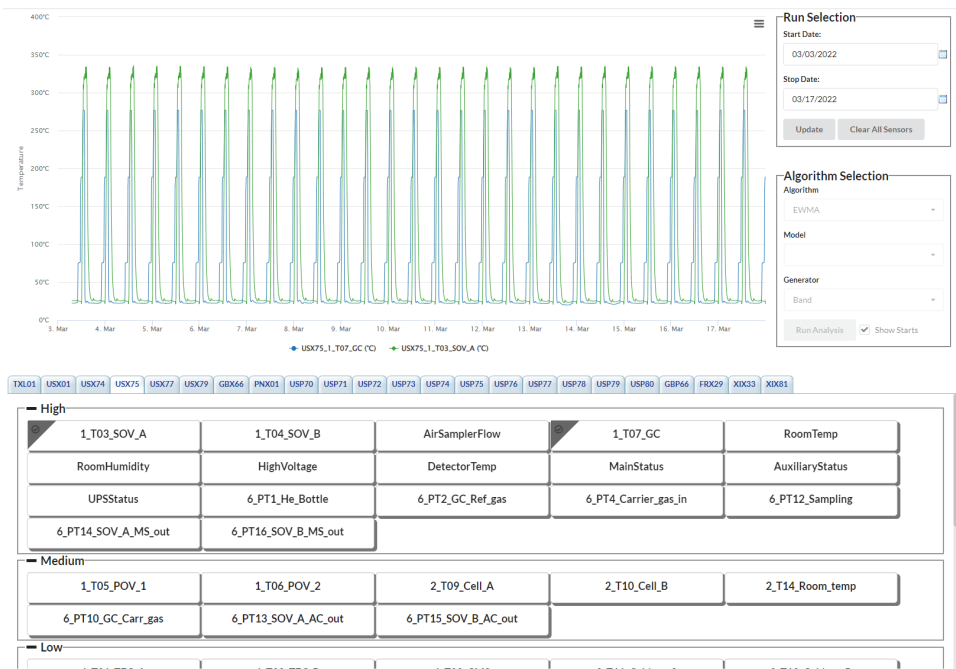


Figure 2-22 Plot of a multiple sensors on the Analysis page

Cards simply list a sensor's name (see section 2.1.2) on this page because it isn't referring to pre-run analysis results with alert counts or statuses for the sensors therein.

2.4.1 Manual Analysis

To perform analysis on a sensor, make sure only a single sensor is selected (else controls will be disabled, as can be seen in Figure 2-20 where two sensors have been selected/plotted). Select the desired algorithm to be used for model generation (algorithms are alphabetized by their simple name). Below we have selected the Simple algorithm, which will “simply” see if the data lies between the defined limits.¹

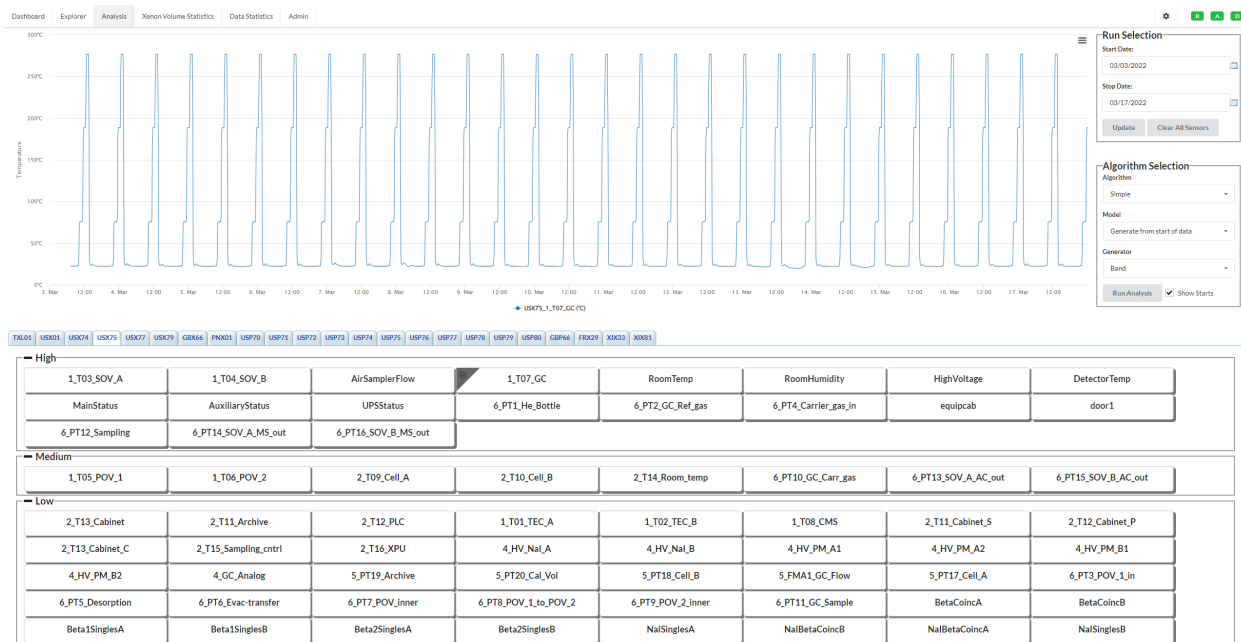
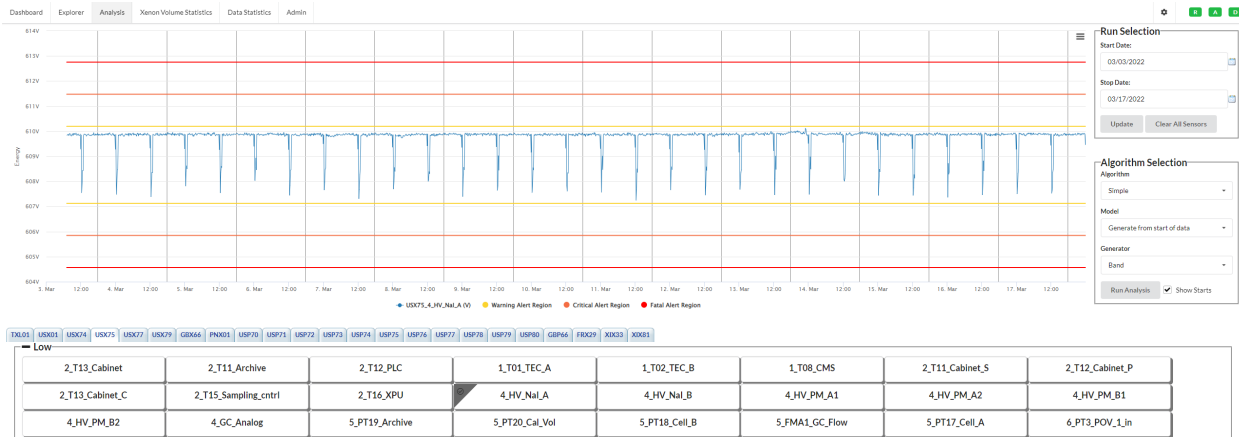


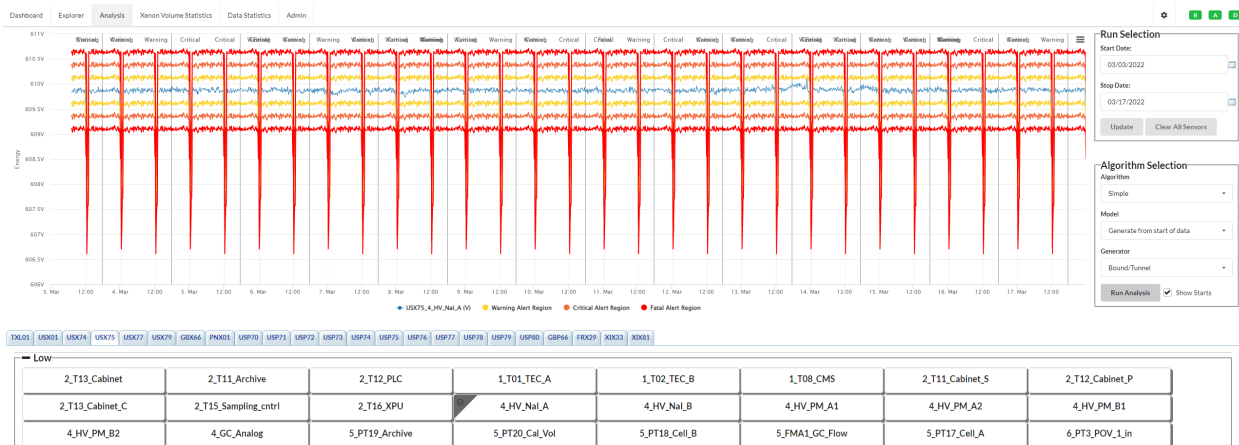
Figure 2-23 Simple Algorithm Selected

Next select the desired model. The default selection is “Generate from start of data.” This option 1) takes the first complete cycle’s worth of data as the initial model’s value and 2) ensure that a sensor may be analyzed despite a formal model having been created or not. To create alert regions, select the desired model generator. The provided alert generator plugins are “Band” and “Bound/Tunnel.” The “Band” generator is intended for sensor’s whose value is generally flat (e.g., high voltage, power input, etc.). It takes the median value of all the data points and creates a constant region that increases the upper and lower limits by 10%, 20% and 30% of the data’s range span.

¹ For more details on alert regions, see section 2.7.4.



The “Bound/Tunnel” generator is intended for sensor’s whose value may fluctuate throughout the cycle, but generally remains “constant” at the same point during each cycle. It takes the span of all the data points, and creates a region that is $\pm 10\%$, $\pm 20\%$ and $\pm 30\%$ of that span from each data point, thus creating a “tunnel” around the model’s center.



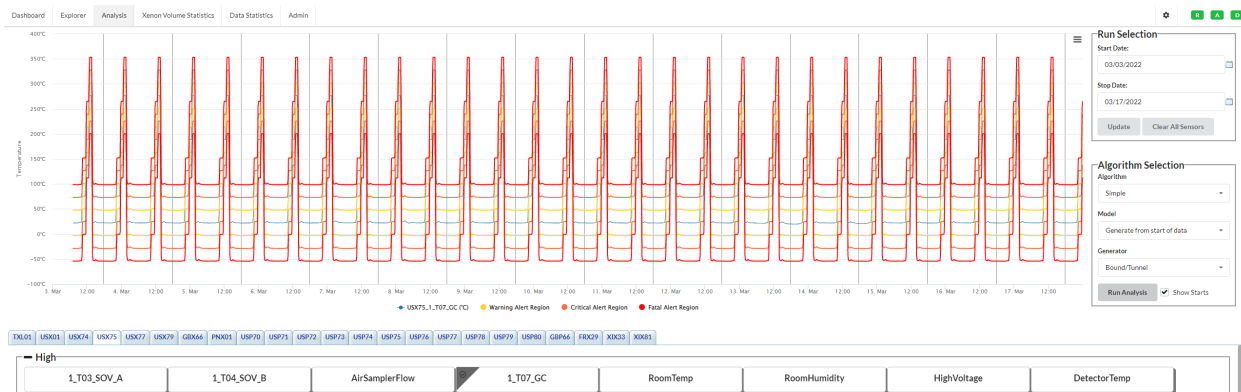


Figure 2-27 Analysis of variable sensor using Bound/Tunnel generated model

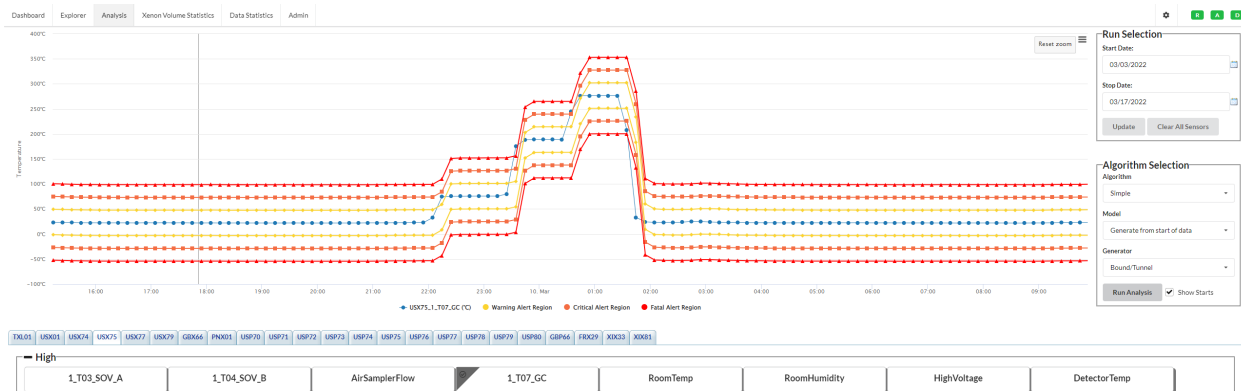


Figure 2-28 Analysis of variable sensor using Bound/Tunnel generated model (zoomed in)

2.5 Xenon Volume Statistics

Though some systems report in their RMSSOH data the volume of xenon, this page pulls the reported Xenon volume from the SAMPLEPHD in the database.¹ Each data point represent the volume for a single detector.

Like the other tabs, the default period is two weeks. There are buttons in the upper right that allow the user to quickly toggle between two weeks, one month or three months. To explicitly set the date, clicking the ‘Custom Range’ button will open a dialog to set the start and stop dates.

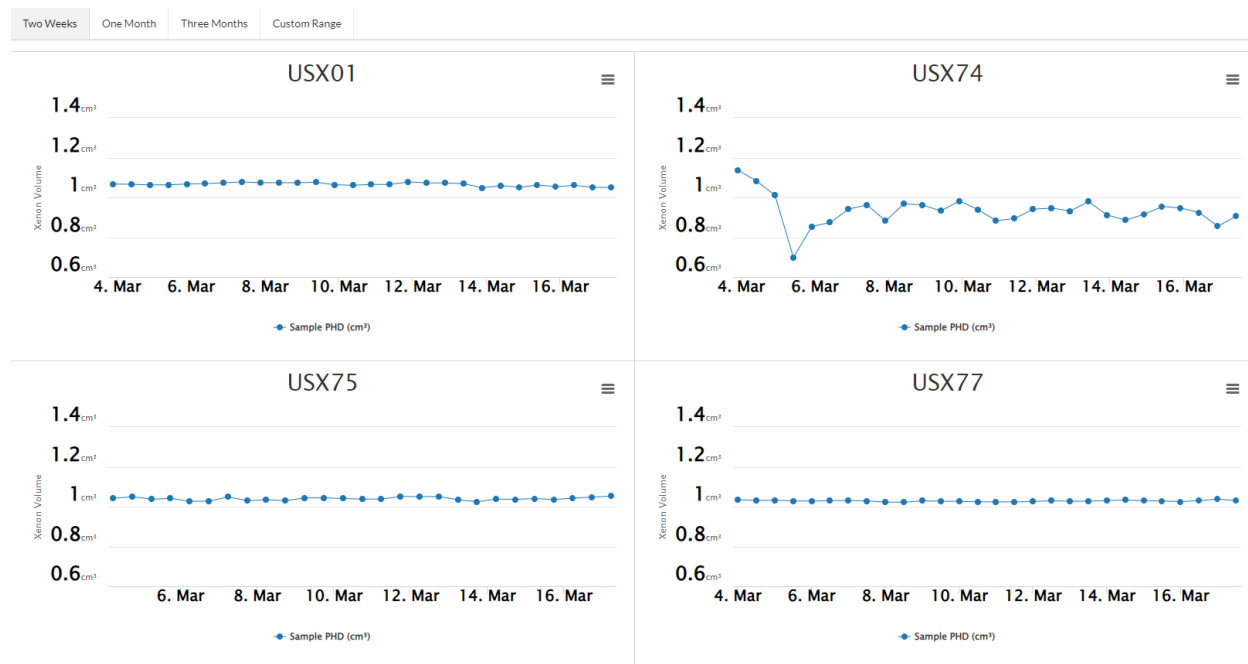


Figure 2-29 Xenon Volume Statistics Plots

The image shows a date picker dialog box. It has two input fields: 'Start Date' with the value '03/03/2022' and 'Stop Date' with the value '03/17/2022'. Each field has a calendar icon to its right. At the bottom of the dialog are two buttons: 'Update' and 'Cancel'.

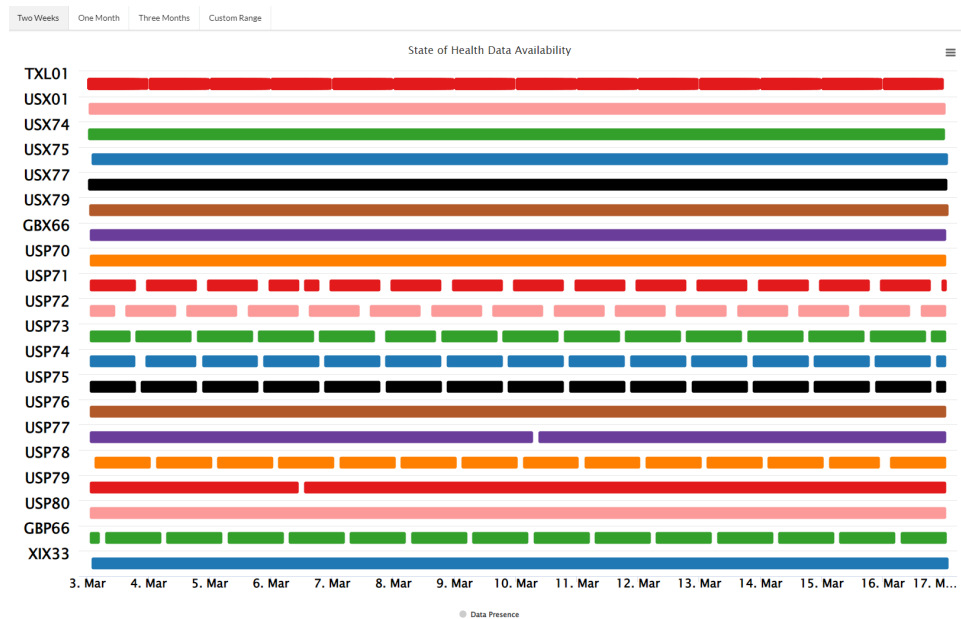
Figure 2-30 Date Picker

¹ The values reported in SAMPLEPHD's often isn't the same value as what is reported in RMSSOH

2.6 Data Statistics

Data Statistics page is used to communicate for what period does the database contain RMSSOH data for a system. It utilizes the sampling start and stop times from the RMSSOH header. If there are time gaps greater than 15 minutes between files, then a new segment is created.

Like the Xenon Volume Statistics page, there are buttons in the upper right that allow the user to quickly toggle between two weeks, one month or three months. To explicitly set the date, clicking the 'Custom Range' button will open a dialog to set the start and stop dates.



2.7 Admin

The admin pages are for configuring page content, auto analysis configuration, and creating analysis models. Until authentication is implemented, this page is accessible to all users. The default subpage for the ‘Admin’ tab is the Daemon Job Setup.

2.7.1 Daemon Job Setup

This page is for setting up a schedule for auto analysis to be performed. Currently the only supported schedule type is ‘periodic’ or cyclical.¹ Periods are defined in minutes. After selection a job, the list of assigned ‘Daemon System Setup’ is displayed in the table below.

Daemon Job Id	Job Name	Creation Date	Last Edit Date	Schedule Type	Job Start Time	Job Period Minute	Job Comment	Active	Delete
1	Checking on arrival	Mon Nov 20 16:00:00 PST 2017	Fri Apr 23 08:43:05 PDT 2021	periodic		100	Running checks on file...	True	

New

Job Name: Schedule Type: Job Period Minute: Job Comment: Active: ☐

System Setup Id: Station Code: Active: ☐ Algorithm Name: Duration Minutes: Dashboard Weight: Delete:

Add Daemon System Setup

Save Cancel

Figure 2-32 Daemon Job Setup Page

Daemon Job Id	Job Name	Creation Date	Last Edit Date	Schedule Type	Job Start Time	Job Period Minute	Job Comment	Active	Delete
1	Checking on arrival	Mon Nov 20 16:00:00 PST 2017	Fri Apr 23 08:43:05 PDT 2021	periodic		100	Running checks on file...	True	

New

Job Name: Schedule Type: Job Period Minute: Job Comment: Active: ☐

Checking on: periodic 100 Running chec ☒

System Setup Id	Station Code	Active	Algorithm Name	Duration Minutes	Dashboard Weight	Delete
181	USX01	True	Simple Limits	20,100	100	
121	PRX01	True	Simple Limits	20,100	100	
191	USX01	True	Exponentially Weighted	20,100	100	
131	USP71	True	Simple Limits	20,100	100	
132	USP75	True	Simple Limits	20,100	100	
8	GBX66	True	Simple Limits	20,100	100	
7	USX74	True	Simple Limits	20,100	100	
8	USX75	True	Simple Limits	20,100	100	
9	USX77	True	Simple Limits	20,100	100	
10	USX79	True	Simple Limits	20,100	100	
11	GBX66	False	Exponentially Weighted	20,100	100	
12	USX74	False	Exponentially Weighted	20,100	100	
13	USX75	True	Exponentially Weighted	20,100	100	
141	USP70	True	Simple Limits	20,100	100	
14	USX77	False	Exponentially Weighted	20,100	100	
15	USX79	False	Exponentially Weighted	20,100	100	
143	USP72	True	Simple Limits	20,100	100	
144	USP73	True	Simple Limits	20,100	100	
145	USP74	True	Simple Limits	20,100	100	
146	USP76	True	Simple Limits	20,100	100	
147	USP77	True	Simple Limits	20,100	100	
148	USP78	True	Simple Limits	20,100	100	
149	USP79	True	Simple Limits	20,100	100	
150	USP80	True	Simple Limits	20,100	100	
151	GBX66	True	Simple Limits	20,100	100	

Add Daemon System Setup

Save Cancel

Figure 2-33 Daemon System Setup Assigned to Job

A ‘Daemon System Setup’ can be assigned from the modal dialog after clicking the ‘Add Daemon System Setup’ button. Select the desired entry and click ‘Ok’ to add. The ‘Daemon System Setup’ list for the job will be automatically reloaded.

¹ Intent is to add weekly, bi-weekly and monthly for jobs

Figure 2-34 Daemon System Setup Modal

The Daemon System Setup page allows the user to assign an SOH Model collection to be used with a specified algorithm to analyze a specific station's (system's) sensors. The system can be set inactive apart from a job. The duration in minutes is the amount of data before now which should be pulled from the database for analysis (20160 minutes = 2 weeks).

Figure 2-35 Daemon System Setup

2.2

System Setup Id	Station Code	Active	Algorithm Name	Duration Minutes	Dashboard Weight	Delete
181	USX01	True	Simple Limits	20,160	100	
121	PX001	True	Simple Limits	20,160	100	
191	USX01	True	Exponentially Weighted	20,160	100	
131	USP71	True	Simple Limits	20,160	100	
122	USP75	True	Simple Limits	20,160	100	
6	GBX66	True	Simple Limits	20,160	100	
7	USX74	True	Simple Limits	20,160	100	
8	USX75	True	Simple Limits	20,160	100	
9	USX77	True	Simple Limits	20,160	100	
10	USX79	True	Simple Limits	20,160	100	
11	GBX66	False	Exponentially Weighted	20,160	100	
12	USX74	False	Exponentially Weighted	20,160	100	
13	USX75	True	Exponentially Weighted	20,160	100	
141	USP70	True	Simple Limits	20,160	100	
14	USX77	False	Exponentially Weighted	20,160	100	
15	USX79	False	Exponentially Weighted	20,160	100	
143	USP72	True	Simple Limits	20,160	100	
144	USP73	True	Simple Limits	20,160	100	
145	USP74	True	Simple Limits	20,160	100	
146	USP76	True	Simple Limits	20,160	100	
147	USP77	True	Simple Limits	20,160	100	
148	USP78	True	Simple Limits	20,160	100	
149	USP79	True	Simple Limits	20,160	100	
150	USP80	True	Simple Limits	20,160	100	
151	GBP66	True	Simple Limits	20,160	100	

New

Station Code

Active

Algorithm Name

Duration Minutes

Dashboard Weight

USX75

☒

Simple Limits

20160

100

SoH Model Id	SoH Model Name	Model Creation Date	Model Comment	Delete
2	SAUNA-BITZ-20100101-000000	Mon Dec 07 16:00:00 PST 2009	Models with common SAUNA BIT models	
6	SAUNA-SHMPLE-USX75-20100101-000000	Mon Dec 07 16:00:00 PST 2009	Simple models built for USX75	

Add SoH Model

Save

Cancel

Figure 2-36 Assigning SOH Model Collections

2.7.3 Soh Model

An ‘SOH Model’ collection defines a group of sensor models to be used together to evaluate a system. This is extremely helpful when sensors across multiple systems can utilize the same models. The name of an SOH Model is only utilized for identification by the user and may be changed at any time.

SoH Model Id	SoH Model Name	Model Creation Date	Model Comment	Delete
39	RASA-SHMPLE-USP70-20200117	Thu Jan 16 16:00:00 PST 2020		
40	RASA-SHMPLE-USP71-20200117	Tue Jan 14 16:00:00 PST 2020		
41	RASA-SHMPLE-USP72-20200117	Tue Jan 14 16:00:00 PST 2020		
42	RASA-SHMPLE-USP73-20200117	Thu Jan 16 16:00:00 PST 2020		
43	RASA-SHMPLE-USP74-20200117	Thu Jan 16 16:00:00 PST 2020		
44	RASA-SHMPLE-USP75-20200117	Thu Jan 16 16:00:00 PST 2020		
45	RASA-SHMPLE-USP76-20200117	Thu Jan 16 16:00:00 PST 2020		
46	RASA-SHMPLE-USP77-20200117	Thu Jan 16 16:00:00 PST 2020		
47	RASA-SHMPLE-USP78-20200117	Thu Jan 16 16:00:00 PST 2020		
48	RASA-SHMPLE-USP79-20200117	Thu Jan 16 16:00:00 PST 2020		
49	RASA-SHMPLE-USP80-20200117	Thu Jan 16 16:00:00 PST 2020		
50	RASA-SHMPLE-GBP66-20200117	Thu Jan 16 16:00:00 PST 2020		
2	SAUNA-BITZ-20100101-000000	Mon Dec 07 16:00:00 PST 2009	Models with common SAUNA BIT models	
4	SAUNA-SHMPLE-GBX66-20100101-000000	Fri Dec 11 16:00:00 PST 2009	Simple models built for GBX66	
5	SAUNA-SHMPLE-USX74-20100101-000000	Mon Dec 14 16:00:00 PST 2009	Simple models built for USX74	
6	SAUNA-SHMPLE-USX75-20100101-000000	Mon Dec 07 16:00:00 PST 2009	Simple models built for USX75	
7	SAUNA-SHMPLE-USX77-20100101-000000	Sun Dec 06 16:00:00 PST 2009	Simple models built for USX77	
8	SAUNA-SHMPLE-USX79-20100101-000000	Sun Dec 06 16:00:00 PST 2009	Simple models built for USX79	
9	SAUNA-EWMA-GBX66-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models built for GBX66	
10	SAUNA-EWMA-USX74-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models built for USX74	
74	SAUNA-USX01-20210331	Wed Mar 31 12:47:00 PST 2021	Beginning model collection for the TXL	
11	SAUNA-EWMA-USX75-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models built for USX75	
12	SAUNA-EWMA-USX77-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models built for USX77	
13	SAUNA-EWMA-USX79-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models built for USX79	
15	SAUNA-SHMPLE-PX001-20190906	Sat Aug 31 17:00:00 PDT 2019	this is just a test	
27	RASA-Basic-20200116	Thu Jan 09 16:00:00 PST 2020	This can be used for all RASA stations	
29	RASA-SHMPLE-USP75-20200114	Mon Jan 13 16:00:00 PST 2020		

New

SoH Model Name

Model Comment

Sensor Model Id

Sensor Name

Version

Sensor Model Name

Comment

Source

Delete

Add Sensor

Save

Cancel

Figure 2-37 SOH Model Collections

After selection a SOH Model, the list of assigned ‘Sensor Model’ is displayed in the table below. A ‘Sensor Model’ can be assigned from the modal dialog after clicking the ‘Add Sensor’ button. Select the desired entry and click ‘Ok’ to add. The ‘Sensor Model’ list for the ‘SOH Model’ collection will be automatically reloaded.

2	SAUNA-BITZ-20100101-000000	Mon Dec 07 16:00:00 PST 2009	Models with common SAUNA BIT models	
4	SAUNA-SIMPLE-GBX66-20100101-000000	Fri Dec 11 16:00:00 PST 2009	Simple models built for GBX66	
5	SAUNA-SIMPLE-USX74-20100101-000000	Mon Dec 14 16:00:00 PST 2009	Simple models built for USX74	
6	SAUNA-SIMPLE-USX75-20100101-000000	Mon Dec 07 16:00:00 PST 2009	Simple models built for USX75	
7	SAUNA-SIMPLE-USX77-20100101-000000	Sun Dec 06 16:00:00 PST 2009	Simple models built for USX77	
8	SAUNA-SIMPLE-USX79-20100101-000000	Sun Dec 06 16:00:00 PST 2009	Simple models built for USX79	
9	SAUNA-EWMA-GBX66-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models build for GBX66	
10	SAUNA-EWMA-USX74-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models build for USX74	
74	SAUNA-USX01-20210331	Wed Mar 31 12:47:02 PDT 2021	Beginning model collection for the TXL	
11	SAUNA-EWMA-USX75-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models build for USX75	
12	SAUNA-EWMA-USX77-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models build for USX77	
13	SAUNA-EWMA-USX79-20190807	Tue Aug 06 17:00:00 PDT 2019	EWMA models build for USX79	
15	XeInt-Simple-PHX01-20190906	Sat Aug 31 17:00:00 PDT 2019	this is just a test	
27	RASA-Basic-20200116	Thu Jan 09 16:00:00 PST 2020	This can be used for all RASA stations	
29	RASA-SIMPLE-USP75-20200114	Mon Jan 13 16:00:00 PST 2020		

Now	
Soh Model Name	Model Comment
SAUNA-BITZ	Models with:

Sensor Model Id	Sensor Name	Version	Sensor Model Name	Comment	Source	Delete
38	2_T11_Cabinet_S	1	SAUNA-BIT-20100101-000000-2_T11_Cabinet_S	Model built using SAUNA BIT parameters	("site":"USX75","span":["20200115-115252",	
27	6_PT9_POV_2_inner	1	SAUNA-BIT-20100101-000000-6_PT9_POV_2_i	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
37	2_T10_Cell_B	1	SAUNA-BIT-20100101-000000-2_T10_Cell_B	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
4	4_HV_PH_A2	1	SAUNA-BIT-20100101-000000-4_HV_PH_A2	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
31	1_T04_SOV_B	1	SAUNA-BIT-20100101-000000-1_T04_SOV_B	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
8	6_PT19_GC_Carr_gas	1	SAUNA-BIT-20100101-000000-6_PT19_GC_Car	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
5	4_HV_PH_A2	1	SAUNA-BIT-20100101-000000-4_HV_PH_A2	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
9	6_PT12_GC_Sample	1	SAUNA-BIT-20100101-000000-6_PT12_GC_Sa	Model built using SAUNA BIT parameters, shift	("site":"none","span":["20100101-000000",2,	
42	2_T15_Sampling_ctrnt	1	SAUNA-BIT-20100101-000000-2_T15_Sampli	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
18	6_PT1_He_Bottle	1	SAUNA-BIT-20100101-000000-6_PT1_He_Bottl	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
26	6_PT8_POV_1_to_POV_2	1	SAUNA-BIT-20100101-000000-6_PT8_POV_1_1	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
10	6_PT12_Sampling	1	SAUNA-BIT-20100101-000000-6_PT12_Sampli	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
1	5_FMA1_GC_Flow	1	SAUNA-BIT-20100101-000000-5_FMA1_GC_Flo	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
17	5_PT19_Archive	1	SAUNA-BIT-20100101-000000-5_PT19_Archiv	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	
22	6_PT4_Carrier_gas_in	1	SAUNA-BIT-20100101-000000-6_PT4_Carrier_	Model built using SAUNA BIT parameters	("site":"none","span":["20100101-000000",2,	

Figure 2-38 Assigning Sensor Models

2.7.4 Sensor Model

Sensor models are utilized to describe the alert regions for a specific sensor. This page allows the user to create sensor model limit, utilizing actual system data to verify its validity/effectiveness (assuming that the system utilized to generate the model is functioning in a known good state). Use the system and dates fields in the upper left margin to select station and duration of time to gather data (start and stop dates). Once start and stop dates are determined, the application will find the cycle start times for plotting data. In a two-week period, there should be approximately 14 cycle starts.

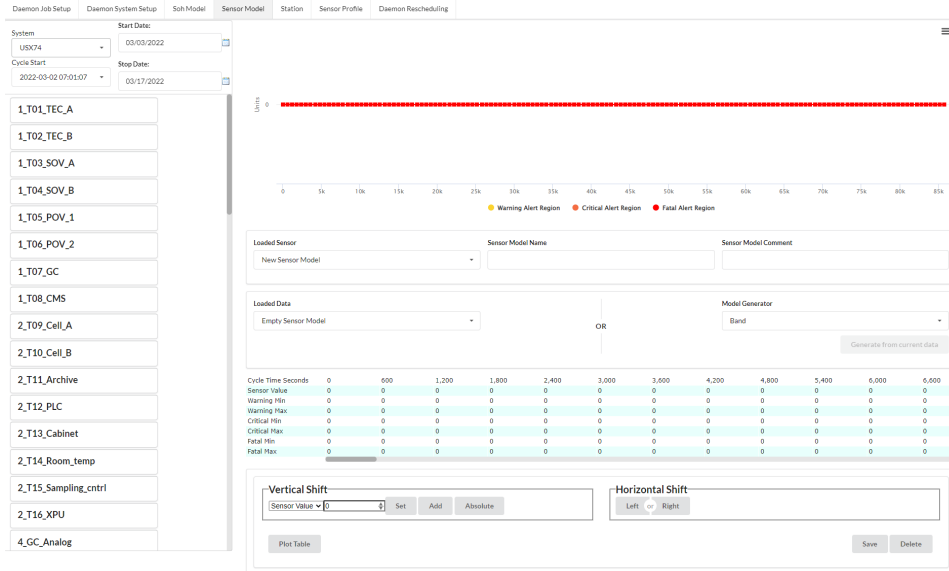


Figure 2-39 Sensor Model page

To create a model, select a sensor. System data for that sensor will be plotted for the cycle which began at the time specified in Cycle State. At any time during this process, the user can change the reference data by changing the start/stop dates and/or the cycle start time. This is helpful to determine if/how the waveforms shift in time or magnitude during the cycle.



Figure 2-40 Reference Sensor Data Loaded

It is assumed that the system cycle is 24 hours. IMS RMSSOH is on a 10-minute interval, therefore there should be 144 datapoints per cycle. The sensor models will utilize 145 bins, with bins 0 and 145 being identical, allowing an algorithm to choose to utilize the bins in inclusive low or inclusive high. To make initial model generation easier, a model generator may be utilized initially. As mentioned previously in section 2.4.1, the alert generator plugins “Band” and “Bound/Tunnel” are provided with Vision.

The “Band” generator is intended for sensors whose value is generally flat (e.g., high voltage, power input, etc.). It takes the median value of all the data points and creates a constant region that increases the upper and lower limits by 10%, 20% and 30% of the data’s range span. As demonstrated in the figure below, the “Band” generator isn’t appropriate for our current waveform.

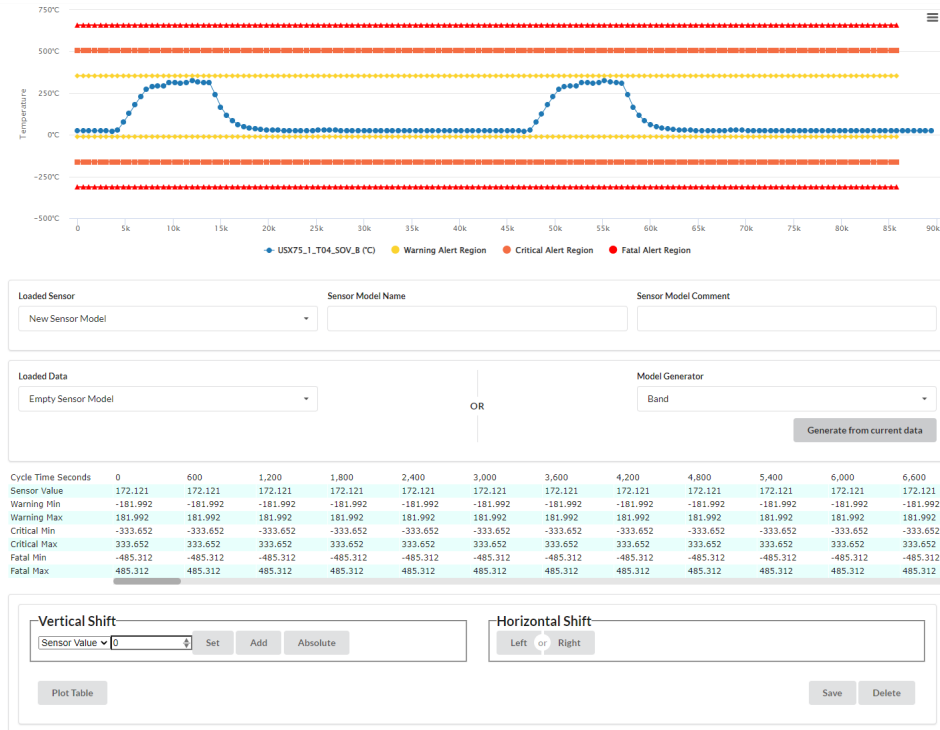


Figure 2-41 Reference Data with Band Generated Model

Looking at the striped table, we’ll discuss how the model is stored. The sensor value is the desired value. Note that for the ‘Band’ generator, this value is the average of the waveform, and is constant across the entire period. Then there are pairs of limits, min and max, for each alert region, Warning, Critical and Fatal. These regions are defined by how much the value of the sensor may vary from the sensor model’s value. In the case the Warning max, the plotted value is $172.121\text{ }^{\circ}\text{C} + 181.992\text{ }^{\circ}\text{C} = 354.113\text{ }^{\circ}\text{C}$. Note, that for the ‘Band’ generator, the magnitude of the min/max pairs are equal. Because both the sensor values and region limits are constant, the limits themselves are constant.

The “Bound/Tunnel” generator is a slight variation of the ‘Band’ generator, intended for sensors whose value may fluctuate throughout the cycle, but generally remains “constant” at the same point during each cycle. It takes the span of all the data points, and creates a region that is $\pm 10\%$, $\pm 20\%$ and $\pm 30\%$ of that span from each data point, thus creating a “tunnel” around the model’s center. Looking at the striped table the sensor value varies with the source sensor’s data, but the magnitude of the min/max pairs are still equal, thus each region limit is a transposed version of the original source’s waveform.



Figure 2-42 Reference Data with Bound/Tunnel Generated Model

Another way to jump start the creation of a model is to start from an existing sensor model. This can be done by selecting the sensor model from the ‘Loaded Data’ drop down. Rather than having to scroll through the complete list of sensor models, the user can search the list of sensor model names.

The figure shows a user interface for loading an existing sensor model. It consists of two main sections:

- Loaded Sensor:** A dropdown menu labeled 'New Sensor Model'.
- Loaded Data:** A search bar containing the text 't04_sov'. Below the search bar, a list of sensor models is displayed, including 'SAUNA-BIT-20100101-000000-1_T04_SOV_B' and 'SAUNA-BIT-20100101-000000-6_PT14_SOV_A_MS_out'.

Figure 2-43 Loading an Existing Sensor Model with Current Data

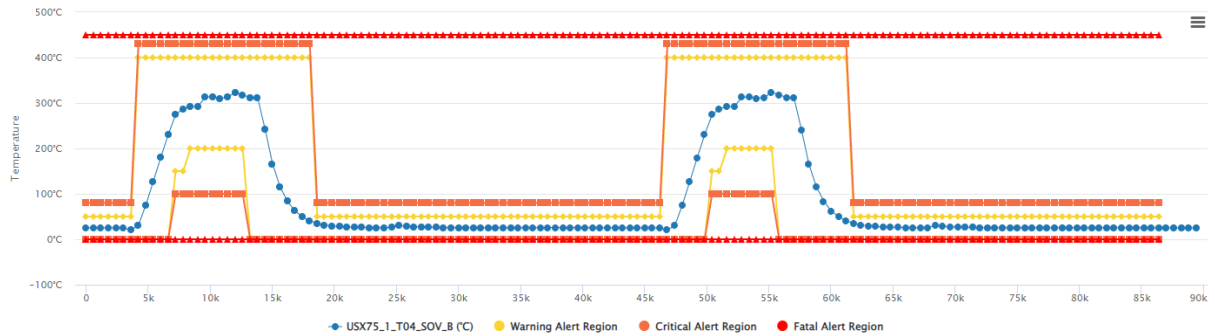


Figure 2-44 Loaded Existing Model Data

This behavior is non-destructive. The user can also make changes to the value directly in the striped table. Once all the desired modifications have been applied to the table, clicking ‘Plot Table’ will apply the changes to the plot. This allows the user to preview their changes before saving.

If the user, instead, were to select the sensor model from the ‘Loaded Sensor’ list, this would load the sensor data from the system that was utilized to generate the model. Once the model was loaded, then any changes made and subsequently saved would be applied to this model, and not to the new model previously under development. If a ‘Loaded Sensor’ model is loaded, and previously model information is lost.

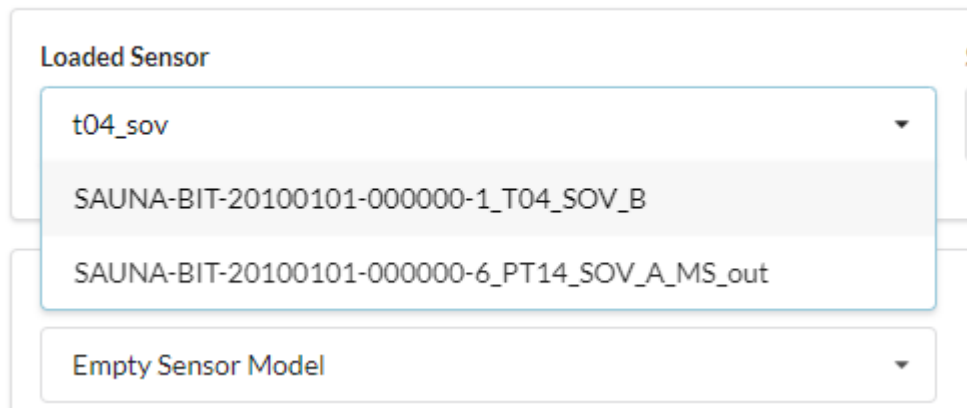


Figure 2-45 Loading Sensor Model and Source System Data

Using the Horizontal Shift Left or Right buttons, we can adjust the model data to align with this system's oven cycle. Below we've shifted the model to the left several times to show it out of time sync with the sensor's waveform.

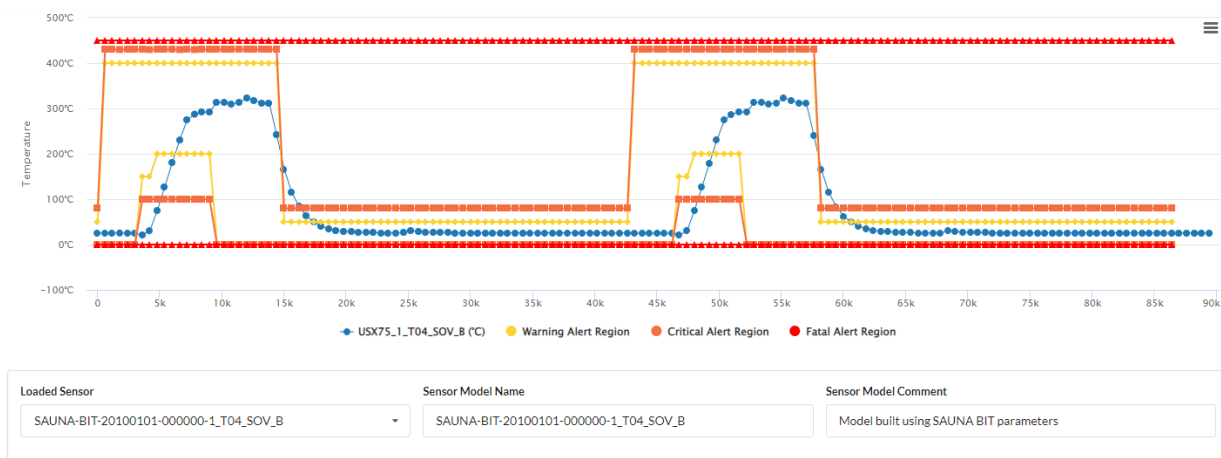


Figure 2-46 Sensor Model with Horizontal Shift Applied

2.7.5 Station

The station page allows the user to associate a station with system model. The system model (RASA, SAUNA, etc.) must be identified so an appropriate schema may be utilized to determine where the cycle t_0 is likely to have been, since this value isn't part of the IMS formats and protocols.

Station Id	Station Code	Country Code	Description	Status	Station Model	Latitude	Longitude	Elevation	Delete
71	TXL01	US	desc	xx	XeInt	0	0	0	
30	TXL00	xx	desc	xx		0	0	0	
135	TXL01	xx	Container to USX01	xx	TXL	54.98	25.761	0	
119	TZP64					0	0	0	
53	USP22	US	From Watchmen, using	ON		11	22	1,122	
62	USL16	US	USL16 (RL16) at PNL			46.345	119.279	0	
120	USP70	US	Sacramento, CA		RASA	38.7	-121.4	0	
121	USP71	US	Sand Point, AK		RASA	55.2	-160.5	0	
122	USP72	US	Halbourne, FL		RASA	28.1	-80.612	0	
40	USP73	us	x	xx	RASA	-64.774	-64.055	0	
123	USP74	US	Ashland, KS		RASA	37.2	-99.8	0	
52	USP75	US	Charlottesville, VA		RASA	38	-78.4	0	
124	USP76	US	Saltchuck, AK		RASA	64.7	-147.1	0	
125	USP77	US	Wake Island		RASA	19.3	166.6	0	
126	USP78	US	Midway Islands		RASA	28.215	-177.376	0	
127	USP79	US	Oahu, HI		RASA	21.5	-158	0	
128	USP80	US	Upl, Guam		RASA	13.6	144.9	0	
26	USX01	xx	desc	xx	SAUNA	54.98	25.761	0	
25	USX02	xx	desc	xx		0	0	0	
20	USX14	US	Ashland, KS		SAUNA	37.2	-99.8	0	
39	USX75	US	Charlottesville, VA		SAUNA	38	-78.4	0	
2	USX77	US	Wake Island		SAUNA	19.3	166.6	0.1	
17	USX79	US	Oahu, HI		SAUNA	21.5	-158	0	
65	XE01	US			XeInt	-46.353	-119.277	0	
43	XE02	US			XeInt	0	0	0	
59	XE03	US			XeInt	0	0	0	
201	XD33	US	Xenon International in ...		XeInt2	47.9	7.9	1,284.2	
133	XD81	US	Knoxville, TN		XeInt2	35.962	-84.14	0	
67	XV505	UK				0	0	0	

New	Station Code	Country Code	Description	Status	Station Model	Latitude	Longitude	Elevation
Sensor Id	Sensor Name	Sensor Display ...	System Type	Sensor Units	Category	Category Group	Priority	
Save	Cancel							

After selection a Station, the list of associated (not assigned) ‘Sensors’ are displayed in the table below. ‘Sensors’ are associated with a system via the Sensor Profile page. Additionally a station’s country code, description, status and location may be updated from this dialog.

39	USX75	US	Charlottesville, VA	SAUNA	38	-78.4	0	
2	USX77	US	Wake Island	SAUNA	19.3	166.6	0.1	
17	USX79	US	Oahu, HI	SAUNA	21.5	-158	0	
65	XEI01	US		XeInt	46.353	-119.277	0	
43	XEI02	US		XeInt	0	0	0	
59	XEI03	US		XeInt	0	0	0	
201	XIX33	US	Xenon International in ...	XeInt2	47.9	7.9	1,284.2	
133	XIX81	US	Knoxville, TN	XeInt2	35.962	-84.14	0	
67	XY505	UK			0	0	0	

New

Station Code

Country Code

Description

Status

Station Model

Latitude

Longitude

Elevation

USX75

US

Charlottesville

SAUNA

38.0

-78.4

0.0

Sensor Id	Sensor Name	Sensor Display ...	System Type	Sensor Units	Category	Category Group	Priority
1,516	2_T13_Cabinet	Temp: Cabinet		°C	temperature	Low	
1,517	2_T11_Archive	Temp: Archive		°C	temperature	Low	
1,518	2_T12_PL_C	Temp: PLC		°C	temperature	Low	
1	1_T01_TEC_A	Temp: TEC A		°C	temperature	Low	
2	1_T03_SOV_A	Temp: S Oven A		°C	temperature	High	2
3	1_T04_SOV_B	Temp: S Oven B		°C	temperature	High	3
4	1_T05_POV_1	Temp: P Oven 1		°C	temperature	Medium	10
772	AirSamplerFlow	Air Sampler Flow		m³/h	processflow	High	
5	1_T02_TEC_B	Temp: TEC B		°C	temperature	Low	
6	1_T08_CMS	CMS		°C	temperature	Low	
7	1_T06_POV_2	Temp: P Oven 2		°C	temperature	Medium	11
8	1_T07_GC	GC		°C	temperature	High	1
9	2_T09_Cell_A	Temp: Cell A		°C	temperature	Medium	12
10	2_T10_Cell_B	Temp: Cell B		°C	temperature	Medium	13
11	2_T11_Cabinet_S	Temp: Cabinet S		°C	temperature	Low	
12	2_T12_Cabinet_P	Temp: Cabinet P		°C	temperature	Low	
13	2_T13_Cabinet_C	Temp: Cabinet C		°C	temperature	Low	
14	2_T14_Room_temp	Temp: Room		°C	temperature	Medium	14

Save

Cancel

2.7.6 Sensor Profile

This page allows the user to create profiles for a specific sensor to aid in query times, unit association, grouping and ordering of sensors on the analysis page. Adherence to IMS Formats and Protocols implies use of specific units for specific sensor categories, but not all systems are compliant and/or some systems include categories not defined in the protocol.

Daemon Job Setup

Daemon System Setup

Sch Model

Sensor Model

Station

Sensor Profile

Daemon Rescheduling

Sensor Id	Sensor Name	Sensor Display ...	System Type	Sensor Units	Category	Category Group	Priority	Delete
1	1_T01_TEC_A	Temp: TEC A	SAUNA	°C	temperature	Low		
2	1_T03_SOV_A	Temp: S Oven A	SAUNA	°C	temperature	High	2	
3	1_T04_SOV_B	Temp: S Oven B	SAUNA	°C	temperature	High	3	
4	1_T05_POV_1	Temp: P Oven 1	SAUNA	°C	temperature	Medium	10	
5	1_T02_TEC_B	Temp: TEC B	SAUNA	°C	temperature	Low		
6	1_T08_CMS	CMS	SAUNA	°C	temperature	Low		
7	1_T06_POV_2	Temp: P Oven 2	SAUNA	°C	temperature	Medium	11	
8	1_T07_GC	GC	SAUNA	°C	temperature	High	1	
9	2_T09_Cell_A	Temp: Cell A	SAUNA	°C	temperature	Medium	12	
10	2_T10_Cell_B	Temp: Cell B	SAUNA	°C	temperature	Medium	13	
11	2_T11_Cabinet_S	Temp: Cabinet S	SAUNA	°C	temperature	Low		
12	2_T12_Cabinet_P	Temp: Cabinet P	SAUNA	°C	temperature	Low		
13	2_T13_Cabinet_C	Temp: Cabinet C	SAUNA	°C	temperature	Low		
14	2_T14_Room_temp	Temp: Room	SAUNA	°C	temperature	Medium	14	
15	2_T15_Sampling_contr	Temp: Sampling Contr...	SAUNA	°C	temperature	Low		
16	2_T16_XPU	Temp: XPU	SAUNA	°C	temperature	Low		
17	4_HV_Nat_A	High Voltage: Nat A	SAUNA	V	voltage	Low		
18	4_HV_Nat_B	High Voltage: Nat B	SAUNA	V	voltage	Low		
19	4_HV_PM_A1	High Voltage: PM A1	SAUNA	V	voltage	Low		
20	4_HV_PM_A2	High Voltage: PM A2	SAUNA	V	voltage	Low		

New

Sensor Name

Sensor Display Name

System Type

Sensor Units

Category

Category Group

Priority

Save

Cancel

Figure 2-47 Sensor Profile Page

Daemon Job Setup		Daemon System Setup		Soh Model	Sensor Model	Station	Sensor Profile	Daemon Rescheduling		
Sensor Id	Sensor Name	Sensor Display Name	System Type	Sensor Units	Category	Category Group	Priority	Delete		
1	1_T01_TEC_A	Temp: TEC A	SAUNA	°C	temperature	Low				
2	1_T03_SOV_A	Temp: S Oven A	SAUNA	°C	temperature	High	2			
3	1_T04_SOV_B	Temp: S Oven B	SAUNA	°C	temperature	High	3			
4	1_T05_POV_1	Temp: P Oven 1	SAUNA	°C	temperature	Medium	10			
5	1_T02_TEC_B	Temp: TEC B	SAUNA	°C	temperature	Low				
6	1_T08_CHS	CHS	SAUNA	°C	temperature	Low				
7	1_T06_POV_2	Temp: P Oven 2	SAUNA	°C	temperature	Medium	11			
8	1_T07_GC	GC	SAUNA	°C	temperature	High	1			
9	2_T09_Cell_A	Temp: Cell A	SAUNA	°C	temperature	Medium	12			
10	2_T10_Cell_B	Temp: Cell B	SAUNA	°C	temperature	Medium	13			
11	2_T11_Cabinet_S	Temp: Cabinet S	SAUNA	°C	temperature	Low				
12	2_T12_Cabinet_P	Temp: Cabinet P	SAUNA	°C	temperature	Low				
13	2_T13_Cabinet_C	Temp: Cabinet C	SAUNA	°C	temperature	Low				
14	2_T14_Room_Temp	Temp: Room	SAUNA	°C	temperature	Medium	14			
15	2_T15_Sampling_cntrl	Temp: Sampling Contr...	SAUNA	°C	temperature	Low				
16	2_T16_XPU	Temp: XPU	SAUNA	°C	temperature	Low				
17	4_HV_NaI_A	High Voltage: NaI A	SAUNA	V	voltage	Low				
18	4_HV_NaI_B	High Voltage: NaI B	SAUNA	V	voltage	Low				
19	4_HV_PH_A1	High Voltage: PH A1	SAUNA	V	voltage	Low				
20	4_HV_PH_A2	High Voltage: PH A2	SAUNA	V	voltage	Low				

New

Sensor Name

Sensor Display Name

System Type

Sensor Units

Category

Category Group

Priority

1_T01_TEC_A

Temp: TEC A

SAUNA

°C

temperature

Low

Save

Cancel

Figure 2-48 Editing Sensor Profile

2.7.7 Daemon Rescheduling

This page provides two functions, 1) showing the status of a Daemon job and 2) allowing the jobs to be rescheduled. Each job has two status blocks, ‘Last Run’ and ‘Last Successful Run’. If these time stamps don’t match, then the ‘Last Run’ row will be colored red to indicate that the last run initialized did not complete.

Daemon Job Setup	Daemon System Setup	Ssh Model	Sensor Model	Station	Sensor Profile	Daemon Reschedule									
Job Name		Status													
Checking on arrival		<table><thead><tr><th></th><th>Job Started</th><th>Job Run Duration</th></tr></thead><tbody><tr><td>Last Run</td><td>Thu Mar 17 17:01:18 PDT 2022</td><td>0s</td></tr><tr><td>Last Successful Run</td><td>Thu Mar 17 15:21:18 PDT 2022</td><td>330s</td></tr></tbody></table>						Job Started	Job Run Duration	Last Run	Thu Mar 17 17:01:18 PDT 2022	0s	Last Successful Run	Thu Mar 17 15:21:18 PDT 2022	330s
	Job Started	Job Run Duration													
Last Run	Thu Mar 17 17:01:18 PDT 2022	0s													
Last Successful Run	Thu Mar 17 15:21:18 PDT 2022	330s													
Reschedule															

Figure 2-49 Last Run Triggered Doesn't Match Last Successful Run

This may be transitory, because during a run, the job duration remains at 0 seconds. Once the job completes, the run entry will be updated with the actual job run duration, at which point this entry become the ‘Last Successful Run’ and then the row with return to the default background color.

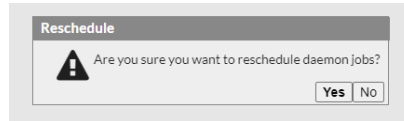
Daemon Job Setup	Daemon System Setup	Soh Model	Sensor Model	Station	Sensor Profile	Daemon Rescheduling
------------------	---------------------	-----------	--------------	---------	----------------	---------------------

Job Name	Status		
Checking on arrival		Job Started	Job Run Duration
	Last Run	Thu Mar 17 15:21:18 PDT 2022	330s
	Last Successful Run	Thu Mar 17 15:21:18 PDT 2022	330s

Reschedule

Figure 2-50 Last Run Triggered Matches Last Successful Run

Occasionally, changes to the setup will require a reschedule. This need should be prompted, but if a user finds that their changes seem to not have taken effect, they should manually come to this page and trigger a reschedule. Before rescheduling, the user will be prompted to verify that they indeed want to reschedule.



3.0 Rest

Rest application description will be provided in a future release.

4.0 Analysis Agent

Analysis Agent application description will be provided in a future release.

5.0 Daemon

Daemon application description will be provided in a future release.

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