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Desktop Analysis Reporting Tool (DART) User's Guide (Version 7.0)

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OAK RIDGE NATIONAL LABORATORY
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Desktop Analysis Reporting Tool (DART)
User's Guide
Version 7.0

A Software Product of Oak Ridge National Laboratory

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List of Acronyms and Abbreviations

CAS	Central Alarm Station
DART	Desktop Analysis Reporting Tool
FWHM	Full Width, Half Maximum
GH	Gamma High
GL	Gamma Low
LLD	Lower Level Discriminator
MCR	Monthly Country Report
NB	Neutron Background
ND	Empty
NH	Neutron High
NS	Neutron Scan
NSDD	Nuclear Smuggling Detection and Deterrence
ORNL	Oak Ridge National Laboratory
OV	Oversized
RPM	Radiation Portal Monitor
SOH	State of Health
SPM	Spectroscopic Portal Monitor
SQL	Structured Query Language
TC	Tamper Close
TT	Tamper Open
ULD	Upper Level Discriminator

1. Overview

The Desktop Analysis Reporting Tool (DART) is a software package that allows users to easily view and analyze daily files that span long periods. DART gives users the capability to quickly determine the state of health of a radiation portal monitor (RPM), troubleshoot and diagnose problems, and view data in various time frames to perform trend analysis. In short, it converts the data strings written in the daily files into meaningful tables and plots.

The standalone version of DART ("soloDART") utilizes a database engine that is included with the application; no additional installations are necessary. There is also a networked version of DART ("polyDART") that is designed to maximize the benefit of a centralized data repository while distributing the workload to individual desktop machines. This networked approach requires a more complex database manager Structured Query Language (SQL) Server; however, SQL Server is not currently provided with DART. Regardless of which version is used, DART will import daily files from RPMs, store the relevant data in its database, and it can produce reports for status, trend analysis, and reporting purposes.

2. Initial Installation and Configuration

DART utilizes a database for the storage of data extracted from the daily files. This database can reside on the local machine, or it can reside on a network location. A user's particular configuration will depend on a combination of the work environment and data storage needs.

2.1 Data Repository Option

Following are typical data repository and application combinations:

1. soloDART: The application and all data reside on a single computer. This is the most common repository application. If this is your combination, proceed to Section 2.2.

2. SQL Server already installed on a network server, and DART being installed on a networked personal computer. If this is your combination, contact Oak Ridge National Laboratory (ORNL) for detailed instructions before proceeding to Section 2.3.

2.2 DART Application Installation

soloDART 7.0 is distributed and installed via ClickOnce, a Microsoft technology[1] that does not require administrative privileges. ClickOnce also makes it easy to receive updates to DART: every time DART is launched, it will check for an update to DART. If an update exists, DART will ask

[1] For more detailed information, see https://msdn.microsoft.com/en-us/library/142dbbz4(v=vs.90).aspx , or search for "ClickOnce Deployment Overview."

the user if he or she wants to update the software. If there is no update, or if an internet connection is not available, DART will run the existing version.

NOTE: Since installation of DART does not require any administration privileges, and updates are handled automatically, the application and many supporting files reside in locations that are generally not user accessible.

NOTE: The database structure has changed since previous versions of DART (e.g., Version 6.0 and earlier). Any data that the user wants to retain in soloDART 7.0 **must** be reprocessed into soloDART 7.0.

2.2.1 DART Installation Email

To obtain a copy of DART, send an email to nsdd@ornl.gov requesting a copy of DART. Provide the following information:

- Your name
- Your email address
- Your country
- The organization you are associated with (e.g., Customs, Local Maintenance Provider, Border Police)

Upon approval, you should receive an email similar to the one below. You will also receive a separate email with a password to open the “Attachments.zip” file.

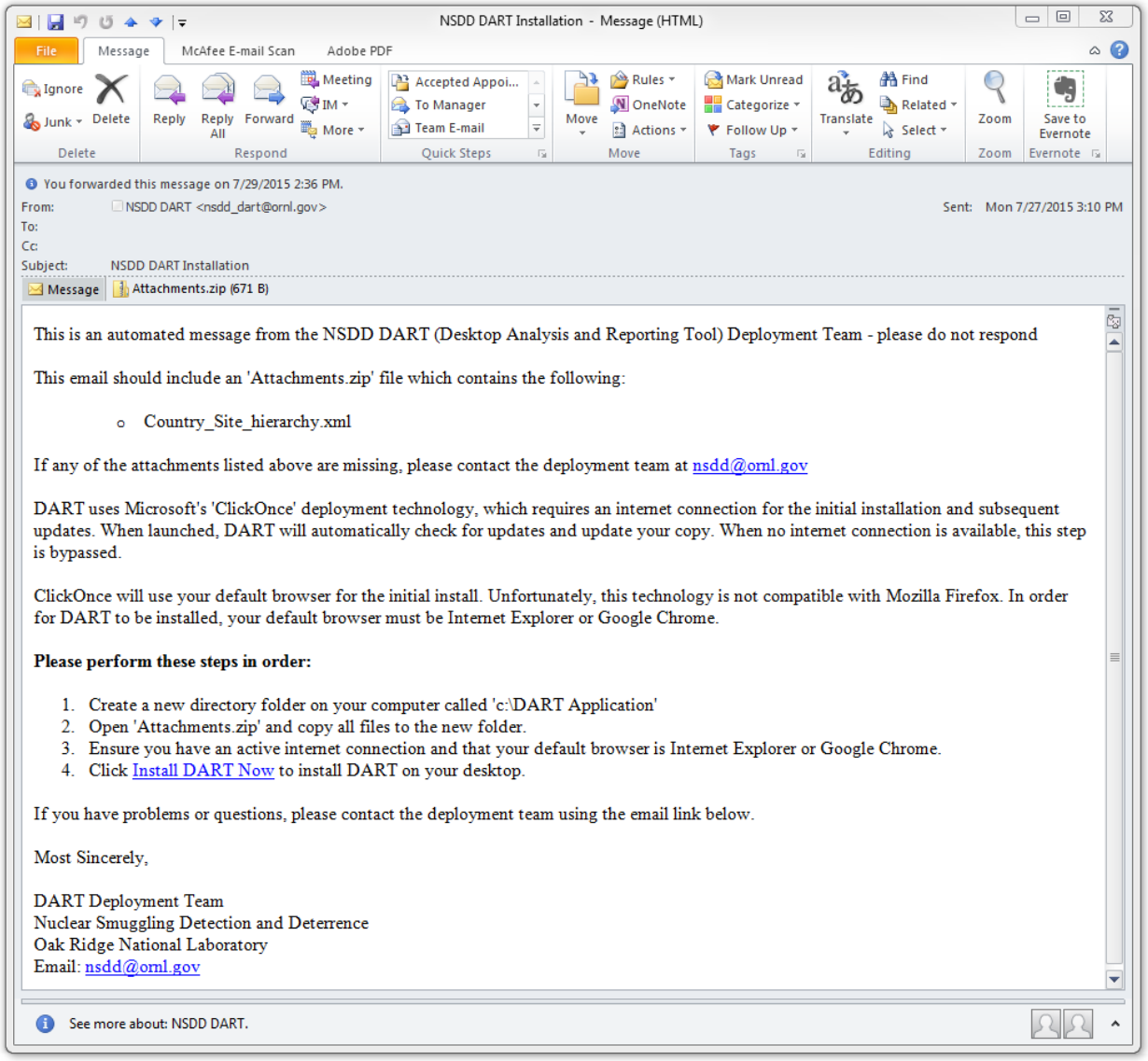


Fig. 1. Sample DART installation email.

The email identifies some steps that need to be taken before installing DART:

- Open the “Attachments.zip” file and place its contents in the “DART Application” folder. This will populate your DART Location Hierarchy with the sites and lanes that exist, according to the Nuclear Smuggling Detection and Deterrence (NSDD) System of Record. If you have already established a hierarchy for your lanes, DART 7.0 will import your existing hierarchy.
- Ensure that the default browser is Internet Explorer or Google Chrome. At the time of this writing, Mozilla’s Firefox browser does not handle ClickOnce requests correctly.

Upon clicking the “Install DART Now” link, DART will be installed via ClickOnce, and a shortcut to the application will be placed on your desktop.

NOTE: The actual application does not reside in a folder that is easily accessible by the user. Do not delete the shortcut, although it can be moved.

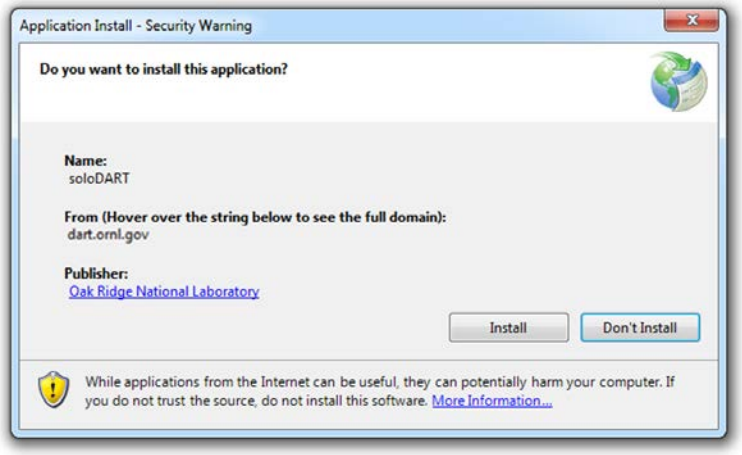


Fig. 2. ClickOnce installation window (choose “Install”).

2.2.2 Starting DART

Double click the soloDART shortcut icon on the desktop. A “splash screen” will appear, followed by the main menu of soloDART. The links should change from gray to blue as DART makes a successful connection with the database. If your soloDART menu looks like Fig. 3, you can skip to Section 3, Main Menu.

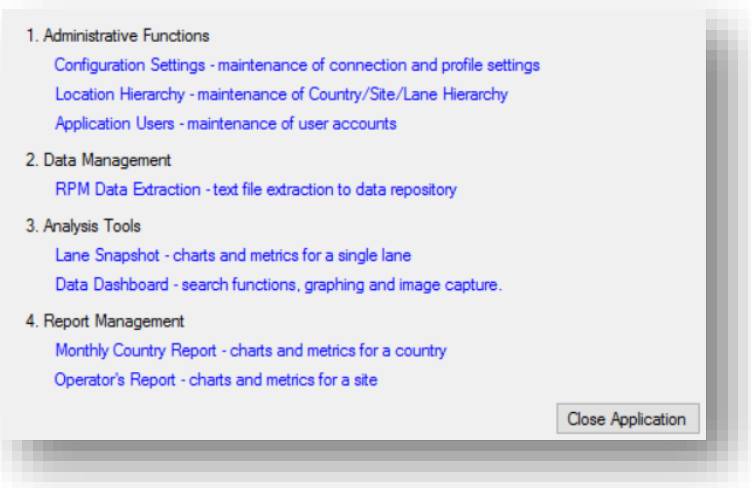


Fig. 3. DART main menu.

Each time soloDART is run, it reads a configuration file that contains settings specific to your version of soloDART. During the initial first run of soloDART, it will automatically create a configuration file and populate it with the most common options.

If soloDART is unable to connect to the database with the default options, all links will be gray and an error message will appear (Fig. 4). You will then be taken to the Configuration Settings.

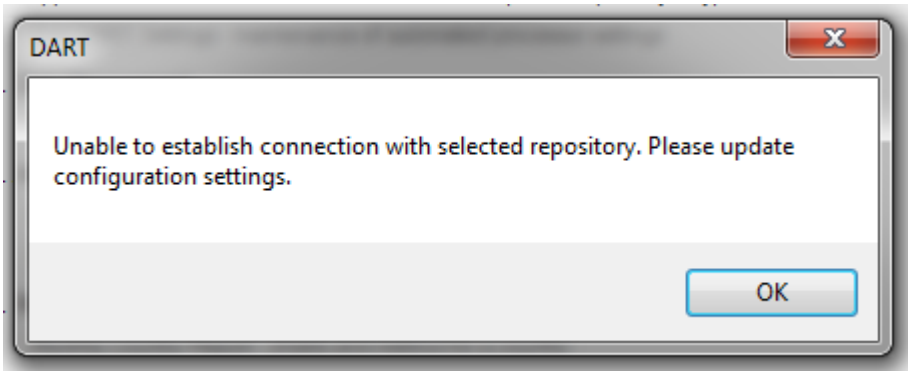


Fig. 4. Configuration message.

2.2.3 Configuration Settings

The Configuration Settings allows users to connect to different databases, as well as select a different language. Usually, these settings are applied once and not changed.

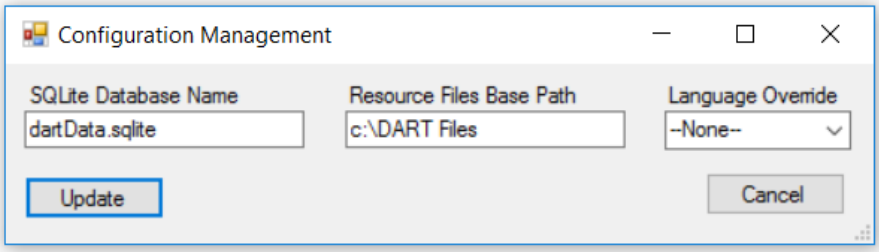


Fig 5. Configuration Management Window

The window is divided into Mode of Operation, Language Override, Local Settings, and Network Settings.

Local Settings

1. **SQLite Database Name:** The default database is named “dartData.sqlite,” and it should be used for most regular data analysis. Using this database, which is located in the C:\DART Files folder, will ensure a smooth transition of data as DART is updated. If any

other database is specified (for example, training.sqlite), soloDART will look for it in the "C:\DART Files" folder.

2. **Resource Files Base Path**: DART utilizes a number of directory folders to manage and organize daily files, images, and reports. These folders are created the first time DART is accessed, but their location will need to be specified. The location must be on the local machine and is typically c:\DART Files.

   Regardless of the location, users must have sufficient permission to create new subfolders as well as to create, move, and delete files within this folder structure. soloDART will automatically generate the resource folder upon initial connection.

3. **Language Override**: By default the language specified by your computer configuration will be displayed, provided DART has a dictionary for that language. soloDART includes English, Spanish, Mongolian, and Russian versions. To select a different language, click the drop-down menu under Language Override and choose from the available options. After clicking *Update*, the menu should be redisplayed in the language selected.

Connecting to DART

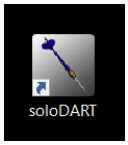
Once the appropriate values are entered, click *Update*. soloDART will try to connect to the database at this point. If errors are encountered during this process, a message will be displayed. If the connection and folder creation were successful, the configuration information will be written to the "soloConfig.xml" file and saved within the "DART Files" folder.

3. Main Menu

Upon successful completion of the configuration settings, the user will be directed to the Main Menu (Fig. 3).

NOTE: As long as the configuration settings remain valid, the user will automatically be directed to the Main Menu, not the Configuration Settings Menu, upon connection.

soloDART is opened for normal use by double clicking the soloDART shortcut on your desktop. After an initial splash screen, the Main Menu is presented. The Main Menu is divided into four groups of functionality, each with one or more options. These options appear as active blue text if the user has successfully connected to the database; otherwise, they are gray.



Click the blue text to proceed with the associated option. These options are discussed in detail in the following sections.

The *Close Application* button ends the session.

3.1 Administrative Functions

Administrative Functions grant the user access to settings and values that control the database connectivity and determine how DART links the data from the daily files to individual lanes.

3.1.1 Configuration Settings

By clicking *Configuration Settings* in the main menu, the user has access to the same configuration management parameters that were set up during the initial DART configuration (see Section 2.2.3, Configuration Settings). These settings do not typically change after the initial setup; however, they are accessible should the users need to change them.

3.1.2 Location Hierarchy

Setting up the Location Hierarchy is an integral step in DART. The Location Hierarchy not only defines the relationships between countries, sites, and lanes, but it also provides the required association between a lane and the corresponding daily files through the *Upload File Pattern*. This *Upload File Pattern* tells DART which daily files belong to which lanes. **It is vital that this information be set up correctly prior to any data extraction (discussed in Section 3.2.1).**

Figure 6 shows the Location Hierarchy as it appears the first time it is accessed. The left window is called the Navigation Pane, and it allows the user to switch between elements (in this case, elements will be countries, sites, and/or lanes). The right window contains specific values associated with various components of the location hierarchy.

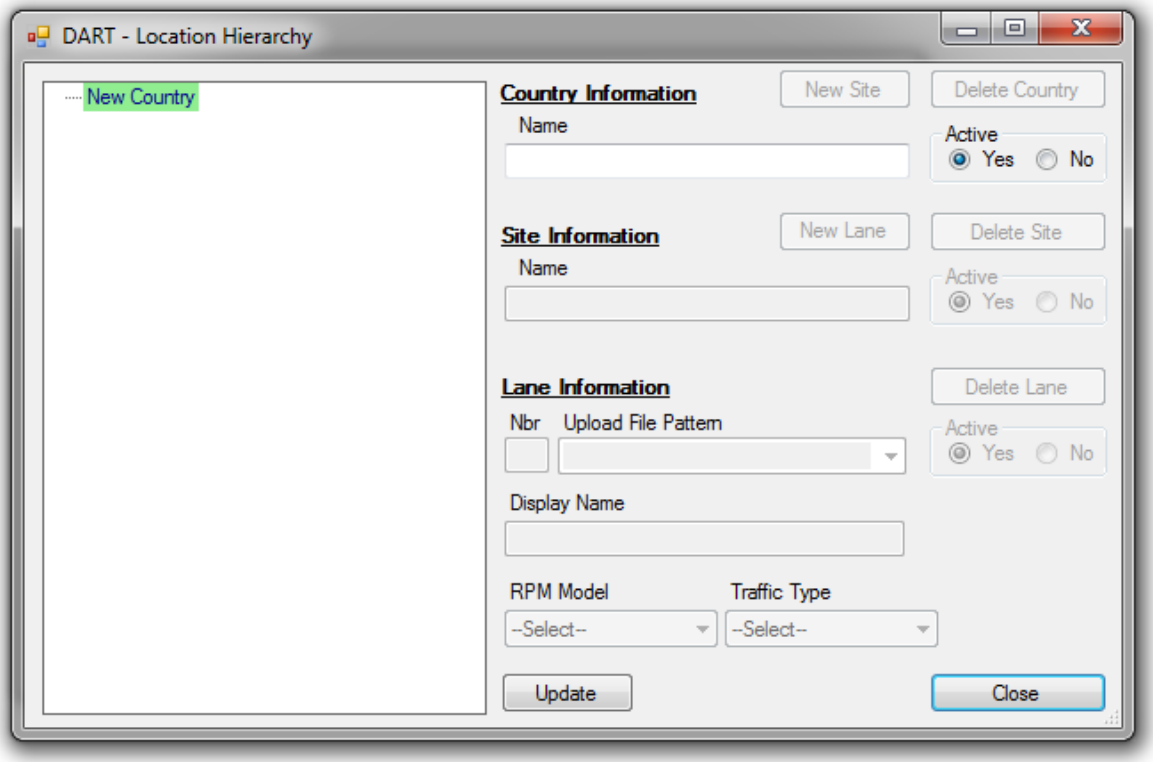


Fig. 6. Blank Location Hierarchy.

Country Information

Setup of the Location Hierarchy must begin with the addition of a new country. First, enter the country name in the *Name* field. By default, the status in the *Active* box will be **Yes**. Click the *Update* button to accept the new country. The page should refresh, and the country should appear in the Navigation Pane on the left. This can be repeated for multiple countries.

Site Information

Sites may now be added to this country; a country may have more than one site. To add a site, click the country name in the Navigation Pane. Then click the *New Site* button next to *Country Information* on the right, which should now be enabled. Under *Site Information*, the site name can then be added to the *Name* field. Again, the status in the *Active* box should be **YES**. Click the *Update* button to accept the new site. The page should refresh, and the country in the Navigation Pane should now have a [+] sign, indicating subordinate elements (sites are subordinate to countries) that can be expanded or collapsed for readability.

At this point, another site can be added by clicking the *New Site* button while the country is highlighted, or lanes can be added to the newly added site. Figure 7 shows the Navigation Pane with the addition of a country (*United States*, in this case) and its site (*Port of Amarillo*).

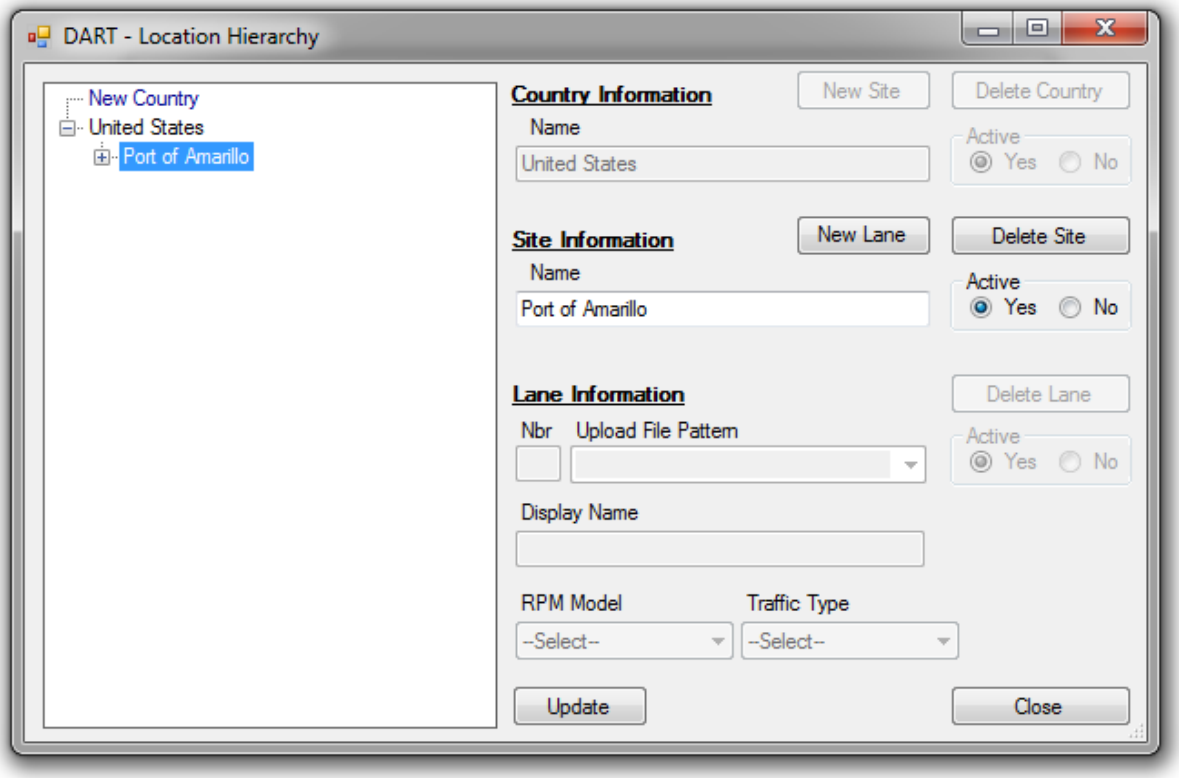


Fig. 7. Hierarchy containing one country and one site.

Lane Information

To add a new lane, first highlight in the Navigation Pane the site to which the lane will belong. In this case, *Port of Amarillo* is highlighted. Then click the *New Lane* button. This will enable the *Lane Information* section on the right. First, the user should enter a number in the *Nbr* field. This number is used as the primary sort column for the list of lanes within DART. If your site uses lane numbers as part of the naming convention, that number SHOULD be used in the *Nbr* field to reduce confusion. Otherwise, number the lanes in the order in which you want them to appear in DART. Lane numbers need not be sequential, but they must be unique.

The *Upload File Pattern* allows DART to associate a group of daily files with a particular lane. As such, it is vital that this value be entered correctly prior to performing data extractions for that lane. To enter this value correctly, the name of the daily file for each lane must be known. Having the daily files ahead of time will expedite the setup of the *Upload File Pattern*.

The published convention for daily file names dictates that the file name be composed of six elements, separated by the underscore (_) character. These elements are country code, site name, lane number, equipment type, software version, and date. A file named in accordance with this convention would look like the following:

US_PortOfAmarillo_L001_Tvm250_v001_2015-01-25.txt

For the *Upload File Pattern*, we are concerned only with enough of the name to determine Country, Site, and Lane. For our example, this would be the following:

US_PortOfAmarillo_L001

This is the value that should appear in the *Upload File Pattern*. It does **NOT** contain equipment type, software version, or date information.

If the daily files are readily available, copy them directly to the "Process Queue" folder in the "Data" resource folder. This was set up earlier in the Resource Folder Setup section and will typically be c:\DART Files\Data\Process Queue. If the daily files are located in this folder, they will appear in the drop-down menu in the right corner of the *Upload File Pattern* field on the right side of the Location Hierarchy screen. This helps ensure that no mistakes or typos are made when entering this value. This also helps populate the "RPM Model" field when setting up the Location Hierarchy (described on the next page). If the daily files are not readily available, the *Upload File Pattern* can be typed into the field.

Again, the *Active* field should be left as **Yes**. You may enter a *Display Name* in the field beneath the *Upload File Pattern*. This display name can be anything used to identify the lane. For example, the daily file name may call the lane L001, but it may be referred to as Export Lane 1 at the site. *Export Lane 1* can be used as the *Display Name* so that the lane is easily identifiable.

At this point, clicking *Update* will add a lane. The page should refresh, and the site in the Navigation Pane should now have a [+] sign (lanes are subordinate to sites). NOTE: A lane cannot exist without a site, and a site cannot exist without a country.

RPM Model: DART now includes a list of all known RPM models (e.g., SLD1P for a single pillar pedestrian portal, SLDVHX for a collimated dual pillar vehicle monitor). If the Daily Files have already been placed in the c:\DART Files\Data\Process Queue folder, DART will automatically populate these fields. The analyst can also override the RPM model and Traffic Type, if necessary.

Setting the model number tells DART what data format to expect, how many detectors to expect, and in what configuration.

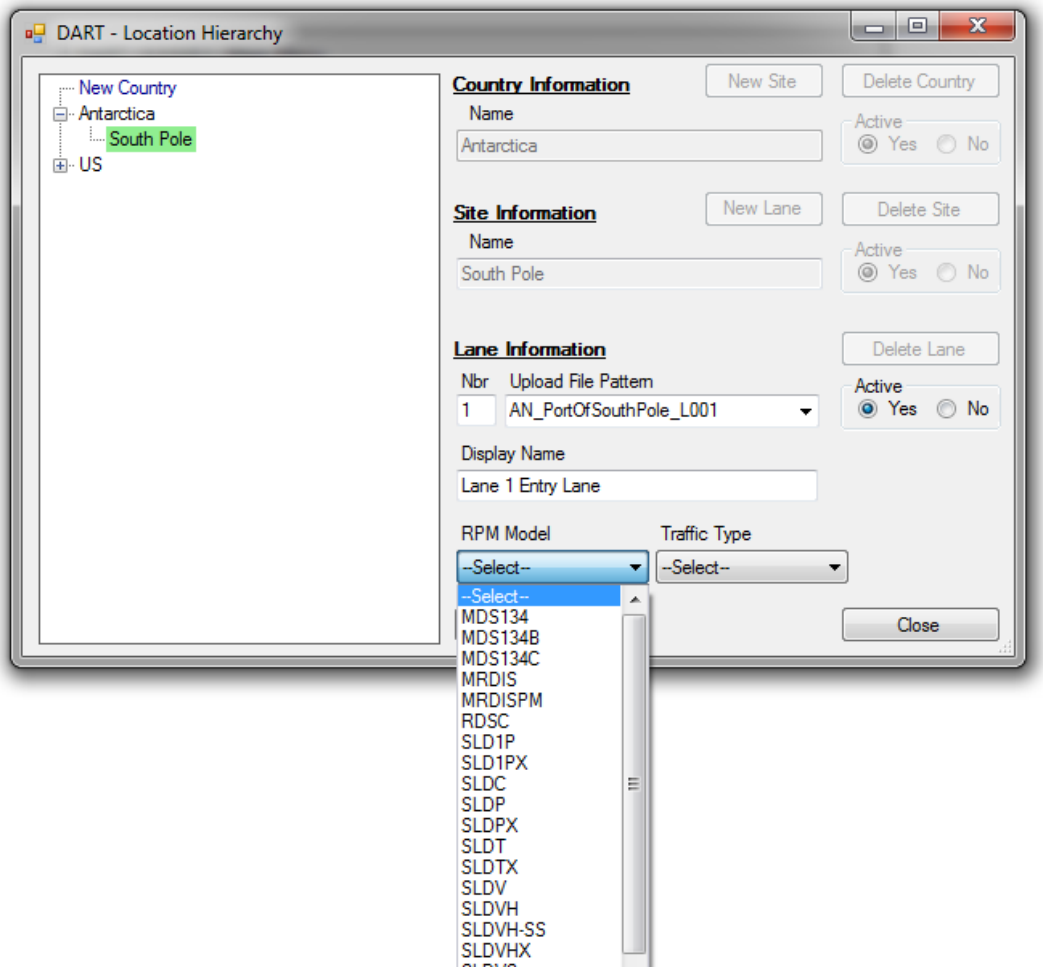


Fig. 8. Selecting an RPM Model from the dropdown list.

Traffic Type: Users can select the type of traffic that is passing through a portal. Defining this can help an analyst, as sometimes rail monitors can be used to scan vehicle traffic.

Click the *Update* button to refresh the Navigation Pane. Continue adding Portal Monitors as needed.

Figure 9 shows a location hierarchy for a sample country (named My Country) with two sites (My Site and Your Site). Each site has two lanes.

Once all sites and lanes are added and updated, click the *Close* button to return to the Main Menu.

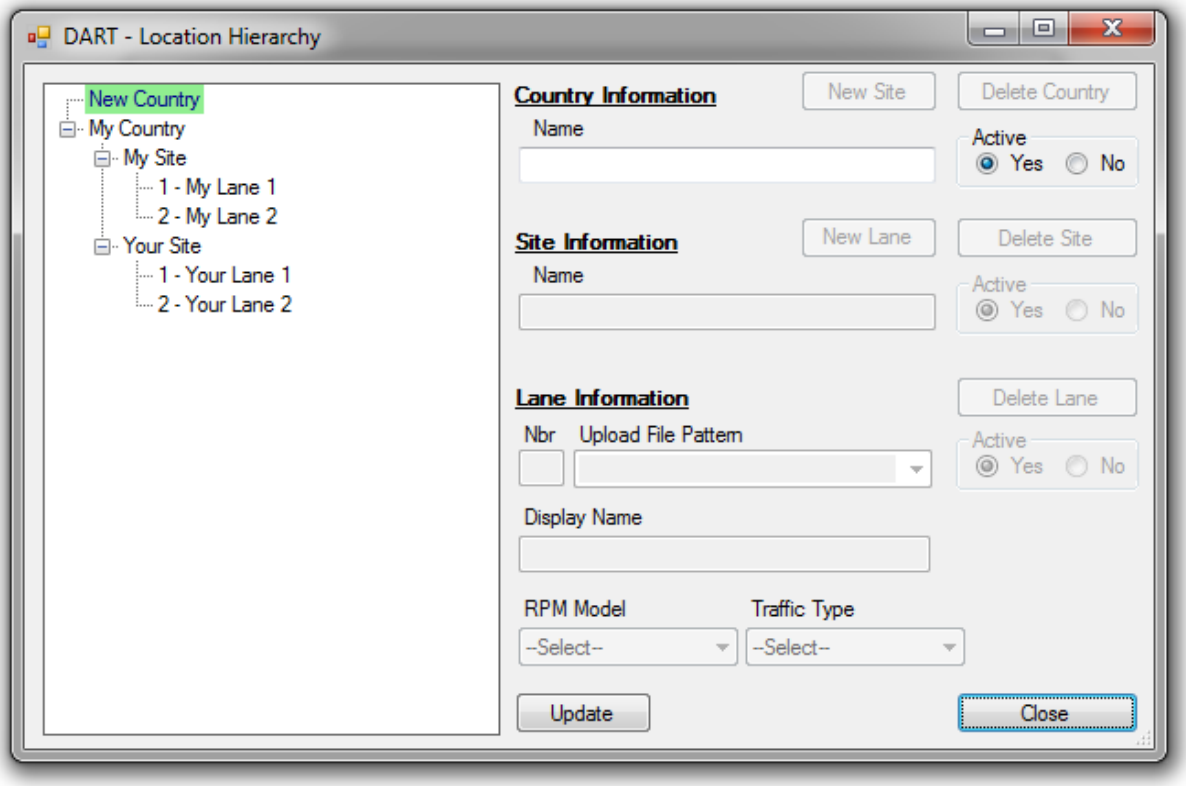


Fig. 9. Location Hierarchy example.

3.1.3 Application Users

The Application Users interface provides a centralized location to store user information, including first and last name, a designated username, email address, and phone number. When the interface is set to active status, the user is allowed to generate reports in DART. Initially, each user must be entered into the software (by clicking the *Add New User* button), as shown in Fig. 10, before any reports can be generated.

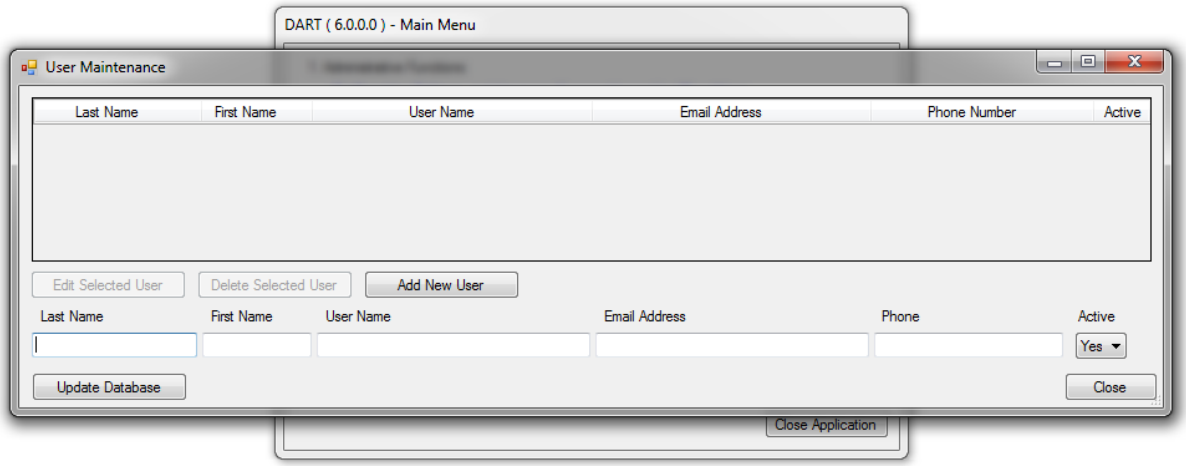


Fig. 10. Application Users Interface.

User information should be added in the appropriate spaces at the bottom of the window. No space may be left blank. To ensure the ability to generate reports, the user must set the active status to *Yes*. Click the *Update Database* button to accept the new user information.

Once at least one user has been added, the *Edit Selected User* and *Delete Selected User* buttons are active as shown in Fig. 11. To complete a change or deletion, the user must click the *Update Database* button.

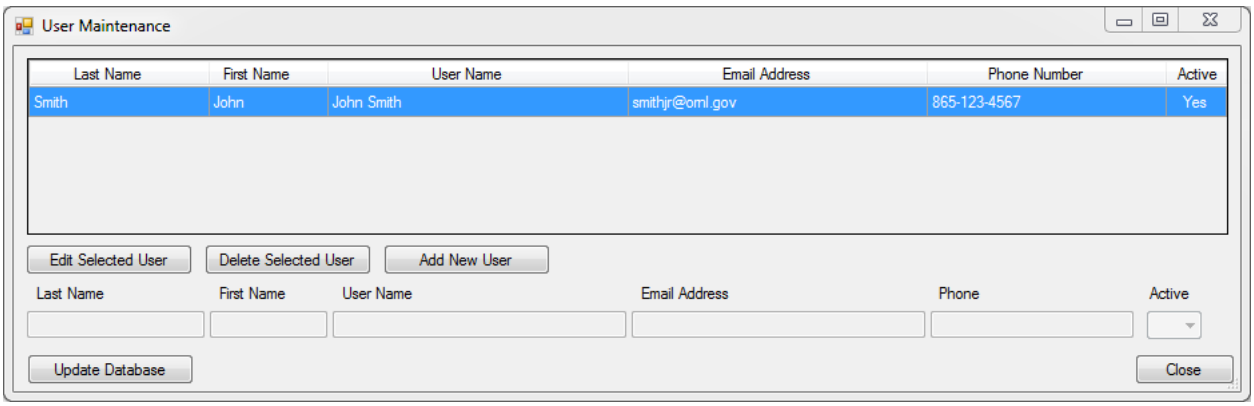


Fig. 11. Application Users Interface, with one user added.

Once the users are defined, the setup should be complete.

3.2 Data Management

The role of Data Management is to process the daily files. In the processing of daily files, also referred to as data extraction, DART reads the daily files and extracts or transfers important data to the database for analysis and reporting.

3.2.1 RPM Data Extraction

RPM Data Extraction provides the mechanism for processing daily files into an SQLite database that can be easily used by the analysis and reporting features (discussed later). In addition to processing new daily files, the RPM Extraction Tool allows users to easily eliminate old data from the SQL database. Only daily files in the "Process Queue" resource folder will be processed (typically c:\DART Files\Data\Process Queue).

Data Upload

The Data Upload tab at the top of the RPM Data Extraction screen is divided into three panes (Fig. 12):

- the Navigation Pane on the left, which displays countries and sites;
- the Site Metrics Pane in the upper right corner, which is used to display site-specific metrics; and
- the Results Pane in the lower right corner, which uses various messages to communicate the results of the data extraction process.

To display the site metrics for a given site, click on the site in the Navigation Pane to the left. If no daily files have been processed, N/A and [0] values will appear in each element of the Site Metrics Pane.

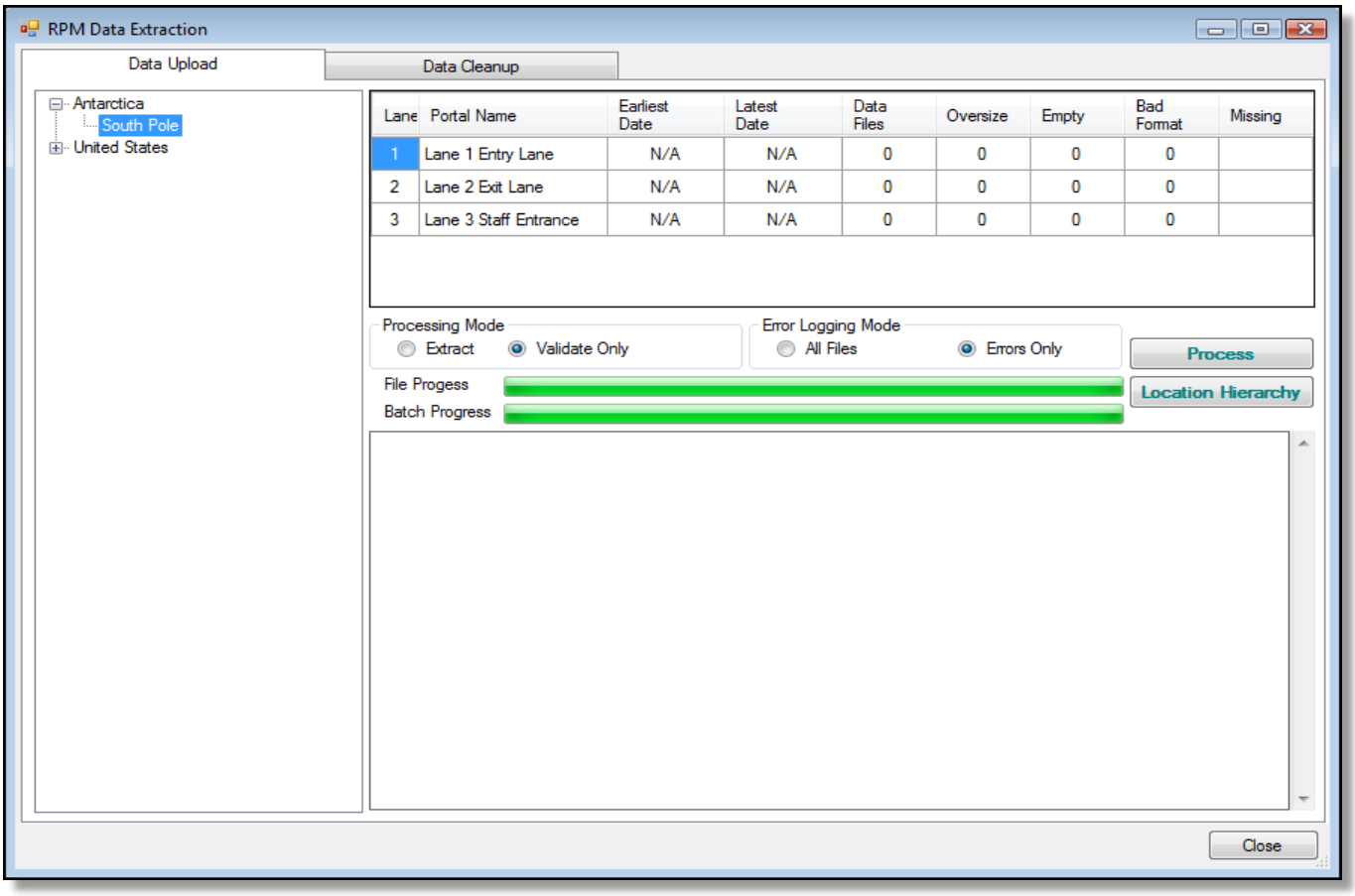


Fig. 12. RPM Data Extraction - Data Upload.

In the middle of the Data Upload tab are two groups of radio buttons, two progress bars, and two action buttons (Process and Location Hierarchy). The Processing Mode section has two radio button options: **Extract** and **Validate Only**. This setting will determine what happens when the *Process* button is clicked. The **Validate Only** option will check that the daily files waiting to be processed (in the c:\DART Files\Data\Process Queue folder) are associated with a lane in the Location Hierarchy via the **Upload File Pattern**; DART knows to which lane they belong. If a daily file cannot be validated, the **Upload File Pattern** is likely set up incorrectly in the Location Hierarchy. To navigate directly to the Location Hierarchy, simply click the *Location Hierarchy* button.

No data extraction will occur when **Validate Only** is selected. If, however, the **Extract** option is selected when the *Process* button is clicked, DART will perform the validation and will then proceed with data extraction for the files that were validated. For each of these actions, the progress bars will reflect the percentage of completion for the current file being processed (File Progress) and the percentage of completion for the entire group of files being processed (Batch Progress). When the extraction process is complete, the Results Pane will update according to the Error Logging Mode option selected.

Depending on the Error Logging Mode selection, messages will appear in the Results Pane upon completion of the task. If the **All Files** option is selected, a message will appear for each file in the "Data" folder. If the **Errors Only** option is selected, an entry will appear only for files that incurred some type of error during the extraction (discussed in the following paragraphs). Regardless of the Error Logging Mode selection, a summary line will always be displayed at the end of the batch.

To extract/process a batch of daily files, first make certain that the daily files are in the correct location (typically c:\DART Files\Data\Process Queue). When daily files for a lane are being processed for the first time, a good practice is to always validate the daily files. Select the **Validate Only** option, the preferred Error Logging Mode, and click the *Process* button. Once the daily files are validated, switch the Processing Mode to **Extract,** and click the *Process* button again. Processing the daily files may take some time, depending on the number of files. Processed daily files will automatically be moved from the "Process Queue" resource folder to the "Processed" resource folder unless errors were encountered.

Once completed, refresh the Site Metrics Pane by clicking on the country and then on the site in the Navigation Pane. The values in the Site Metrics Pane should now be updated to reflect:

- **Earliest Date**, the earliest file date existing in the database;
- **Latest Date**, the latest file date existing in the database;
- **Data Files**, the number of daily files processed;
- **Oversize**, the number of daily files that were larger than 9 MB;
- **Empty**, the number of daily files that were smaller than 5 kB;
- **Bad Format**, the number of daily files that had unexpected formats; and
- **Missing**, the number of daily files missing between the Earliest and Latest File Dates.

Ideally, there will be no Oversized, Empty, Bad Format, or Missing daily files. DART will flag oversized, empty, and bad format daily files as errors in the Results Pane. Note that daily files with bad format are not actually processed.

Figure 13 shows the Site Metric Pane after thirty daily files have been processed. The summary message is visible in the Results Pane. Once daily files are processed, the Analysis Tools may be used.

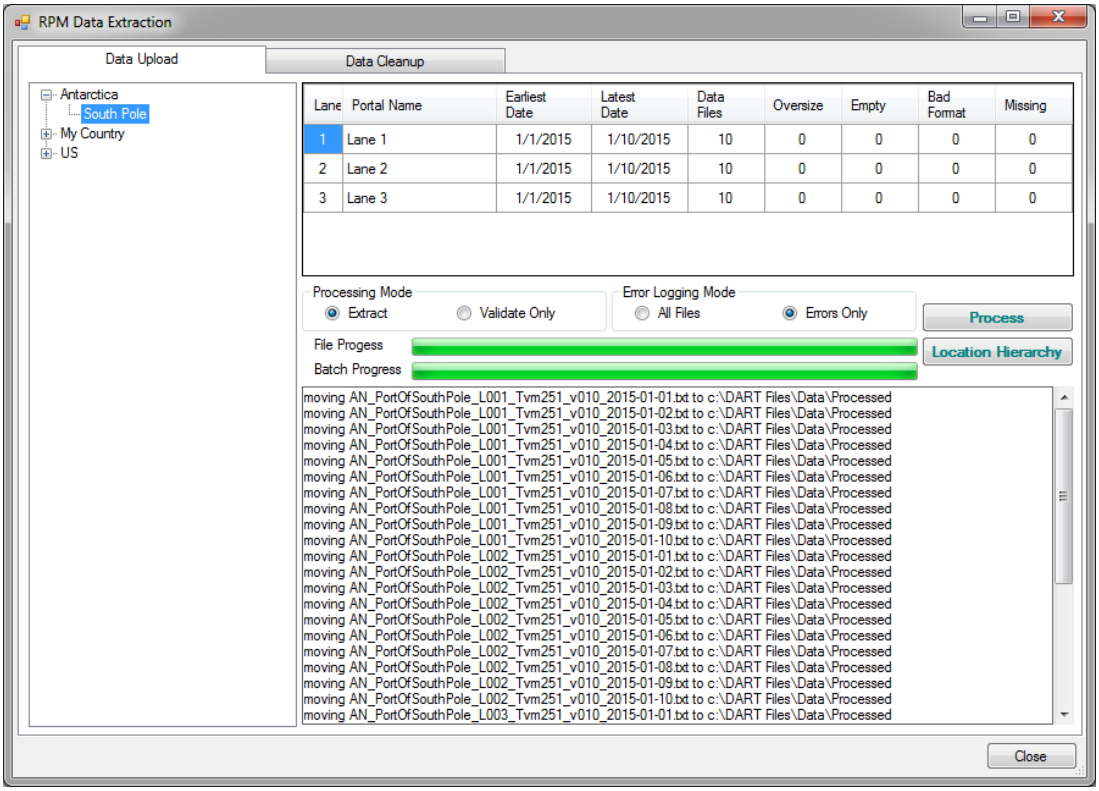


Fig. 13. RPM extraction example.

Data Cleanup

The SQLite database used in soloDART has a size limit of 140 terabytes, but this limit will never be encountered in daily use. However, if data need to be removed from the database, perhaps to free up hard drive space, the Data Cleanup tab near the top of the RPM Data Extraction window allows this.

The Data Cleanup tab is similar to the Data Upload tab. The country, site, and lane appear at the left in the Navigation Pane; the Site Metrics Pane, again at the top; and the Results Pane, at the bottom. Instead of Extraction Options being in the center of the page, however, there are three radio buttons that specify date intervals, two date selection boxes (the second visible only when needed), a graphical representation of the amount and dates of data that will be deleted, and a *Delete* button (Fig. 14).

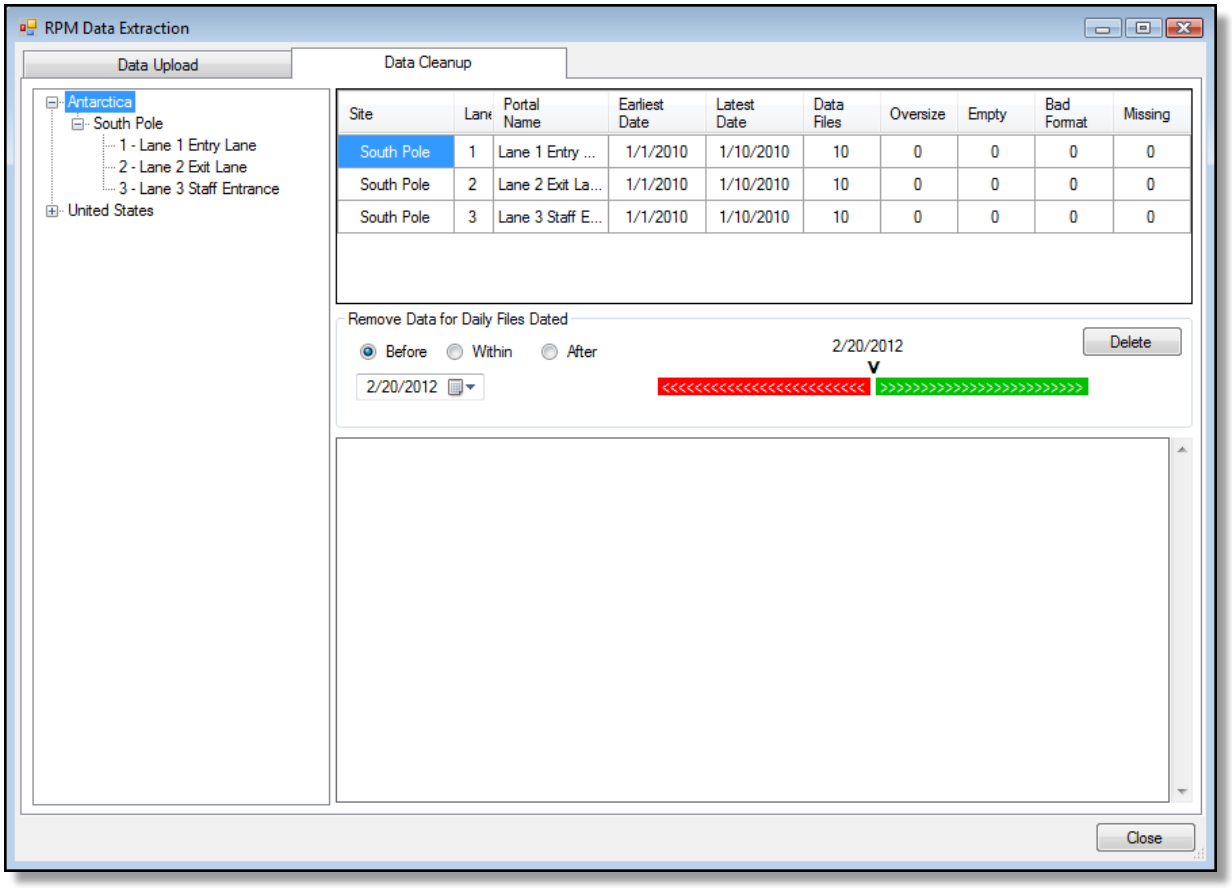


Fig. 14. RPM Data Extraction - Data Cleanup.

The amount of data deleted depends on two factors: the hierarchy level highlighted in the Navigation Pane, and the dates of the data to be deleted. Data can be deleted at the lane, site, or country level, depending on what is highlighted in the Navigation Pane. For example, the user can delete data related to a single lane by highlighting the lane in the Navigation Pane. Likewise, the user can delete data related to an entire site or country by highlighting that site or country, respectively, in the Navigation Pane. **NOTE: If data are deleted for a selected item, the data for anything subordinate to it will also be deleted (e.g., deleting a site will delete the data for all lanes associated with it).**

The amount of data deleted also depends on the dates selected with the radio buttons, as shown in Fig. 15. The graphical representation of the data indicates the specific data to be deleted (in red) based on the selection criteria.

- Selecting **Before** will delete data for dates prior to, but not including, the selected date.
- Selecting **Within** will delete data for dates between, and including, the selected dates.
- Selecting **After** will delete data for dates after, but not including, the selected date.

Fig 15. Examples of Data Cleanup date range.

To delete data, first choose the level from which the data should be deleted, and select it in the Navigation Pane on the left of the Data Cleanup window. Then select a date range (it is most common to delete data older than a particular date by selecting the *Before* option). Choose a date. When you are ready to delete the data, click the *Delete* button. The message shown in Fig. 16 is presented as a safety measure.

Fig. 16. Warning prior to data deletion.

Select *Yes* to proceed with the data deletion, or select *No* to select some other combination. Clicking *Yes* will permanently delete the data, update the message area, and redisplay the data for the selected country. If at any time you want to look at the deleted data again, you must reprocess the daily files in the Data Upload window.

3.3 Analysis Tools

Analysis Tools contains options for examining the data extracted from the daily files. These tools provide the user with useful metrics and plots and allow the user to manipulate the data to extract useful operational and functional information. Two analysis tools are available: the Lane Snapshot and the Data Dashboard.

3.3.1 Lane Snapshot

The Lane Snapshot (Fig. 17) provides a one-page functional summary of a single lane. In most cases, an overview of a single RPM can be determined through evaluation of the Lane Snapshot. The Lane Snapshot is divided into four main sections: Navigation Pane on the left, Lane Metrics at the top of the screen, Plots in the center of the screen, and Settings at the bottom of the screen. Each of these sections is described in the following paragraphs.

To view the snapshot for a specific lane, **first choose the date range of interest** in the area at the top of the Lane Snapshot screen. Selecting the date range before selecting the lane in the Navigation Pane increases the speed at which soloDART displays the correct data. After the date range is set, expand the country and site in the Navigation Pane. Click on a lane to display the snapshot.

Navigation Pane

The Navigation Pane is used to select a specific lane for analysis. All metrics, plots, and settings shown in the Lane Snapshot are specific to the lane selected in the Navigation Pane.

Lane Metrics

The Lane Metrics portion of the Lane Snapshot contains a number of tables that display data associated with the daily files. The Lane Metrics portion comprises five sections: Data Availability, Occupancy Metrics, Gamma Metrics, Neutron Metrics, and Fault Metrics. In addition to providing metrics and settings, soloDART highlights unexpected or undesirable values for specific metrics. The parameters susceptible to highlighting, and the criteria, are provided in the following sections.

Data Availability

The Data Availability table (Fig. 18) contains information specifically about the daily files (e.g., dates of, presence of, validity of, etc.). Table 1 lists the Data Availability metrics and describes each one. If a value for oversized, empty, bad format, or missing files is nonzero, that value will be highlighted to draw attention to the issue.

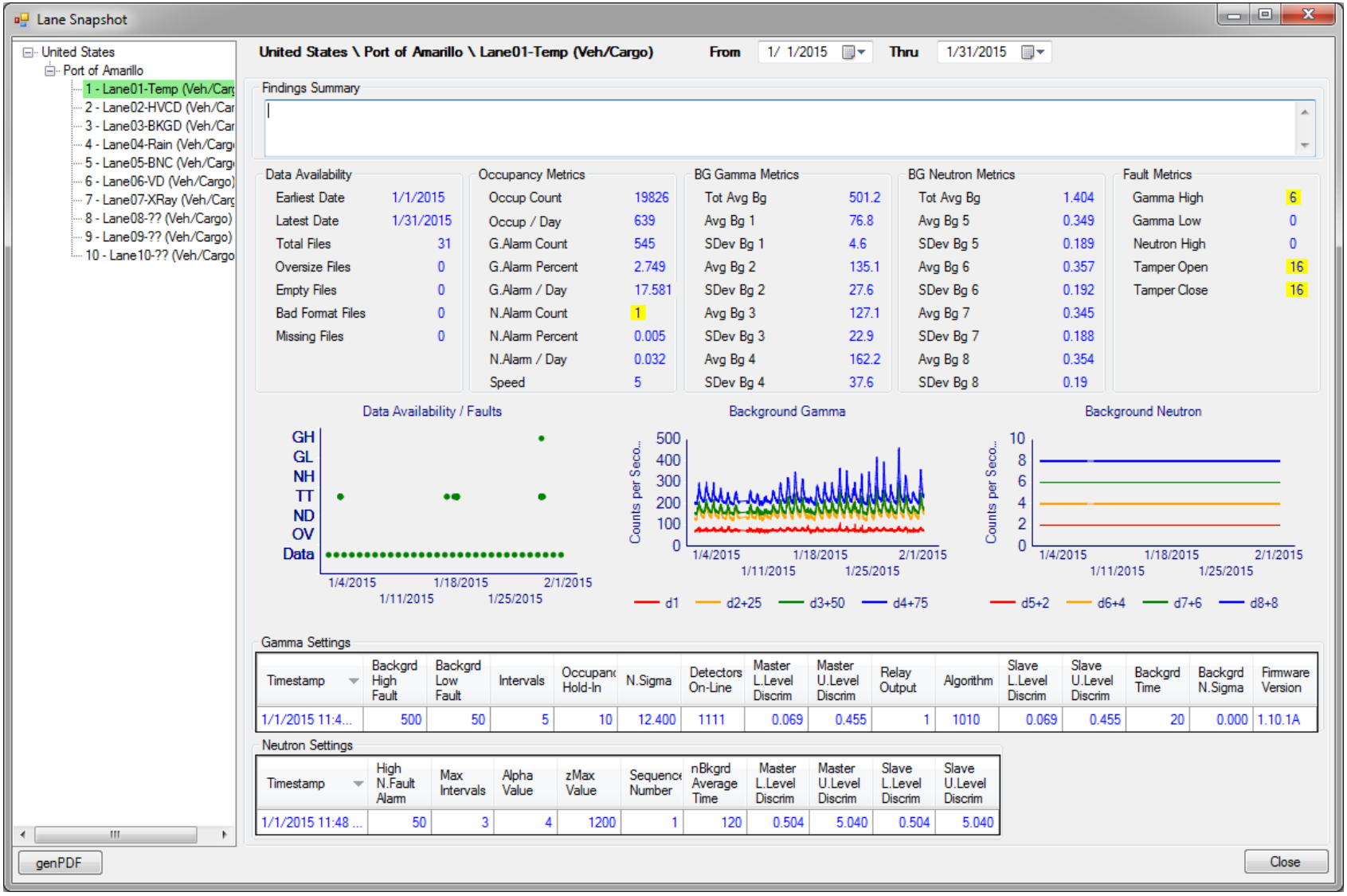


Fig. 17. Lane Snapshot.

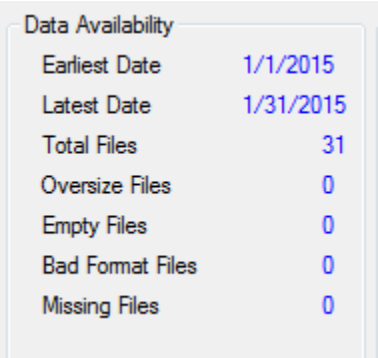


Fig. 18. Lane Snapshot - Data Availability.

Table 1. Lane Snapshot – Data Availability Metrics

Metric	**Description**
Earliest Date	Date of first daily file available within date range selected
Latest Date	Date of last daily file available within date range selected
Total Files	Total number of daily files processed within date range selected
Oversized Files	Total number of oversized (>9 MB) daily files within date range selected
Empty Files	Total number of empty (<5 kB) daily files within date range selected
Bad Format Files	Total number of bad format (unprocessed) daily files within date range selected
Missing Files	Total number of missing daily files within date range selected

Occupancy Metrics

The Occupancy Metrics table (Fig. 19) lists details related to the occupancies experienced by the lane. For example, the occupancy count (Occup Count) gives the total number of occupancies seen by the RPM for the date range selected, while the Gamma Alarm Count (G. Alarm Count) gives the total number of alarms seen by the RPM for the date range selected. A complete list of these metrics with definitions is given in Table 2.

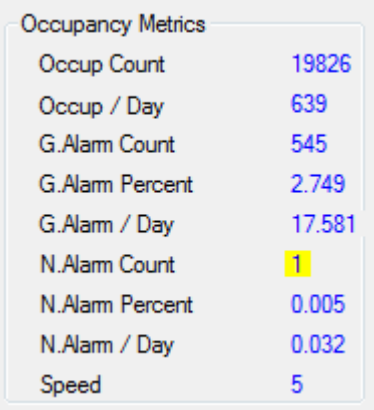


Fig 19. Lane Snapshot - Occupancy Metrics.

Table 2. Lane Snapshot – Occupancy Metrics

Occupancy Metric	Definition
Occup Count	Total number of occupancies during date range selected
Occup / Day	Total number of occupancies divided by number of days in date range
G. Alarm Count	Total number of gamma alarms during date range selected
G. Alarm Percent	Gamma alarm count divided by occupancy count as percent; gamma alarm rates greater than 3% will be highlighted in the Lane Snapshot
G. Alarm / Day	Total number of gamma alarms divided by number of days in date range
N. Alarm Count	Total number of neutron alarms during date range selected; a neutron count that is nonzero will be highlighted in the Lane Snapshot
N. Alarm Percent	Neutron alarm count divided by occupancy count as percent; a neutron alarm rate greater than zero will be highlighted in the Lane Snapshot
N. Alarm / Day	Total number of neutron alarms divided by number of days in date range
Speed	Most common speed recorded during date range selected, in kph

Gamma Metrics

The Gamma Metrics (BG Gamma Metrics) table (Fig. 20) lists the average gamma background, in counts per second (cps), for each detector assembly over the date range selected (Avg Bg X). The standard deviation for each background count rate (SDev X) is included in this table. In addition to the individual background responses, the total, or sum, of all the detector averages is also given (Tot Avg Bg). These values should be fairly consistent across all of the detector assemblies.

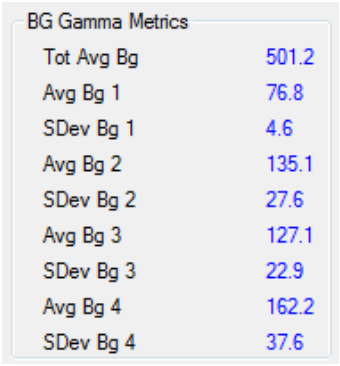


Fig. 20. Lane Snapshot – Gamma Metrics.

Neutron Metrics

The Neutron Metrics (BG Neutron Metrics) table (Fig. 21) lists the average neutron background, in cps, for each individual detector assembly over the date range selected (Avg Bg X). Included in this table is the standard deviation for each background count rate (SDev X). In addition to the individual background responses, the total, or sum, of all the detector averages is also given (Tot Avg Bg). Again, these values should be consistent across all of the detector assemblies.

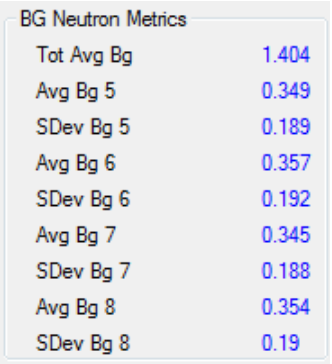


Fig. 21. Lane Snapshot - Neutron Metrics.

Fault Metrics

The Fault Metrics table (Fig. 22) shows the number of gamma high (GH), gamma low (GL), neutron high (NH), tamper open (TT), and tamper close (TC) faults experienced by the RPM over the date range selected. Ideally, the number of faults will be zero. If any of these values are nonzero, they will be highlighted.

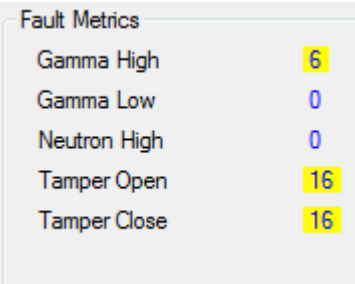


Fig. 22. Lane Snapshot - Fault Metrics.

Plots

The Plots section of the Lane Snapshot provides a graphical interpretation of the Data Availability, Gamma Metrics, Neutron Metrics, and Fault Metrics tables. You can zoom in on any region by clicking and dragging the mouse over the region of interest. To exit the zoomed-in view, click the circles at the left and/or top of the graph axes

Data Availability/Fault

The Data Availability/Faults plot (Fig. 23) shows the date for which daily files were present; the daily files, if any, that were oversized (OV) or empty (ND); and

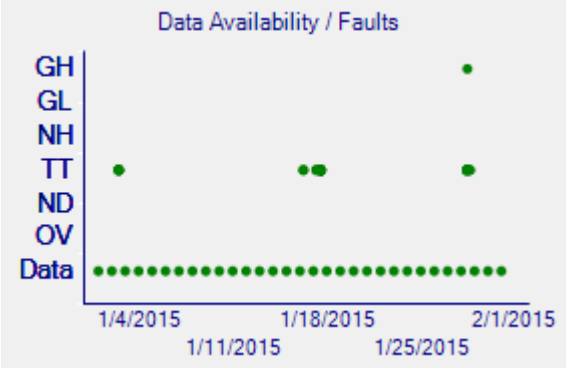


Fig. 23. Lane Snapshot - Data Availability/Faults Plot.

the dates on which each fault condition occurred.

Background Gamma

The Background Gamma plot (Fig. 24) shows the background profiles for each detector assembly. The values are offset to more easily distinguish each detector.

- Detector 1 (d1) is not offset
- Detector 2 (d2) is offset by 25 counts (25 counts are added to the actual background counts for plotting purposes)
- Detector 3 (d3) is offset by 50 counts (50 counts are added to the actual background counts for plotting purposes)
- Detector 4 (d4) is offset by 75 counts (75 counts are added to the actual background counts for plotting purposes)

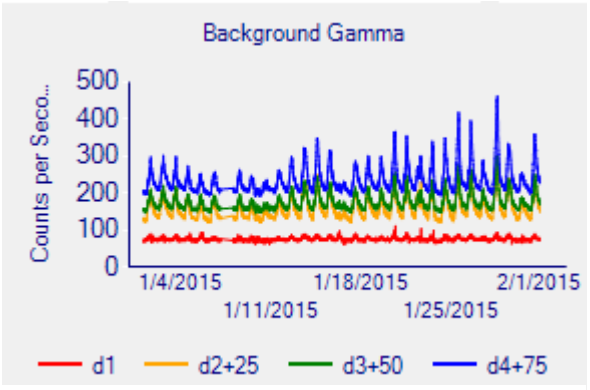


Fig. 24. Lane Snapshot – Background Gamma.

The user can zoom in on a region of this plot by clicking and dragging the mouse over the region of interest. To exit the zoomed-in view, click the circles at the left and/or top of the graph axes.

Background Neutron

The Background Neutron plot (Fig. 25) shows the background profiles for each detector assembly. The values are offset to more easily distinguish each detector:

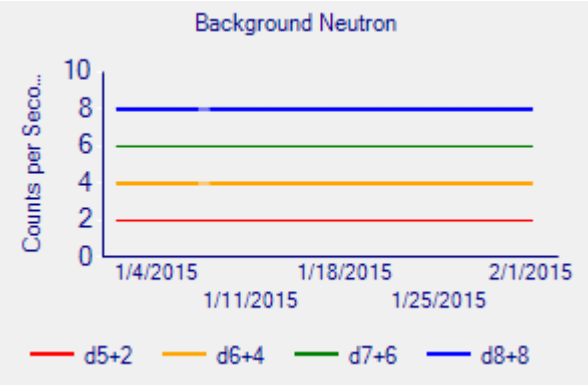


Fig. 25. Lane Snapshot - Background Neutron.

- Detector 5 (d5) is offset by 2 counts (2 counts are added to the actual background counts for plotting purposes)
- Detector 6 (d6) is offset by 4 counts (4 counts are added to the actual background counts for plotting purposes)
- Detector 7 (d7) is offset by 6 counts (6 counts are added to the actual background counts for plotting purposes)
- Detector 8 (d8) is offset by 8 counts (8 counts are added to the actual background counts for plotting purposes)

The user can zoom in on a region of this plot by clicking and dragging the mouse over the region of interest. To exit the zoomed-in view, click the circles at the left and/or top of the graph axes.

Settings

The Settings portion of the Lane Snapshot is composed of two tables: Gamma Settings and Neutron Settings. The gamma settings are listed first; the neutron settings are listed second (Fig. 25). The gamma settings and their descriptions can be found in Table 3; the neutron settings and their descriptions can be found in Table 4. Note that the available settings for Aspect or Spectroscopic Portal Monitor (SPM) systems will be different from those for the TSA monitors.

Gamma Settings

Timestamp	Backgrd High Fault	Backgrd Low Fault	Intervals	Occupanc Hold-In	N.Sigma	Detectors On-Line	Master L.Level Discrim	Master U.Level Discrim	Relay Output	Algorithm	Slave L.Level Discrim	Slave U.Level Discrim	Backgrd Time	Backgrd N.Sigma	Firmware Version
1/1/2015 11:4...	500	50	5	10	12.400	1111	0.069	0.455	1	1010	0.069	0.455	20	0.000	1.10.1A

Neutron Settings

Timestamp	High N.Fault Alarm	Max Intervals	Alpha Value	zMax Value	Sequence Number	nBkgrd Average Time	Master L.Level Discrim	Master U.Level Discrim	Slave L.Level Discrim	Slave U.Level Discrim
1/1/2015 11:48 ...	50	3	4	1200	1	120	0.504	5.040	0.504	5.040

Fig. 26. Lane Snapshot – Settings.

Table 3. Lane Snapshot - Gamma Settings

Setting	Description
Timestamp	Date and time of entry in daily file
Background H Fault Alarm	Threshold at which monitor will enter Gamma High (GH) fault condition (based on a single detector)
Background L Fault Alarm	Threshold at which monitor will enter Gamma Low (GL) fault condition (based on a single detector)
Intervals	Number of 200 ms intervals to "look back" after start of an occupancy
Occupancy Hold-In	Number of 200 ms intervals monitor will maintain occupancy after end of occupancy
Nsigma	Alarm threshold
Detectors On-line	1 indicates detector is online, 0 indicates detector is offline (All on = 1111)
Master LLD	Master lower level discriminator – cuts out signal at lower energy range
Master ULD	Master upper level discriminator – cuts out signal at upper energy range
Relay Output	1 indicates local alarms are on (lights and horns), 0 indicates alarms are off
Algorithm	Dictates which detectors or combination of detectors contribute to alarm decisions
Slave LLD	Slave lower level discriminator – cuts out signal at lower energy range
Slave ULD	Slave upper level discriminator – cuts out signal at upper energy range
Background Time	Background counting time for the system
Background Nsigma	Threshold for "throw-through" alarms
Firmware Version	Indicates which firmware version is loaded in RPM

Table 4. Lane Snapshot - Neutron Settings

Setting	Description
Timestamp	Date and time of entry in daily file
High N Fault Alarm	Threshold at which monitor will enter Neutron High (NH) fault condition (based on a single detector)
Maximum Intervals	Maximum number of one-second intervals for alarm decision
Alpha Value	Value used to select alarm and background values, used to express false alarm rate
zMax Value	Alarm threshold used after MAX intervals is reached with no alarm decision
Sequential Intervals	Number of consecutive 200 ms intervals above background needed to alarm or enter neutron high (NH) fault condition
nBackground Average Time	Counting time for establishing neutron background
Master LLD	Master lower level discriminator – cuts out signal at lower energy range
Master ULD	Master upper level discriminator – cuts out signal at upper energy range
Slave LLD	Slave lower level discriminator – cuts out signal at lower energy range
Slave ULD	Slave upper level discriminator – cuts out signal at upper energy range

The settings found in the daily files appear in white if it is consistent with the default value (the widely accepted value hardwired into the DART software). If, however, the settings differ from an expected value, it is highlighted in yellow. This is meant to draw attention to a potentially incorrect setting. The highlighted settings and their rules are as follows:

Table 5. Settings Highlighting Rules

Gamma Setting	Value
Hi Gamma Fault	No target
Lo Gamma Fault	>0
Intervals	5
Occ Hold In	Peds or Conveyor: 5 All others: 10
N. Sigma	No target
Detectors Online	Veh, Rail, 2P: 1111 1 Pillar Ped: 1100 Conveyor: 1000
Gamma LLD	0.069
Gamma ULD	0.455
Relay Output	no target
Algorithm	Veh, Rail: 1010 2P: 1010 or 1000 1Pillar or Conveyor: 1000
Bkgrd Time	20
Bkgrd N.Sigma	0
Firmware	No target
Neutron Setting	**Value**
Hi N Fault	50
Max Intervals	3 or 5
Alpha Value	4 or 47
Zmax	1200
Sequential Intervals	1 (2 for ped & rail RPMs)
n Bkgrd Avg Time	120
Neutron LLD	0.504
Neutron ULD	5.04

In the event that the settings have changed over the date range selected, the table heading (Gamma Settings or Neutron Settings) will appear in RED, and a scroll bar will appear on the right side of the settings table. Clicking the timestamp column will change the order of settings (e.g., current settings on top, oldest settings on bottom).

The highlighting mechanism in the Lane Snapshot is an important feature. It gives the user the ability to quickly look at the information related to a single lane and to determine whether further analysis is required.

Generating a Lane Report

DART has the ability to generate a PDF report for a single lane. By clicking the *genPDF* button on the left bottom of the Lane Snapshot, DART will print the findings (entered in the allocated space at the top of the Lane Snapshot) along with the metrics and plots shown in the Lane Snapshot. The report will automatically be stored in the Lane Report subfolder (typically c:\DART Files\Reports\Lane Report).

3.3.2 Data Dashboard

The Data Dashboard is the more advanced option for detailed data analysis (Fig. 27). The information provided in the Lane Snapshot is also available, albeit not on one single page, in the Data Dashboard. In addition to the metrics/plots available in the Lane Snapshot, the Data Dashboard also allows the user to review more detailed background profiles, individual alarm profiles, traffic flow through the lane, and various other data. These analysis functions are discussed in this section.

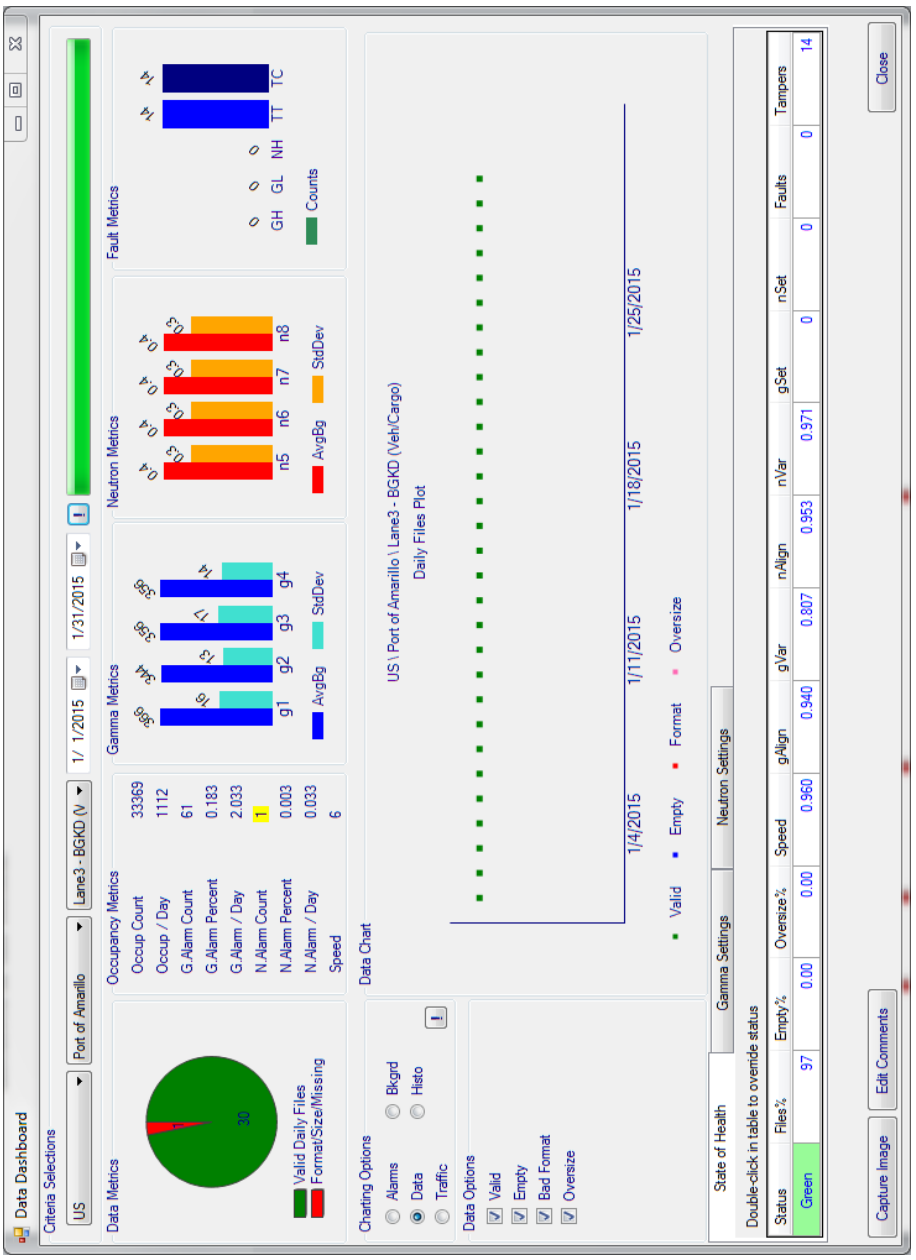


Fig. 27. Data Dashboard.

To navigate to the Data Dashboard, click the Data Dashboard option from the Main Menu. The Data Dashboard is divided into three main sections: Lane Metrics at the top of the screen, Charting Options in the middle of the screen, and Settings at the bottom of the screen. To view data in the Data Dashboard, a country, site and a lane must be selected from the Criteria Selection dropdown menus at the top of the screen. Additionally, the date range must be selected. Once the criteria are set, click the *exclamation mark* button to the right to retrieve the data.

The plotted image in the center of the Data Dashboard can be saved and comments added. However, **a Monthly Country Report must already be generated for that country and month**,

because all images are associated with a Report. These images may provide additional details and are automatically attached to the Monthly Country Report as discussed in the "Charting Options" section that follows. To capture an image, simply ensure that the image is currently displayed, and click the Capture button on the bottom left of the Data Dashboard. The image will automatically be saved in the Images subfolder (typically c:\DART Files\Images). Comments may be added to the image in the Monthly Country Report interface.

Lane Metrics

The Lane Metrics portion of the Data Dashboard encompasses a number of graphical plots and tables showing data associated with the daily files. The Lane Metrics portion comprises five sections: Data Metrics, Occupancy Metrics, Gamma Metrics, Neutron Metrics, and Fault Metrics.

Data Metrics

The Data Metrics section (Fig. 28) contains a pie chart that displays the number of valid daily files (in green) and the number of missing or corrupt (oversized, empty, bad format) daily files (in red) processed during the date range selected.

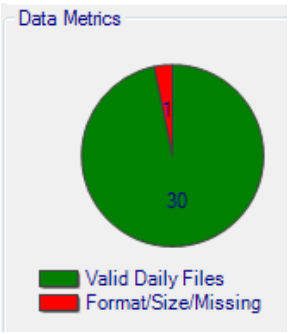


Fig. 28. Data Dashboard - Data Metrics.

Occupancy Metrics

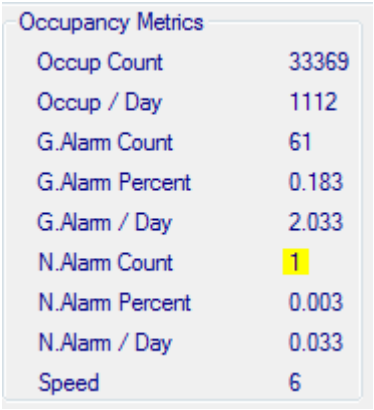


Fig. 29. Data Dashboard - Occupancy Metrics.

The Occupancy Metrics table (Fig. 29) lists details related to the occupancies experienced by the lane. For example, the occupancy count (Occup Count) is the total number of occupancies seen by the RPM for the date range selected; the Gamma Alarm Count (G. Alarm Count) is the total number of alarms seen by the RPM for the date range selected. A complete list of these metrics with definitions is given in Table 6.

Table 6. Data Dashboard – Occupancy Metrics

Occupancy Metric	Definition
Occup Count	Total number of occupancies during date range selected
Occup / Day	Total number of occupancies divided by number of days in date range
G. Alarm Count	Total number of gamma alarms during date range selected
G. Alarm Percent	Gamma alarm count divided by occupancy count as percent
G. Alarm / Day	Total number of gamma alarms divided by number of days in date range
N. Alarm Count	Total number of neutron alarms during date range selected
N. Alarm Percent	Neutron alarm count divided by occupancy count as percent
N. Alarm / Day	Total number of neutron alarms divided by number of days in date range
Speed	Most common speed recorded during date range selected, in kph

Note that the speed reported is the mode, not the average. This number provides the speed at which most vehicles pass through the portal. ORNL's experience in data analysis has shown the mode speed to be more relevant than the average speed, which can be artificially increased by just a few high speed readings of 160 kph.

Gamma Metrics

The Gamma Metrics chart (Fig. 30) is a bar graph showing the average gamma background, in cps for each detector assembly over the date range selected. These bars are dark blue. The light blue bars represent the standard deviation. These values should be fairly consistent across all the detector assemblies. If one differs significantly from the other three, that is usually a sign that more attention is needed.

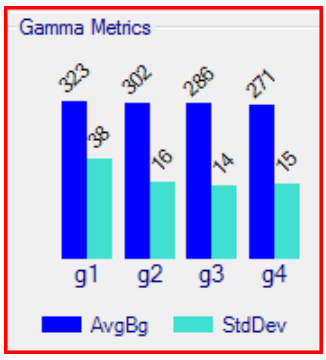


Fig. 30. Data Dashboard - Gamma Metrics.

Neutron Metrics

The Neutron Metrics chart (Fig. 31), although similar to the Gamma Metrics chart, displays a graphical analysis of the average neutron background, in cps for each detector assembly over the date range selected. These background rates are shown in red, whereas standard deviation is shown in orange. Again, these values should be consistent across all the detector assemblies.

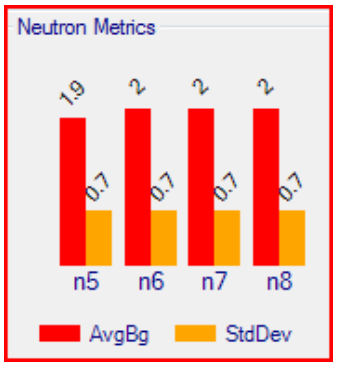


Fig. 31. Data Dashboard - Neutron Metrics.

Fault Metrics

The Fault Metrics chart (Fig. 32) shows the number of gamma high (GH), gamma low (GL), neutron high (NH), tamper open (TT), and tamper close (TC) faults experienced by the RPM over the date range selected. Ideally, all GH, GL, and NH readings will be zero. TT and TC indications may be common based on RPM maintenance. The number of TTs does not always equal the number of TCs because frequently the RPM door is closed before the RPM can completely establish communications with the CAS, thus missing the Tamper Close signal.

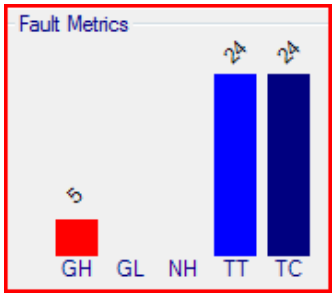


Fig. 32. Data Dashboard - Fault Metrics.

Charting Options

The Charting Options section of the Data Dashboard is where the bulk of the analysis is performed. Under the Charting Options section, radio buttons indicate the types of information that can be analyzed [i.e., Data, Background Profiles (Bkgrd), Alarms, Histogram Options (Histo), and Traffic]. Once a Charting Option is selected, the *exclamation mark* button must be clicked to update the interface. After the interface is updated, additional plotting options may be available. When all options are selected, the data will be plotted in the chart window in the center of the Data Dashboard. These options are explained in detail in the following sections.

During the data analysis, any image plotted in the Data Dashboard may be captured/saved by clicking the Capture button located at the bottom of the Data Dashboard. Images that are captured this way are automatically attached to the Monthly Country Report for that month. The images are also saved in the "Images" resource subfolder (typically c:\DART Files\Images).

Data

The Data option allows the user to obtain information about the daily files. Daily files are represented by colored dots in the Data Chart. If there is not a dot for a specific day, no daily file was received. The default Data Options are Valid, Empty, Bad Format, and Oversize. If these options remain selected, the dots will be color coordinated according to the following criteria:

Green – valid/present daily files

Blue – empty daily files (less than 5 kB in size). This means the CAS was on but did not receive data from that lane for that day.

Red – daily files with a bad format (not compatible with DART or does not have a valid upload file pattern)

Pink – oversized daily files (over 9 MB in size). This usually indicates an occupancy sensor is stuck "ON" or something is causing the RPM to be occupied for at least 10 hours in a day.

This Charting Option provides users with a simple way to determine whether all the daily files were received, if and when daily files were missing, and if and when problems were encountered with any of the daily files. An example of the Data Charting Option where three days of data are missing is shown in Fig. 33.

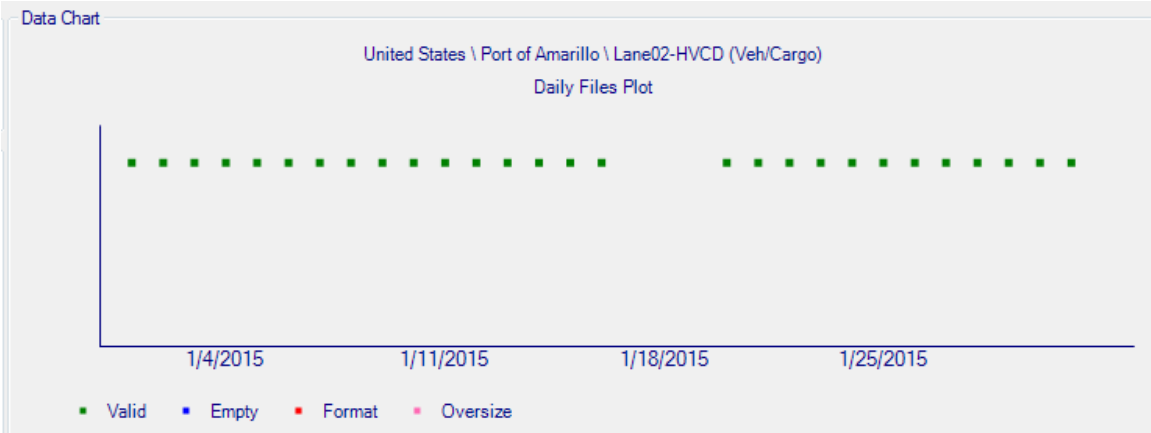


Fig. 33. Charting Options – Data.

Background Profiles

The Background Charting Option allows the user to view background profiles for gamma and/or neutron detector assemblies. In the daily file, the background count rate is provided every 5 seconds. When extracting data into DART, one data point every 10 minutes is selected (not averaged). When the monitor is occupied, a rolling sum is used to convert 200 ms data from the daily file into a 1-second count rate in DART.

Under Background Options, the user has the ability to choose which detectors, individual or in combinations, are displayed in the plot. For example, if the user chooses gamma detectors 1, 2, 3, and 4 (Gam 1, Gam 2, Gam 3, and Gam 4), the individual responses from all four assemblies will be plotted. This is shown in Fig. 34.

Similarly, if the user chooses neutron detectors 5, 6, 7, and 8, the plot would show the response from each of the four neutron assemblies. If the two groups were both selected, the gamma and neutron profiles would both be plotted on the same graph. Additionally, pillar sums can be plotted (i.e., Gam 1, 2; Gam 3, 4; Neu 5, 6; Neu 7, 8) as well as the sums of all detectors (i.e., Gam Tot and Neu Tot).

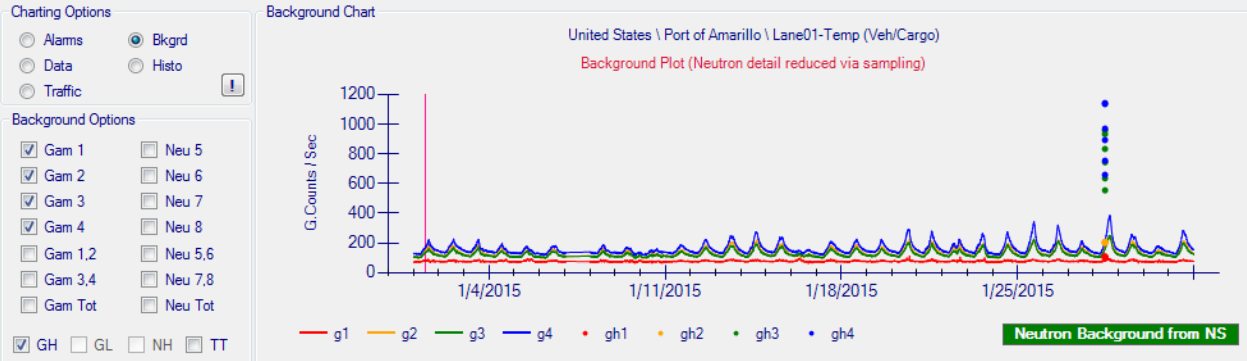


Fig. 34. Charting Options – Background.

In addition to plotting the background profiles, DART has the ability to overlay the fault conditions selected under Background Options. In the example above, the gamma high (GH) fault box is checked – and each GH data point is explicitly plotted as circles. Tamper Faults (TT) are shown as blue vertical bars. To maintain system responsiveness, DART does not plot fault points if there are more than 1,000 faults in the month, and the text is highlighted in red. The checkbox is grayed out and not selectable if there are no faults in the month.

By pairing the fault condition with the background profile, the user may be able to identify causes of various fault conditions. The user can zoom in on a region of the plot by clicking the mouse and dragging over a portion of the plot to enlarge it. Note that the initial click must be inside the chart area.

The type of neutron background that is plotted can be toggled. Since the presence of a vehicle usually has only a small effect on the neutron background, the NS (Neutron Scan) values from a non-alarming vehicle can be used as an effective background. Frequently, these values are more insightful than the NB (Neutron Background) values provided in the Daily File, due to how the NB values are calculated. NB values are provided once every 5 seconds; the number of NS values

plotted depends on how many occupancies occurred in the time specified. Clicking on the green "Neutron Background from NS" button will toggle between showing NB values and NS values.

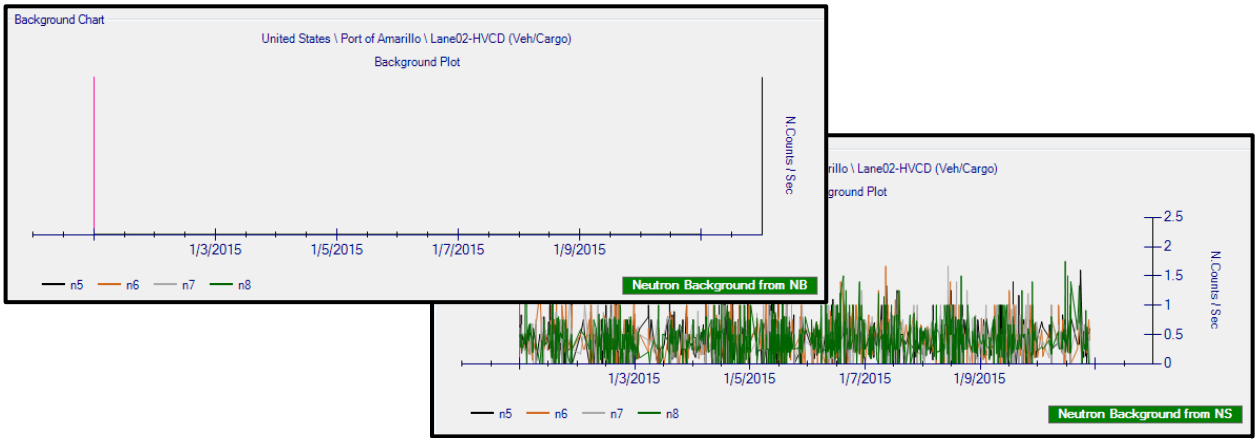


Fig. 35. Neutron Backgrounds from NB (left) and NS (right) values - same lane.

Alarm Profiles

The Alarms Charting Option allows the user to view gamma and neutron alarm profiles. Under Alarm Options RPM, the user can select an alarm for viewing from the dropdown menu as shown in Fig. 36. The alarms are prioritized in the following order: gamma/neutron (GN), neutron (N), and gamma (G) alarms. The data and time stamp associated with the alarm is also listed in the dropdown menu. Once an alarm is selected, the user must select the appropriate detectors for the plot. This is similar to the Background Charting Option.

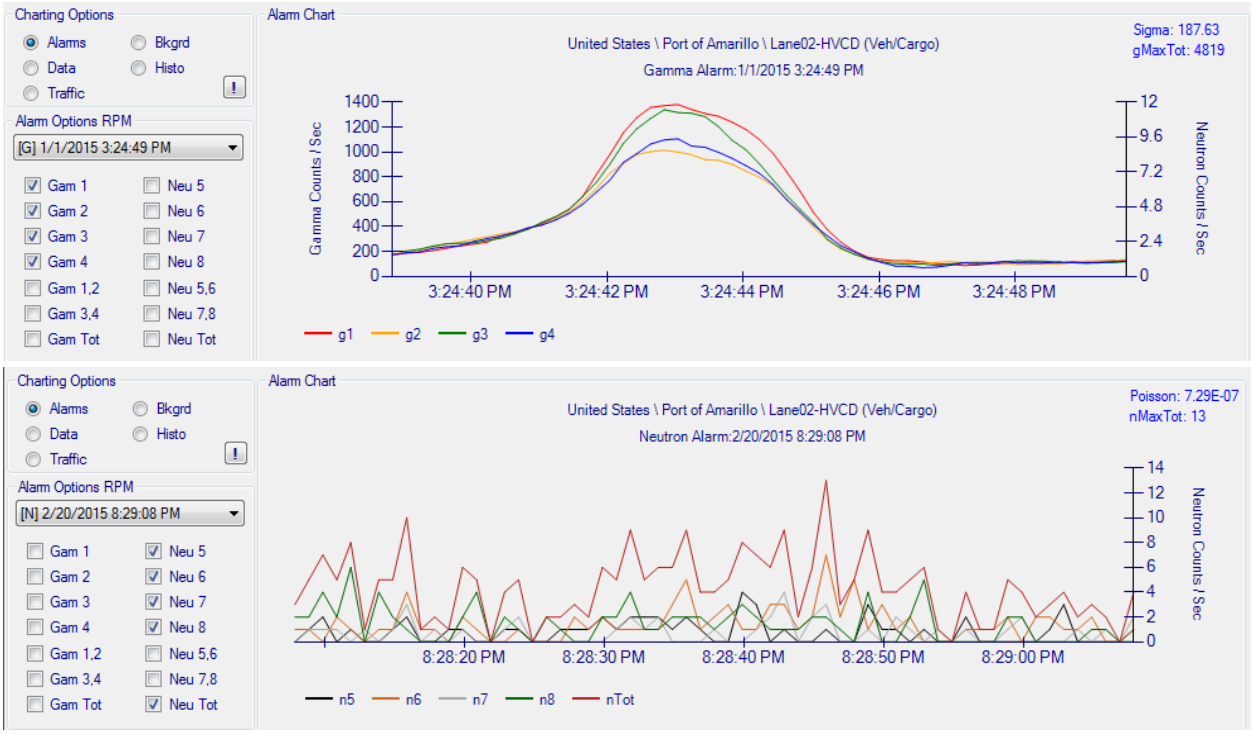


Fig. 36. Charting Options - Sample Gamma and Neutron Alarms.

Again, the user can zoom in on the plot by dragging the mouse over the region of interest. In the upper right corner, relevant alarm-related information is provided:

- For gamma alarms, the calculated sigma, as well as the highest total gamma counts in one second are shown. If the calculated sigma is frequently LESS than the "N.Sigma" setting of the portal, that indicates that a single pillar may be causing the alarms, rather than all four gamma detectors. In that case, look for a directional source (e.g., nearby x-ray machine) that is causing the alarms.
- For neutron alarms, the Poisson probability and the highest total neutron count in one second are shown. In the above figure, the Poisson value of 7.29E-07 means that the probability of recording 13 neutron counts given the background for that occupancy *due to statistical variations alone* is 0.000000729. This is very unlikely, and the alarm is probably not due to random, statistical variations: Either there was a real neutron source in this occupancy, or some other electrical failure in the neutron channels caused an elevated neutron count rate.

Histogram Options

The Histogram Charting Option ("Histo") allows users to view various distributions of data. The dropdown menu under Histogram Options RPM contains a number of options that reflect the nature of the histogram displayed. The histogram options are background suppression, container

length, gamma intervals, and speed. These options are further discussed in the following paragraphs.

In addition to allowing the user to simply select the histogram type, the dropdown menu gives access to a table of filter parameters. These parameters allow the user to filter the data included in the histogram. The criteria include histogram ranges and bin sizes. It is important to note that these filters are additive and that the data must meet all the criteria in the table for it to be included in the plot. The default criteria automatically expand to include all occupancies in the selected time period; the user can then narrow the criteria of interest to focus on the type of occupancies the analyst is interested in. In addition to showing the filtered distributions, the number of occupancies meeting the selected criteria is shown on the plot (filtered occupancies), as well as the number of alarms, and the resulting alarm percentage are shown. This is useful in some data analysis scenarios.

For instance, suppose a lane primarily has large trucks driving through it; however, due to site operations, people frequently walk through the portal as they go back and forth to the trucks. The people walking through artificially increase the number of occupancies, and *decrease* the overall alarm rate. Using the "Histo" tool, the analyst can filter out occupancies that are likely due to pedestrians and focus solely on the large trucks. Thus, the real alarm rate for trucks can be reported.

Background suppression. Background suppression (Suprs) is the phenomenon that causes the presence of a cargo/container to reduce the background observed by the RPM. The values in the criteria table for low and high are normalized relative to the background values. For example, in Fig. 37, the plot has been narrowed to only show from 40% background suppression (−0.40) to 0% suppression (0.00). 0% background suppression is effectively the average background.

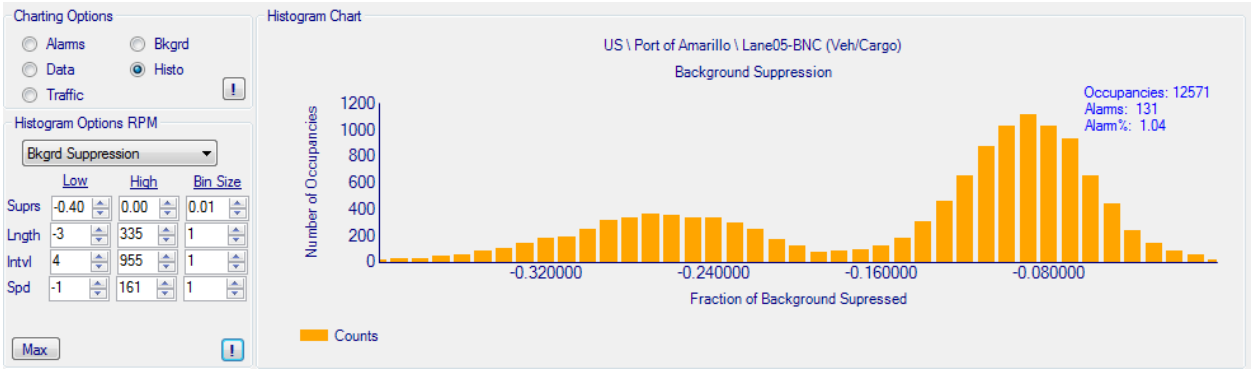


Fig. 37. Charting Options - Histograms - Background Suppression.

The example in Fig. 37 shows two averages, one with ~30% suppression and one with ~10% suppression. This typically means that two distinct types of cargo are passing through this monitor. Some high-activity alarms can have a positive background suppression value because the counts during the entire occupancy are always above background.

Container length. The container length (Lngth) for the cargo passing through the monitor is calculated with the speed and the number of intervals for each occupancy. The values in the criteria table are in meters. In Fig. 38, the Length has been narrowed to between 0 meters and 25 meters. The plot shows two lengths common for vehicles: one at about 3 meters, and a distribution from about 8 meters to about 20 meters. These correspond to vehicles (or trucks not towing a trailer), and trucks towing various lengths of containers.

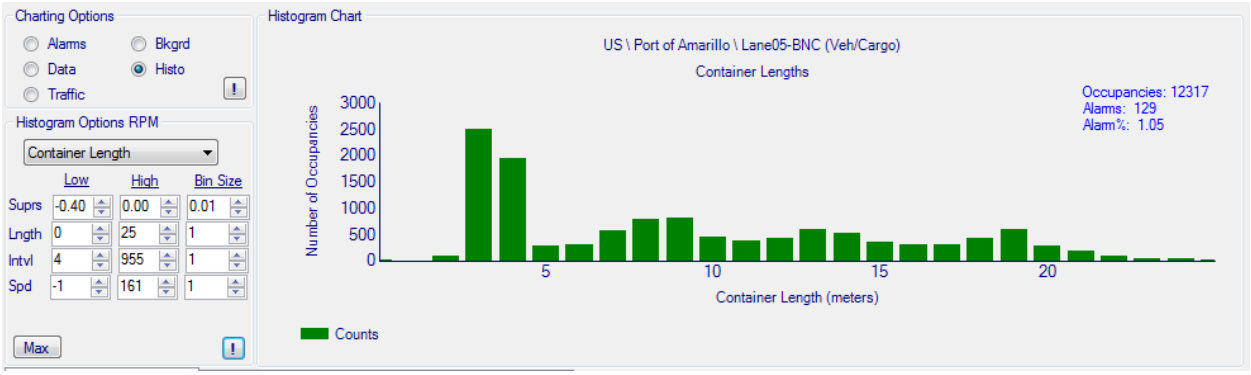


Fig. 38. Charting Options - Histograms - Container Length.

Such information may help operators determine the usual types of cargo that pass through each lane, perhaps leading to better traffic flow patterns or operations in general.

Gamma intervals. Gamma intervals (Intvl) refer to the number of 200-ms intervals recorded for a given occupancy. The values for low and high in the criteria table refer to the number of intervals. In the example shown in Fig. 38, the plot spans from 0 to 100 intervals; any occupancy lasting more than 100 intervals would not be included. The minimum number of intervals expected for any occupancy is the Gamma setting "intervals" (always set to 5) + the "Occupancy Hold In" setting (usually 10 but sometimes 5) = 15 intervals. In rare cases, an occupancy can have fewer than this minimum number. This can happen if communication is interrupted between the RPM and the CAS, or if the CAS becomes very busy and cannot record all the data from an RPM.

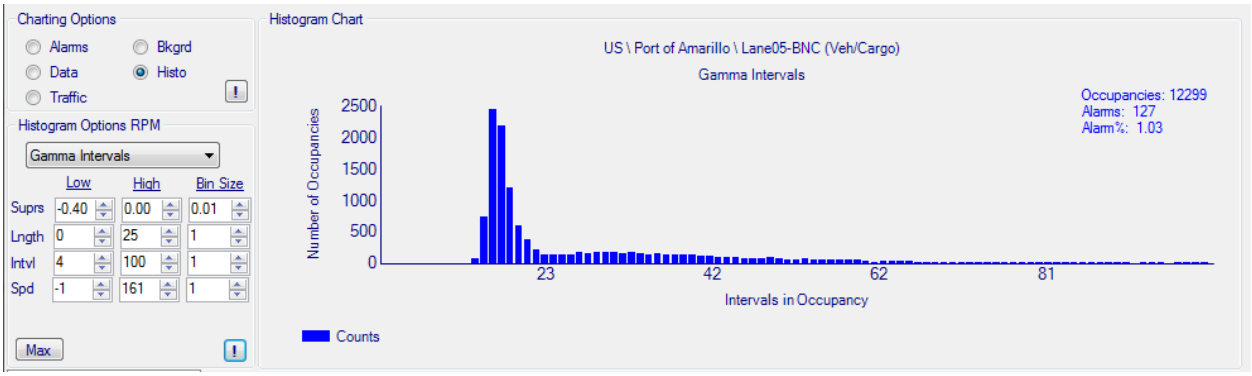


Fig. 39. Charting Options - Histograms - Gamma Intervals.

Figure 39 shows two distributions, a peak at ~20 intervals and a broad distribution between about 25 and 60 intervals. Occupancies with fewer than 25 intervals (for vehicle or rail traffic) are typically false occupancies; they indicate an occupancy time of less than 2 seconds and are frequently due to small cars or people walking through the portal. This distribution may help operators understand the rate at which people or cargo pass through the monitors.

Speed. The infrared occupancy sensors provide speed messages for each occupancy. These speed messages are recorded in the daily files and therefore are captured in DART. The values in the criteria table are in kilometers per hour. Although there can be multiple speed messages for each occupancy, DART shows the lowest nonzero speed for each occupancy. This prevents the data from being artificially skewed by 161-kph speed messages (99.999 miles per hour). If there is no speed message for an occupancy, that occupancy's speed is recorded as "−1." In the example shown in Fig. 40, the plot will only include occupancies with recorded speeds between −1 and 20 kph. From the plot, most vehicles pass through the monitor at around 10 kph. This plot can be expanded to see speed messages that register speeds upwards of 20 kph. Such information may help operators determine whether they need to implement better speed control.

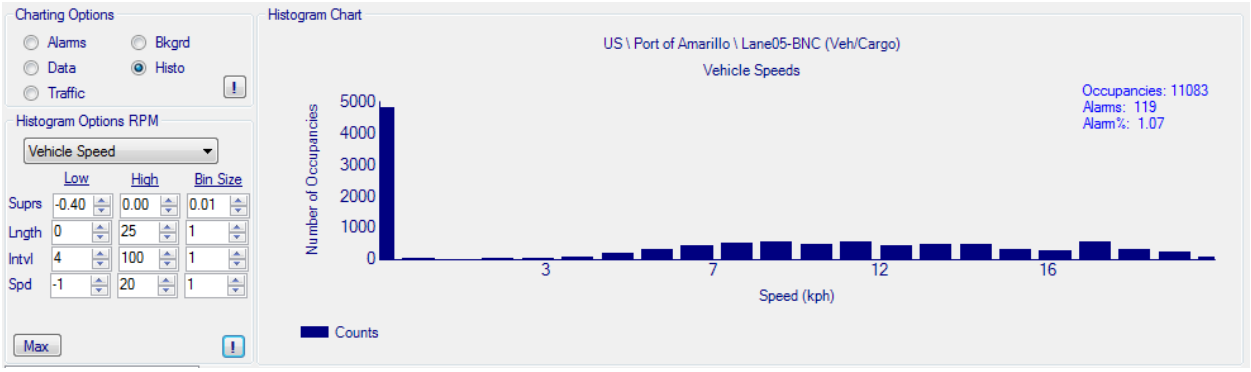


Fig. 40. Charting Options - Histograms – Speed.

In Fig. 40, note that there are about 5,000 occupancies with no speed message, and there are just a few (two, in this case) that have speed messages of 0 kph, where the vehicle was moving too slowly for the RPM to register a valid speed message.

As demonstrated above, the histograms feature in DART provides advanced analysis capabilities that will assist in making lane operations more efficient.

IMPORTANT: Remember that the data included in the plot must meet all the criteria in the options table. To illustrate, in Fig. 40, the criteria have been narrowed from the maximum settings. For the data to be included in this plot, *all* of the following must have occurred: The cargo caused background suppression (Suprs) between −0.4 and 0, container length (Lngth) was between 0 and 25 meters, occupancy was between 4 and 100 intervals (Intvl), and the cargo travelled at a speed (Spd) between −1 and 20 kph. Of the 12,607 occupancies originally recorded, 11,083 of them meet

all these criteria. The alarm rate shown (1.07% in this case) includes both gamma and neutron alarms.

Traffic Distribution

The Traffic Charting Option allows the user to view the frequency of occupancies and alarms for each lane. Viewing the throughput of a lane may help operators optimize traffic flow and staffing needs. The Traffic Options, available in the dropdown menu, allow the user to determine how the data will be charted. The options are as follows:

Hour – shows the distribution of occupancies and alarms for every hour. For example, each occupancy that occurred between 6:00 and 7:00, no matter the day, will be combined. This may help operators better understand daily staffing needs.

Day – shows the distribution of occupancies and alarms for every day in the selected date range. This may help operators understand daily or weekly trends (e.g., traffic flow on weekends).

Month – shows the total number of occupancies and alarms for each month.

Quarter – shows the total number of occupancies and alarms for each quarter.

Yearly – shows the total number of occupancies and alarms for each year.

The last three options require many months of data to be loaded in DART to be useful. Note that the selected date range overrides any conflicting Traffic Options selection. For example, choosing "Yearly" will still only show the data within the date range selected. In the bar graph depicting the traffic distribution, the green portion of the bar represents the non-alarming occupancies, while the red portion of the bar represents the alarming occupancies. An example of the throughput by day is given in Fig. 41. Scrolling the mouse over the bar will yield the exact number of occupancies in a pop-up box.

The default graph is logarithmic on the *y*-axis to better show the wide variation between occupancies and alarms.

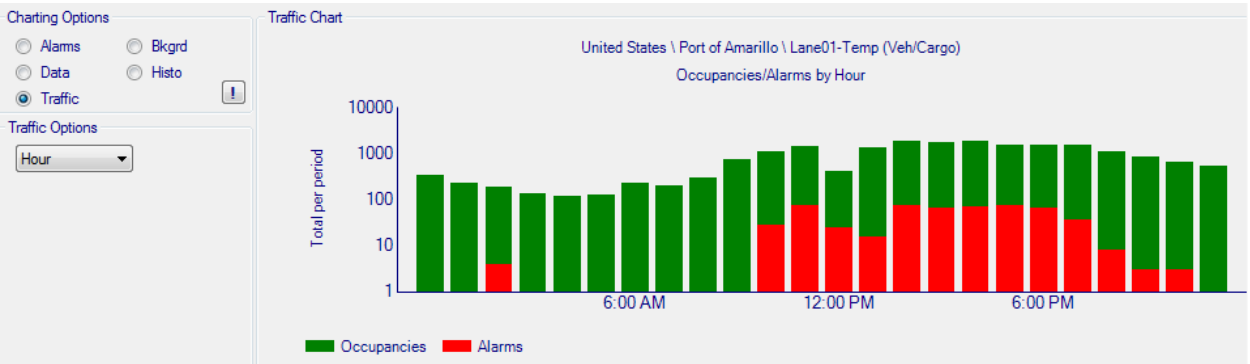


Fig. 41. Charting Options – Traffic.

State Of Health

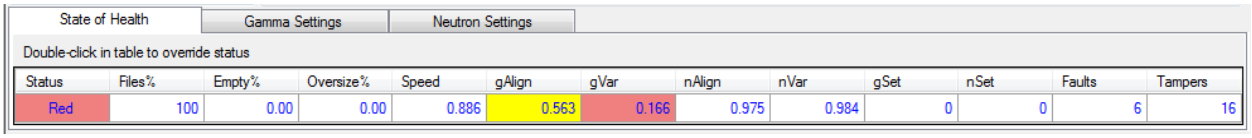


Fig. 42. Sample State of Health for a lane.

State of Health (SOH) provides a quick, automatic way to categorize each lane as Red, Yellow, or Green, based on observations from the daily files. In Fig. 42, the overall lane is colored Red (indicating that the lane needs attention as soon as practical), and this is due to the gamma alignments ("gAlign") being inconsistent with what is normally observed. The variation seen in the gamma detectors ("gVar") is also inconsistent, but the performance is only yellow, which indicates that attention should be given to it when convenient.

The overall status of each lane is determined by the worst performance of the 11 criteria. Elements are only shaded yellow or red; if the performance is "Green" it is not colored. The individual State of Health elements and their criteria are described below.

Table 7. State of Health Elements, Descriptions, and Criteria

Element	Description	Red	Yellow	Green
Empty%	% of empty daily files	>= 30%	>= 10%	< 10%
Oversize%	% of files over 9 MB	>= 30%	>= 10%	< 10%
Speed %	Fraction of occupancies with a speed message (N/A for Ped & Conveyors)	N/A	< 50%	>= 50%
gAlign	Gamma background min/gamma background max (within a pillar)	<= 0.5	<= 0.8	> 0.8
gVar	Minimum std. dev. of gamma background / maximum std. dev. of gamma background	< 0.2	< 0.5	>= 0.5
nAlign	Neutron bkgd. Min/neutron bkgd max (within a pillar)	<= 0.6	<= 0.8	> 0.8
nVar	Minimum std. dev. of neutron background / maximum std. dev. of neutron background	< 0.6	< 0.8	>= 0.8
gSet	Major gamma settings: Intervals, Detectors On-Line. All others minor.	>= 1 Major	>= 1 Minor	none
nSet	Major neutron settings: Max Intervals, Sequential Intervals	>= 1 Major	>= 1 Minor	none
Faults	Total of GH, GL, and NH faults	>= 200	>= 50	<50
Tampers	Total number of tamper faults	>= 1000	>= 100	< 100

The red, yellow, and green criteria were empirically derived based on analyzing the behavior of hundreds of RPMs for over a year.

From within the Data Dashboard, an analyst can override the SOH color by double-clicking on the SOH bar. For instance, a problem may have adversely affected RPM performance in the beginning

of the month (causing the SOH to reflect Red), but it is clear from the data that the problem has been corrected and RPM operation is now acceptable. In this case, the analyst can change the SOH to Green and provide a justification for the override.

Settings

The Settings portion of the Data Dashboard is composed of two tables, Gamma Settings and Neutron Settings, and is similar to the Settings table in the Lane Snapshot. (The settings will appear differently for Aspect daily files.) The gamma settings are listed first; the neutron settings listed second (Fig. 43). The gamma settings and their descriptions can be found in Table 8; the neutron settings and their descriptions can be found in Table 9.

The settings found in the daily files appear in white if it is consistent with the default value (the widely accepted value hardwired into the DART software). If, however, the settings differ from an expected value, it is highlighted in yellow. The highlighting rules are described in Table 5, Settings Highlighting Rules. This is meant to draw attention to the potentially incorrect setting. The potentially highlighted settings are the following:

Gamma Settings

- Upper level discriminators
- Lower level discriminators
- Intervals
- Occupancy Hold-in
- Detectors On-line
- Algorithm
- Background Time
- Background nSigma
- Firmware Version Suffix

Neutron Settings

- Upper level discriminators
- Lower level discriminators
- zMax

State of Health | Gamma Settings | Neutron Settings

Timestamp	Backgrd High Fault	Backgrd Low Fault	Intervals	Occupanc Hold-In	N.Sigma	Detectors On-Line	Master L.Level Discrim	Master U.Level Discrim	Relay Output	Algorithm	Slave L.Level Discrim	Slave U.Level Discrim	Backgrd Time	Backgrd N.Sigma	Firmware Version
1/1/2015 11:48 ...	500	50	5	10	12.400	1111	0.069	0.455	1	1010	0.069	0.455	20	0.000	1.10.1A

State of Health | Gamma Settings | Neutron Settings

Timestamp	High N.Fault Alarm	Max Intervals	Alpha Value	zMax Value	Sequence Number	nBkgrd Average Time	Master L.Level Discrim	Master U.Level Discrim	Slave L.Level Discrim	Slave U.Level Discrim
1/1/2015 11:48 AM	50	3	4	1200	1	120	0.504	5.040	0.504	5.040

Fig. 43. Data Dashboard – Settings.

Table 8. Data Dashboard - Gamma Settings

Setting	Description
Timestamp	Date and time of entry in daily file
Background H Fault Alarm	Threshold at which monitor will enter Gamma High (GH) fault condition (based on a single detector)
Background L Fault Alarm	Threshold at which monitor will enter Gamma Low (GL) fault condition (based on a single detector)
Intervals	Number of 200-ms intervals to “look back” after start of an occupancy
Occupancy Hold-in	Number of 200-ms intervals monitor will maintain occupancy after end of occupancy
Nsigma	Alarm threshold
Detectors On-line	1 indicates detector is on-line, 0 indicates detector is off-line
Master LLD	Master lower level discriminator – cuts out signal at lower energy range
Master ULD	Master upper level discriminator – cuts out signal at upper energy range
Relay Output	1 indicates local alarms are on (lights and horns), 0 indicates alarms are off
Algorithm	Dictates which detectors or combination of detectors contribute to alarm decisions
Slave LLD	Slave lower level discriminator – cuts out signal at lower energy range
Slave ULD	Slave upper level discriminator – cuts out signal at upper energy range
Background Time	Counting time for establishing gamma background
Background Nsigma	Threshold for “throw-through” alarms
Firmware Version	Indicates which firmware version is loaded in RPM

Table 9. Data Dashboard - Neutron Settings

Setting	Description
Timestamp	Date and time of entry in daily file
High N Fault Alarm	Threshold at which monitor will enter Gamma High (GH) fault condition (based on a single detector)
Maximum Intervals	Maximum number of one-second intervals for alarm decision
Alpha Value	Value used to select alarm and background values, used to express false alarm rate
zMax Value	Alarm threshold used after MAX intervals is reached with no alarm decision
Sequential Intervals	Number of consecutive 200-ms intervals above background needed to alarm or enter neutron high (NH) fault condition
nBackground Average Time	Counting time for establishing neutron background
Master LLD	Master lower level discriminator – cuts out signal at lower energy range
Master ULD	Master upper level discriminator – cuts out signal at upper energy range

Slave LLD	Slave lower level discriminator – cuts out signal at lower energy range
Slave ULD	Slave upper level discriminator – cuts out signal at upper energy range

In the event that the settings have changed over the date range selected, the table heading (Gamma Settings or Neutron Settings) will appear in RED, and a scroll bar will appear on the right side of the settings table. Clicking the timestamp column will change the order of settings (e.g., current settings on top, oldest settings on bottom).

The Data Dashboard provides advanced analysis capabilities not available in the Lane Snapshot. By utilizing a combination of these two analysis functions, users have the ability to assess, diagnose, and troubleshoot RPM issues based on the data provided in the daily files.

3.4 Report Management

The Report Management function provides an ability to produce structured reports, including data for all lanes set up in the within a single country.

3.4.1 Monthly Country Report

The Monthly Country Report (MCR) is a summary report outlining the important parameters, RPM behaviors, and states of health of each monitor within a specified country. Findings are recorded and summarized in multiple layers. To create a new MCR, click the Monthly Country Report option in the DART Main Menu. The Country Report List will appear (Fig. 44). Choose a country, date range, analyst (remember, an analyst must be created from the "Application Users" link on the Main Menu), and click the *New Report* button.

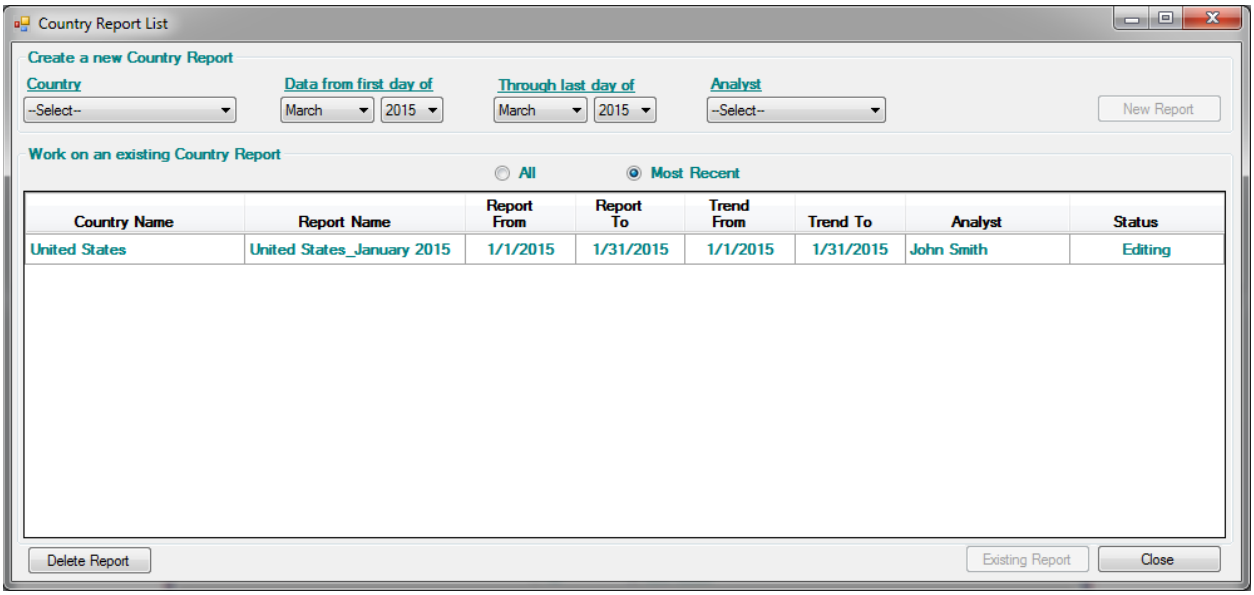
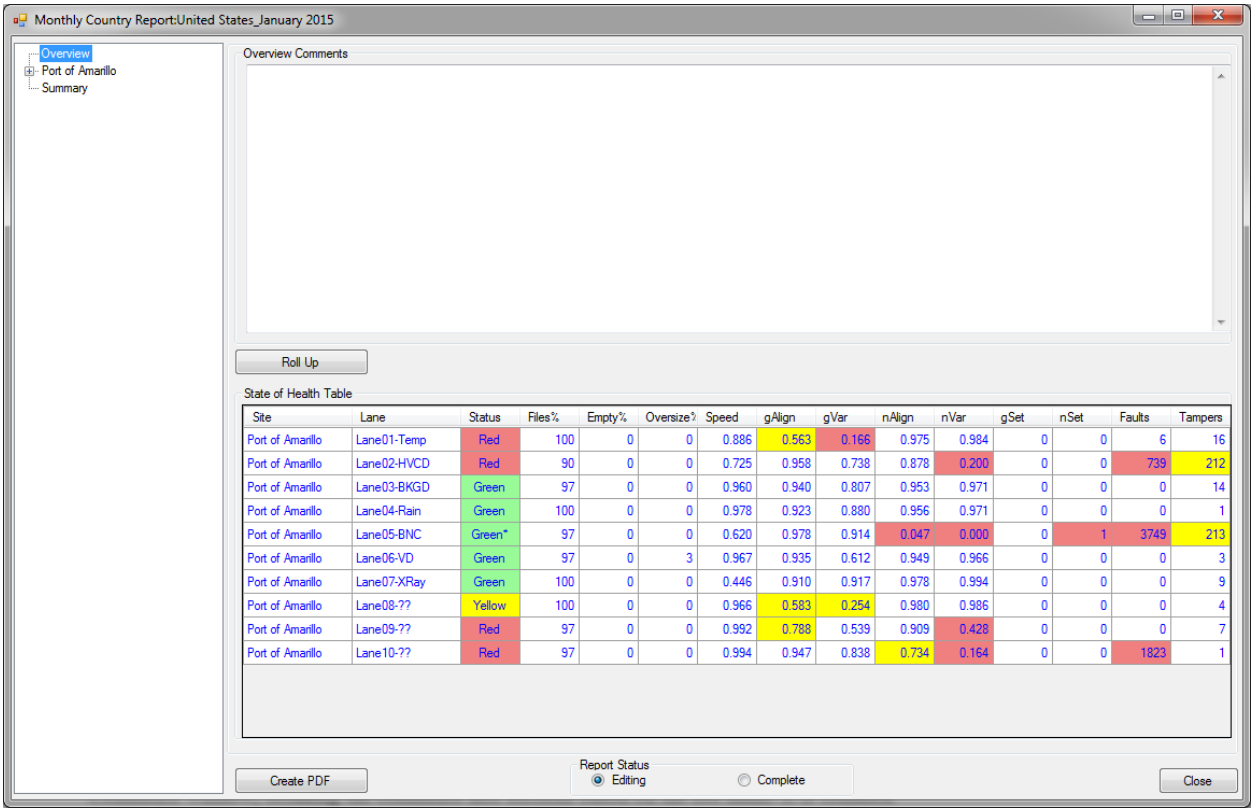


Fig. 44. Monthly Country Report - Country Report List.

The MCR Report window will open. The Navigation Pane appears on the left, and the analysis window appears on the right. In the Navigation Pane are an Overview section, a list of sites (each having a [+] sign if lanes are contained within that site), and a Summary. Inactive sites (as set in the Location Hierarchy) will not appear in the MCR.



Site	Lane	Status	Files%	Empty%	Oversize%	Speed	gAlign	gVar	nAlign	nVar	gSet	nSet	Faults	Tampers
Port of Amarillo	Lane01-Temp	Red	100	0	0	0.886	0.563	0.166	0.975	0.984	0	0	6	16
Port of Amarillo	Lane02-HVCD	Red	90	0	0	0.725	0.958	0.738	0.878	0.200	0	0	739	212
Port of Amarillo	Lane03-BKGD	Green	97	0	0	0.960	0.940	0.807	0.953	0.971	0	0	0	14
Port of Amarillo	Lane04-Rain	Green	100	0	0	0.978	0.923	0.880	0.956	0.971	0	0	0	1
Port of Amarillo	Lane05-BNC	Green*	97	0	0	0.620	0.978	0.914	0.047	0.000	0	1	3749	213
Port of Amarillo	Lane06-VD	Green	97	0	3	0.967	0.935	0.612	0.949	0.966	0	0	0	3
Port of Amarillo	Lane07-XRay	Green	100	0	0	0.446	0.910	0.917	0.978	0.994	0	0	0	9
Port of Amarillo	Lane08-??	Yellow	100	0	0	0.966	0.583	0.254	0.980	0.986	0	0	0	4
Port of Amarillo	Lane09-??	Red	97	0	0	0.992	0.788	0.539	0.909	0.428	0	0	0	7
Port of Amarillo	Lane10-??	Red	97	0	0	0.994	0.947	0.838	0.734	0.164	0	0	1823	1

Fig. 45. Monthly Country Report - Overview Section.

Overview

The Overview option in the Navigation Pane allows the user to summarize all comments made at the site level into the Overview Comments. By clicking the *Roll Up* button at the bottom of the window, DART rolls all the comments made in the Site Comments window into the Overview Comments window, breaking the comments into sections based on the site name. It is common to complete the Overview section after the lanes and sites have been reviewed and comments have been added. It is best to work from the lowest level (each lane) up to the highest level (country overview).

The Overview section also has the State of Health information listed for each lane: the overall status and the results for each of the 12 individual criteria. This is a quick and useful way to determine which RPM lanes need attention. If a data analyst has used the override function in the Data Dashboard to change the State of Health for a lane, then there is an asterisk next to the label under the “Status” field. This can be seen, for example, in Lane 05 in Fig. 45.

Site

The Site option in the Navigation Pane allows the users to summarize all comments made at the lane level into the Site Comments. By clicking on the *Roll Up* button at the bottom of the window, DART rolls all the comments made in the Findings Summary for each lane into the Site Comments window, breaking the comments into sections based on the lane name. It is common to complete the Site section after the lanes have been reviewed and the findings have been documented.

Lanes

Expanding the [+] at the site level causes the lanes to appear. Lanes with no traffic type or detector type selected in the Location Hierarchy will not appear in the MCR hierarchy. Upon expanding the [+] at the lane level, two options become available: Snapshot and Images.

Snapshot

Clicking on the Snapshot option provides the user with the Lane Snapshot for the lane. This snapshot is identical to the Lane Snapshot available in Analysis functions except that the Plots include data from the date range selected. The metrics will reflect only the data for the date range selected.

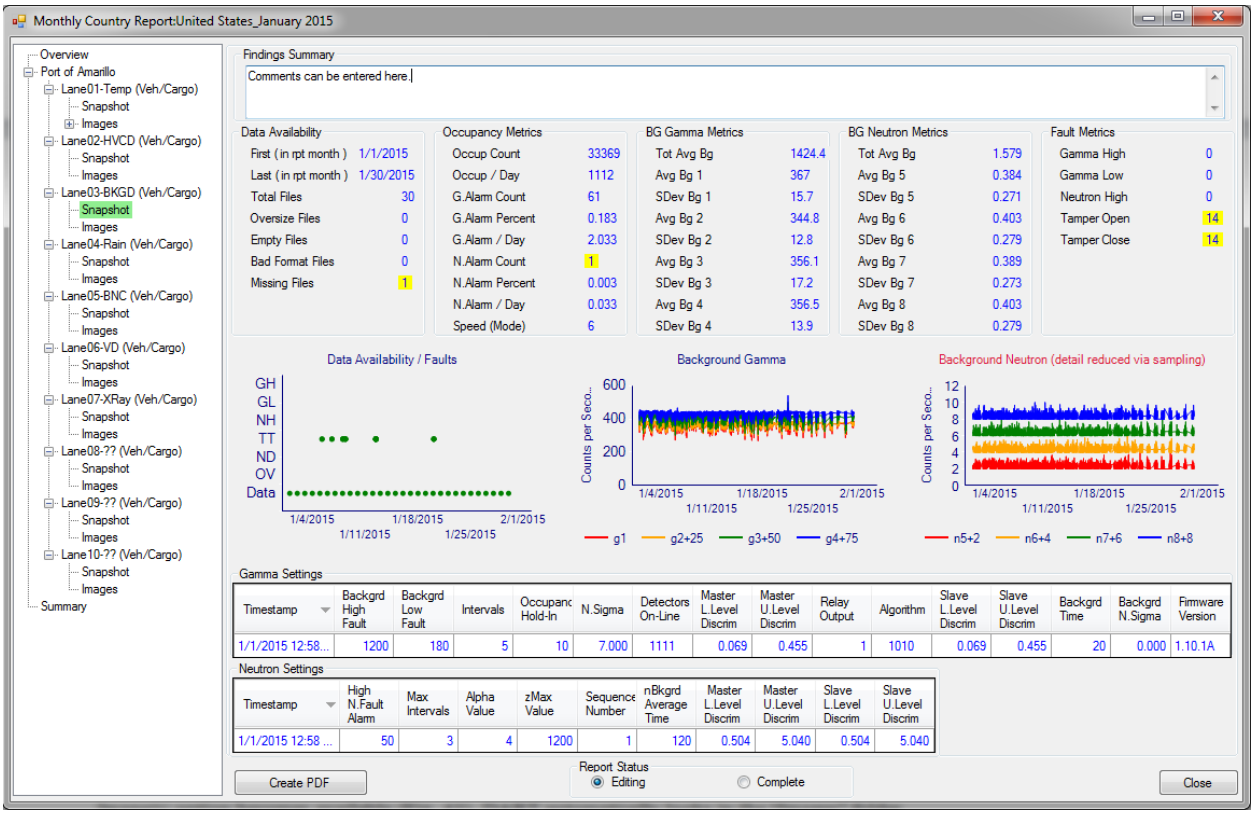


Fig. 46. Snapshot of a Lane in the Monthly Country Report.

In the Snapshot, a Findings Summary is at the top of the window. Comments regarding issues, findings, or concerns may be entered into this field. These comments will be saved automatically

in DART, and they will also appear in the Lane Overview window. It is particularly helpful to note if maintenance actions were performed here; for example, “Entered RPM and changed desiccant on 15 January.”

Images

In the event that more details are warranted, DART has the ability to include additional images from the Data Dashboard.

- Any image that was captured in the Data Dashboard (via the “Capture Image” button), along with any comments, is automatically appended to the Monthly Country Report for that month.
- By clicking the Images option in the Navigation Pane, an *Attach Image(s)* option becomes available (Fig. 47). DART automatically looks in the “Images” folder (typically c:\DART Files\Images). Images that were captured in the Data Dashboard (as discussed in Section 3.3.2 Data Dashboard) are available and automatically included as part of the MCR. To attach additional images that were not captured from the Data Dashboard, select the “Attach Image(s)” button.

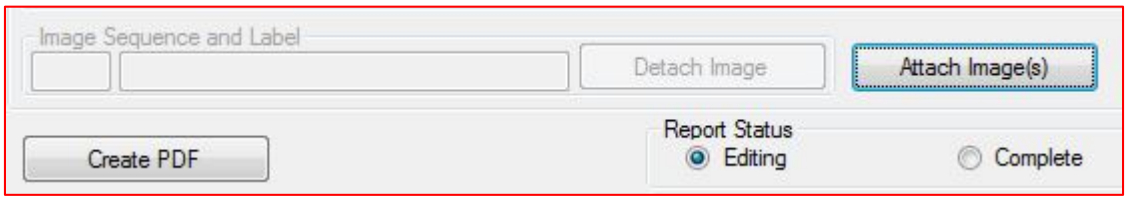


Fig. 47. Monthly Country Report – Images.

After the image is attached, its label can be changed to reflect the content of the image. Additional comments about the image can be added to the Image Comments section of the window. Images can also be deleted from the report by clicking on the image in the Navigation Pane, then clicking the *Detach Image* button.

When the comments for all lanes have been documented, the site comments can be completed. This is most easily done by the “Roll Up” button at the Site level. Upon completion of the site comments, the overview comments can be concluded, again, usually by the “Roll Up” button at the Overview level.

Summary

The Summary table at the end of the Navigation Pane (Table 10) provides a quick summary of key metrics for all the lanes within the country. This table provides a quick and easy method of viewing key metrics for all lanes at one time (e.g., alarm rates).

Table 10. Monthly Country Report - Summary Table

Parameter	Description
Site	Site Name

Table 10. Monthly Country Report - Summary Table

Parameter	Description
Portal Name	Display Name (from Location Hierarchy)
Portal Traffic Type	Intended cargo type
First (in RPT month)	Date of first daily file in report month
Last (in RPT month)	Date of last daily file in report month
Data Days	Number of daily files present for report month
Bad Format	Number of daily files with unexpected format or features
G. tot Ave Bkg (cps)	Total average gamma background (sum of all detectors)
N. tot Ave Bkg (cps)	Total average neutron background (sum of all detectors)
Occup Per Day	Number of occupancies divided by number of days in report month
G. Alarm Per Day	Number of gamma alarms divided by number of days in report month
N. Alarm Per Day	Number of neutron alarms divided by number of days in report month
G. Alarm Percent	Gamma alarm rate for report month
N. Alarm Percent	Neutron alarm rate for report month
Speed (Mode)	Most common speed registered for all occupancies in report month
GH Count	Number of Gamma High faults in report month
GL count	Number of Gamma Low faults in report month
NH Count	Number of Neutron High faults in report month
TT Count	Number of Tamper faults in report month

After all comments have been documented in the Monthly Country Report, a PDF file can be generated by clicking the *Create PDF* button at the bottom of the MCR window (see Fig. 45). This may take a few minutes depending on the number of sites and lanes included in the report. When document generation is complete, click the **Complete** radio button under Report Status. The MCR will be saved in the "Reports" resource folder (typically c:\DART Files\ Reports\Complete). The user may revisit an existing report in DART by selecting the report and clicking the *Existing Report* button shown in Fig. 44.

3.4.2 Operator's Report

This feature, introduced in DART 6.0, gives an overview of site characteristics and metrics that are useful to operators on a single page. soloDART 7.0 adds a second page to this report, the Secondary Backlog report.

Select "Operator's Report" from the DART main menu, enter the Country, Site, and Month desired, and then select the number of minutes required to complete a secondary inspection (in minutes). This value is used to calculate the secondary backlog. Finally, select the "Create Report" button.

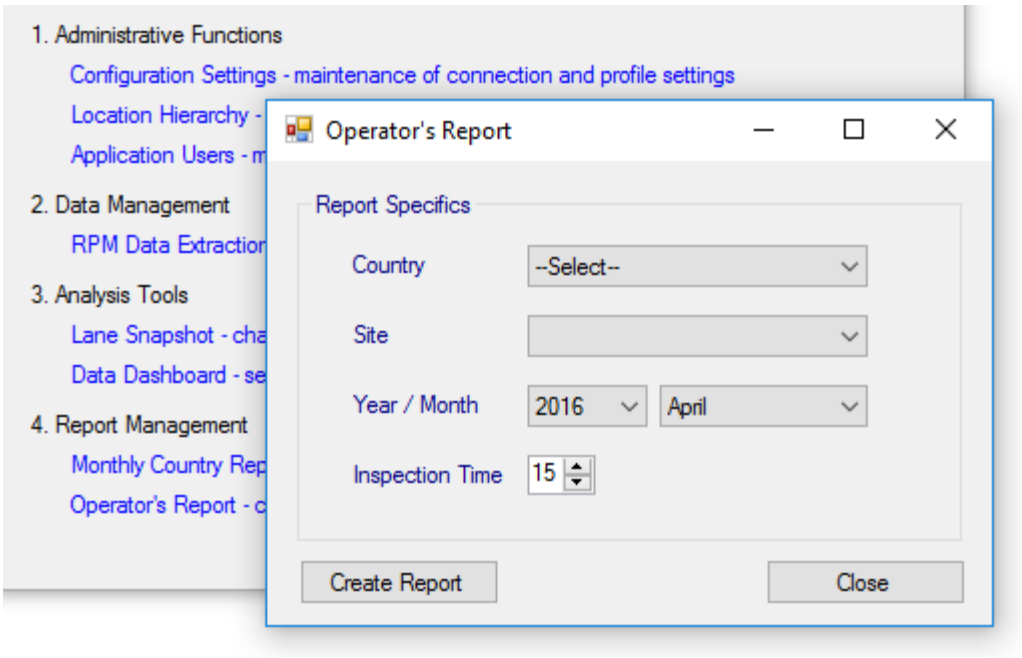


Fig. 48. Creating an Operator's Report.

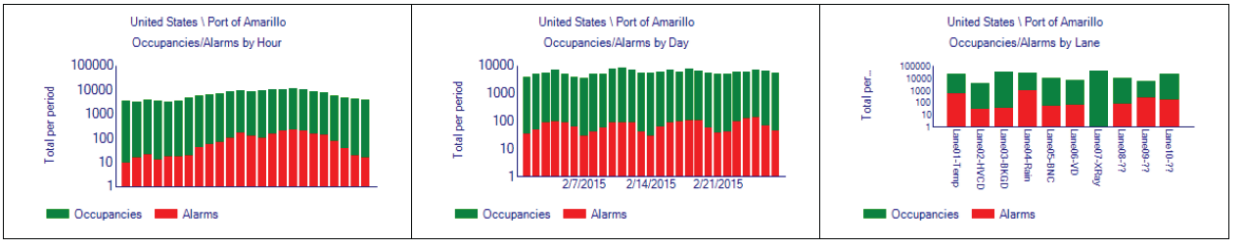
Creating the report can take one to two minutes as DART collects occupancy and alarm information from each lane at a site for an entire month. When the report is complete, the report will be opened in the computer's PDF viewer.

Operator's Report
United States\Port of Amarillo - February, 2015

Current and 2 most-recent reports metrics

February, 2015		January, 2015		--n/a--	
Number of Lanes	10	Number of Lanes	10	Number of Lanes	0
Percent of Expected Data	96.43	Percent of Expected Data	97.42	Percent of Expected Data	0.00
Number of Occupancies	155669	Number of Occupancies	168623	Number of Occupancies	0
Gamma Alarm Rate	1.24	Gamma Alarm Rate	1.21	Gamma Alarm Rate	0.00
Number of Gamma Alarms	1930	Number of Gamma Alarms	2044	Number of Gamma Alarms	0
Number of Neutron Alarms	55	Number of Neutron Alarms	203	Number of Neutron Alarms	0
Number of Gamma/Neutron Alarms	1	Number of Gamma/Neutron Alarms	3	Number of Gamma/Neutron Alarms	0
Most Common Speed (KPH)	6	Most Common Speed (KPH)	6	Most Common Speed (KPH)	0

February, 2015 Occupancy/Alarm Histograms



Lane with the most occupancies: Lane07-XRay 34761

Lane with the fewest occupancies: Lane02-HVCD 3573

Lane with the highest gamma alarm rate: Lane09-?? 4.906

February, 2015 Lane Metrics

Lane	Number of Occupancies	Number of Alarms	Days of Data	Uptime%	SOH	Reasons
Lane01-Temp	19492	450	28	100	Red	Gamma variance
Lane02-HVCD	3573	60	28	92.86	Red	Neutron alignment, Neutron variance, Faults, Gamma variance
Lane03-BKGD	27188	37	25	80	Red	Neutron settings
Lane04-Rain	22158	869	26	100	Green	
Lane05-BNC	8797	47	28	100	Green	
Lane06-VD	6648	55	26	96.15	Green	
Lane07-XRay	34761	0	28	100	Green	
Lane08-??	8792	74	27	92.59	Green	
Lane09-??	4953	243	28	100	Green	
Lane10-??	19307	151	26	100	Red	Neutron variance, Faults

Operator's Report
US\Port of Amarillo - February, 2015

This page displays the expected wait times for secondary inspection at this site, based on actual occupancies and alarms during the reporting period.
These values are based on the following assumptions:
- all alarms are considered for secondary inspection
- the secondary inspection process requires 15 minutes to complete

Secondary Inspection Metrics

Scenario	Maximum Wait	Average Wait	Median Wait	% Had to Wait	95% Waited Under	Sec Insp Rate
One secondary lane	1705	353.3	275.0	92.8	1076.3	100
Two secondary lanes - route to assigned lane	895	106.5	47.0	79.6	405.9	100
Two secondary lanes - route to shortest lane	300	30.1	11.0	64.0	128.8	100
One secondary lane - bypass inspection if wait > 60 min	74	37.0	39.0	80.2	92.4	69

Secondary Inspection Plots (Scenario 1)

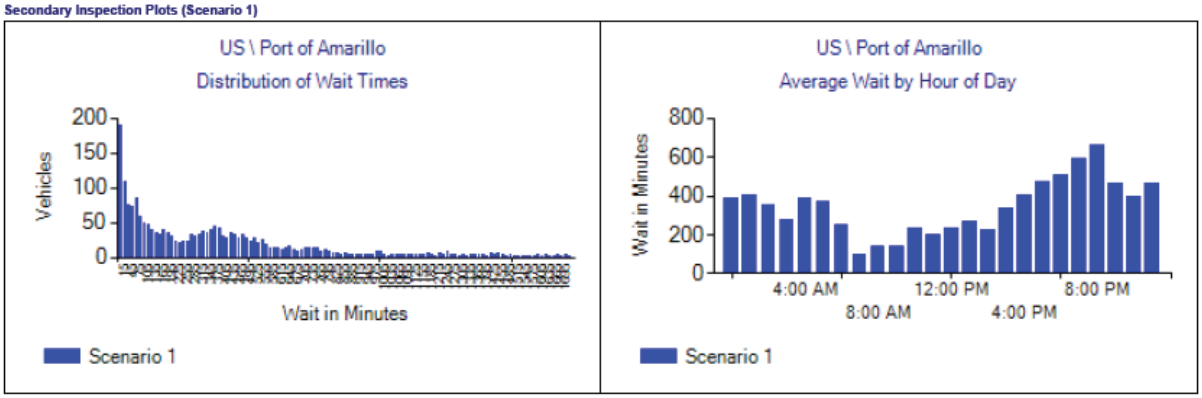


Fig. 49. A sample Operator's Report for February 2015, from the training.sqlite database.

The first page of the Operator's Report is divided into three horizontal rows.

The first row provides site metrics (for instance, number of occupancies, numbers of alarms, most common speed at the site) for the current month and the two previous months for which a report was generated. This is intended to provide site administrators with site-level metrics that can be used to trend traffic and alarm rates from month to month.

The second row shows the number of occupancies (in green) and alarms (in red) for each hour, for each day, and for each lane. Note that all charts are logarithmic on the *y*-axis. The left-most chart can highlight what hours are busiest for the site, both for occupancies and alarms. The center chart shows what days are busiest: In this case, the number of occupancies and alarms observed during the weekends is about half of the value during the week. The right-most chart shows the occupancies and alarms for each lane at the site.

Text just below these charts highlights some features that an administrator may wish to know: the lane with the most occupancies; the lane with the fewest occupancies; and the lane with the highest gamma alarm rate. If these are not consistent with an administrator's expectations, then that may be an indication that either some equipment is malfunctioning or operations are not performed correctly.

The bottom section of the Operator's Report provides metrics for each lane. Each column is described below:

- Number of Occupancies. In text form, this is the same information as provided on the right-most chart.
- Number of Alarms. In text form, this is the same information as provided in the right-most chart.
- Days of Data. The number of days of data (e.g., daily files) that were included in the analysis. If days of data are unexpectedly missing, that is an indication that there is a communications problem between the RPM and the CAS.
- Uptime %. Uptime is a coarse metric that answers the question, "Is the RPM on and functioning?" Things that can lead to poor uptime are stuck occupancy sensors (or vehicles parked in the portal for hours), failed gamma or neutron detectors, or an RPM that is turned off.
- State of Health. State of Health is a more detailed metric that attempts to answer the question, "How well is the RPM operating?" State of Health and Uptime are not necessarily linked; in the above example, Lane 10's Uptime is 100% but the State of Health is "Red." This is because, although all detectors are on and functioning in Lane 10, the neutron detectors are not behaving as expected.
- Reasons. This lists the reasons why the State of Health is not Green.

The second page of the Operator's Report (lower portion of Fig. 49) is the Secondary Backlog analysis. This provides an estimate of how long vehicles would have to wait under different

assumed conditions. This shows operators and supervisors when the busiest times are for secondary inspections, and it allows them to develop ways to manage the workload over time. Four scenarios are automatically calculated:

- **One Secondary Lane**: This assumes all vehicles from the site go to a single secondary inspection lane for alarm resolution.
- **Two Secondary Lanes – route to assigned lane**: In this scenario, half of the lanes are routed to one secondary inspection station, and the other half of the lanes goes to a different secondary inspection station.
- **Two Secondary Lanes – route to shortest lane**: In this scenario, an alarming occupancy from any lane can be sent to either of two secondary inspection stations. Alarming vehicles are sent to the secondary inspection station with the shortest wait time.
- **One Secondary lane – bypass if wait >60 min**: Although this method is not sanctioned by NSDD, this provides the results if alarming vehicles are not sent to the secondary inspection station if the current wait time is greater than 60 minutes. Note that the maximum wait time under this scenario is 59 minutes + the duration to perform a secondary inspection (default = 15 minutes), since if the backlog is 59 minutes, an alarming vehicle will be sent to the secondary inspection station.

The time to complete a secondary inspection, which includes transit time to the secondary inspection station, is defined by the user at the Operator's Report screen (Fig. 48). All times reported are in minutes:

- **Maximum Wait Time**: The longest time any vehicle had to wait to receive a secondary inspection.
- **Average Wait Time**: The average number of minutes that vehicles had to wait.
- **Median Wait Time**: Because the average wait time can be skewed if a small number of vehicles had to wait a very long time, the median wait time is also presented. 50% of all vehicles that had to wait had a wait time less than this; 50% of all vehicles that had to wait had a wait time greater than this. (Note: vehicles with zero wait time are not included in this calculation.)
- **% Had to Wait**: This is the percent of vehicles that had to wait to receive a secondary inspection.
- **95% Waited Under**: 95% of the vehicles had to wait less than this time, in minutes. Operators and supervisors may choose to use this time as an upper bound.
- **Secondary Insp Rate**: The % of vehicles that received a secondary inspection. In all but the last scenario (Bypass inspection if wait time >60 minutes), this should be 100%.

Appendix A: Spectroscopic Portal Monitors

DART also has the capability to display and report on data received from SPMs that produce daily files in accordance with the Spectroscopic Daily File Format[2]. A typical SPM Daily File is about 10 MB in size. Generic SPM daily files for training purposes are available from ORNL upon request, but they are not included with the standard training material.

Setting Up an SPM Lane

To set up a lane as an SPM, select the RPM model as "SPM", as shown in Fig. B.1:

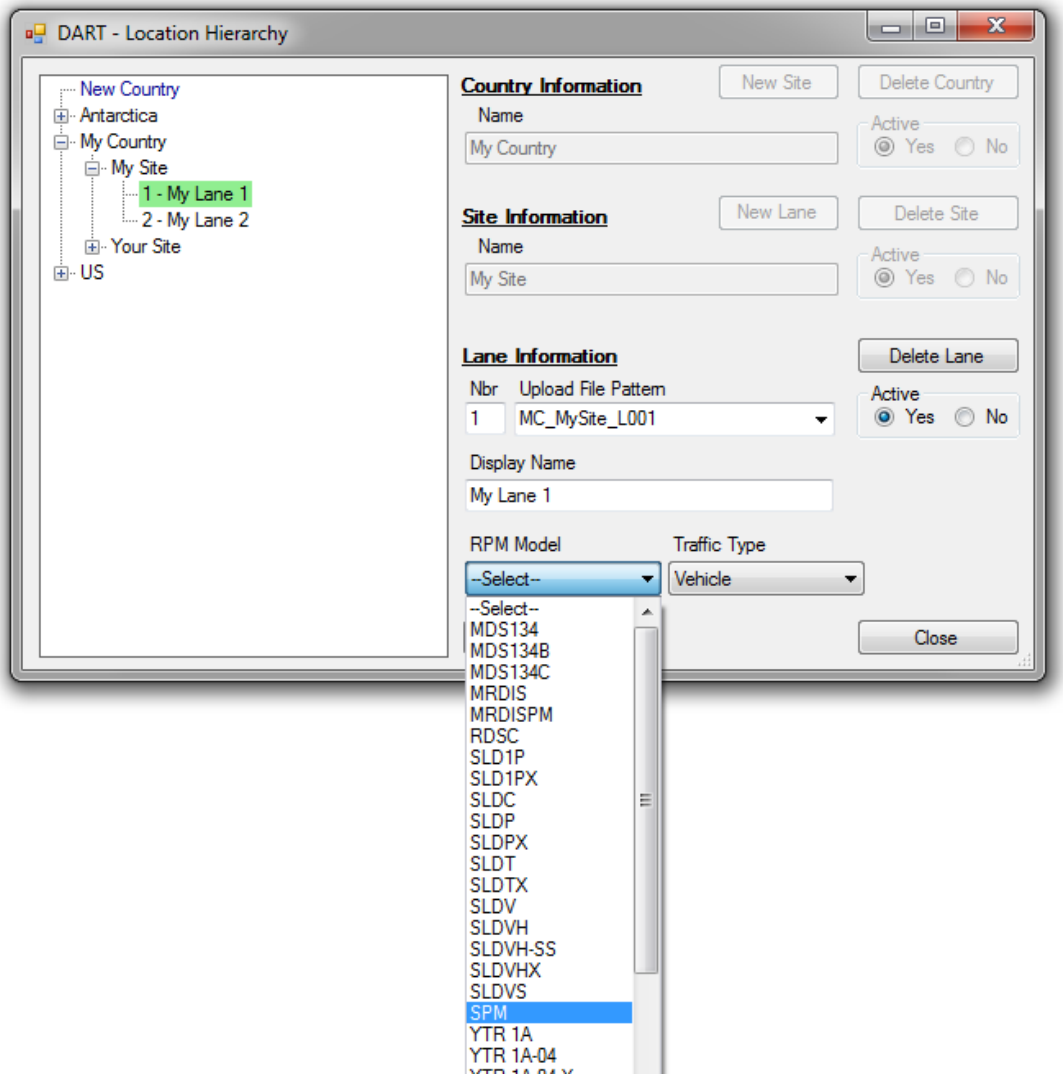


Fig. B.1. Designating a lane as an SPM in the Location Hierarchy.

[2] "Detailed Requirements for Spectroscopic Daily Files," Revision 3, August 2011. Available from ORNL upon request.

DART will now expect data for “My Lane 1” to be in the Spectroscopic Daily File format.

The Data Dashboard

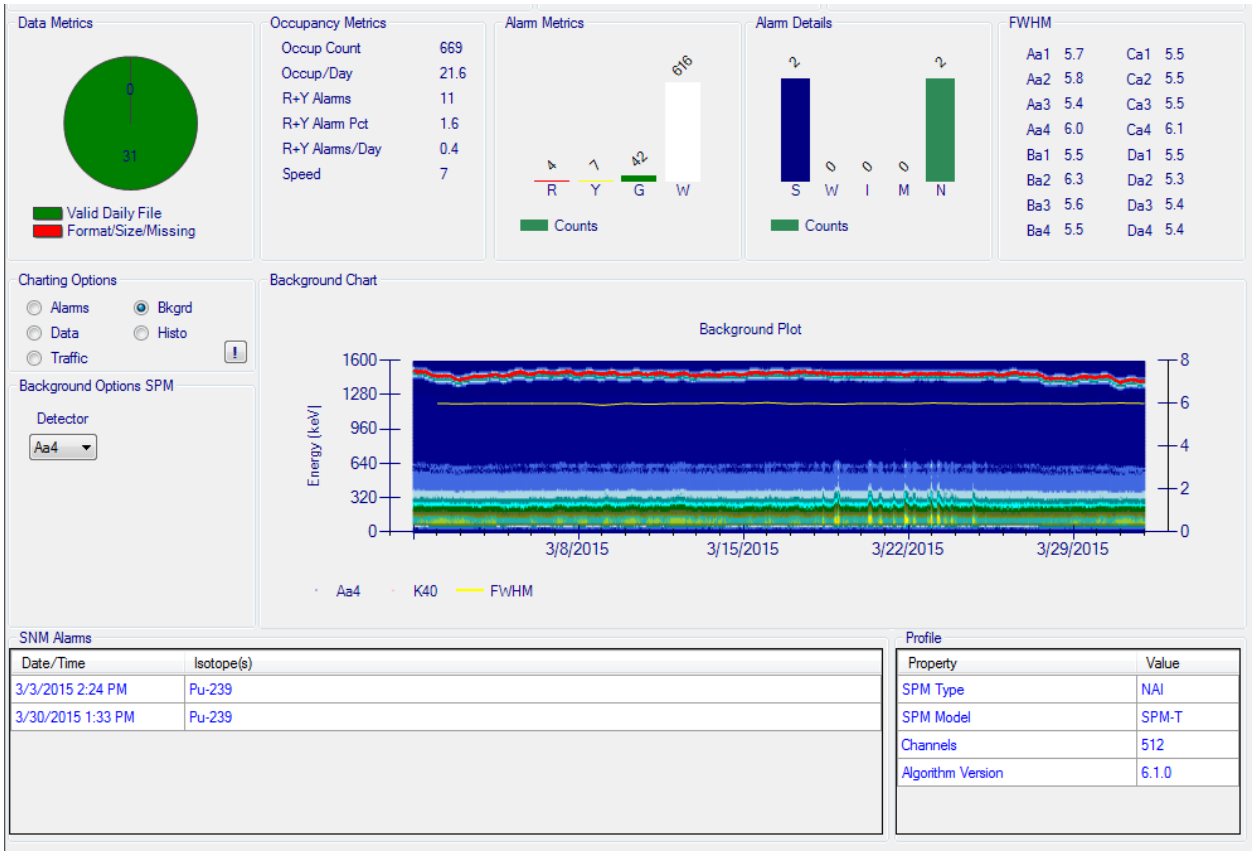


Fig. B.2. Data Dashboard for an SPM Lane.

The SPM Data Dashboard shows information that is relevant for SPMs.

The top row shows occupancy and alarm metrics for the SPM. Depending on what is identified in the container, the SPM generates one of four types of output, as shown in “Alarm Metrics”:

- Red (R). Operator action is necessary based on a positive identification from the SPM. This can include medical isotopes, industrial isotopes, special nuclear material, and related isotopes (such as ^{238}U and ^{241}Am).
- Yellow (Y). Operator action is likely necessary because the SPM cannot make a firm decision. A Yellow alarm is generated if the NORM activity is so high that the SPM cannot confirm there *is not* SNM in the container, or if there appears to be an isotope that the SPM cannot identify.
- Green (G). No operator action is necessary. The SPM has identified only NORM isotopes.
- White (W). No operator action is necessary. No radioactive isotopes were identified.

Also in the top row are "Alarm Details". This shows a breakdown of the Red Alarms that were generated in the month:

- Special Nuclear Material (S). These include identifications of ^{235}U or ^{239}Pu.
- Weapons Indicating (W). These include ^{238}U and ^{241}Am.
- Industrial (I). These include industrial isotopes such as ^{137}Cs, ^{60}Co, and ^{192}Ir.
- Medical (M). These include ^{99m}Tc and ^{131}I.
- Neutrons (N). If the SPM detects the presence of neutrons, these also generate a Red alarm. (Note this is different from the RPM response.) The number of neutron alarms in the month is shown here.

Lastly, in the top row is the Full Width, Half Maximum value (FWHM)[3]. It is a measure of the width of the peak associated with K-40 (at 1461 keV). This is one indicator of detector health. Although there are other ways a detector can fail, if the FWHM goes above about 12, then the algorithm ignores that detector from its analysis set. If the FWHM goes above 12 and stays above 12, then it may be time to consider replacing that detector.

The Charting Options are similar to the RPM Charting Options, except the Background plots need additional explanation.

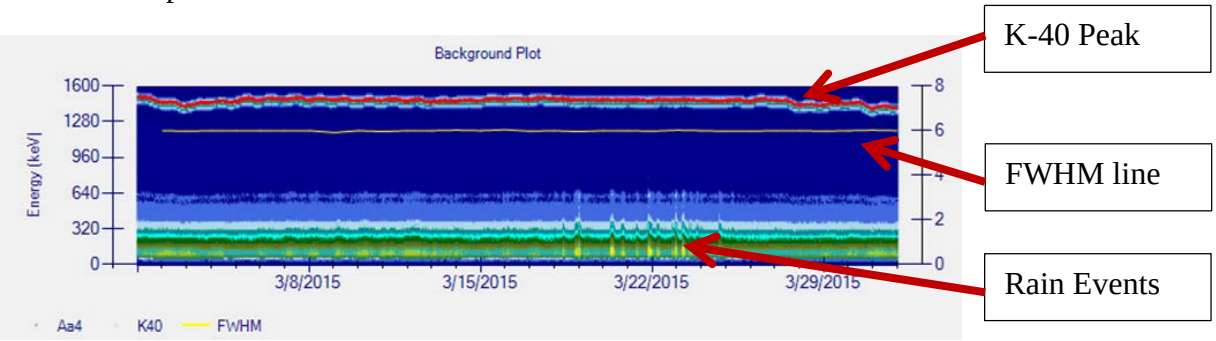


Fig. B.3. Detailed explanation of the SPM Background Plot.

Similar to RPMs, time is plotted along the *x*-axis. The *y*-axis is energy from 0 to 1,600 keV, as labelled on the left-hand axis. Although the SPM collects energy spectra from 0 to 3,000 keV, only a subset of that is plotted for analysis. Color is used to indicate the number of counts in each channel. Users can zoom in on the plot, all the way down to the individual background spectra recorded every 30 minutes. Rain events can be seen as small spikes in the lower energy region of the background because rain tends to deposit more low-energy emitters (such as ^{214}Pb and ^{214}Bi). The FWHM is plotted as a thin yellow line, and its value is shown on the right-hand *y*-axis. A typical value for FWHM is between 5 and 8%; if the detector is consistently higher than 12%, it should be considered for replacement.

[3] For speed purposes, DART calculates an approximate the FWHM value. Fitting a Gaussian shape to each and every background would be computationally expensive.

Each detector must be plotted separately. Usually, the FWHM summarized on the top-right corner of the dashboard can be a good indicator if a detector needs to be examined in detail. Plotting the background of a detector may require a few seconds because as thousands of points must be plotted for each detector.

On the very bottom of the data dashboard is a listing of the specific date and time that ^{235}U or ^{239}Pu were identified. These alarms can be investigated in more detail in the “Alarms” section of the Data Dashboard.