Data Visualization and Reporting Module
PSS®E 34.8.2

February 2021

SIEMENS

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Chapter 1
Installation Procedures

1.1. Introduction

This section explains how to install and configure the third party products that are required in order to work with the Data Visualization and Reporting Module (DVRM) functionality provided with PSS®E.

1.1.1. Prerequisites

If you have purchased DVRM as an add-on module to PSS®E, you will need to install Microsoft SQL Server Express. Additionally, if you are configuring an enterprise server, you will need Microsoft SQL Server as well. These products are available from Microsoft.com.

You will also need to install the Tableau software provided by Siemens PTI; instructions for downloading and installing Tableau software are provided in Section 1.2, Installation.

Note: Only *.acc files created with PSS ®E 33.2 or above are supported.

1.2. Installation

This section includes the steps required for installing DVRM.

1.2.1. Standard DVRM Installation

1.   Download the DVRM installation files from:s

     www.siemens.com/power-technologies

2.   Open **TableauDesktop-9-3-0-Siemens-64bit.msi** or
      TableauDesktop-9-3-0-Siemens-32bit.msi to start the installation process:
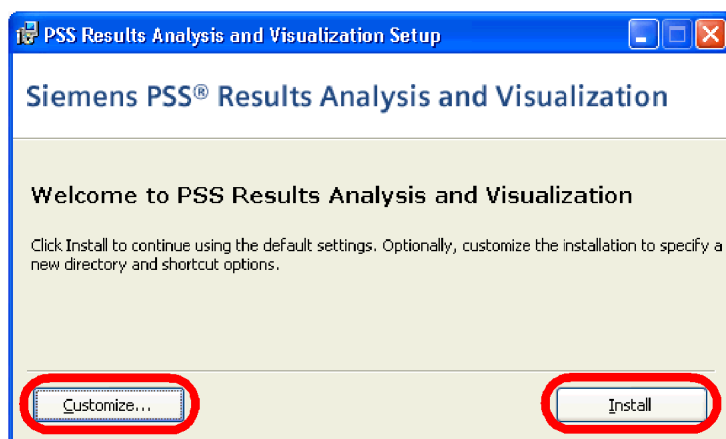
Figure 1.1. DVRM Installer Initial Screen

3.   The Tableau installer is a silent installer requiring minimal user interaction to install.

4.   The Tableau installer will report its progress as it installs on your system:
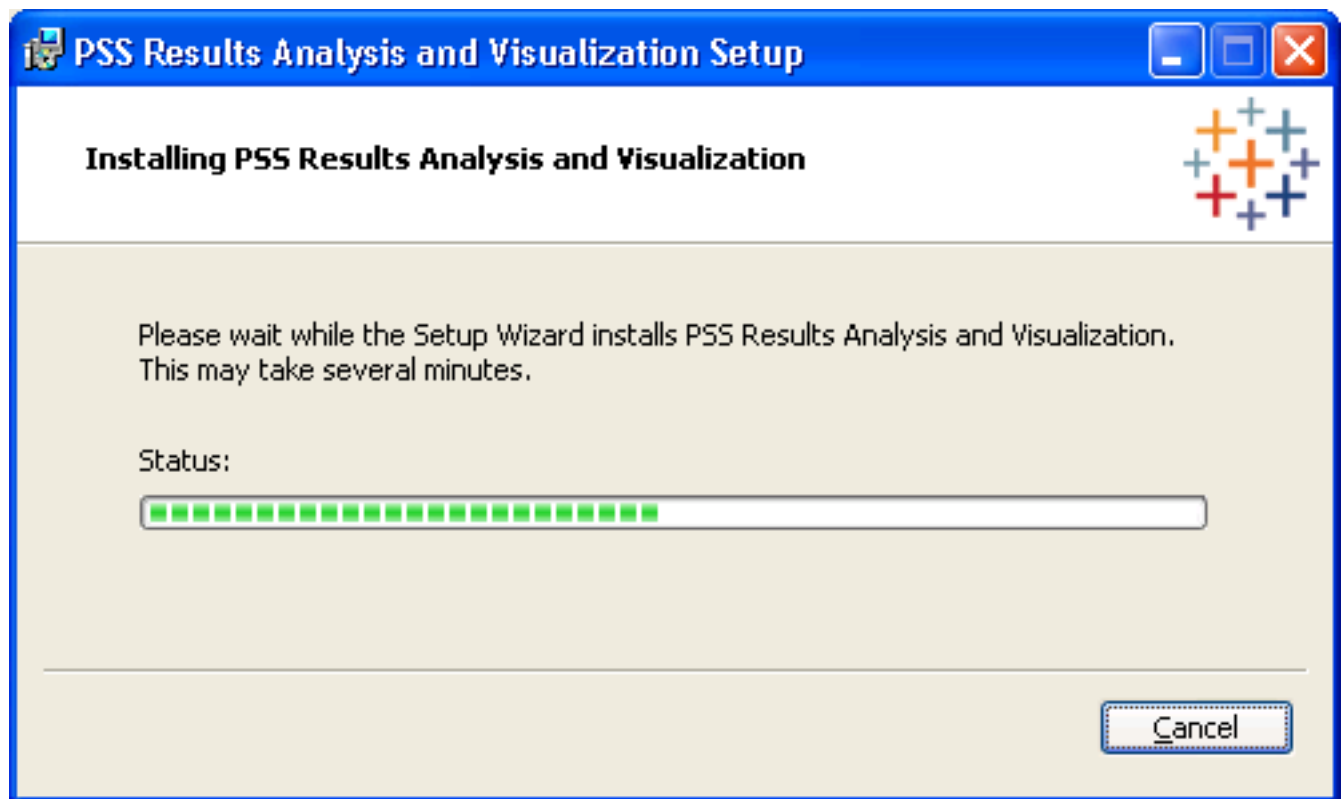
Figure 1.2. DVRM Installation in Progress

5. Once the installation is complete, you will need to activate the Tableau installation. Select "PSS® Data. Visualization and Reporting Module" and then from the Help menu select "Manage product keys...
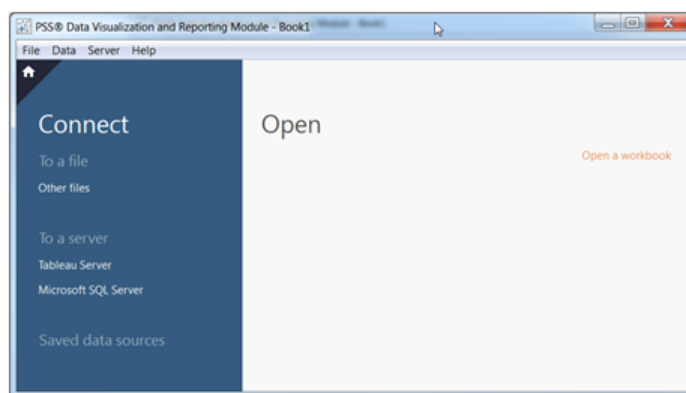
Figure 1.3. Activate Tableau

6. Type your product key in the text box and click Activate.
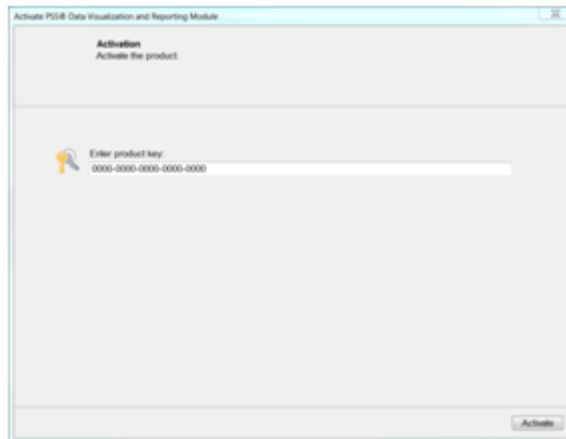
Figure 1.4. DVRM Activation Key

7. Once you have activated the DVRM key, the following dialog box will appear:

Figure 1.5. DVRM Registration

8. Fill in the appropriate information and click register to continue the operation.

Figure 1.6. DVRM Activation Complete

9. Click continue to complete the activation.

1.3. Verify DVRM Installation

To verify that DVRM has been installed, open **PSS**®**E** from the *Start menu* and select **PSS**® **Data Visualization and Reporting Module**. Alternatively, you can open the *PSS*® *E Power Flow menu* and select **Data Visualization and Reporting Module**.

1.4. Deactivate a DVRM Product Key

DVRM product keys that have expired should be deactivated. To deactivate a DVRM Product Key:

1. Select Manage Product Keys from the Help menu. The following dialog box appears:
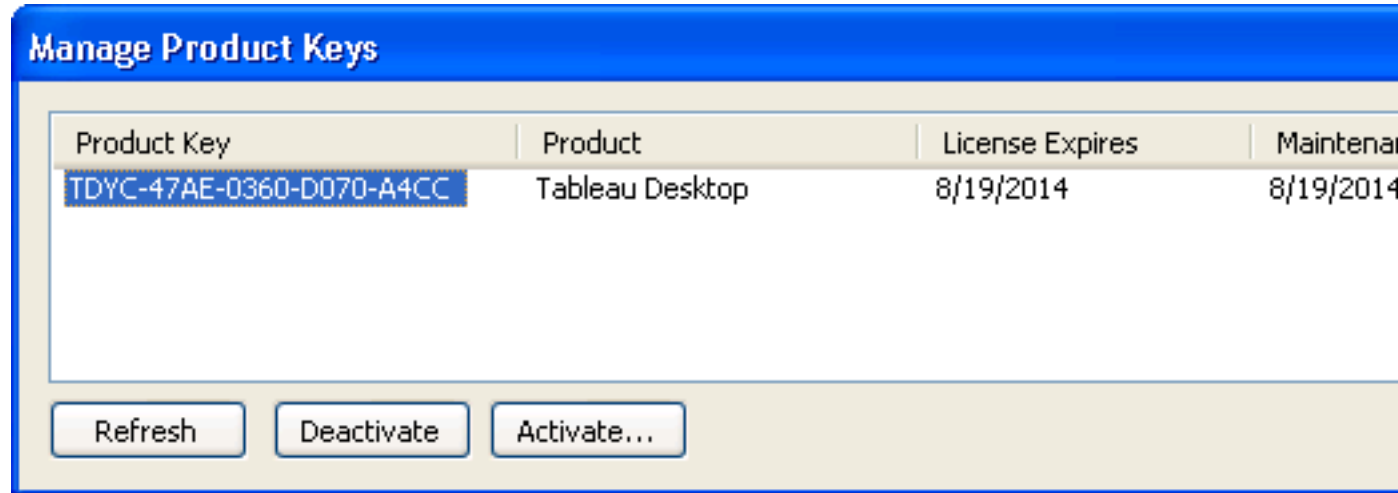
Figure 1.7. DVRM Key deactivation

2. Select the product key that you want to deactivate and click *Deactivate*.

Chapter 2
Working with the DVRM

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2.1. Overview

The objective of the Data Visualization and Reporting Module (DVRM), is to provide a streamlined process for taking PSS® product results and presenting them in a manner that is visually interactive and highly intuitive. As the amount of results produced by varied forms of analysis continues to grow, the means to quickly interpret the data becomes essential. The DVRM provides the engineer with a tool that will allow him or her to visually review the PSS® results, and quickly drill into areas of interest and formulate their analysis without having to pour over pages of output.

2.2. Using the DVRM

The workflow of using the DVRM can be broken into four steps:

1.   Performing the Analysis

2.   Creating the DVRM database

3.   Connecting the DVRM Template Workbook to the SQL Database

4.   Launching the DVRM Visualizer

DVRM analysis of all result types will follow this same basic workflow.

2.2.1. Performing the Analysis

In this step the PSS® product is used to perform the desired analysis, capturing the results of that analysis in a results output file that can be later used for post processing, such as customized reporting, or use in the DVRM itself. So, for example, if you wish to use the DVRM with ACC results, you must first run one of the PSS®E Contingency analysis functions that produce an ACC results file, for example, either ACCC, Multi-level ACCC, N-1-1, or one of the other forms of Contingency analysis.

Note: Only *.acc files created with PSS®E 33.2 or above are supported. If you attempt to use files that are included with versions that were released before PSS®E 33.2, an error message will be displayed.

2.2.2. Manage the DVRM Database

The **DVRM (Data Visualization and Reporting Module)** dialog box is used to manage the DVRM database. To open this dialog box, open the *Power Flow* menu and select *Data Visualization and Reporting Module*.
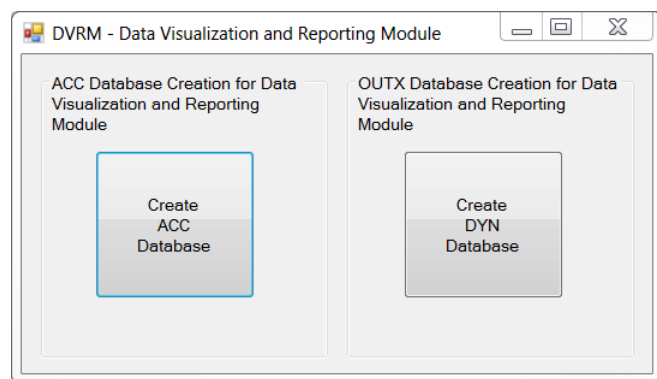
Figure 2.1. DVRM Dialog

This initial dialog box and the ones that follow are used to interact directly with the DVRM Visualizer and the associated DVRM Workbooks used to visualize the PSS® results. As you become more familiar with the DVRM and the associated DVRM Workbooks, you can skip some usage of this dialog and make modifications directly. Be aware, however, that the creation of the SQL Database is always managed from this dialog.

To manage DVRM databases:

1.   Use the pushbuttons to select the type of PSS® results that are to be converted to a DVRM database. This will be the type of file(s) created in Section 2.2.1, Performing the Analysis. Currently only PSS®E ACCC and PSS®E Dynamic results are supported. Once the results type has been selected the next dialog will appear.
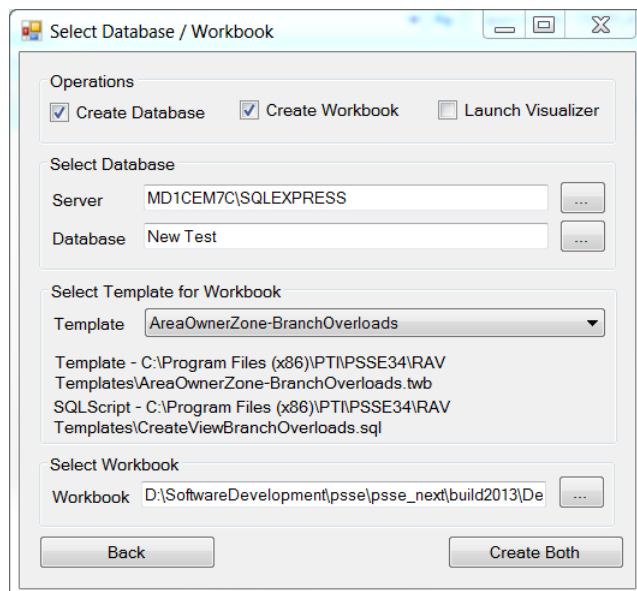
Figure 2.2. DVRM Dialog

<indent>From this dialog we can create a result SQL Database, create a DVRM Workbook that will tie a specific Database to a prepared Visualization, and launch the DVRM Visualizer. Notice that you can return to a previous dialog by using the "Back" button. The button labeled "Create Both" in the Figure above will changed depending what options are selected at the top of the dialog. If only "Create Database" is selected the button will read "Create Database". If only "Create Workbook" is selected the button will read "Create Workbook". If multiple items are selected the button will reflect that multiple selection as seen above.</indent>

• To create or modify an SQL Database that includes the PSS® result data, check the field titled *Create/update results database*.

• To create a Workbook that will be used with the DVRM Visualizer to actually view and interact with your results, check the field titled *Create Workbook*.

• To launch the DVRM Visualizer with the selected Workbook, check the field titled *DVRM Visualizer*.
<indent>If "Create Database" or "Create Workbook" was selected, the fields to select an SQL Server and SQL Database are enabled. </indent>

2.   Type SQL Server and SQL Database names in the SQL Server and SQL Database fields. Click the "..." button to the right of these fields to select an SQL Server and the SQL Data- base available on that server.
<indent>**Note:**The **SQL Server Selection** dialog can look locally for SQL Servers. This would commonly be an installation of SQL Server Express, or SQL Servers installed on the network. The selection of local or network SQL Servers is controlled by the selection of the field titled *Local SQL Servers only*.</indent>
<indent>Double click the server to select it and dismiss the dialog.</indent>
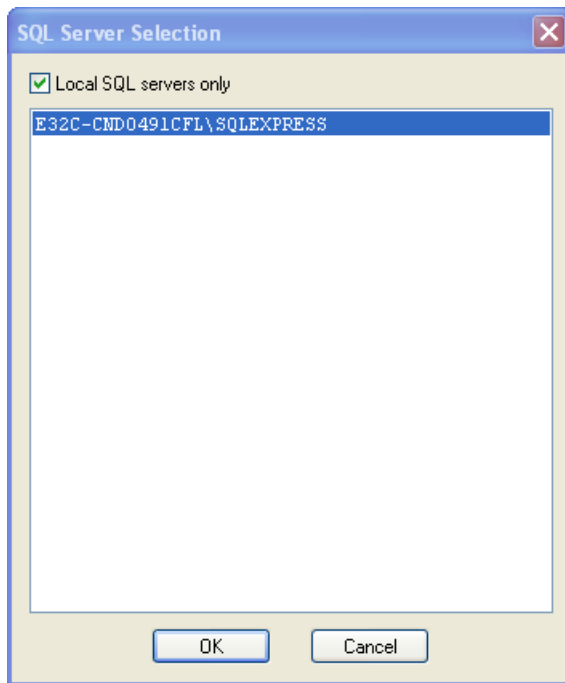
Figure 2.3. SQL Server selection dialog

<indent>The **SQL Database Selection** dialog will list all the existing databases found on the selected SQL Server. Double click a database to select it and dismiss the dialog.</indent>
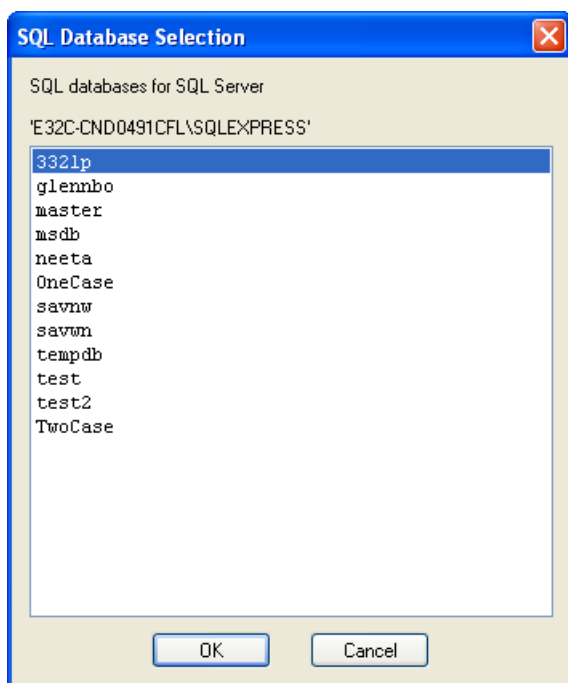
Figure 2.4. SQL Server selection dialog

Selecting the *SQL Server*, and the *SQL Database* are all that you need to do in order create the DVRM database. If you only want to create the DVRM database, click the button on the right of the dialog titled "Create Database". Otherwise, if you want to connect a DVRM Template Workbook to the SQL Database specified for creation in this step for use with the DVRM Visualizer, then proceed to Section 2.2.3, Connecting the DVRM Template Workbook to the SQL Database.

If you have selected to create a DVRM database you will be prompted to select the files to include in the database.
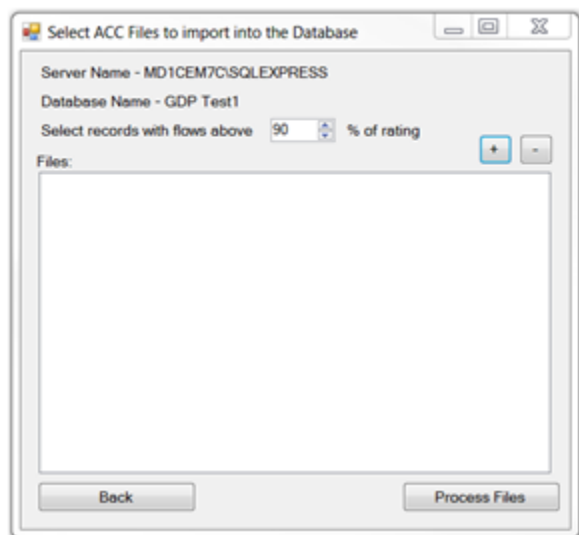
Figure 2.5. Select files to create a DVRM Database

Click on "+" to add or "-" to remove files to the list of files that will be used to create the DVRM database.

2.2.3. Connecting the DVRM Template Workbook to the SQL Database

Creating the DVRM database is the first step to using the DVRM Visualizer. Before you can use the DVRM Visualizer with the database created in Section 2.2.2, Manage the DVRM Database, you must first connect a DVRM Template Workbook to the DVRM database.

DVRM Template Workbooks are predefined visualizations for use with your PSS® result database. They usually have a *.twb suffix associated with them. The connection between the DVRM Template Workbook and the database created in Section 2.2.2, Manage the DVRM Database is established with two fields contained in any *.twb file, dbname='XXXXX' server='XXXXXXX'. These two fields are automatically updated for you as part of this step. Once you become familiar with the DVRM and the DVRM Workbooks you may edit these files manually if you want, or you can use the DVRM dialog as described in this section.

By selecting the *Create Workbook* check box, the DVRM Template Workbook will be automatically modified to connect to the specified SQL Server and Database, creating a DVRM Workbook.

Note: When connecting a DVRM template workbook to a SQL database, you will need to select both the correct workbook and database type for the specific visualization (ACC or Dynamics).

For example, if you want to create an ACC workbook and want to use an existing database (by un-checking the "Create Database" option), you must verify that the selected database contains ACC data. (SQL Server Management Studio can be used to view the contents of the database.) It is important to select the template workbook type that corresponds to the database type, otherwise the workbook will not be populated. It is recommended that when you assign names to your databases that the names include either ACC or DYN in order to easily identify your databases by type.

1. Identify the DVRM Template Workbook that you want to modify by selecting it using the "Template" combo-box. This will present a list of the DVRM Template Workbooks supplied with the DVRM. (The DVRM Template Workbooks are typically found in the "DVRM TEMPLATES" directory found in the PSS®E

installation.) If you'd like to use a custom template not found in the "DVRM TEMPLATES" directory, select "Custom" from the "Template" combo-box and it will allow you to browse for a .twb file.

The *SQL script field* is used to specify a SQL script used to optimize the performance of the DVRM data-base with the DVRM Workbooks. Once you have selected the DVRM Template Workbook, this field is automatically populated with the appropriate script from the DVRM directory.

Note: The DVRM database only has to be optimized once, usually when first created and launching the first workbook that uses it. Execution of the same SQL script against a DVRM database that has already had the script run against it will not cause a problem but will not yield any further performance optimization.

2. The *Workbook* field is automatically populated when the DVRM Template Workbook is selected. The DB connected workbook refers to the DVRM Workbook. This DVRM Workbook name is automatically generated by pre-pending the SQL Database name to the DVRM Template Workbook name. (You may change this name to something more meaningful if you wish.) Once the DVRM Workbook has been generated it contains all the connection information to work directly with the DVRM Visualize and needs no further modification to use the DVRM Visualizer in later sessions.

2.2.4. Launching the DVRM Visualizer

Once a DVRM database and a DVRM Workbook have been created, the DVRM Visualizer can be launched to view and interact with the DVRM database. Select the *Launch the DVRM visualizer* checkbox to startup/launch the DVRM Visualizer with the DVRM Workbook created in Section 2.2.3, Connecting the DVRM Template Workbook to the SQL Database.

Use the *Workbook* field to identify the workbook that you want to launch. Click the "..." button to the right of this field to select a DVRM Workbook from those found on the system. The DVRM Workbook is created in the same directory as the DVRM Template Workbooks. (DVRM Template Workbooks are typically found in the DVRM directory found in the "RAV TEMPLATE" directory of the PSS®E installation.)

The steps to create the DVRM database, connect the DVRM Template Workbook to the SQL Data- base, and launch the DVRM Visualizer can be implemented and completed subsequently or all at once. Click the button on the bottom right of the dialog to implement any selections you have chosen

2.3. Common Workflows for Using the DVRM

This section describes some of the common workflows for using the DVRM in terms of the four steps described in Section 2.2, Using the DVRM.

2.3.1. Workflow 1 - Creating the DVRM Database and Launching the DVRM

In this workflow, a user has just created a PSS® result file and now wants to create the appropriate DVRM database, create the DVRM Workbook and launch the DVRM Visualizer.

1. Select the appropriate controls and supply the appropriate values as described in Section 2.2.2, Manage the DVRM Database.

2. Select the appropriate controls and supply the appropriate values as described in Section 2.2.3, Connecting the DVRM Template Workbook to the SQL Database.

3. Select the appropriate controls and supply the appropriate values as described in Section 2.2.4, Launching the DVRM Visualizer.

4. Click the **Create and Launch** button on the bottom right of the dialog.

2.3.2. Workflow 2- The DVRM Database exists, launch the DVRM against the existing database

In this workflow the user wants to visualize the data for an existing database.

1. Select the appropriate controls and supply the appropriate values as described in Section 2.2.3, Connecting the DVRM Template Workbook to the SQL Database.

2. Select the appropriate controls and supply the appropriate values as described in Section 2.2.4, Launching the DVRM Visualizer.

3. Click the **Launch DVRM** button on the bottom right of the dialog.

2.3.3. Workflow 3 - The DVRM Database exists, the DVRM Visualizer is already launched, and the user wants to load a different DVRM Workbook

In this case the user is already analyzing data in the DVRM Visualizer and wants to see another DVRM Workbook against the same database. This different workbook has NOT yet been modified.

1. Select the appropriate controls and supply the appropriate values as described in Section 2.2.3, Connecting the DVRM Template Workbook to the SQL Database.

2. Click the **Create and Launch DVRM** button on the bottom right of the dialog.

3. In the DVRM Visualizer that is currently running, select File > Open and select the DVRM Workbook you created.

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Workflow 4 - DVRM Database exists and
the user wants to launch an existing
DVRM Workbook

4. If desired, you may select the appropriate controls in Section 2.2.4, Launching the DVRM Visualizer and launch a second copy of the DVRM Visualizer with the new DVRM Workbook. The efficiency of this will depend on the resources of you computer, specifically the available RAM.

2.3.4. Workflow 4 - DVRM Database exists and the user wants to launch an existing DVRM Workbook

In this workflow, both the DVRM Database and the DVRM Workbook have been created, and the user wants to continue working with the existing DVRM Workbook.

1. Select the appropriate controls and supply the appropriate values as described in Section 2.2.4, Launching the DVRM Visualizer.

2. Click the **Launch DVRM** on the bottom right of the dialog.

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2.4. The DVRM Visualizer

The DVRM Visualizer may be launched as described in the workflows above, specifically Section 2.2.4, Launching the DVRM Visualizer, or may be launched as a standalone Windows application.

The following procedures explains how to launch the DVRM Visualizer:

1. Complete the steps described in Section 2.2.4, Launching the DVRM Visualizer in the DVRM dialog.

2. Click on the PSS® Data Visualization and Reporting Module icon that appears on the desktop.

3. Click on the PSS® Data Visualization and Reporting Module item that appears in the **PSS®E 34 Start** menu entry.

Once the DVRM Visualizer has been started, a DVRM Workbook can be opened. Select **Open Wordbook**. from the *File* menu, or select from one of the recently used DVRM Workbooks that appears on the startup screen of the DVRM Visualizer (see Figure 2-4)
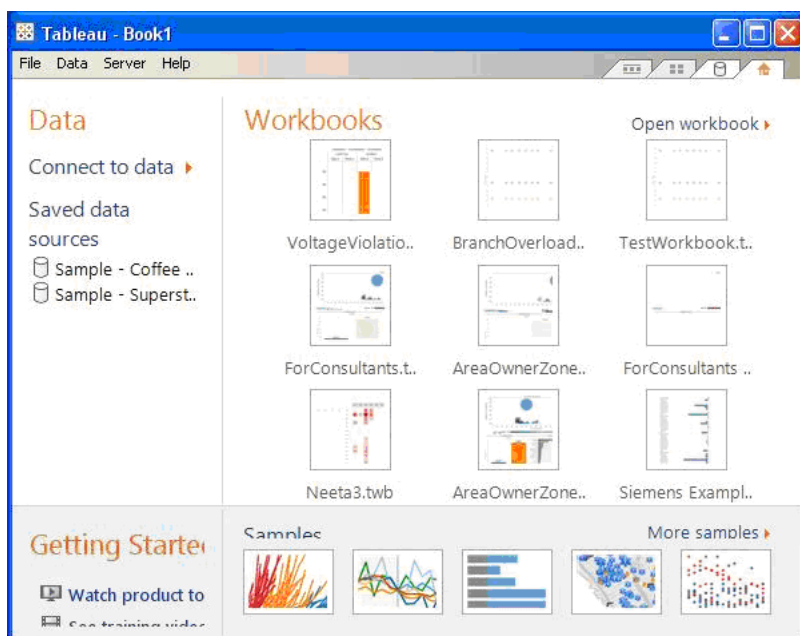
Figure 2.6. DVRM Visualizer Start Page

A DVRM Workbook consists of one or more dashboards set up to explore predefined queries.

2.5. Using DVRM Workbooks

Two families of DVRM Workbooks have been developed for the introduction of the DVRM module. These families of workbooks focus on the analysis of PSS®E ACC and Dynamics results. There are several workbooks in each family that are used to investigate and analyze specific areas of interest for those analyzing the output of ACC and Dynamics results.

2.6. Exploring the DVRM Visualizer on your own

DVRM gives you the freedom to create your own worksheets and add them to new dashboards with any combination of dimensions and measures as desired. To create a new worksheet, select the new worksheet tab at the bottom of the window (see Figure 2-6) using the current data connection.
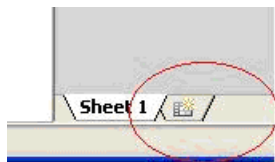
Figure 2.7. DVRM Visualizer worksheet creation

The dimensions and measures that appear in a list in the left panel are used to examine our data. Typically measures are the numerical quantities we wish to examine in detail and dimensions are used to categorize the data. Dimensions can be hierarchical which enables drilldown operations, and gives you the ability to search quickly.

For suggestions on best practices, the **Show Me** feature recommends chart types particularly suited to the number of measures and dimensions in the chart. The measures and dimensions are dragged onto the rows and column fields within the new worksheet to add data to the display.
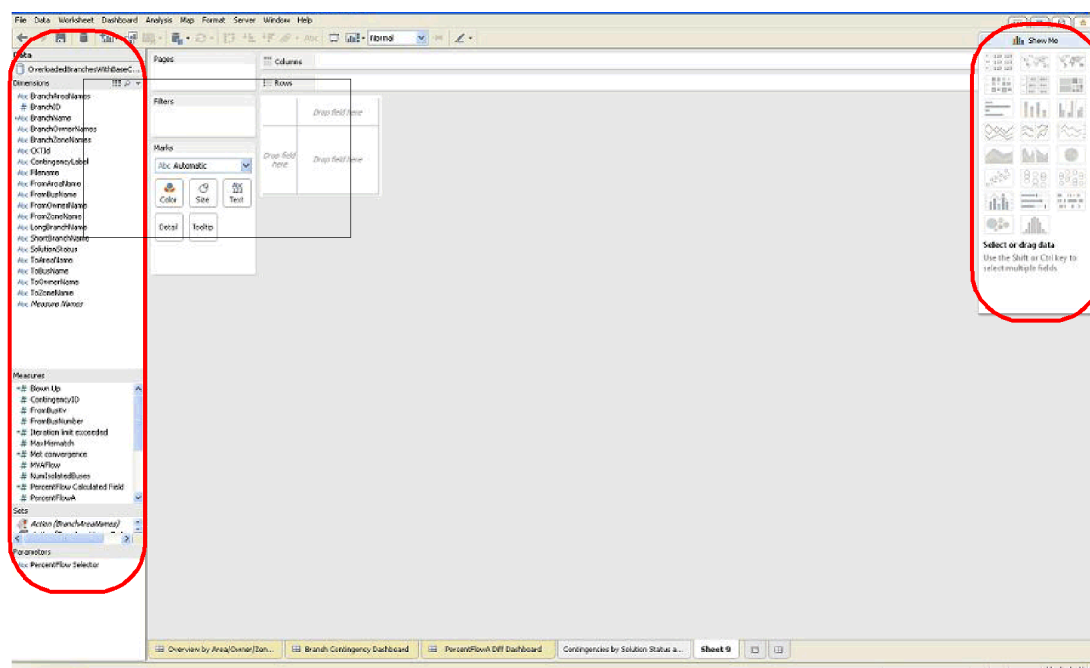
Figure 2.8. DVRM Visualizer dimensions and "Show Me" feature

Chapter 3

DVRM Visualization Worksheets and Dashboards

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3.1. Terminology

- DVRM Visualization can be a scatter plot, bubble diagram, bar chart, etc.

- DVRM Dashboard is a logical collection of Visualizations together in a single view.

- DVRM Workbook is a collection of tabbed Dashboards.

3.2. Worksheet Templates

PSS®E DVRM provides several worksheet templates. These templates provide examples of the types of visualizations available, and provide a starting point for building custom visualizations.

Many of the template dashboards are set up to populate visualizations based on selections. If you're not sure what to do next, try selecting some of the data by drawing a box around markers with the mouse, or "Ctrl-clicking" several markers. A marker is a bubble in a bubble chart, a bar in a bar chart, etc. In many cases, making a selection will result in filtering the data and causing the charts and dashboards with more detailed information to populate. You can also get more detailed information in a tool-tip box as you mouse over specific markers.

The workbooks are designed to tell a story by navigating through the dashboards in a particular order. The sequence is intended to start with top level information and drill down to specific details. There are two types of workbooks, ACCC and Dynamics.

3.3. ACCC Workbooks

3.3.1. Area, Owner, and Zone Workbooks

DVRM includes the following workbooks:

1. AreaOwnerZone-BranchOverloads

2. AreaOwnerZone-BusVoltageViolations

These workbooks allow you to see aggregated violation results grouped by acc filename (accc result files), areas, owners and zones, and to drill down to more detailed information by selecting subsets of the data. Below are descriptions of the Dashboards and Visualizations contained in these workbooks. Branch Overloads can be analyzed using either Rate A, Rate B or Rate C. This is done with the Percent Flow Selector on the dashboard.

a. When PercentFlowA is selected, only results for base case overloads and RateA are displayed.

b. When PercentFlowB is selected, only results for contingency overloads and RateB are displayed.

c. When PercentFlowC is selected, only results for contingency overloads and RateC are displayed.

Once the choice is made, it is applied globally to all the visualizations within a workbook.

Analysis within the Voltage Violation workbooks is done by selecting violations that are either below the minimum voltage limit or above the maximum voltage limit. This choice is made with the help of the Voltage Limit Selector on the Dashboard.

a. When BaseCase High is selected, results are displayed for BaseCase high voltage violatons.

b. When BaseCase Low is selected, results are displayed for BaseCase low voltage violations.

c. When Contingency High is selected, results are displayed for Contingency cases high voltage violations.

d. When Contingency Low is selected, results are displayed for Contingnecy cases low voltage violations.

A high voltage violation is determined by the Maximum Voltage value defined by the monitored voltage record for a bus. Similarly, a low voltage violation is determined by the Minimum Voltage value defined by the monitored voltage record associated with a bus.

Once selected, the filter applies across all the Dashboards within the workbook.

Warning: The Dashboards within the workbooks must be used in the order in which they are presented below. Starting the analysis at any Dashboard could result in the display of meaningless data as the results displayed in a dashboard depend on filters selected in previous dashboards.

Dashboards

This section provides details about the types of dashboards currently available and how to interpret the information presented on each.

Overview by Area, Owner, Zone, and CaseType Dashboard

This dashboard contains a scatter plot, and bubble diagram, and a bar chart showing information for violations aggregated by areas, zones, owners, and acc files. The scatter plot shows the number and average severity of violations by area. The shapes denote the acc file. Selecting some or all of the markers in the scatter plot populates the bottom two charts.

Based on the selected scatter plot markers, the bubble diagram will show zone bubbles whose sizes are proportional to violation count. The Bar chart to the right shows the same information more quantitatively for each zone and acc file.

Select some of the bars from the bar chart to filter the dataset and automatically move to the next dashboard for more detailed information.
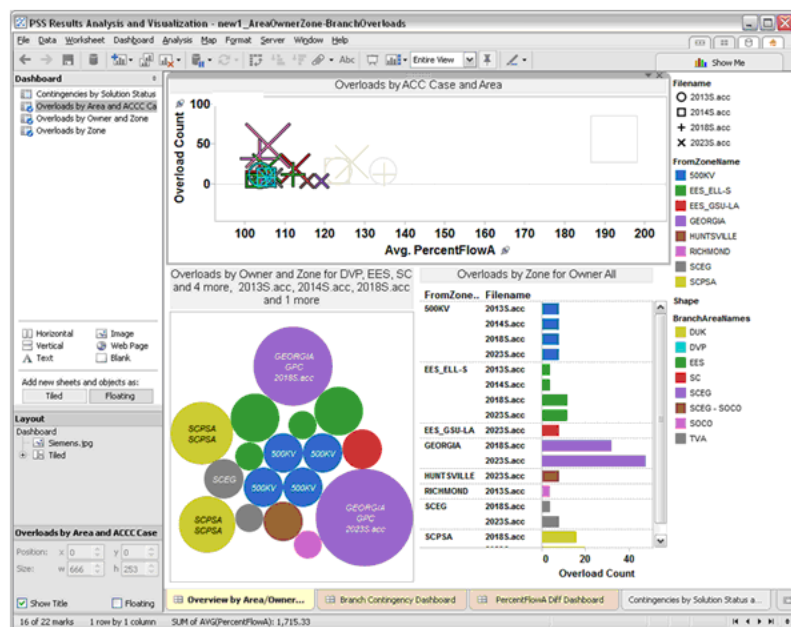
Figure 3.1. Overview by Area/Owner/Zone – Branch Overload workbook

Branch/Bus Contingency Dashboard

Based on the selection from the previous dashboard, this dashboard will show overload statistics for individual branches/buses and contingencies. The bar chart on the left shows overload count and average loading information for individual branches/buses. Selecting some of the bars on the left populates the chart on the right with overload information for the contingencies that cause the overloads on the selected branches/buses.
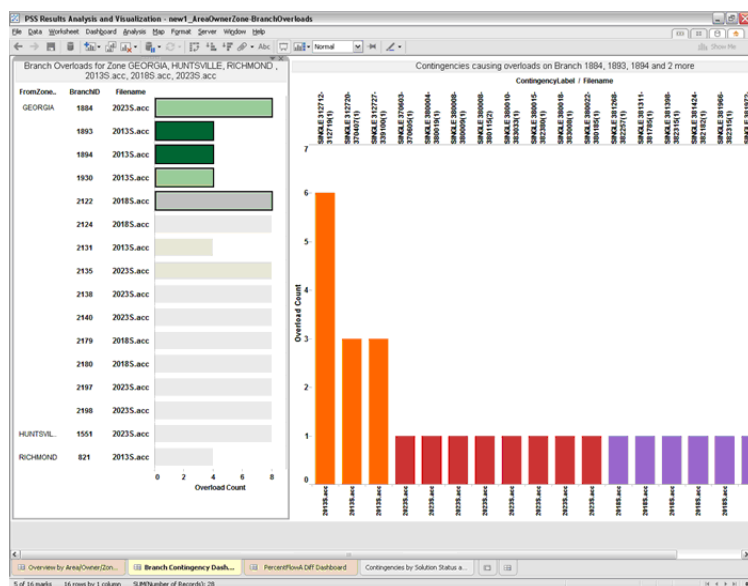
Figure 3.2. Branch Contingencies – Branch Overload workbook

Percent Flow/Voltage Differences Dashboard

Based on the selection made in the previous dashboard, this dashboard allows you to compare the severity of overload-causing contingencies for the selected branches/buses. Selecting some of the bars in the top chart populates the bottom heat map. This heat map gives you a matrix view of the overload severities for individual monitored element/contingency combinations.

Figure 3.3. Percent Flow Difference– Branch Overloads workbook

3.3.2. Contingency Solution Status Workbooks

This section provides details about the different ContigencySolutionStatus Workbooks.

DVRM Templates

1. ContingencySolutionStatus-BranchOverloads.twb

2. ContingencySolutionStatus-BusVoltageViolations.twb

These workbooks allow you to visualize aggregate and detailed contingency statistics.

Dashboards

Solution Status Dashboard

This dashboard shows solution status aggregates for each acc file in the top bar chart, and detailed contingency solution status and average violation severity in the below bar chart based on the selection made in the top bar chart.
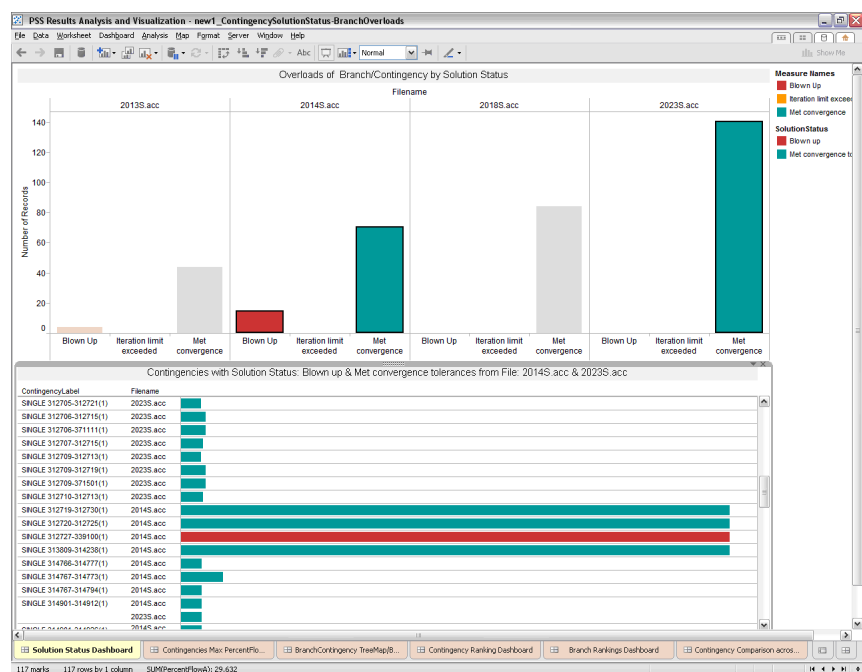
Figure 3.4. Solution Status – Branch Overload workbook

Contingencies Max Percent Flow/Voltage Violation Dashboard

This dashboard displays the worst violations for selected contingencies. Selecting contingencies in the top bar chart populates the bottom chart with the related branch violation details.
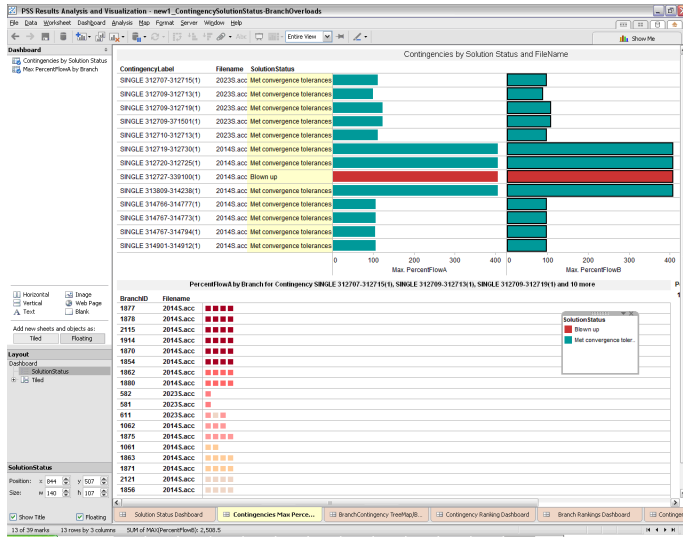
Figure 3.5. Contingencies Max Percent Flow – Branch Overload workbook

Branch/Bus Contingency Tree Map/Bubble Chart Dashboard

Based on the selection made in the previous dashboard, this dashboard shows tree maps for violations for
the selected monitored elements. Selecting some of these tree maps will populate the bubble chart to the
right for the related contingencies.
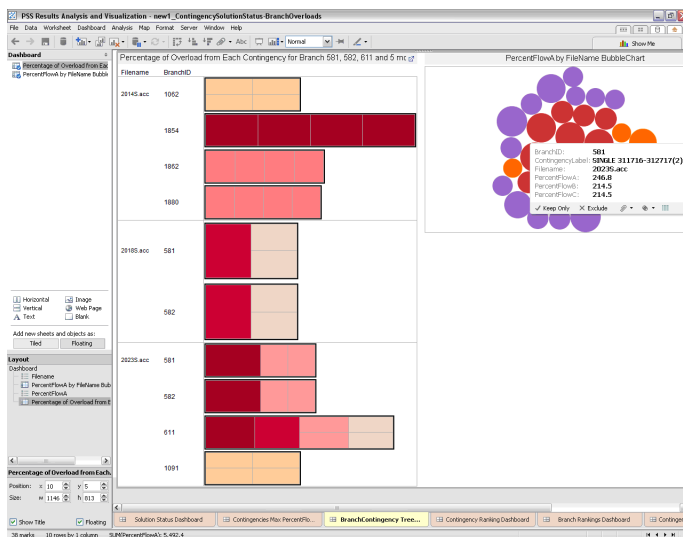
Figure 3.6. Branch Contingency Tree Map/Bubble Chart – Branch Overload workbook

Contingency Ranking Dashboard

This dashboard allows you to quickly zero-in on the worst contingencies. The contingencies are listed in the
bar chart on the left. Selecting some of these contingencies plots their relative rankings in the line plot on
the right, showing trends across the acc files.
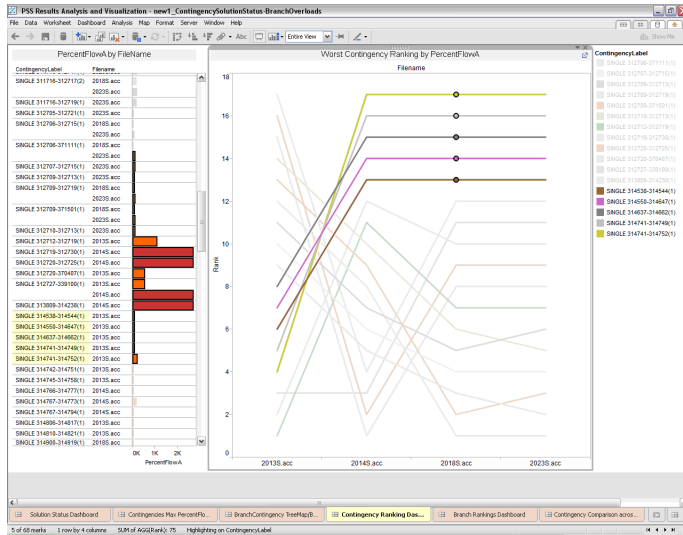
Figure 3.7. Contingency Ranking – Branch Overload workbook

Branch/Bus Ranking Dashboard

This dashboard allows you to quickly zero-in on the worst branches/buses. The branches/buses are listed on the right. Selecting some of these branches/buses plots their relative rankings in the line plot on the right, showing trends across the acc files.
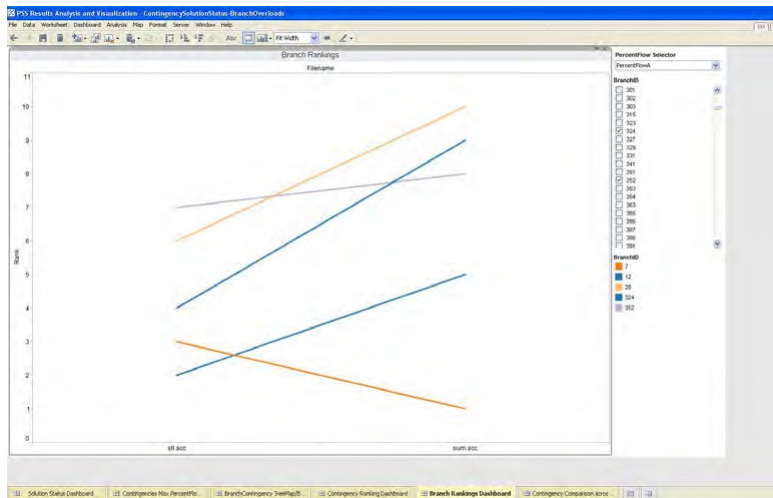
Figure 3.8. Branch Rankings Dashboard - Branch Overload workbook

3.3.3. Tree Map Overview Workbooks

This section describes how to interpret Tree Map Workbooks.

DVRM Templates

1.   TreeMapOverview-BranchOverloads.twb

2.   TreeMapOverview-BusVoltageViolations.twb

These workbooks show you the relative severity of results for various areas, owners, and zones.

Tree Map Area, Owner, Zone Dashboard

This dashboard shows violations by areas and zones using tree maps. Selecting some of the areas on the left populates the zone tree maps on the right.
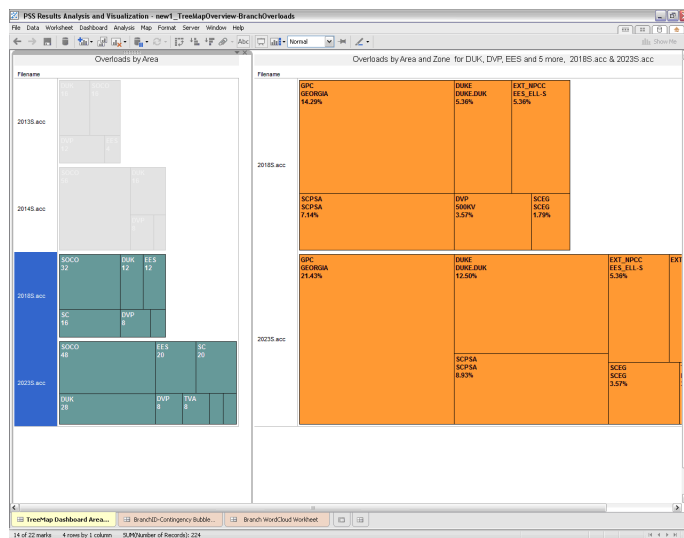
Figure 3.9. TreeMap Area, Owner, Zone – Branch Overload workbook

Branch Id/Bus Contingency Bubble Map Dashboard

Based on the selection made in the previous dashboard, this dashboard shows a branch/bus bubble diagram visualizing violation count by size and violation severity by color. Selecting some of these bubbles populates the bar chart below showing violation count and severity information for the related contingencies.
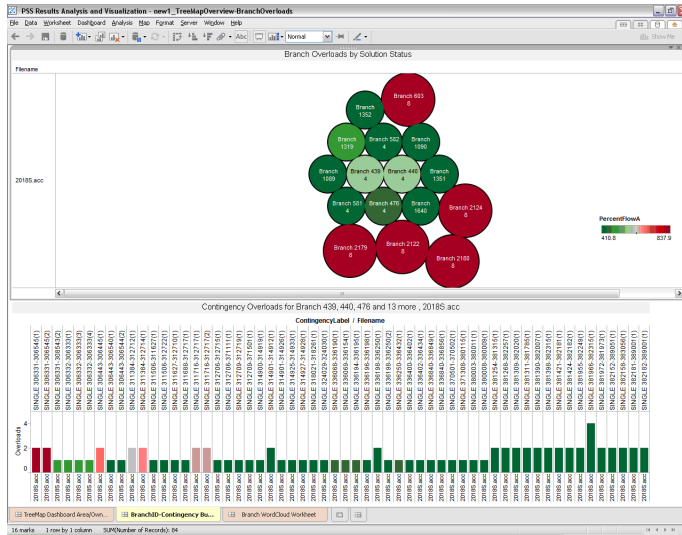
Figure 3.10. Branch Contingency Bubble Chart – Branch Overload workbook

Branch/Bus Word Cloud

The word cloud shows the severity of the violations for branches/buses based on the selected contingencies in the Branch/Bus Contingency Bubble Map. Color and size of the branch/bus label indicate average Voltage or Percent Flow.

Figure 3.11. Bus Word Cloud - Bus Voltage Violation workbook

3.4. Dynamics Workbooks

DVRM for dynamics provides template workbooks to analyze and compare the results of dynamic simulations contained in extended channel output files (extended channel output files are those channel output files that contain additional metadata that is required for the performing visualization using the DVRM tool).

Two workbook templates are provided for the visualization of dynamic simulation results:

1. Dynamics-BusVoltage workbook

2. Dynamics-BusFrequency workbook

The bus voltage and bus frequency workbooks allow you to compare aggregated results across multiple extended channel output files and perform drilldown operations. Although the workbook supplied operates on area selection, this can be easily modified by the user to drill down by owners or zones. Working through the various dashboards in each workbook, you can locate specific buses for which the bus voltage and/or frequency is outside of a maximum and minimum value that you have specified and drill down further to analyze corresponding channel data in depth over the desired time period.

The workbooks can be easily extended once you become familiar with the interactive DVRM visualizer. The workbook templates supplied with PSS®E installation are by no means exhaustive and are only intended to give you an idea of what is possible and serve as an easy starting point for visual analysis. The entire workbook or any of the individual dashboards can also be saved to PDFs format for inclusion in reports.

3.4.1. Dynamics-BusVoltages and Dynamic BusFrequency workbook

This BusVoltage and BusFrequency workbook each consists of four dashboards that allow you to progressively drill down to more detailed data. The descriptions of the dashboards provided below apply to both BusVoltage workbook and BusFrequency workbook.

I.   Dashboard 1 shows the number of maximum and minimum voltage violations in each of the by selected extended channel output file.

II. Dashboard 2 shows the number of maximum and minimum voltage violations violations by Area.

III. Dashboard 3 shows the magnitude of maximum and minimum voltage at each bus.

IV. Dashboard 4 shows the plots or traces of bus voltage channels w.r.t time.

Warning: The Dashboards within the workbooks must be used in the order in which they are presented below. Starting the analysis at any arbitrary Dashboard could result in the display of meaningless data as the results displayed in a dashboard depend on filters selected in previous dashboards.

Dashboard 1: Violations by File Dashboard

The first dashboard in this workbook displays the number of bus voltage violations above the specified maximum voltage and below the specified minimum voltage value. A bus is in violation if its channel value goes above the maximum voltage for at least one time step. Similarly, a bus is included in the minimum violation count if its channel value goes below the minimum voltage at least once. In this dashboard, the user can specify the following:

• The time period during which the maximum and minimum voltage violation check is to be made.

• The per unit values of the maximum and minimum voltage values.

The time filter is a slider that allows the user to analyze data over the specified time periods. The various channel output files in this display are differentiated from one another via distinct customizable colors (refer to either the documentation or the Help Menu for details about customizing the colors). The bars are labeled

with the violation count. By hovering over any of the bars, tooltips are displayed that can be customized (refer to either the documentation or the Help Menu for details).
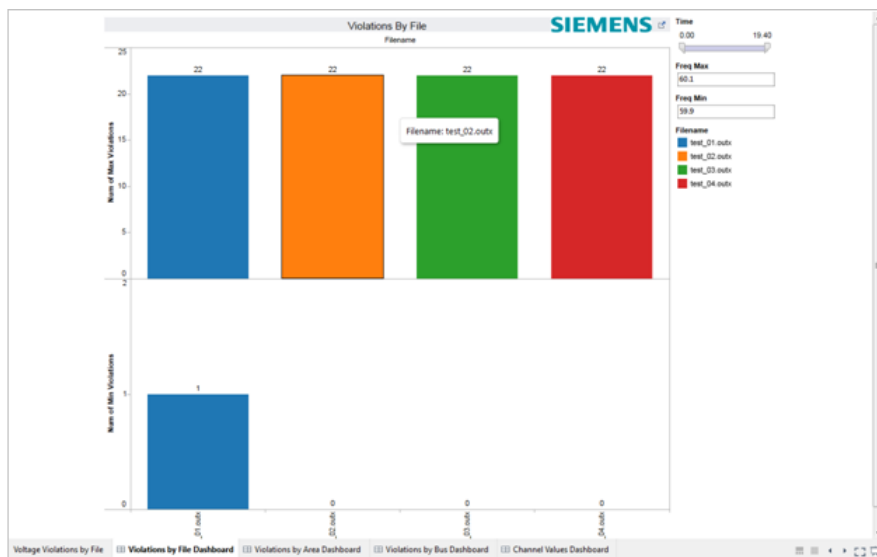
Figure 3.12. Violations by File Dashboard
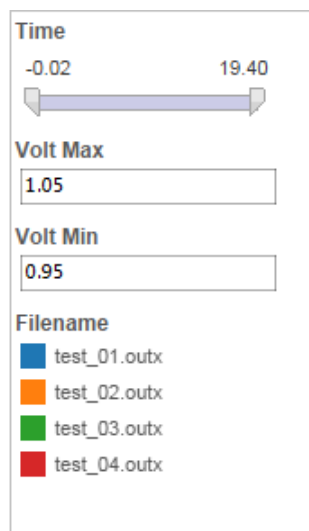
Figure 3.13. Filters and Legend for File Dashboard

Once you narrow down the files to be compared, they can be selected either via a rubber band dragging action, or by holding the Ctrl key and selecting the files and then choosing **ViewAreas filter** from the popup menu. This automatically open the next dashboard in the series that display area wise information on the number of violations for the selected areas and channel output files.

Dashboard 2: Violations by Area Dashboard

The second dashboard in this workbook is a bar chart similar to the first one, except that the information is now displayed by area for each of the files selected in the first dashboard.
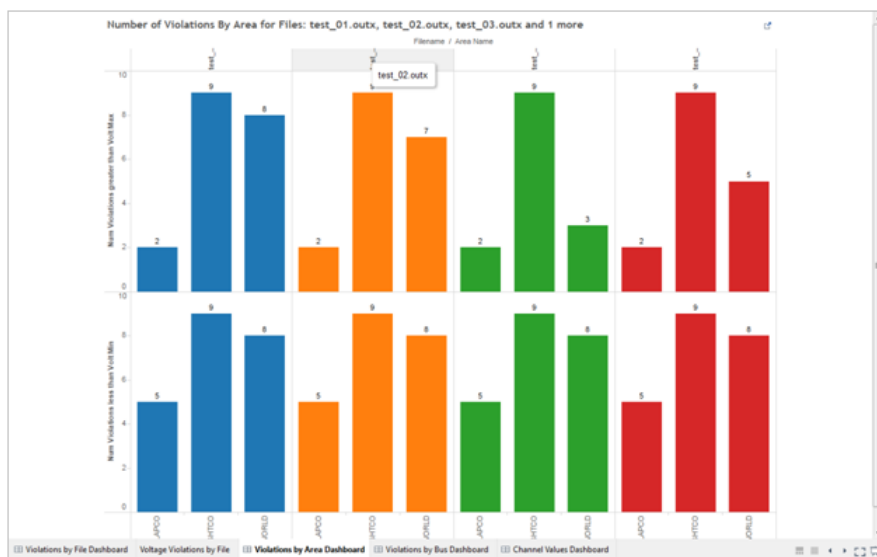
Figure 3.14. Dashboard 2: Violations by Area

By using a rubber band select action or via a filter as before, files and areas are chosen for inspection at a more granular level. If an individual file/area combination is desired, simply click on the bar that represents the desired combination. Color is used to differentiate files. The next dashboard will display bus level information for the files and areas selected here.

Dashboard 3: Violations by Bus Dashboard

This dashboard presents a bubble chart for each bus number within the selected area/file combination. The maximum and minimum voltage for each bus is displayed as a circle in relation to the voltage maximum and minimum that you have set (the maximum and minimum voltage values that was selected in Dashboard 1 is displayed as a red dotted line). The color of the line can be customized (refer to either the documentation or the Help Menu) To display tooltips with specific information about a data point, hover over the circle. The information in the tooltip can be customized (for details see documentation or go to Help Menu ◊ Open Help, or Press F1).

The desired buses are once again selected either by first rubber band dragging or using the CTRL key to select circles, and then clicking on the ViewChannels filter link in the tooltip. This action allows you to navigate to the last dashboard (Dashboard 4) in the workbook.
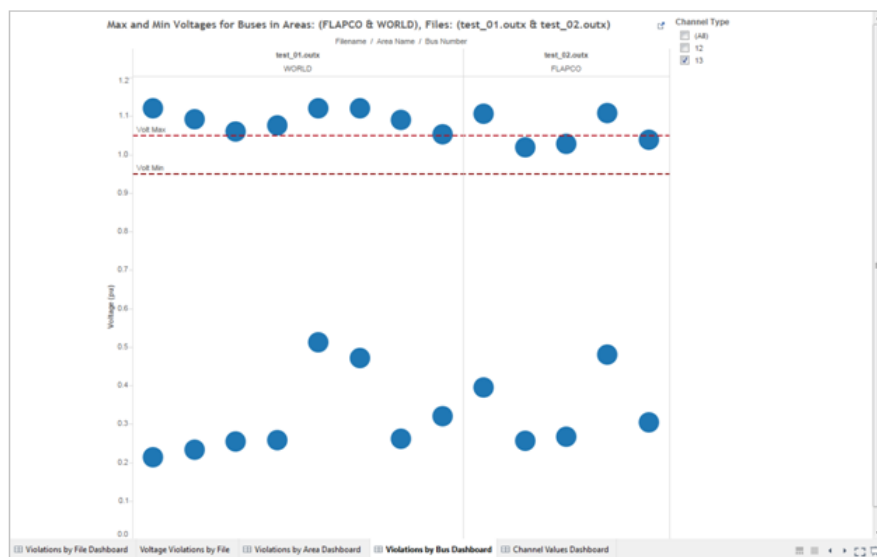
Figure 3.15. Dashboard 3: Violations by Bus Dashboard
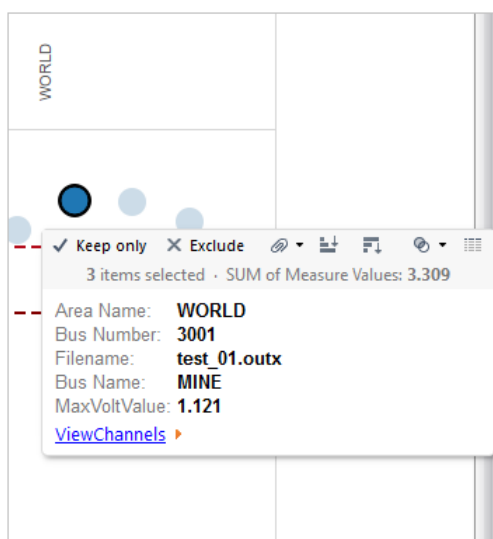
Figure 3.16. Dashboard 3: Navigating to the ViewChannels Filter

Dashboard 4: Channel Values Dashboard

This dashboard contains plots of voltages for one or more buses selected in Dashboard 3. In this dashboard, channel value curves for the selected buses are presented. By hovering over the channel values, more detailed information is available via tooltips that can be customized. (refer to either the documentation or the Help Menu). You can zoom in on certain sections of the data. To turn zoom on, use the context menu within the chart area and select **Show View ToolBar.** This displays a toolbox that can be used for zooming and panning operations.
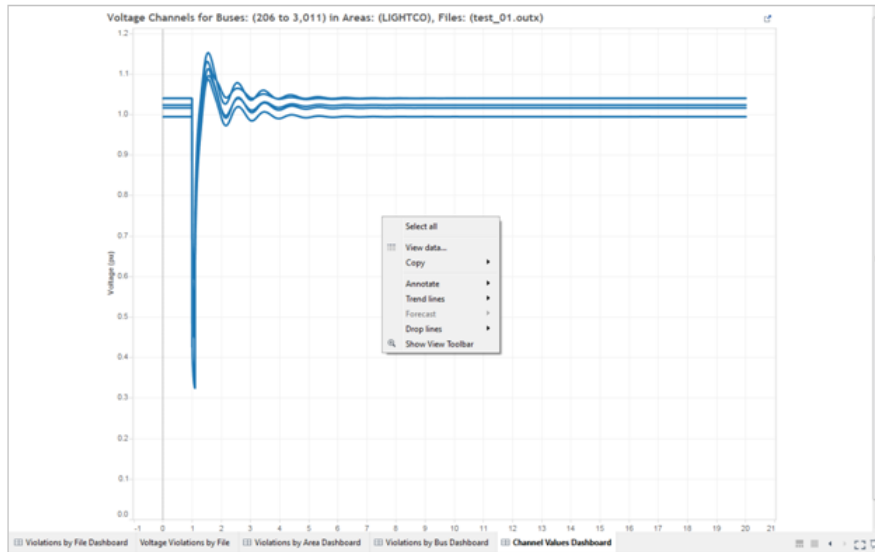
Figure 3.17. Dashboard 4: Channel Values Dashboard

3.4.2. Dynamics-BusFrequecies workbook

This workbook consists of four dashboards that allow you to progressively drill down to more detailed data. They follow the same progression as the voltage workbooks described in the previous section.

I.   Violations by File Dashboard

II.   Violations by Area Dashboard

III. Violations by Bus Dashboard

IV.   Channel Values Dashboard

Warning: The Dashboards within the workbooks must be used in the order in which they are presented below. Starting the analysis at any Dashboard could result in the display of meaningless data as the results displayed in a dashboard depend on filters selected in previous dashboards.

Violations by File Dashboard

The first dashboard in the series displays the number of bus violations above the specified maximum frequency and below the specified minimum frequency value. A bus is in violation if its channel value goes above the maximum frequency for at least one time step. Similarly, a bus is included in the minimum violation count if its channel value goes below the minimum frequency at least once. You can specify the time period over which he wishes to compare results as well the maximum and minimum frequency values. The time filter is a slider that allows the user to analyze data over different periods of time. Color is used to differentiate between files. You can modify these colors, refer to either the documentation or the Help Menu for more details.
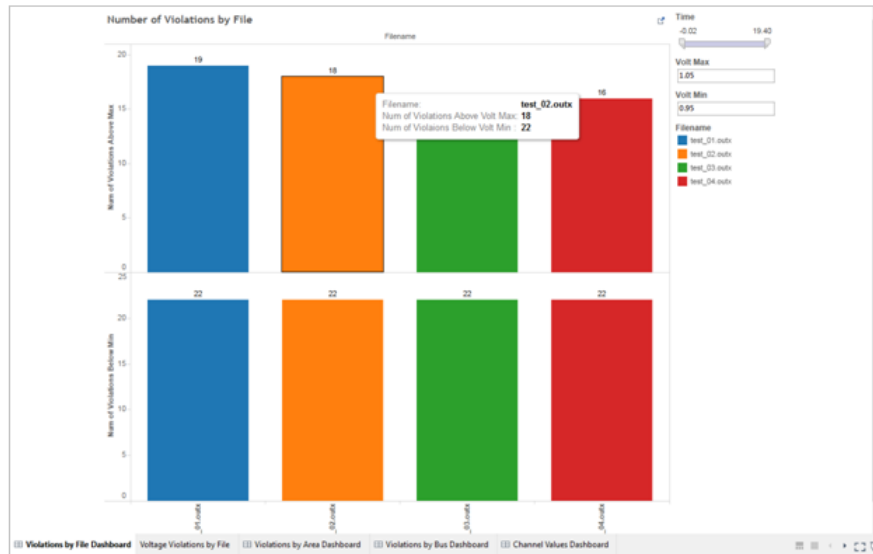
Figure 3.18. Violations by File Dashboard
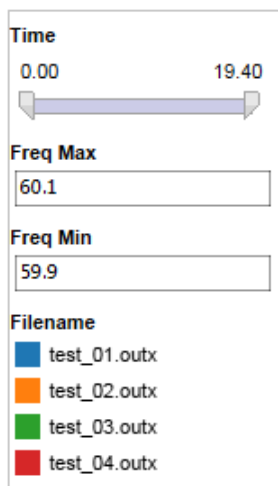
Figure 3.19. Filters and Legend for Files Dashboard

Once you narrow down the files to be compared further, you can select them using the rubber band dragging action. This automatically opens the next dashboard in the series that display areas wise information for the selected files.

Violations by Area Dashboard

The second dashboard in the series is a bar chart similar to the first one, except that the information is now displayed by area for each of the files selected in the first visual.

Figure 3.20. Violations by Area Dashboard

From this dashboard, you can narrow down the files and areas that you want to investigate further. By using a rubber band select action as before, files and areas are chosen for inspection at a more granular level. If an individual file/area combination is desired, simply click on the bar that represents the desired combination. Color is used to differentiate files. The next dashboard will display bus level information for the files and areas selected here.

Violations by Bus Dashboard

This dashboard presents a bubble chart for each bus number within the areas selected in the previous view. The maximum and minimum frequency for each bus is displayed in relation to the frequency maximum and minimum set by the user and displayed as a red dotted line. To display tooltips with specific information about a data point, hover over the circle. The information in the tooltip can be customized the users. Refer to either the documentation or the Help Menu.

The desired buses are once again selected by rubber band dragging. This action allows you to navigate to the last dashboard in the workbook.
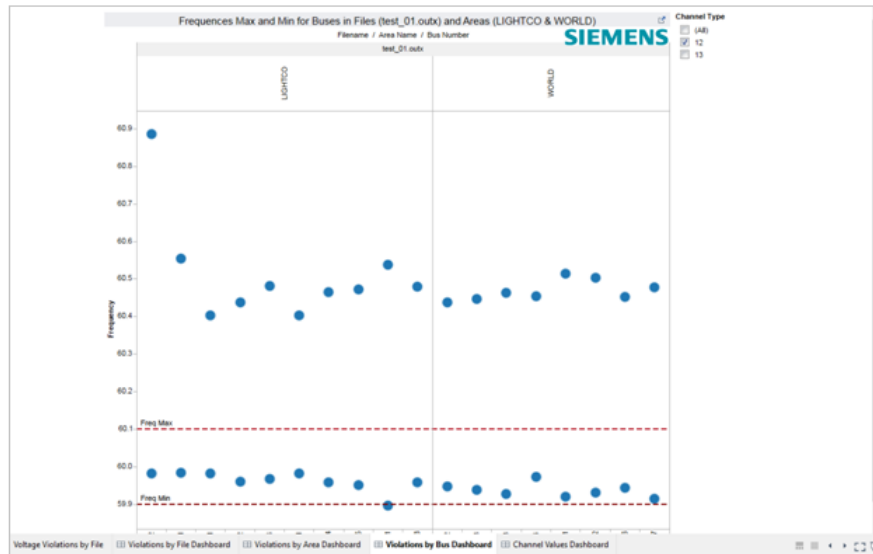
Figure 3.21. Violations by Bus

Channel Values Dashboard

In this dashboard, channel value curves for the selected buses are presented. By hovering over the channel values, more detailed information is available via tooltips that can be customized. Refer to either the documentation or the Help Menu. You can zoom in on certain sections of the data. To turn zoom on, right click within the chart area and select **Show View ToolBar**. This displays a toolbox that can be used for zooming and panning operations.
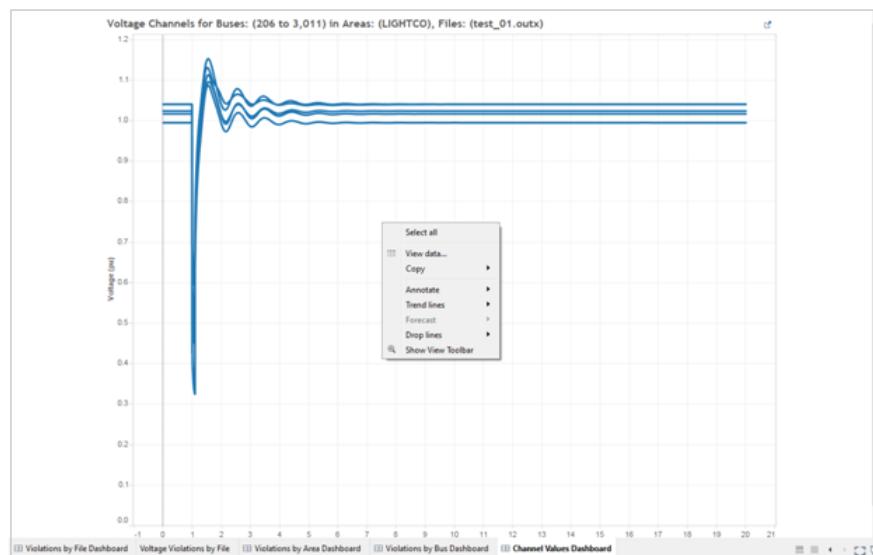
Figure 3.22. Channel Values Dashboard for Frequencies

Chapter 4
DVRM APIs

This chapter describes the API routines used in PSS®E DVRM. This allows DVRM to be easily integrated into your automation workflow. Rather than saving to a text file or Microsoft Excel spreadsheet, you can instead quickly modify your automation scripts to take advantage of the analysis features of DVRM.

Please note that these routines are members of the pssrdb Python extension module, not psspy.

These routines will be recorded when recording is enabled, and the Python recording will reference each of these functions within the pssrdb namespace.

4.1. DVRMCREATEACCDATABASE

Use this API to create a DVRM ACCC results database.

Batch command syntax:

```
BAT_DVRMCREATEACCDATABASE  NFILES  RFILES(1)...RFILES(NFILES) SQLSERV
SQLDBASE THRESHOLD
```

Python syntax:

```
ierr = dvrmcreateaccdatabase(nfiles, rfiles, sqlserv, sqldbase, threshold)
```

Fortran syntax:

```
CALL DVRMCREATEACCDATABASE(NFILES, RFILES, SQLSERV, SQLDBASE, THRESHOLD, IERR)
```

where:

Integer NFILES	Is the number of .ACC result files to be processed (input; no default allowed).
Character RFILES (NFILES)*260	Is an array of NFILES names of .ACC result files (input; no defaults allowed).
Character SQLSERV*260	Is the name of the SQL Server to create the database in (input, no default allowed).
Character SQLDBASE*260	Is the name of the SQL database to create the database on the SQL Server identified in SQLSERV (input, no default allowed).
Integer THRESHOLD	Is the threshold value used to filter out overloads in the ACCC results database. Any elements overloaded by less than this value will not be added to the ACCC results database. (input, 90 by default)
Integer IERR	Is the error code (output).

IERR = 0 no error occurred.
IERR = 1 no RFILES specified.
IERR = 2 no SQL Server specified.
IERR = 3 no SQL database specified.
IERR = 4 error creating the SQL database.

4.2. DVRMCREATEDYNDATABASE

Use this API to create a DVRM Dynamic results database.

Batch command syntax:

```
BAT_DVRMCREATEDYNDATABASE  NFILES  RFILES(1)...RFILES(NFILES) SQLSERV
SQLDBASE THRESHOLD
```

Python syntax:

```
ierr = dvrmcreatedyndatabase(nfiles, rfiles, sqlserv, sqldbase, threshold)
```

Fortran syntax:

```
CALL DVRMCREATEDYNDATABASE(NFILES, RFILES, SQLSERV, SQLDBASE, THRESHOLD, IERR)
```

where:

Integer NFILES	Is the number of .OUTX result files to be processed (input; no default allowed).
Character RFILES (NFILES)*260	Is an array of NFILES names of .OUTX result files (input; no defaults allowed).
Character SQLSERV*260	Is the name of the SQL Server to create the database in (input, no default allowed).
Character SQLDBASE*260	Is the name of the SQL database to create the database on the SQL Server identified in SQLSERV (input, no default allowed).
Integer THRESHOLD	Not currently used (input).
Integer IERR	Is the error code (output).

    IERR = 0   No error occurred.
    IERR = 1   no RFILES specified.
    IERR = 2   no SQL Server specified.
    IERR = 3   no SQL database specified.
    IERR = 4   error creating the SQL database.

4.3. DVRMATTACHANDLAUNCHWORKBOOK

Use this API to create an ACCC or Dynamics visualization workbook and launch the data visualizer.

Batch command syntax:

```
BAT_DVRMATTACHANDLAUNCHWORKBOOK  SQLSERV  SQLDBASE  DVRMTMPWRKBK  SQLSCRIPT
DVRMWRKBK sATCHWRKBK  LAUNCHDVRM
```

Python syntax:

```
ierr = dvrmDVRMattachandlaunchworkbook (sqlserv, sqldbase, DVRMtmpwrkbk,
sqlscript, DVRMwrkbk ,atchwrkbk, launchDVRM)
```

Fortran syntax:

```
CALL DVRMATTACHANDLAUNCHWORKBOOK (SQLSERV, SQLDBASE, DVRMTMPWRKBK,
SQLSCRIPT, DVRMWRKBK, ATCHWRKBK, LAUNCHDVRM, IERR)
```

where:

Character SQLSERV*260	Is the name of the SQL Server to create the database in (input, no default allowed).
Character SQLDBASE*260	Is the name of the SQL database to create the database on the SQL Server identified in SQLSERV (input, no default allowed).
Character DVRMTMPWRKBK *260	Is the name of the DVRM Template Workbook to attach to the SQL Server and Database.
Character SQLSCRIPT *260	Is the name of the SQL script to be run against the SQL Database. This script is usually used to optimize the performance of the da-ta-base with the DVRM Workbook.
Character DVRMWRKBK *260	Is the name of the DVRM Workbook to use to launch the DVRM Visualizer. This workbook has been modified to attach to a data source.
Integer ATCHWRKBK	Is a flag used to indicate whether the DVRM Template Workbook identified by DVRMTMPWRKBK is to be "attached" to the identified SQL Server and Database (input, 0 by default). ATCHWRKBK= 0 do not create an "attached" DVRM Workbook. ATCHWRKBK= 1 create an "attached" DVRM Workbook from the DVRM Template Workbook.
Integer LAUNCHDVRM	Is a flag used to indicate "launch" the DVRM Visualizer with the "at-tached" DVRM Workbook identified by DVRMWRKBK (input, 0 by de-fault). LAUNCHDVRM = 0 do not launch the DVRM visualizer. LAUNCHDVRM = 1 launch the DVRM visualizer.
Integer IERR	Is the error code (output). IERR = 0 No error occurred. IERR = 1 No SQL Server specified. IERR = 2 No SQL database specified.

IERR = 3   No Template workbook specified.
IERR = 4   No attached workbook specified.