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SAS[®] Energy Distribution Optimization 5.1

User's Guide

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SAS® Energy Distribution Optimization 5.1: User's Guide

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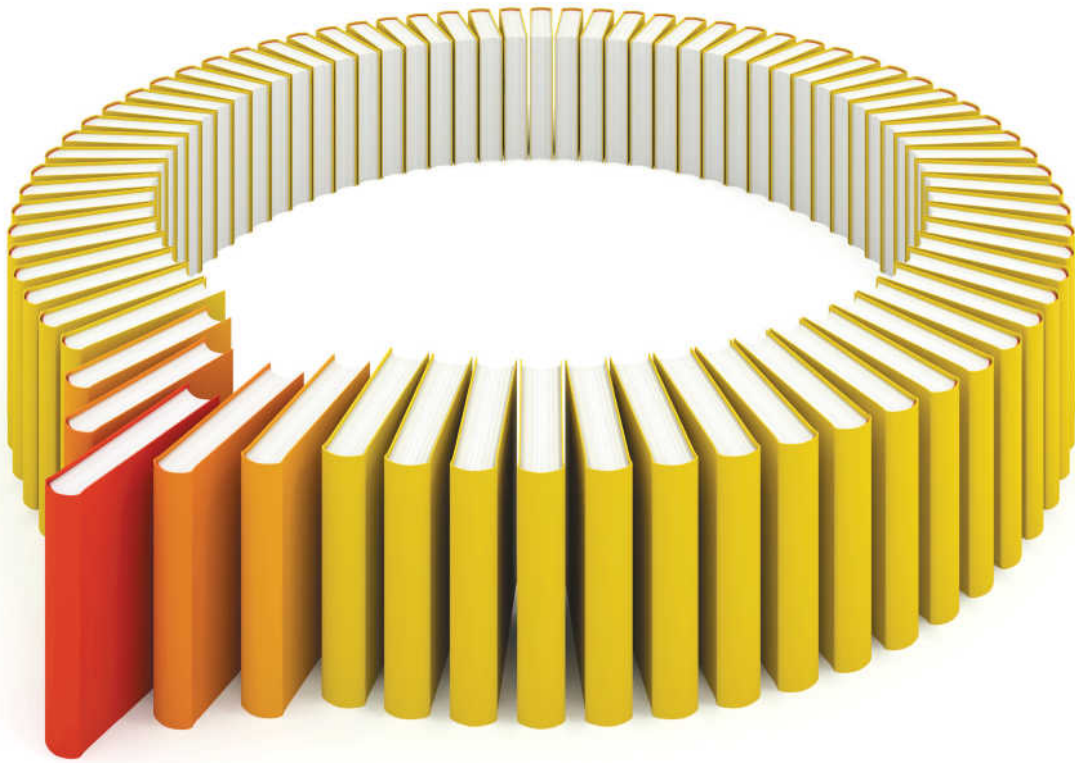
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Using This Book

Audience

SAS Energy Distribution Optimization is designed for the following users:

- Grid Engineers responsible for creating and scheduling runs for optimization.
- Operators responsible for viewing and implementing the optimized plans.
- Report Viewers or Managers responsible for viewing and analyzing the forecasted results.
- Administrators responsible for data management and application environment setup.

This document explains the tasks that you can perform by using the SAS Energy Distribution Optimization user interface, as per the assigned user roles. These roles determine the tabs and type of records that are visible within the user interface. For more information about working with users and groups, see *SAS Energy Distribution Optimization: Administrator's Guide*.

Prerequisites

Here are the prerequisites for using SAS Energy Distribution Optimization:

- A user ID and password for logging on.
- A supported browser installed on your desktop.

If you have any questions whether you are ready to use SAS Energy Distribution Optimization, contact your system administrator.

Accessibility

Accessibility Notice

For more information about the accessibility of this product, see [Accessibility Features of SAS Energy Distribution Optimization at support.sas.com](#).

Recommended Reading

SAS Energy Distribution Optimization is supported by the following documents:

- *SAS Energy Distribution Optimization: Administrator's Guide*
- *SAS/OR 13.1 User's Guide: Mathematical Programming*

For a complete list of SAS books, go to support.sas.com/bookstore. If you have questions about which titles you need, please contact a SAS Book Sales Representative:

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Introduction to SAS Energy Distribution Optimization

<i>What Is SAS Energy Distribution Optimization?</i>	1
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What Is SAS Energy Distribution Optimization?

SAS Energy Distribution Optimization enables electric distribution companies to optimize the performance of their electric distribution networks through advanced analytical methods such as loss minimization and conservation voltage reduction (CVR). It uses the smart grid technology to collect data from passive or active devices located in substations and along distribution feeders to forecast network performance. This data provides recommendations for the optimal switching of devices such as voltage regulators, transformer load tap changers, static volt-ampere reactive (VAR) compensators, capacitors, and synchronous condensers or generators. The optimal device settings reduce transmission and distribution losses, minimize electricity consumption, improve voltage profiles, conserve energy, and manage peak load through voltage reduction.

The optimization results help operators, engineers, and managers of the electric distribution companies to minimize network operating costs and reduce demand without

violating regulatory or industry limits for consumers. It minimizes the cost of energy and facilitates the introduction of new technologies, such as wind power, solar power, storage and micro-generation technologies.

Features Of SAS Energy Distribution Optimization

SAS Energy Distribution Optimization is designed for the operations sector of the electric utilities industry and for operators of institutional electric distribution systems.

Following are the key features of SAS Energy Distribution Optimization:

- Uses energy forecasts to develop an hourly load curve for each utility network that is applied to individual network loads. SAS Energy Distribution Optimization also contains features to modify the existing settings of the electric load based on the current environmental factors affecting the electric demand of the utility.
- Recommends the accurate tap settings for voltage regulators that are located in the substations and along distribution feeders to regulate the power flow. The recommended settings can minimize losses and increase the electricity savings of the substation.
- Recommends the optimal voltage levels required for each device to operate the distribution system and minimize the electricity demand. The suggested voltage levels help to reduce electricity consumption and to minimize the need of rolling blackouts during critical peak periods.
- Provides reactive power support for the transmission and distribution bus and increases efficiency by reducing system loss caused by reactive power.
- Displays automated reports of the optimization results using interactive graphs in the dashboard.

How Does SAS Energy Distribution Optimization Work?

SAS Energy Distribution Optimization uses heuristic algorithms to determine the optimal solution for optimizing the voltage and VAR requirements on the electric distribution networks. You can optimize the operations of a distribution network by managing the voltage and capacitance levels. The CVR methodology helps reduce the real and reactive power while loss minimization helps to achieve the lowest level of losses without violating any voltage constraints.

In CVR mode, the energy supplied by the source bus is reduced by lowering the demand of the network. To reduce the demand of the network, voltage regulators are adjusted to their lowest tap settings and capacitor banks are set to either on or off so that the lowest network voltage is achieved without violating regulatory limits. The algorithm searches through each regulator and capacitor, varying their settings until the optimal solution is found.

In loss minimization mode, losses are minimized by adjusting the voltage and capacitance of the distribution network to achieve the highest possible voltage level, without violating regulatory limits. The algorithm first calculates the voltage regulator tap setting needed to achieve a voltage level of 1.05 per unit and runs the initial load flow. It then adjusts the capacitor and regulator tap settings until the optimal loss level is achieved. The premise of the loss minimization algorithm is that the bulk of the network load is constant power and raising the voltage reduces the current, thereby lowering losses. The impact that voltage has on losses is greatly influenced by the zero-inflated poisson (ZIP) model used in representing customer load.

2

Managing Access to SAS Energy Distribution Optimization

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Roles and Capabilities

Depending on the user roles, SAS Energy Distribution Optimization users have a defined set of tasks that they are authorized to perform for the user group to which they belong. Roles are mapped to capabilities that define the operations a user can perform. SAS Energy Distribution Optimization supports the following user groups:

- Grid Engineers, who have complete control over the user interface (UI) to create and manage runs for optimization.
- Operators, who can analyze and implement the suggested optimized results.
- Report Viewers or Managers, who can view and analyze the suggested optimized results.

- Administrators, who are responsible for data management and application environment setup. Administrators also define new user roles to access the application and specify the capabilities to perform.

The following table provides information about the capabilities for the user roles that are defined in SAS Energy Distribution Optimization. The four columns on the right indicate the type of access authorization that is required for performing the tasks that are listed on the left.

Table 2.1 *User Roles and Capabilities*

Capabilities	Grid Engineer	Operator	Report Viewer or Manager	Administrator
Create LookAhead Run	Yes	No	No	No
Delete LookAhead Run	No	No	No	Yes
Schedule LookAhead Run	Yes	No	No	No
View LookAhead Run Results	Yes	No	No	No
Modify Operations Plan	Yes	No	No	No
Publish Operations Plan	Yes	No	No	No
Implement Operations Plan	No	Yes	No	No
Create Optimization Reports	No	No	Yes	No
View Optimization Reports	No	No	Yes	No

Capabilities	Grid Engineer	Operator	Report Viewer or Manager	Administrator
Delete Optimization Reports	No	No	No	Yes

Log On to SAS Energy Distribution Optimization

Administrators register the necessary users in the metadata server and group the users based on their privileges. You can use the SAS Energy Distribution Optimization interface only if you have appropriate access permissions.

To access the SAS Energy Distribution Optimization log on window, paste the address that your administrator has provided in your web browser. For example, you might enter `http://server123.domain.com:9080/SASEnergyDistributionOptimization/` or a similar address.

To log on, enter your user ID and password, and click **Log On**. The main application window of SAS Energy Distribution Optimization appears.

Note: Your password is case-sensitive. Your user ID might be case-sensitive, depending on the operating system that is used to host the web application server. If you need assistance, contact your system administrator.

Log Off from SAS Energy Distribution Optimization

To log off from SAS Energy Distribution Optimization, on the application bar, click **Log Off**.

If you lose your connection to SAS Energy Distribution Optimization (for example, your session times out), you must begin again at the point where you last saved your work.

By default, if there is no activity for 25 minutes, SAS Energy Distribution Optimization prompts you to either continue the session or log off from the application. If you do not select either of the options within a certain time (the default is 5 minutes), SAS Energy Distribution Optimization directs you to a window displaying the **Return to Application** button that enables you to access the application without logging on again. Further, if there is no activity for the next 12 hours, SAS Energy Distribution Optimization automatically logs you off and displays the Log On window.


Your system administrator can change the inactivity period and the countdown period. As a best practice, save your work frequently.

Log On to SAS Energy Distribution Optimization from the SAS Visual Analytics Hub

You can connect to SAS Energy Distribution Optimization from the SAS Visual Analytics Hub if the SAS Visual Analytics server (SaSserver12) is active.

To access the SAS Visual Analytics Hub log on window, paste the address that your administrator has provided in your web browser. For example, you might enter `http://server.host.com/SASVisualAnalyticsHub/` or a similar address.

- 1 Enter your user ID and password, and click **Log On**. The main page appears.
- 2 From the Common Actions section, select **Open EDO Workspace**. The main application window of SAS Energy Distribution Optimization appears.

Alternatively, you can select the workspace from the  or the **More Actions** list.

3

Overview of the SAS Energy Distribution Optimization Interface

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SAS Energy Distribution Optimization User Interface

The SAS Energy Distribution Optimization interface helps you optimize the electric substation banks and distribution feeders using loss minimization and conservation voltage reduction (CVR) methods. It also helps you generate reports to analyze the performance of the substation banks.

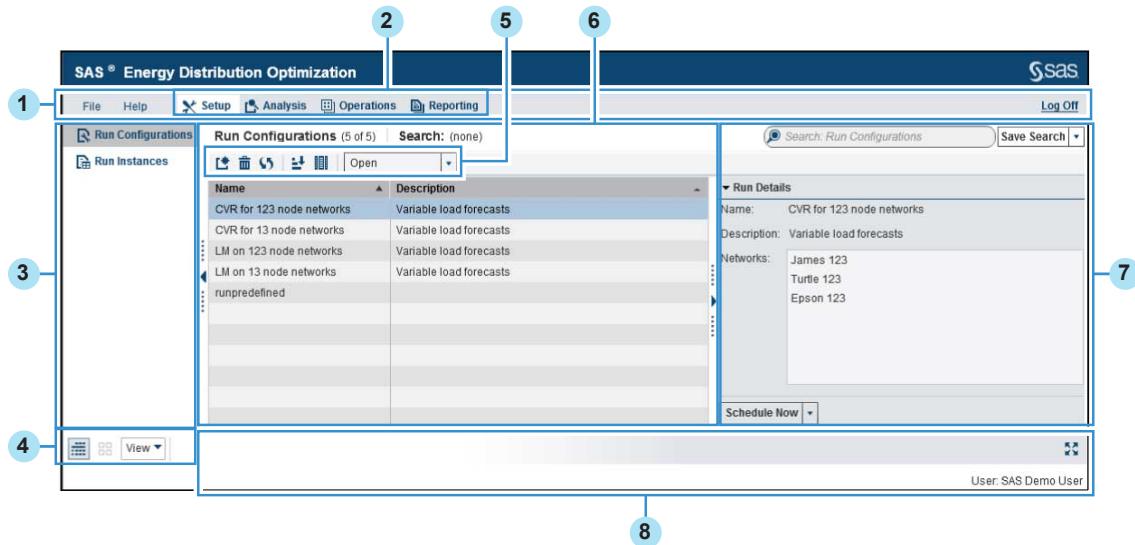
Note: This user's guide discusses tasks that you might not be able to perform, depending on your user role. For more information about the different user roles and capabilities in SAS Energy Distribution Optimization, see [“Roles and Capabilities” on page 5](#).

Components of the User Interface

The SAS Energy Distribution Optimization user interface (UI) is divided into various parts that enable you to manage your data selections.

The following image shows the SAS Energy Distribution Optimization UI and its primary components.

Figure 3.1 SAS Energy Distribution Optimization User Interface



1 Application Bar

The application bar is located at the top of the application window. The application bar contains the **File** menu, the **Help** menu, the workspace buttons, and the **Log Off** option.

2 Workspace Bar

The workspace bar consists of the **Setup**, **Analysis**, **Operations**, and **Reporting** workspace buttons.

3 Categories Pane


The categories pane contains the category view buttons that switch between two categories of the workspace.

4 Tile Pane

The tile pane contains the summary of items that are open in the current workspace. It manages the layout within a workspace. When you open an item, you can add it to the tile pane as a minimized item or open it and work with it in the layout. A *layout* is

simply a collection of one or more open items in a specific order or arrangement in the tile pane.


Click  to close the item's tile.

Click  to return to the previously displayed category pane.

Click  to display the most recently viewed detail tile.

Click **View** and select **Close All** to close all open items.

Click **View** and select **Show All** to open the tiles for all of the minimized items in the tile pane.

Click  at the far right of the tile pane to maximize the display of the currently opened objects.

5 Toolbar

All views contain a toolbar. The toolbar contains icons that you can use to perform frequent tasks.

6 Object Navigator

The object navigator displays a list of objects that are defined for the type of object that you have selected in the category pane.

7 Details Pane

The details pane contains the descriptions of the optimization attributes.

8 Status Bar

The status bar displays the name of the user and other status messages.

Time Zones

You can access the UI of SAS Energy Distribution Optimization by using a browser. The optimization date and time that you see on the UI is the time zone of the browser. If the

server and the browser are located in different time zones, the data is converted to the browser's locale and is displayed based on the browser's time zone.

Note: The optimization result reports are generated based on the server's time zone.


Interface Help

Help Menu

The **Help** menu is located on the application bar. Use the **Help** menu to access the following information about SAS Energy Distribution Optimization:

- **SAS on the Web:** Provides links to SAS Customer Support, SAS Training, and the SAS home page.
- **About SAS Energy Distribution Optimization:** Displays the version number, copyright details, and other information about SAS Energy Distribution Optimization.
- **User's Guide:** Opens the PDF file of the *SAS Energy Distribution Optimization: User's Guide* in a new window.
- **How To:** Provides links to the Help topics identified for the currently used page.

Embedded User Assistance

Embedded User Assistance is a help component that displays detailed information about corresponding field or interface elements. Click  to view the information.

Search Items


Search Text

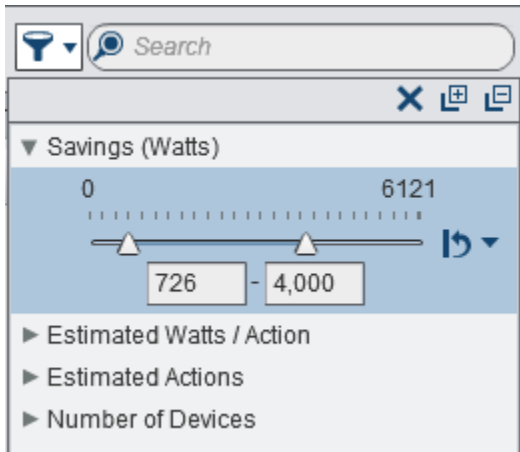
The **Search** field enables you to search the name of plans and optimization results listed in the workspace.

Save Search Item

The **Save Search** option enables you to save the search items for future reference. When you click **Save Search**, the Save Search window appears and details of the search criteria are saved. To view or delete the saved search criteria, select **Save Search ► Manage Saved Searches**.

Additional Search Options

In the Analysis workspace, you can filter banks that are in a specific optimization range by selecting the  icon next to the **Search** field. Enter the values by using the slider scale or by entering the specific values in the appropriate slider box. For example, if you want to view substation banks whose electricity savings are between 726 watts and 4,000 watts, then select that range from the **Savings (Watts)** field. The substation banks with electricity savings in that range are displayed.

Display 3.1 Search Filter

Setting Preferences

Preferences provide a way for you to customize the user interface. Preferences for each user are stored in metadata and retained if your deployment is migrated or reconfigured. To open the Preferences window, select **File** ► **Preferences**. There are two general categories of preferences: global preferences and SAS Energy Distribution Optimization preferences. The SAS Energy Distribution Optimization preferences contain both general and advanced run configuration options.

Set Global Preferences

Global preferences apply to all SAS web applications that are displayed with the Adobe Flash Player. When you set a global preference, it applies only to the user that you are logged on as.

To set global preferences, select **Global Preferences**. The following global preferences are available:

User locale

specifies the geographic region whose language and conventions are used in the applications. This setting might also apply to some SAS web applications that are

not displayed with the Adobe Flash Player. Locale changes take effect after you log off and log back on.

Theme

specifies the collection of colors, graphics, and fonts that appear in the applications. The theme that is set as the default theme is displayed in parentheses. Your site administrator can change the default theme. A theme change might take a few seconds to apply if many items and features are open in the application.

Invert application colors

inverts all of the colors in the application window, including both text and graphical elements. You can also temporarily invert or revert the colors for an individual application session by pressing Ctrl+~.

Override settings for focus indicator

controls the appearance of the highlighting that surrounds the currently selected field in the SAS Energy Distribution Optimization interface.

Reset

controls the display of warning and confirmation messages.

Note: Whenever necessary, click **Reset to Defaults** to restore the original default settings and values.

SAS Energy Distribution Optimization General Preferences

SAS Energy Distribution Optimization general preferences apply to SAS Energy Distribution Optimization only.

Open application using this workspace

controls which workspace is displayed by default when you log on to SAS Energy Distribution Optimization.

Workspace bar

controls whether the toolbar for the workspace displays icons, text labels, or both.

Advanced Run Configuration Options

Note: Knowledge of SAS/OR and the load flow model is required to edit the advanced run configuration options. These options are important for the stability of the SAS Energy Distribution Optimization application. It is recommended that you contact SAS Technical Support before editing these options.

Use the advanced run configuration options to edit the predefined configuration settings of the runs. These settings will be applied to all the run configurations when they are created. You can choose to edit the configuration settings for a particular run by selecting the **Show Advance Options for Run Configuration** check box. The **Advanced Options** tab in the Create Configuration window or in the edit window of the run is activated.

The advanced run configuration options are referenced from the SAS/OR nonlinear programming (NLP) solver. For more information about the NLP solver, see the *SAS/OR® 13.1 User's Guide: Mathematical Programming*, which is located at <http://support.sas.com/documentation/cdl/en/ormpug/66851/PDF/default/ormpug.pdf>.

The advanced run configuration options includes the following fields. These fields are activated when you select the **Override Defaults** check box.

Algorithm

indicates the algorithm that is used to solve the problem. It consist of the following values:

- **Interior Point:** The interior point algorithm to produce the solution data.
- **Active Set:** The active set algorithm to produce the solution data.
- **Concurrent:** The concurrent algorithm to run algorithms concurrently.

Local solver

specifies the maximum number of iterations. The value can be any integer between 1 and the largest 4-byte signed integer ($2^{31}-1$). The default value is 100.

Multiple-Start

defines the maximum number of starting points to be used for local optimization. That is, there are less than N local optimization calls in the multistart algorithm. You

can specify N to be any nonnegative integer. When $N = 0$, the algorithm uses the default value of this option. In a shared memory computing environment, the default value is 20. In a distributed computing environment, the default value is a number proportional to the number of threads across all the grid nodes.

Optimization tolerance

specifies the optimality tolerance in $[1\text{E}-9, 1\text{E}-4]$ for declaring the optimality. The default value is $1\text{E}-6$.

Optimization feasibility tolerance

specifies the feasibility tolerance in $[1\text{E}-9, 1\text{E}-4]$ for determining the optimization feasibility of a variable value. The default value is $1\text{E}-6$.

Load flow tolerance

specifies the load flow tolerance in $[1\text{E}-9, 1\text{E}-4]$ for declaring the load flow. The default value is $1\text{E}-9$.

Load flow feasibility tolerance

specifies the feasibility tolerance in $[1\text{E}-9, 1\text{E}-4]$ for determining the load flow feasibility of a variable value. The default value is $1\text{E}-6$.

These settings are applied to all the run configurations that are created.

4

Setting Up an Optimization Run

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About Run Configurations

A *run configuration* forecasts the performance of a network and its substation banks. The forecast results help the grid engineers and operators initiate actions for optimizing the transformer banks and distribution feeder devices in real time. These actions enable the utility to minimize distribution losses, compensate the reactive power in the system, maintain voltage, and reduce the demand during peak load periods.

A run configuration consists of the network list of substation banks that need to be optimized, the type of optimization method, the forecast criteria, and the optimization schedule for the run. You can create a run configuration in the Setup workspace. For more information, see [“Create a Run” on page 25](#).

Display 4.1 Create Run Configuration

Create Configuration

Name: * Reedy Creek

Description: Savings under Reedy Creek

Select networks: *

Optimization type: Loss minimization

Forecast settings:

Search

Test

VARIABLE

Group 1

James 123

James 123 Bank #1

Reedy Creek 13

Reedy Creek 13 Bank #1

SAS Bank 13

SAS 13 Bank #1

SAS 13 Bank #2

Group 2

Cary East 13

Cary East 13 Bank #1

Cary West 13

Standard Options

Advanced Options

Percent load modification: 5

Start date offset: 3

Start time: 08:00 AM

End time: 02:00 PM

OK

Schedule Now

Cancel

Types of Optimization

SAS Energy Distribution Optimization uses the loss minimization and conservation voltage reduction (CVR) optimization methods. You can select these methods while creating a run configuration.

- The loss minimization method helps to minimize the distribution loss of electricity between the time the electricity is generated in the utility-generating station and the time it first reaches consumers. The results of the optimization display the optimal

device settings to reduce transmission and distribution losses, and they suggest the corrective actions required for the devices in the utility. For example, the results can indicate an action to turn a capacitor bank device on or off or to display the optimal tap settings required to regulate the load flow for voltage regulators and transformers.

- The CVR optimization method helps achieve demand reduction using voltage reduction, without violating regulatory or industry limits for consumers when the demand for electricity is high. The optimization results suggest the optimal device settings for capacitors and regulators to minimize the electricity demand. For example, the results can indicate the optimal voltage levels required on regulators to reduce the demand for energy, thus enabling significant savings.

Forecast Criteria for Optimization

The forecasting feature in SAS Energy Distribution Optimization enables you to set the date and time to start the forecasting while creating a run configuration in the Setup workspace.

This feature also enables you to change the forecasted electric load percentage based on the current electric demand in the utility. The values for the base load forecast are provided by the utility in the form of an hourly load curve and the expected future peak load. This information is based on the historical performance of the utility. Due to various factors, there can be changes to the current load settings of the utility. For example, if extremely hot or cold weather is expected over the next several days, the electricity load requirement would vary. You can either increase or decrease the forecast percentage for the electric load, depending on the expected electric demand of the utility.






About the Setup Workspace

The Setup Workspace

The Setup workspace enables you to create a run configuration and set an optimization schedule for the run. It consists of the Run Configurations and Run Instances categories, toolbar options, and the Run Details pane.

Here are the toolbar options that are available in the Setup workspace:

Table 4.1 *Toolbar Icons*

Toolbar Icons	Action	Description
	Create a configuration	Creates a run configuration for optimization. For more information, see “Create a Run” on page 25 .
	Delete	Deletes the run configuration that is selected in the category list.
	Refresh	Updates the category view with the latest data.
	Sort	Sorts the rows in the category according to the values of the columns.
	Manage Columns	Selects the columns to be displayed in the category and customizes the view.

View the Optimization Runs

The Run Configurations category displays the list of runs created for optimization. You can create, edit, delete, and schedule these run configurations for optimization.

View the Scheduled Run Instances

The Run Instances category displays the status of the runs that are scheduled for optimization. The runs are grouped in a hierarchy based on the optimization schedule. The main folder contains the runs for all time periods. Expand this folder to view the scheduling status of each substation bank in the run. The subfolder contain runs that are scheduled at the same date and time.

Display 4.2 Run Instances Category

File Help Setup Analysis Operations Reporting				
Run Configurations Run Instances				
Run Instances (20 of 20) Search: (none)				
<div> <input type="text" value="Open"/> </div>				
Name	Description	Status	Optimization Type	Run Details
▶ CVR for 13 node networks	Variable load forecasts	🟢	CVR	Name: CVR for 13 node networks Description: Variable load forecasts Identifier Group ID: 3 Start date: Thursday, March 20, 2014 Start time: 06:30 PM End date: Thursday, March 20, 2014 End time: 07:33 PM Status: Completed Type: CVR Start time: 08:30 PM End time: 02:30 AM Percent load modification: 0 Start date offset: 1 <div>Cancel</div>
▶ CVR for 123 node networks	Variable load forecasts	🟢	CVR	
▶ LM on 13 node networks	Variable load forecasts	🟢	Loss minimization	
▶ LM on 123 node networks	Variable load forecasts	🟢	Loss minimization	

Here are the details of the scheduled list of runs:

- **Name** of the run. Expand the run folder to view the status of each instance when the run was scheduled.
- **Description** of the run.
- **Status** of the run that is scheduled for optimization. The different statuses are:
 - 🟢 indicates that the run is being scheduled for optimization.

- ✔ indicates that the optimization is complete. The optimized results of the successful runs are displayed in the Analysis workspace.
- ✘ indicates that the run is not scheduled for optimization and the results will not be displayed. You can right-click the run instance to view the error log for that run.
- ⊖ indicates that some of the substation banks in the run are not scheduled for optimization. The results of the failed banks are not displayed.
- ⛔ indicates that the scheduling process of the optimization was canceled by the grid engineer.
- 🔄 indicates that the run is scheduled for a recurring or future date and time.
- **Optimization Type** indicates the type of optimization method selected while creating the run configuration—loss minimization or CVR.

View Run Details

The Run Details pane displays the additional properties for the selected run. Some of the properties listed in this pane are the same as those in the Run Instances category. For more information, see [“View the Scheduled Run Instances” on page 23](#). Here are the properties that are also available in the Run Details pane:

- **Identifier Group ID** indicates the internal IDs of the data associated with each optimized run.
- **Start date** and **Start time** indicate the date and time at which the optimization schedule started.
- **End date** and **End time** indicate the date and time at which the optimization schedule stopped.
- **Start date offset** indicates the start date for the forecast.
- **Percent load modification** indicates the modified percentage value of the forecast electric load.
- **Forecast Start time** and **Forecast End time** indicate the start and end times for the forecast.



You can click **Cancel** to stop the scheduling process of the optimization.

Working with the Setup Workspace

Create a Run

A run enables you to define the criteria for optimization.

To create a run:

- 1 In the Run Configurations category, click . The Create Configuration window appears.
- 2 Enter a unique name for the run in the **Name** field. The name of a run is limited to 50 characters and cannot contain the ! % ^ . & = \ / | ' ; > and < characters.
- 3 Enter the description in the **Description** field. The description size is limited to 255 characters and cannot contain the ! % ^ . & = \ / | ' ; > and < characters.
- 4 Expand the **Select networks** list, and select the required networks and substation banks. You can also use the  box to filter the network list.

A check mark appears next to the selected substation banks.

- 5 From the **Optimization type** list, select the optimization method for the run:
 - Select **Loss Minimization** to view the optimal device settings for minimizing the electricity distribution loss between the utility and consumers.
 - Select **CVR** to view the optimal voltage levels of the utilities for minimizing the electricity demand.

For more information, see [“Types of Optimization” on page 20](#).

- 6 In the Forecast settings section,
 - Click **Standard Options** to specify the following forecast criteria for the run:
 - **Percent load modification** indicates the percentage value to modify the forecast electric load based on the current electric demand in the utility.

Note: The percentage value should be between -50 and 50.

- **Start date offset** indicates the number of days to set the forecast start date after the run is scheduled. For example, a value of 0 indicates that the run is forecasted on the scheduled date while a value of 1 indicates that the run is forecasted a day after the scheduled date.

Note: The value should be between -180 and 180 days.

- **Start time** and **End time** indicate the start and end times for forecasting the optimization.
- Click **Advanced Options** to edit the predefined configuration settings of the run. A confirmation message is displayed. For more information, see “[Advanced Run Configuration Options](#)” on page 17.

Note: The **Advanced Options** tab is displayed only if the **Show Advance Options for Run Configuration** check box is selected in the **Preferences ► Advanced Run Configuration Options** section.

- 7 You can choose to save or schedule a time for the run to generate the optimization results once, at recurring intervals, or at a future date. A warning message is displayed if the scheduled date and time of the run is set prior to the current date.
 - Click **OK** to save the run without scheduling it for optimization. The new run is listed in the Run Configurations category.
 - Select **Schedule Now** to schedule the run immediately.
 - Select **Schedule Later** to schedule the run at a later date. In the Schedule window, select the start date and time.
 - Select **Schedule Recurrence** to schedule the run at a regular time during the selected time period.

The status of the runs that are scheduled for optimization are displayed in the Run Instances category.


To exit out of the Configuration window without saving or scheduling the run, click **Cancel**.

Edit a Run


- 1 Double-click the run in the Run Configurations category. The window containing the run configuration details appears.


For more information about the configuration fields, see [“Create a Run” on page 25](#).

- 2 Edit the required fields in the run and click **Save**.

Note: A  icon indicates that the run is being edited by another user. You can edit the details and set a schedule for the run, but you cannot save the run.

Delete a Run

- 1 Select a run from the Run Configurations or Run Instances category and click  on the toolbar. The Confirm Delete window appears.
- 2 Click **Yes** to delete the run configuration or run instance. A progress bar indicating that the delete process is in progress is displayed.

Note: You cannot delete a run instance before the forecast date when there is a published plan in the Analysis workspace. If you try, an error message is displayed. You need to recall the published plan and then click .

Schedule a Run for Optimization

You can schedule a date and time for the run to generate the results once, at recurring intervals, or at a future date. The status of the scheduled run is displayed in the Run Instances category. You can set a schedule while creating, modifying, or viewing the run.

- To schedule a new run, select the schedule options in the Create Configuration window. For more information about scheduling a run when a new run is created, see [“Create a Run” on page 25](#).

- To schedule a run while editing, select the schedule options in the Run Configuration window.
- To schedule a predefined run, select the run and the schedule options in the Run Details pane of the Run Configurations window.

Note: If you want to cancel the schedule process, select the run and click **Cancel** in the Run Details pane of the Run Instances window.

5

Analyzing the Optimized Plan

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What Is a Plan?

The optimization results of a run that is scheduled through the Setup workspace are displayed as a plan in the Analysis workspace. The results of the plan are displayed based on the selections that you made while creating a run configuration. You can view the optimized plan results in a grid and graph format. A plan contains the following:


- List of optimized substation banks
- Load forecast for a selected interval

- Power savings
- Number of estimated actions to be taken on the associated devices to minimize losses
- Estimated savings for each preventive action taken
- Number of devices associated with the substation bank

Note: For ad hoc analysis of the plan, see the *SAS Energy Distribution Optimization: Administrator's Guide* to understand the output data tables.

Analyzing the Optimized Plan Results

The optimization results are displayed according to the schedule or interval that was defined while creating the plan. The forecasted information helps you understand the performance of the substation banks in a network. The loss minimization optimization method displays the optimal device settings to reduce electricity losses, and the CVR optimization method displays the optimal voltage settings to reduce electricity demand. You can also view the detailed results of the power savings, demand reduction, and estimated switching actions for each interval. These results are later published to the operator for implementation in the Operations workspace.


Note: An error  might be displayed for those substation banks whose network was reloaded after the optimization was run. You need to remove the bank from the plan and update the interval settings. If the plan is published, recall the plan before updating the settings.

Updating the Interval Settings

Depending on the analysis, you can make changes to the results by selecting the banks that display the best optimized results and update the interval of the plan with these results. For example, you can select the banks with the maximum electric savings and

the minimum remedial actions (loss minimization) or you can select banks with a large reduction in demand and minimal remedial actions (CVR). Banks that do not have savings or contain errors in any of the intervals appear disabled.

For loss minimization, you can select the required banks at each interval and then update the interval with the new settings. The load flow for the remaining intervals is run based on the new settings.

Note: Sometimes the new settings might produce an under- or overvoltage condition or some other error while forecasting the load for future intervals. An error  is indicated and the bank cannot be included in that interval. To clear the error, change the selection of the bank in a previous interval and run the load flow again. If the error is still displayed, you need to remove the bank from the plan.

For CVR, when a bank is added in one of the intervals, it is subsequently included in the remaining intervals. To remove the bank from the plan, you need to select the interval in which the bank was added, remove the bank, and then update the interval settings.

For more information, see [“Update the Optimized Plan Results” on page 39](#).

About the Analysis Workspace

The Analysis Workspace

The Analysis workspace displays the forecasted optimization results and the appropriate actions to be taken to minimize losses and reduce demand. It consists of the **Intervals** and **Summary Schedule** tabs; the toolbar options; and the **Summary**, **Device Settings**, and **Comments** tabs.

Analyze the Optimized Plan Results at Each Interval



The optimization results are displayed according to the schedule that you defined while creating the plan. The forecasted information helps you understand the performance of the substation banks in a network. The loss minimization optimization method displays the optimal device settings to reduce electricity losses, and the CVR optimization

method displays the optimal voltage settings to reduce electricity demand. You can also view the detailed results of the power savings, demand reduction, and estimated switching actions for each interval. These results are later published to the operator for implementation in the Operations workspace.

The **Intervals** tab displays the optimization results of the substation banks at each interval. The interval is set based on the time scheduled for optimization while the plan was created. For better analysis, the optimized data is displayed in a grid and graph format. Depending on the sorting order of the table columns, the graph display also changes.

Select an interval from the Interval list. The optimization results of the substation banks in that interval are displayed as follows:

Table 5.1 Loss Minimization Optimization Results at Each Interval

Field	Description
Select	Selects the banks to be included for an interval.
Status	<div>Displays the optimization status of the banks in the plan at each interval. The status changes when intervals are updated or networks containing the banks are reloaded.</div> <div><div><div><div><div></div><div></div></div><div>■  indicates that the optimization results are displaying without errors.</div></div><div><div><div><div></div><div></div></div><div>■  indicates a failure to produce optimization results for the next interval. The recommended settings might have resulted in high– or low–voltage conditions for another interval.</div></div></div><div>Or</div><div>indicates an error for those substation banks whose network was reloaded after the optimization was run. You need to remove the bank from the plan and update the interval settings. If the plan is published, recall the plan before updating the settings.</div></div></div>

Field	Description
Bank	Displays the substation banks that are added in the selected plan.
Load Forecast (KW)	Displays the load forecasted for the substation bank during the selected interval.
Savings (Watts)	Displays the power savings (watts) at each interval.
Estimated Actions	Displays the number of estimated actions to be taken on the associated devices, to minimize losses.
Estimated Watts/Action	Displays the estimated power savings (watts) if the suggested actions are implemented.
Number of Devices	Displays the number of devices associated with the substation bank.

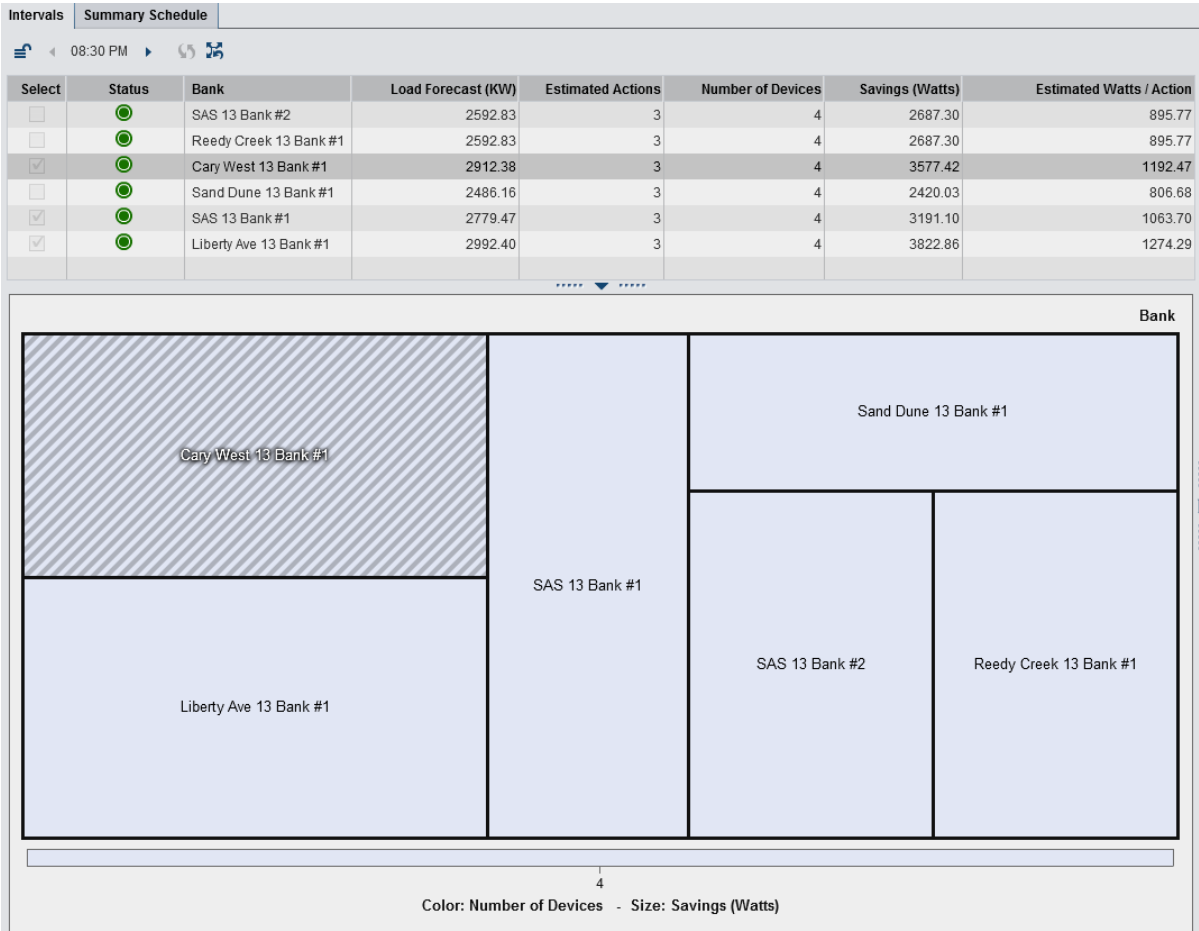
The CVR optimization results display the following additional columns:

Table 5.2 CVR Optimization Results at Each Interval

Field	Description
Total Demand Reduction (Watts)	Displays the reduced demand of power (watts) at each interval if the suggested actions are implemented.
Lowest Estimated Nodal Voltage	Displays the estimated values for the lowest recommended voltage.

Note: You can change the order of the columns by selecting a column and dragging it to the desired location.

Display 5.1 Graphical View of Optimization Results at Each Interval



The Intervals category consists of the following tabs:

- The **Summary** tab contains the **Interval Summary** and **Plan Summary** sections. The **Interval Summary** section displays the optimization results of the selected bank for an interval. The **Plan Summary** section displays the summarized results of the complete optimized plan.
- The **Device Settings** tab displays the devices connected to each substation bank in a hierarchical tree format that you can expand or collapse. The tab consists of the name of the substation bank, the associated feeders, the corresponding switching devices (such as capacitor banks or voltage regulators), and the actions required for each device to perform well.

Note: An asterisk (*) indicates that the optimized results of the device are different from the previous interval.

- The **Comments** tab enables you to add comments to share your analysis about the optimization results with other users or to make notes to yourself. A plan can have multiple comments. Each comment becomes a separate comment thread, to which other users can reply. For more information, see [“Add Comments to Plans” on page 39](#).

Analyze the Optimized Plan Result Summary

Bank/Device Summary

The **Bank/Device Summary** option displays the summary of the optimization results of the substation banks and the devices associated with the banks. Expand the required bank to view the list of devices associated with the bank.

The loss minimization results display the settings required for each device to minimize losses and to increase the electricity savings of the substation bank. For capacitors, the action indicates whether you should turn the capacitor on or off. For voltage regulators and transformers, the values indicate the optimal tap settings required to regulate the load flow. The CVR results display the optimal voltage levels required for each device to minimize the electricity demand.

Display 5.2 Optimization Results

Intervals

Summary Schedule

Bank/Device Summary

Savings Summary

	08:30 PM	10:30 PM
<div><div></div><div>Cary West 13 Bank #1</div></div>	Actions: 3	Actions: 2
<div><div></div><div>Cary East 13 Bank #1</div></div>	Actions: 4	
<div><div></div><div>SAS 13 Bank #1</div></div>	Actions: 3	Actions: 2
<div><div><div></div></div><div>reg1</div></div>	*	
<div><div><div></div></div><div>Phase A Tap:</div></div>	16 (3.75 %)	16 (0.00 %)
<div><div><div></div></div><div>Phase B Tap:</div></div>	14 (3.75 %)	14 (0.00 %)
<div><div><div></div></div><div>Phase C Tap:</div></div>	16 (3.13 %)	16 (0.00 %)
<div><div><div></div></div><div>XFM-1</div></div>		
<div><div><div></div></div><div>Phase A Tap:</div></div>	0	0
<div><div><div></div></div><div>Phase B Tap:</div></div>	0	0
<div><div><div></div></div><div>Phase C Tap:</div></div>	0	0
<div><div><div></div></div><div>cap1</div></div>	*	*
<div><div><div></div></div><div>Phase A:</div></div>	Off	On
<div><div><div></div></div><div>Phase B:</div></div>	Off	On
<div><div><div></div></div><div>Phase C:</div></div>	Off	On
<div><div><div></div></div><div>cap2</div></div>	*	*
<div><div><div></div></div><div>Phase C:</div></div>	Off	On

For example, in this figure, the optimization results of the ‘SAS 13 Bank #1’ substation bank display the number of estimated actions (Actions: 3) to be taken on the regulators (reg 1) and capacitor banks (cap1 and cap2) at each interval.

- For the regulator tap settings at the first phase (Phase A Tap), the recommended tap settings is 16 and the resultant increase in voltage is 3.75% in the 8:30 P.M. interval. The 10:30 P.M. interval does not recommend any changes to the regulator settings, so there is no change in voltage from the previous setting (0.00%).

- For the capacitor settings at all phases, the recommended action is to turn off the capacitor in the 8:30 P.M. interval and to turn it on in the 10:30 P.M. interval.

To print the optimized result summary, click .

Savings Summary


The **Savings Summary** option displays the average savings at each interval if the suggested actions are implemented. Expand the required bank to view the savings for the actions.

For loss minimization optimization results, the average power savings are displayed.

Display 5.3 Loss Minimization Savings Summary

Intervals

Summary Schedule



☐ Bank/Device Summary

☒ Savings Summary


	08:30 PM	10:30 PM
<input checked="" type="checkbox"/> Interval W Summary	16712.16	48796.38
Total Actions	13	6
Average W/Action	1285.55	8132.73
<input checked="" type="checkbox"/> Cary West 13 Bank #1	3577.41	16416.50
Total Actions	3	2
Average W/Action	1192.47	8208.25
<input checked="" type="checkbox"/> Cary East 13 Bank #1	6120.78	
Total Actions	4	
Average W/Action	1530.19	

For example, in this figure, the summary results of the ‘Cary West 13 Bank #1’ substation bank display a total of 3 actions that would result in a savings of 3577.41 watts at the 8:30 P.M. interval. The 10:30 P.M. interval recommends 2 actions that would result in an additional savings of 16416.50 watts.

Display 5.4 CVR Savings Summary

Intervals

Summary Schedule



☐ Bank/Device Summary

☒ Savings Summary

	08:30 PM	09:30 PM
<input checked="" type="checkbox"/> Interval W Summary	520978.38	514184.43
Total Actions	19	4
Average W/Action	27419.91	128546.10
<input checked="" type="checkbox"/> Reedy Creek 13 Bank #1	74485.07	73407.63
Total Actions	3	1
Average W/Action	24828.35	73407.63
<input checked="" type="checkbox"/> SAS 13 Bank #2	74485.07	73407.63
Total Actions	3	1
Average W/Action	24828.35	73407.63

For CVR optimization results, the average power reduction at each interval is displayed. For example, in this figure, the summary results of the ‘SAS 13 Bank #2’ substation bank display a total of 3 actions that would result in a power reduction of 74485.07 watts at the 8:30 P.M. interval. The 10:30 P.M. interval recommends 1 action that would result in an additional power reduction of 73407.63 watts.

To print the optimized result summary, click .

Working with the Analysis Workspace

Select a Plan for Analysis

To view the optimization results of the substation banks added in the plan:


- 1 In the Analysis workspace, the Open window displays the plans.

- 2 Expand the required plan to view the optimization schedules of that plan. Alternatively, you can also enter the plan name in the **Search** field to search the plan.
- 3 Select a schedule date for the plan whose optimization results you want to view and analyze.
- 4 Click **OK**. The **Intervals** screen appears by default, and a grid containing the substation banks of that plan is displayed.

To select a plan at a later time, select **File ► Open Plan**.

Add Comments to Plans


To add a comment:



- 1 Click the **Intervals** tab. The optimization results of the substation banks at each interval are displayed.
- 2 Click the **Comments** tab to start adding your comments.
- 3 Enter a title for the comment in the **Enter a topic name** field.
- 4 Enter your comment in the **Enter a comment** field.
- 5 (Optional) Click  to attach files.
- 6 Click **Post**. The comment is displayed across all intervals of the plan.



Note: To update your comments, click **Edit**. To search an existing comment, use the **Search within comments** field.

Update the Optimized Plan Results

To edit the optimization results:



Note: The  icon indicates that the plan cannot be updated because it is being used by another user.


- 1 From the **Intervals** tab, select the banks whose results you want to display in the Operations workspace. The  icon is enabled.
- 2 Click  to update the interval for the plan. A progress bar indicates that the update process is in progress.




Note: For loss minimization, when an interval is updated, it might produce an error while forecasting the load for future intervals. An error  is indicated and the bank cannot be included in that interval. To clear the error, change the selection of the bank in the previous interval and click . If the error is still displayed, you need to remove the bank from the plan.

Publish the Optimization Plan Results

To publish a plan to the operator for implementation:

- 1 Select a plan to view the optimized plan results. You can view the plan results at each interval or as a summary.
- 2 From the **Intervals** tab, process through each interval, and then select the banks whose results you want to display in the Operations workspace.
- 3 Click  whenever you want to update any interval of the plan.
- 4 In the last interval of the plan, click  to publish the results in the Operations workspace. A progress bar indicates that the publish process is in progress.

Note: The  icon is enabled only after you select the last interval of the plan while you are updating it.

After a plan is published, the  icon changes to . If you want to change the optimized results, click  to recall the plan in the Analysis workspace.

Note: If the network associated with a published plan is updated, you need to recall the plan before creating a new plan with the updated results. This ensures the accuracy of the optimization results in the Operations and Reporting workspace.

6

Viewing the Optimized Plan Results

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About Optimization Results

The forecasted optimization results help an operator understand the actions to take to minimize electric losses and reduce demand for power. These results of the optimized plan are displayed in the Operations workspace after the plan is published by the grid engineer from the Analysis workspace.

The Operations workspace consists of the **Intervals** tab and the **Summary Schedule** tab. You need to select a plan first before you can view its optimization results.

Working with the Operations Workspace

Select a Plan

To view the optimization results of the substation banks added in the plan:

- 1 In the Operations workspace, the Open window displays the plans.
- 2 Expand the required plan to view the optimization schedules of that plan.
Alternatively, you can also enter the plan name in the **Search** field to search the plan.
- 3 Select a schedule date for the plan whose optimization results you want to view and analyze.
- 4 Click **OK**. The **Intervals** screen appears by default, and a grid containing the substation banks of that plan is displayed.

To select a plan at a later time, select **File ► Open Plan**.

View Results at Each Interval


The **Intervals** tab displays the settings required for the devices associated with the substation banks at each interval. The values contain the optimal voltage settings for voltage regulators and transformers and the recommended actions for capacitors.

Select an interval from the drop-down list. The optimization results of the substation banks in that interval are displayed as follows:


Table 6.1 Interval Results

Field	Description
Bank	Displays the substation banks that are added in the selected plan.
Device	Displays the settings required for the device. For capacitors, the action indicates whether you should switch the capacitor on or off. For voltage regulators and transformers, the values indicate the optimal tap settings required to regulate the load flow.

Display 6.1 Results at Each Interval

Intervals		Summary Schedule				
 08:30 PM						
Bank	Device	Device	Device	Device	Device	Device
James 123 Bank #1	reg1*	reg2*	reg3*	reg4*	cap1	cap2
	-7 (-8.75 %)	-4 (-1.88 %)	-1 (-0.63 %)	3 (0.00 %)	On	On
	-7 (-8.75 %)	0 (0.00 %)	0 (0.00 %)	-4 (-1.88 %)	On	On
Turtle 123 Bank #1	reg1*	reg2*	reg3*	reg4*	cap1	cap2
	-7 (-8.75 %)	-4 (-1.88 %)	-1 (-0.63 %)	3 (0.00 %)	On	On
	-7 (-8.75 %)	0 (0.00 %)	0 (0.00 %)	-5 (-2.50 %)	On	On
	reg1*	reg2*	reg3*	reg4*	cap1	cap2
	-7 (-8.75 %)	0 (0.00 %)	-3 (-1.25 %)	-1 (-1.25 %)	On	On
	-7 (-8.75 %)	0 (0.00 %)	-3 (-1.25 %)	-1 (-1.25 %)	On	On

This figure displays the recommended device settings for the substation banks at the 8:30 P.M. interval. The new tap settings for all four regulators are indicated by the asterisks. In the 'James 123 Bank #1' substation bank, the new regulator tap setting for reg 1 is -7 and the voltage drop percentage is (-8.75%). There are no changes recommended in the settings for the two capacitor banks, so they remain the same.

To print the optimized results at each interval, click .

The Intervals category consists of the following tabs:

- The **Device Settings** tab displays the devices connected to each substation bank in a hierarchical tree format that you can expand or collapse. The tab consists of the name of the substation bank, the associated feeders, the corresponding switching devices (such as capacitor banks or voltage regulators), and the actions required for each device to perform well.

Note: An asterisk (*) indicates that the optimized results of the device are different from the previous interval.

- The **Comments** tab enables you to add comments to share your analysis about the optimization results with other users or to make notes to yourself. A plan can have multiple comments. Each comment becomes a separate comment thread, to which

other users can reply. For more information, see [“Add Comments to Plans” on page 39](#).

View the Summary of Results

The **Summary Schedule** tab displays the summary of the optimized substation banks, their associated devices, and the recommended actions to take to minimize losses. In addition, a savings summary forecasts information about the average amount of power that the utility can save if the recommended actions are followed. For more information, see [“Analyze the Optimized Plan Result Summary” on page 35](#).

The Plan Summary pane displays the summarized results of the complete optimized plan. The summary consists of the total number of banks and associated devices in the plan and the average values of the power savings.

7

Managing Reports

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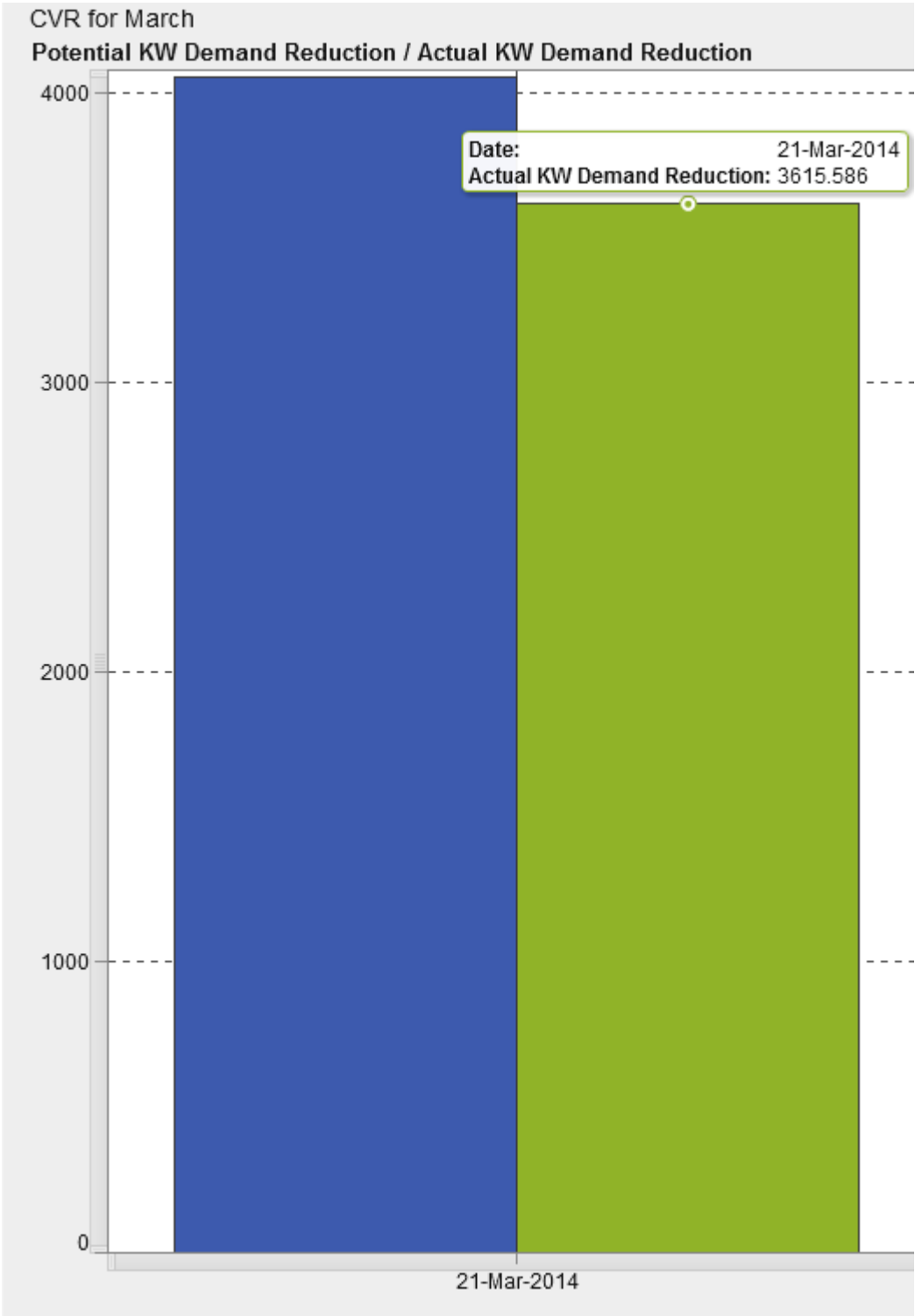
Overview of Reports

SAS Energy Distribution Optimization displays the optimization results using interactive graphs in the dashboard. These graphs help the utility to monitor the electric load requirement and the consumption of a substation bank. You can compare the optimization results across all the electric substation banks under that utility and understand the savings or demand reduction in the substation banks when the results are implemented.

SAS Energy Distribution Optimization uses SAS Visual Analytics to display the graphs for the loss minimization and conservation voltage reduction (CVR) optimization results. You can select the day or date range to generate the reports of the optimized plans that are published during the selected period. The graphical reports are generated as a time graph or a bar chart. You can also view these reports in a PDF format.

The following figure describes an example of a bar chart report for one of the CVR optimization results. The blue bar displays the SAS Energy Distribution Optimization suggested optimization results for reducing demand, and the green bar displays the actual results of the reduced demand during the selected period.

Display 7.1 Sample Report



Type of Reports

SAS Energy Distribution Optimization provides the following type of time graph and bar chart reports:

CVR Demand Reduction for Period

Displays the comparison between the optimized and actual results of the reduced demand during the selected period.

CVR Demand Reduction for Day

Displays the comparison between the optimized and actual results of the reduced demand during the selected day.

Loss Minimization Reduction for Period

Displays the comparison between the optimized and actual results of the electricity saved during the selected period.

Loss Minimization Reduction for Day

Displays the comparison between the optimized and actual results of the electricity saved during the selected day.

Power Factor for Period

Displays the comparison between the initial power factor at the start of each interval and the results of the power factor after optimization.

Power Factor for Day

Displays the comparison between the initial power factor at the start of each day and the results of the power factor after optimization.







Note: The reports are displayed based on the time zone of the server. If the server and browser are located in different time zones, the data is displayed based on the server's locale.


About the Reporting Workspace

The Reporting workspace enables you to generate reports of the loss minimization and CVR results. The workspace consists of the toolbar, a workspace area to display the reports, and options to select the predefined reports and create customized reports according to your preferences.

Here are the toolbar options that are available in the Reporting workspace:

Table 7.1 *Toolbar Icons*


Toolbar Icons	Action	Description
	Back	Navigates to the location of the last browsed folder.
	Up	Navigates to a level above the current folder location.
	Refresh	Reloads the items in the grid.
	Delete	Deletes the item that is selected in the grid. Note: Only a user with the administrator role can delete optimization reports.
	New Folder	Creates a new folder in which you can create your reports.
	Views	The Details view displays the Name, Type, and Date Modified columns of the report. The List view displays only the name of the report.

Toolbar Icons	Action	Description
	Search	Opens the Search window, in which you can search for reports that contain a specific text string.

Working with the Reporting Workspace

Create a Report

You can define the type and format of the graph report. To create a report:

- 1 Select **File** ► **New** or select **New** in the Open window. The Create Report window appears.
- 2 Click **Browse** to select a folder location for your report. The Choose a Location window appears.
 - a You can select an existing folder location, or click  to create a folder. The location appears in the **Selected Location** field.
 - b Click **OK**. The folder location is displayed in the **Location** field of the Create Report window.

Note: The **OK** button is disabled if you do not have permissions to the selected folder.

- 3 Enter a unique name for the report in the **Name** field. The name of a report is limited to 60 characters and cannot contain the ! % ^ . & = \ / | ' ; > and < characters.

Note: If the name is duplicated, an error is displayed while creating the report.

- 4 Enter a description for the report in the **Description** field. The description of a report is limited to 60 characters and cannot contain the ! % ^ . & = \ / | ' ; > and < characters.

- 5 Select the type of report in the **Type** drop-down list.
 - **CVR Demand Reduction for Period** to view the optimized and actual results of the reduced demand during the selected time.
 - **CVR Demand Reduction for Day** to view the optimized and actual results of the reduced demand during the selected day.
 - **Loss Minimization Reduction for Period** to view the optimized and actual results of the electricity saved during the selected time.
 - **Loss Minimization Reduction for Day** to view the optimized and actual results of the electricity saved during the selected day.
 - **Power Factor for Period** to view the initial power factor at the start of each interval and the results of the power factor after optimization.
 - **Power Factor for Day** to view the initial power factor at the start of each day and the results of the power factor after optimization.
- 6 Select the graph format as a **Time Graph** or **Bar Chart** from the **Format** drop-down list.
- 7 Select the **Start date** and **End date** of the optimization schedule in which you require the report results to be generated.

Note: If there are no optimized plans available in the selected date range, the report results appear blank.
- 8 Click **OK**. A progress bar indicates that the report creation process is in progress.

The optimization results are displayed in the selected graph format.

Note: Sometimes, loss minimization reports might display negative savings. Contact your network administrator for assistance.

View Reports

To view the predefined reports for comparing the results of the substation banks before and after the optimization process:

- 1 Select **File** ► **Open**. The Open window appears.
- 2 Select the report to view and click **OK**. The reports are displayed in the Time Graph or Bar Chart graph format.

Note: The reports are displayed based on the time zone of the server. If the server and browser are located in different time zones, the data is displayed based on the server's locale.

You can also view the reports in a PDF format:

- 1 Select **File** ► **Print PDF**. The Print (pre-production) window appears.
- 2 Select the orientation type, paper size, options, and margins to set the display of the PDF report.
- 3 Click **Print**. The report is displayed in the PDF format.

The PDF preferences are displayed at the bottom of the page when you position your cursor over the PDF. You can use these options to save and print the PDF report.

Note: Ensure that SAS Visual Analytics server (SaSserver12) is active while you are creating reports in PDF.

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