



**NETWORK MANAGEMENT SYSTEM  
DISTRIBUTION MANAGEMENT SYSTEM (DMS)  
v 2.5**

**5.4.3.3 NMS(DMS).Manage Suggested Switching**

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## Brief Description

<b>Business Process:</b>	<b>5.4.3.3 NMS(DMS).Manage Suggested Switching</b>
<b>Process Type:</b>	<b>Sub Process</b>
<b>Parent Process:</b>	<b>5.5.1 NMS(DMS).Manage Network Faults</b>
<b>Sibling Processes:</b>	<b>5.4.3.1 NMS(DMS).Manage Powerflow, 5.5.4.1 NMS(OMS).Manage Planned Outage Event, 5.5.3.2 NMS(OMS).Manage Unplanned Outage Event</b>

Utility personnel perform switching operations on network as part of regular maintenance, improvement and restoration. Specific switching scenarios involve isolating a device or part of network, isolating a part of network and restoring power for rest of the network, restoring power to de-energized sections, transferring loads on feeders, etc.

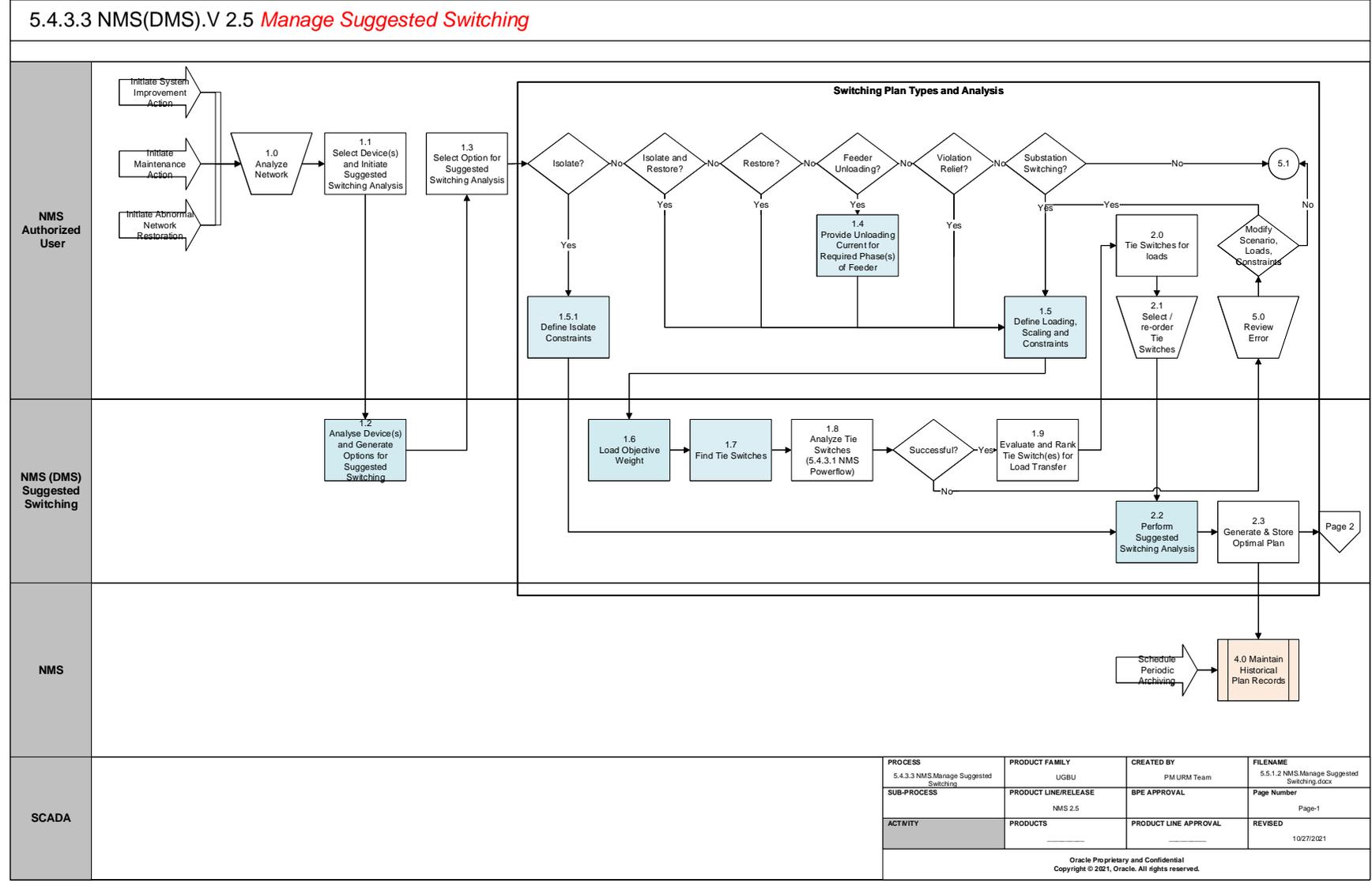
Suggested Switching is an Advanced Distribution Management System (ADMS) tool that suggests NMS Users with various Switching Plans for specific switching scenarios on network. This process takes place in a user's Study Session with DMS functionality activated.

Specific scenarios can include Isolate, Isolate and Restore, Restore, Feeder Unloading, Violation Relief and Substation Switching. The tool provides facility for the user to define loadings, scaling factors and constraints for tuning the Suggested Switching plans. Further it provides facility to review the plans, look into plan details and review violations.

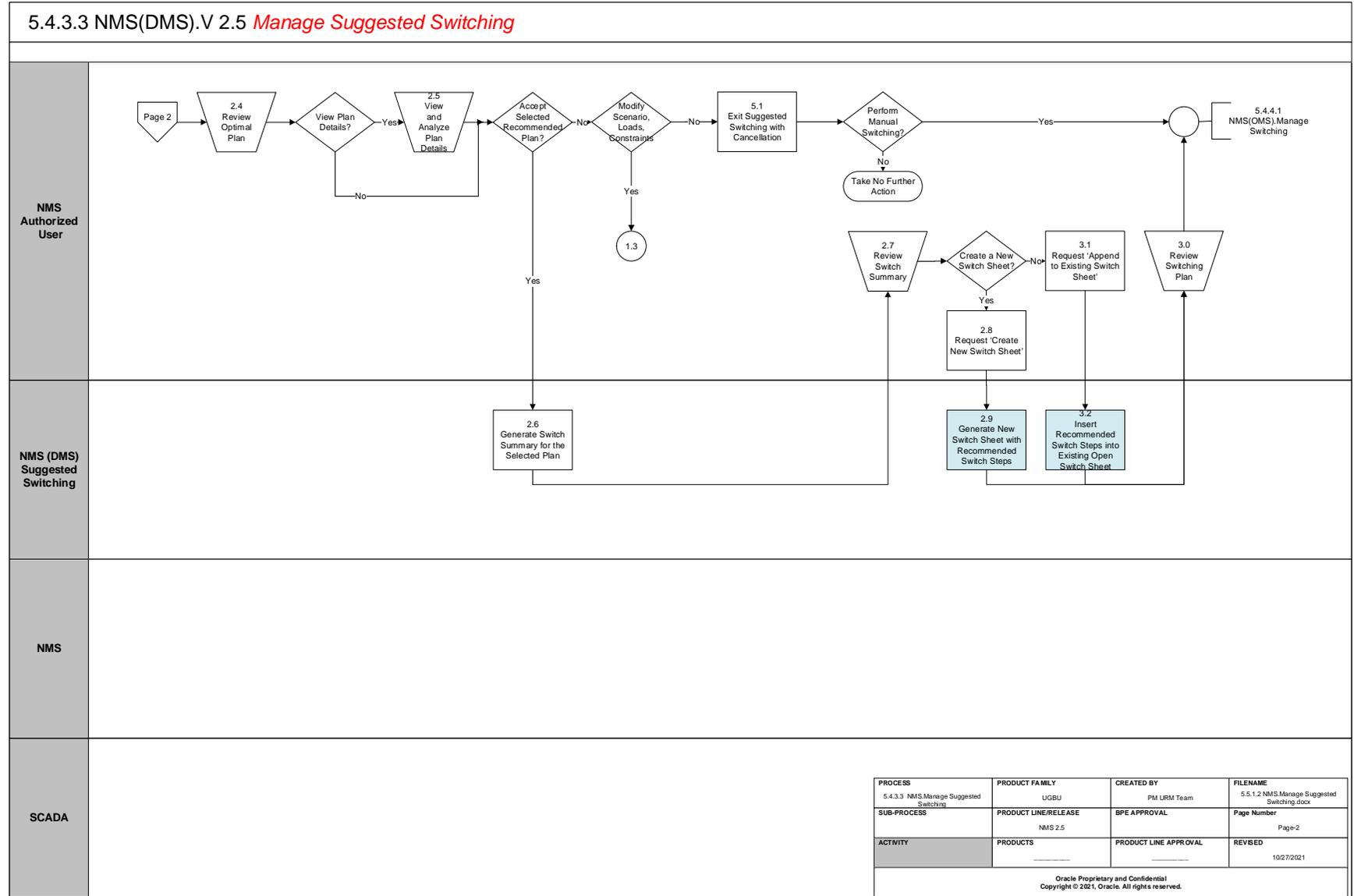
Finally, the user can generate a new plan or generate and append the switching steps into an existing plan as may be required.

# Business Process Model Page 1

5.4.3.32 NMS.Manage Suggested Switching



## Business Process Model Page 2



## Detail Business Process Model Description

### 1.0 Analyze Network

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User analyzes network in NMS to identify devices leading switching action related to network improvement or maintenance or restoration.

### 1.1 Select Device(s) and Initiate Suggested Switching Analysis

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User switches to study mode, with DMS functionality enabled. Then they select devices in Viewer and [Initiate Suggested Switching Analysis](#) from the Tools menu.

Task Customizable (Y)

Available Rule(s):

Mechanism	Rule
Project Xml Configuration	VIEWER_MENUBAR.inc VIEWER_TOOLBAR.inc

Configuration required (N)

Entities to Configure:

Entity	Requirements	Product value
DMS_STUDY_MODE_PERMISSION	Visibility	True
MNU_SUGGESTED_SWITCHING	Provide Visibility	True

### 1.2 Analyze Device(s) and Generate Options for Suggested Switching

**Actor/Role:** NMS (DMS) Suggested Switching

**Description:** Suggested Switching application analyzes devices and generates respective options relevant for the devices selected. Options generated are dependent on Device Class of devices selected and their inheritance.

Task Customizable (Y)

Available Rule(s):

Mechanism	Rule
Inheritance	pf_sub_xfmr
Inheritance	pf_feeder_cls

Configuration required (Y)

Entities to Configure:

Device Class Configurations
-----------------------------

**1.3 Select Option for Suggested Switching Analysis**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User selects the [Option relevant for the scenario](#) to perform Suggested Switching Analysis.

**Group: Switching Plan Types and Analysis**

**1.4 Provide Unloading Current for Required Phase(s) of Feeder**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User can enter [phase-wise feeder unloading current](#) in amps as an input for Suggested Switching application in the scenario of Feeder Unloading.

**Task Customizable (Y)**      **Available Rule(s):**

Mechanism	File
Project Xml Configuration	SuggestedSwitching.xml

**Configuration required (Y)**      **Entities to Configure:**

Entity	Requirements	Product value
DS_SS.UnloadAAmps	Provide default	50
DS_SS.UnloadBAmps	Provide default	50
DS_SS.UnloadCAmps	Provide default	50

**Group: Switching Plan Types and Analysis**

**1.5 Define Loading, Scaling and Constraints**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User can configure and provide various inputs such as loading, [scaling and constraints](#) for the Switching Application to run and generate switching plans. In the absence of any inputs, the application proceeds with the default configuration made in the system.

- Load Profile configuration provides option to use current Real-time load or specific period History Data as load profile
- Scaling factor allows to scale the selected loads by entered factor
- Limits allow user to select the limit type, Season, High and Low Voltage limits
- Constraints allow user to select variations on what the engine can consider.

**Task Customizable (Y)**      **Available Rule(s):**

Mechanism	File
Project Xml Configuration	SuggestedSwitching.xml

**Configuration required (Y) Entities to Configure:**

Entity	Requirements	Product value
Only use SCADA devices	Provide default	False
Exclude devices with inhibit tags	Provide default	False
Minimize impacted areas with non-load break switches	Provide default	False
Allow dispatch DG to achieve objectives	Provide default	False
Allow shed load to achieve objectives	Provide default	False
Disconnect DG (IEEE-1547 rules)	Provide default	True
Cold Load Pickup	Provide default	False
Evaluate Protection Reach violations	Provide default	True
Allow single phase operations on 3-phase scenario	Provide default	False
Force KVA engine	Provide default	False

**Group: Switching Plan Types and Analysis**

**1.5.1 Define Isolate Constraints**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User can configure and provide [constraints](#) for the Suggested Switching isolation Application to run and generate switching plans. In the absence of any inputs, the application proceeds with the default configuration made in the system.

- Constraints allow use to select variations on what the engine can consider.

These constraints are not independently configurable from those defined in Section 1.5. They are documented here for relevance to this box on the process flow chart. Configuring the defaults for section 1.5 is sufficient for covering this section too.

**Task Customizable (Y) Available Rule(s):**

Mechanism	File
Project Xml Configuration	SuggestedSwitching.xml

**Configuration required (Y) Entities to Configure:**

Entity	Requirements	Product value
Only use SCADA devices	Provide default	False
Exclude devices with inhibit tags	Provide default	False
Minimize impacted areas with non-load break switches	Provide default	False
Allow single phase operations on 3-phase scenario	Provide default	False

**1.6 Load Objective Weights**

**Actor/Role:** NMS Administrator

**Description:** NMS Administrator can configure weighting values that determine how some variables are used to determine preferable and optimal paths through the search.

**Task Customizable (Y)**

**Available Rule(s):**

Mechanism	Rule	Product Value / Default
Average Feeder Voltage Weight	SS_AVG_VOLTAGE_WEIGHT	3
Critical Customer Column definition	criticalCustomerColumn	c_priority != 0 d_priority != 0 k_priority != 0
Critical Customer Weight	SS_CRIT_CUST_WEIGHT	50
Customer Weight	SS_CUST_WEIGHT	5
Feeder Capacity Weight	SS_FDR_CAP_WEIGHT	1
Generate Tags on open switches	SS_GENERATE_TAG_STEPS	yes
Minimum Feeder Voltage Weight	SS_MIN_VOLTAGE_WEIGHT	10
Tie Capacity Weight	SS_TIE_CAP_WEIGHT	1
Tie Distance Weight	SS_TIE_DISTANCE_WEIGHT	6
Number of tiers to consider	SS_NUM_TIERS	3
Inhibit Classes	SS_INHIBIT_CLASSES	

**Configuration required (Y)**

**Entities to Configure:**

**Group: Switching Plan Types and Analysis**

**1.7 Find Tie Switches**

**Actor/Role:** NMS (DMS) Suggested Switching

**Description:** NMS runs the start of Suggested Switching to locate suitable isolate and/or restore switches via upstream/downstream traces.

Inheritance	pf_isolate_switch
-------------	-------------------

**Task Customizable (Y)**      **Available Rule(s):**

Inheritance	pf_restore_switch
Inheritance	pf_scada_isolate_switch
Inheritance	pf_scada_restore_switch
Inheritance	pf_rack_switch
Inheritance	pf_non_load_break_switch

**Configuration required (Y)**      **Entities to Configure:**

Inheritance
-------------

**Group: Switching Plan Types and Analysis**  
**1.8 Analyze Tie Switches (5.4.3.1 NMS.Manage Powerflow)**

**Actor/Role:** NMS (DMS) Suggested Switching  
**Description:** NMS runs Power Flow application on areas of network to be isolated and areas of network that are potential locations for receiving a load transfer/pickup. Please refer to the process 5.4.3.1 NMS Manage Power Flow for further details.

**Group: Switching Plan Types and Analysis**  
**1.9 Evaluate and Rank Tie Switch(es) for Load Transfer**

**Actor/Role:** NMS (DMS) Suggested Switching  
**Description:** NMS summarizes the PowerFlow results and ranks the tie switches based on previously loaded objective weights.

**Group: Switching Plan Types and Analysis**  
**2.0 Review Tie Switch(es) Load**

**Actor/Role:** NMS Authorized User  
**Description:** NMS Authorized User [reviews the list of Tie switches](#) presented along with their priority available for load transfer

**Group: Switching Plan Types and Analysis**  
**2.1 Select / Re-order Tie Switches**

**Actor/Role:** NMS Authorized User  
**Description:** After review the NMS Authorized User must select / deselect and/or re-prioritize the Tie Switches for the Switching Application to execute.

**Task Customizable (Y)**      **Available Rule(s):**

Mechanism	Rule

Configuration required (Y)    Entities to Configure:

**Group: Switching Plan Types and Analysis**

**2.2 Perform Suggested Switching Analysis and Generate Recommend Plan(s)**

**Actor/Role:**    NMS (DMS) Suggested Switching

**Description:**    Suggested Switching application performs switching analysis for the devices selected for the switching scenario. It will endeavor to find the optimal plan and will optionally consider DER management if DERMS is licensed and the user has requested DERMS steps in the plan.

Task Customizable (Y)    Available Rule(s):

Mechanism	Rule	Product Value / Default
Switch Operation Weight	SS_SWITCH_WEIGHT	5000
DERMS enabled	Product Licensing	None

Configuration required (Y)    Entities to Configure:

**Group: Switching Plan Types and Analysis**

**2.3 Generate and Store Optimal Plan**

**Actor/Role:**    NMS Authorized User

**Description:**    The optimal plan is found and stored in the database.

**2.4 Review Optimal Plan**

**Actor/Role:**    NMS Authorized User

**Description:**    NMS Authorized User can review the various plans generated by Suggested Switching tool. Details related to affected feeders, affected switches, Violations before and pose execution of respective plan are displayed.

**2.5 View and Analyze Plan Details**

**Actor/Role:**    NMS Authorized User

**Description:**    NMS Authorized User can [view details of selected plan](#). Plan details are displayed in terms of Switching Steps and Feeder Changes.

Switching steps category provides information about step-wise device action, actionable device feeder and substation details. It further provides information about current, voltage, and power flows before the action and post-execution of the step.

Feeder Changes category provides information of current, voltage, power flows of before and post switching scenarios for each feeder affected.

**2.6 Generate Switch Summary for the Selected Plan**

**Actor/Role:** NMS (DMS) Suggested Switching

**Description:** NMS Authorized User accepts the switching plan generated based on the review and requests to generate plan summary.

**2.7 Review Switch Summary**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User [reviews Switch summary](#). Switch summary provides information about actionable devices and their open/close action.

**2.8 Request 'Create New Switch Sheet'**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User makes a request to create new switch sheet.

**2.9 Generate New Switch Sheet with Recommended Switch Steps**

**Actor/Role:** NMS (DMS) Suggested Switching

**Description:** Suggested Switching tool generated new switch sheet with recommended switch steps.

**Task Customizable (Y) Available Rule(s):**

Mechanism	Rule
Event Management Rules	N/A

**Configuration required (Y) Entities to Configure:**

Template Switch Open
Template Switch Close
Template Switch Undo Action
Template Tag
Template Der Kvar
Template Der Kw
Generate Tags on open switches
protSchemeTemplateRelayAction1
protSchemeTemplateRelayAction2
protSchemeTemplateRelayAction3
protSchemeTemplateRelayAction4
protSchemeTemplateRelayAction5
protSchemeTemplateRelayAction6
protSchemeTemplateRelayAction7
protSchemeTemplateRelayAction9
protSchemeTemplateDisable
protSchemeTemplateEnable

### 3.0 Review Switching Plan

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User [reviews Switching Plan](#) generated in the Work Agenda window.

### 3.1 Request 'Append to Existing Switch Sheet'

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User makes a request to append switching steps into an existing Switch Sheet. For this action, the user needs to open an existing switch sheet at the very beginning of initiating the Suggested Switching tool, and have "Record Steps" activated.

<b>Task Customizable (Y)</b>	<b>Available Rule(s):</b>	<b>Mechanism</b>	<b>Rule</b>
		Event Management Rules	N/A

<b>Configuration required (Y)</b>	<b>Entities to Configure:</b>	Appendable Switch Sheet Class
-----------------------------------	-------------------------------	-------------------------------

### 3.2 Insert Recommended Switch Steps into Existing Open Switch Sheet

**Actor/Role:** NMS (DMS) Suggested Switching

**Description:** Suggested Switching tool inserts recommended switch steps into an existing open switch sheet.

### 4.0 Maintain Historical Plan Records

**Actor/Role:** NMS Scheduled Maintenance Task

**Description:** Implementation team is responsible for managing the maintenance of historical Suggested Switching plans. The plans generated are stored indefinitely in the database. It is highly recommended that a maintenance script be written to purge old records.

The tables to be purged, and the key columns to use are:

Table	Key Columns	Description
SS_SOLUTIONS	SOLUTION_ID START_DATE	Should purge records that have a start date older than the required limit. The solution_id is a key for joining to the the other tables.
SS_TIE_SWITCHES	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_PLANS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_TIE_SWITCHES	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_FDR_SUMMARY	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_FDR_VIOLATIONS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_FDR_DERS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_STEPS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS

SS_STEP_VIOLATIONS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_STEP_DERS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS
SS_ISLAND_LOADS	SOLUTION_ID	Delete records that join by this column to SS_SOLUTIONS

Task Customizable (Y)

Available Rule(s):

Mechanism	Rule
Purge script	N/A

Configuration required (Y)

Entities to Configure:

RDBMS tables purged of old records
------------------------------------

**Group: Switching Plan Types and Analysis**

**5.0 Review Error**

**Actor/Role:** NMS Authorized User

**Description:** NMS Application [report errors](#) when it encounters any errors while executing Power Flow application. NMS Authorized can review this error.

**Group: Switching Plan Types and Analysis**

**5.1 Exit Suggested Switching**

**Actor/Role:** NMS Authorized User

**Description:** NMS Authorized User uses the cancel button to exit Suggested Switching.

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### Test Documentation related to the Current Process

ID	Document Name	Test Type

## Document Control

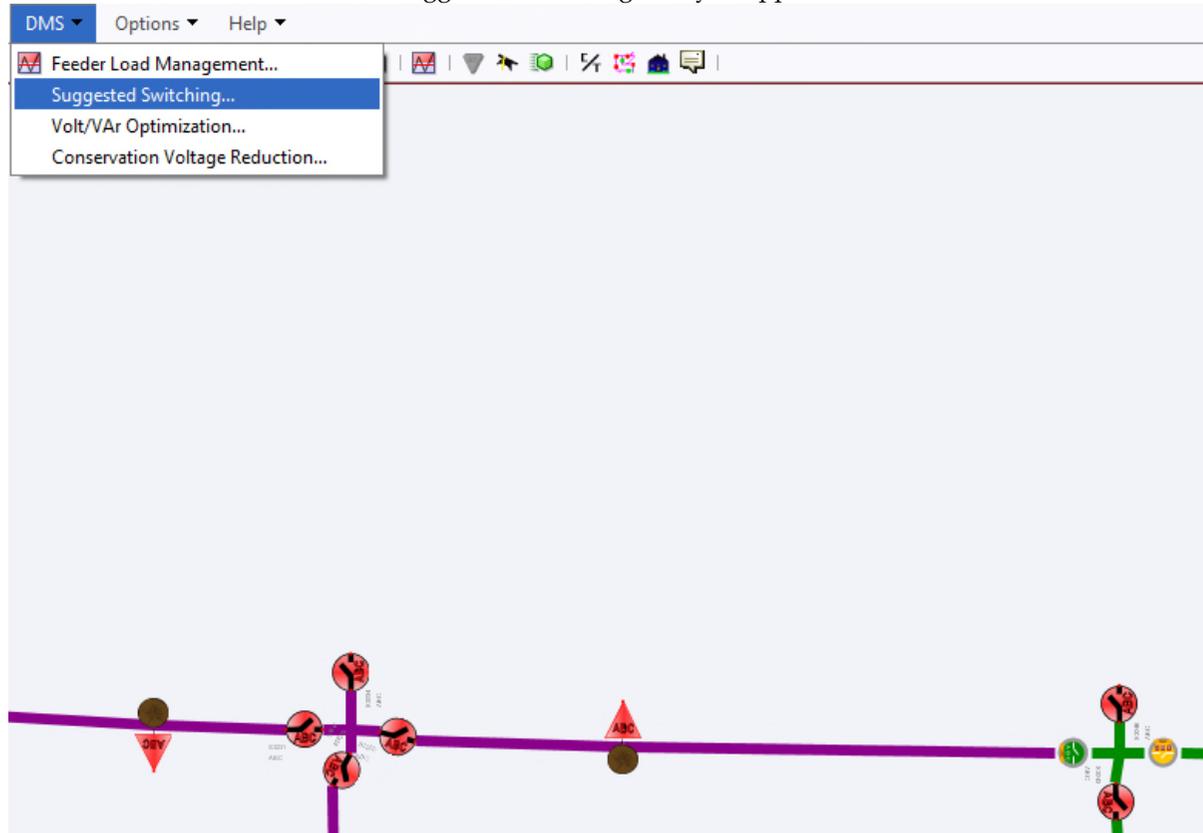
### Change Record

Date	Author	Version	Change Reference
04/06/2014	Srinivas Kanteti	1	Initial Version
06/24/2021	Mike Langford	2.5.0.1	Updated to 2.5.0.1 Version
06/29/2021	Saurabh Gupta	2.5.0.1	Reviewed
7/1/2021	Ian Hoogendam	2.5.0.1	Reviewed
7/23/2021	Andrew Neddermeyer	2.5.0.1	Reviewed
08/05/2021	Palak Jain	2.5.0.1	Reviewed
08/21/2021	Galina Polonsky		Reviewed, Approved

## Attachments

### Select Device(s) and Initiate Suggested Switching Analysis

User selects a device and initiates Suggested Switching Analysis application from DMS Menu



### Select Option for Suggested Switching Analysis

On initiating Suggested Switching Analysis application, various plan types relevant for the selected device are highlighted. Below, Isolate Only, Isolate and Restore, and Feeder Unloading are highlighted.

**Suggested Switching**

Choose which type of suggested switching operation to perform for the selected item(s).

**Plan Type**

Summary

Selected Devices: S3245P  
Selected Feeders: 2022

Only use SCADA devices

**Isolate Only**  
Isolate the selected device. Load may be lost. Can "isolate" a deenergized device to create potential restore sections.

**Isolate and Restore**  
Isolate selected device and restore as many sections as possible.

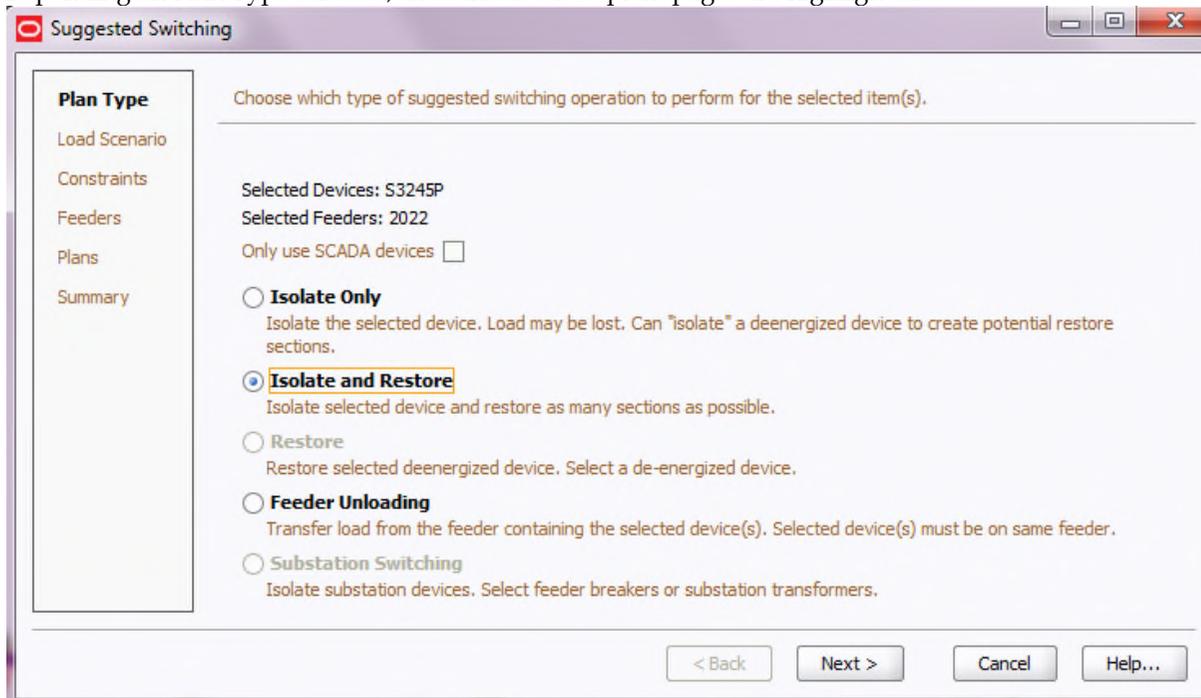
**Restore**  
Restore selected deenergized device. Select a de-energized device.

**Feeder Unloading**  
Transfer load from the feeder containing the selected device(s). Selected device(s) must be on same feeder.

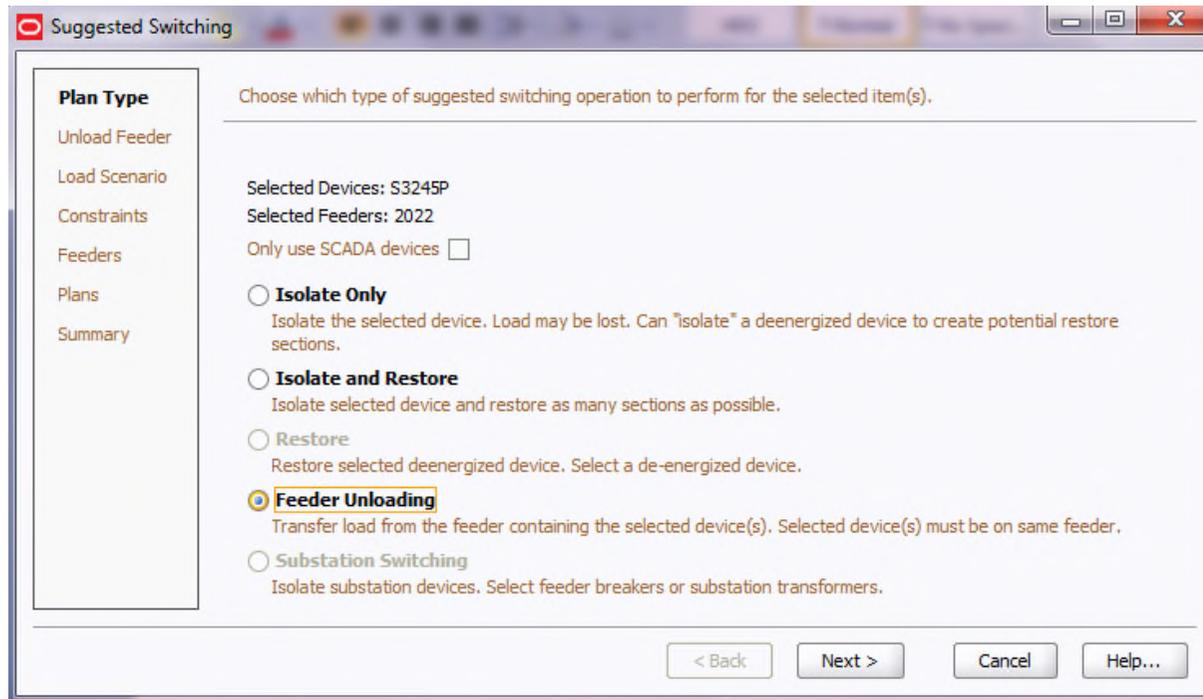
**Substation Switching**  
Isolate substation devices. Select feeder breakers or substation transformers.

< Back   Next >   Cancel   Help...

Depending on Plan Type selected, the various subsequent pages are highlighted.



In the below screen, you can view the additional Unload Feeder screen page when Feeder Unloading option is highlighted.



### Define Loading, Scaling, Constraints, and Objective Weights

In this page, User can click on Modify button and update the Load Profile, Scaling, Limits, etc.

The screenshot shows a software window titled "Suggested Switching". On the left is a navigation pane with the following items: Plan Type, Load Scenario (highlighted), Constraints, Feeders, Plans, and Summary. The main area contains a message: "Review the currently selected Power Flow load and limit scenarios. The solution will use these settings when determining the best options for switching." Below this is a section titled "Power Flow Study Mode Load Scenario" with a "Modify" button. Under "Load Profile", there are two radio buttons: "Real-time" (selected) with the description "Use loading for present real-time system data", and "Specific Period" with the description "Loading for the specified hour and day". Below "Specific Period" are dropdowns for "Hour" (set to 7) and "Day" (set to "Seasonal Peak, day capacitors ON"). To the right is a "Scaling factor" input field set to 1. Below that is a "Limits" section with two columns: "Limit Type" (dropdown set to "Normal") and "Season" (dropdown set to "Spring"); "Voltage Hi Limit" (input field set to 1.06) and "Voltage Low Limit" (input field set to 0.95). At the bottom are four buttons: "< Back", "Next >", "Cancel", and "Help..."

In this page, User can update Constraints and Objective Weights

**Suggested Switching**

Select parameters for choosing switching plans. Constraints determine acceptable system conditions. Weights determine the importance of different factors (0-100, higher is more important).

**Constraints**

Maximum Number of Plans:

Number of Steps in Plan:

Maximum Time to Search:  Minutes

**Objective Weights**

	Relative Weight
Minimum Feeder Voltage:	<input type="text" value="10"/>
Average Feeder Voltage:	<input type="text" value="3"/>
Distance to Feeder Head:	<input type="text" value="6"/>
Feeder Remaining Capacity:	<input type="text" value="1"/>
Tiepoint Remaining Capacity:	<input type="text" value="1"/>

< Back   Next >   Cancel   Help...

### Provide Unloading Current for Required Phase(s) of Feeder

In this page, User can enter the load in amps for unloading it on the feeder.

Suggested Switching

Plan Type

**Unload Feeder**

Load Scenario

Constraints

Feeder

Plans

Summary

Select how much load you want to transfer from this feeder to adjacent feeders.

Feeder Unloading Current (amps)

A	<input type="text" value="50"/>
B	<input type="text" value="50"/>
C	<input type="text" value="50"/>

< Back   Next >   Cancel   Help...

### Review and Select Tie Switch(es) for Load Transfer

Use the checkboxes to control which tie switches to use for load transfers, and use the Move buttons to prioritize which switches to use. Click Next to calculate switching plans.

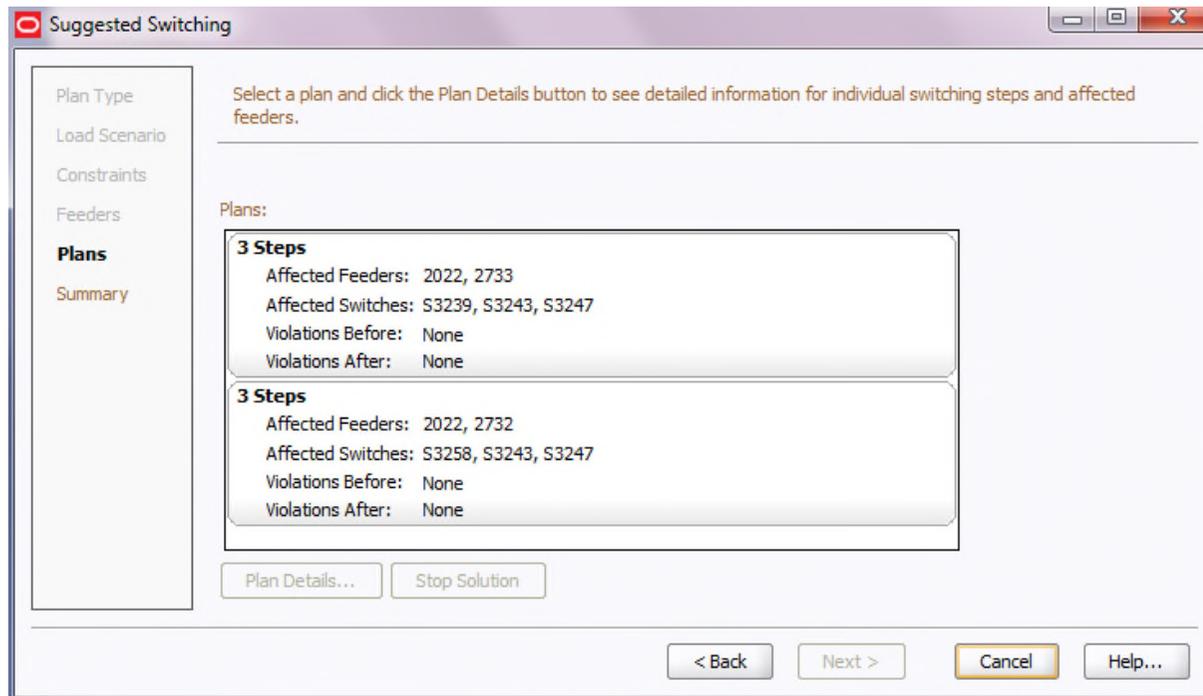
Tie Switches to Use for Load Transfer (in order of priority):

Use	Feeder	Substation	Tie Switch	Tie Capacity	Fdr Capacity	Distance	Avg Volt	Min Volt	SCADA
<input checked="" type="checkbox"/>	2733	SUB_Canton	S3239	591 / 591 / ...	1978 / 1978...	15221	1.03	1.03	<input type="checkbox"/>
<input checked="" type="checkbox"/>	2732	SUB_Canton	S3258	598 / 598 / ...	1978 / 1978...	18519	1.03	1.03	<input type="checkbox"/>

View... Move Up Move Down

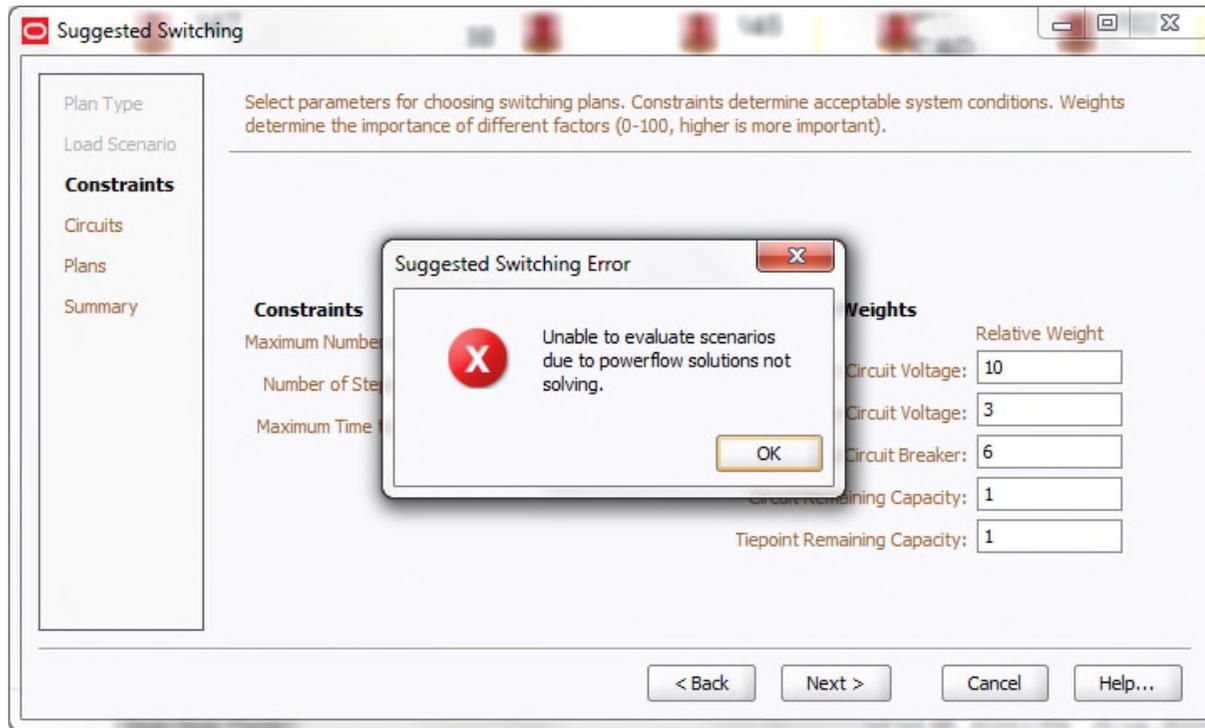
< Back Next > Cancel Help...

### Perform Suggested Switching Analysis and Generate Recommend Plan(s)



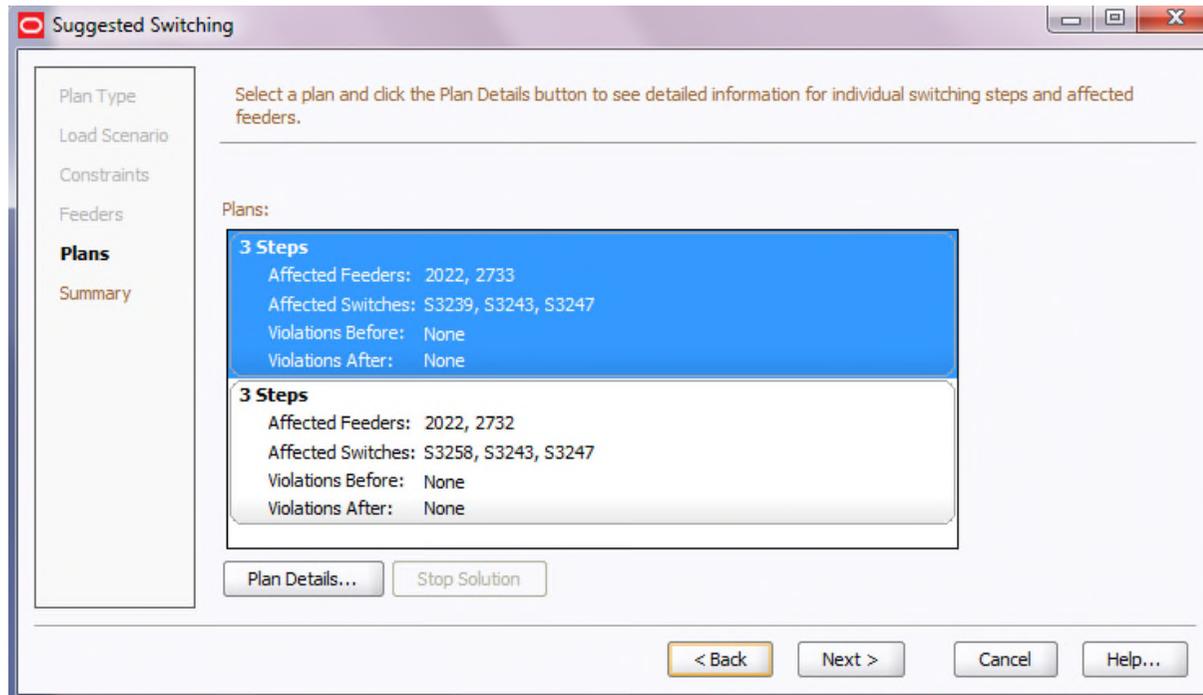
## Review Error

In the case of errors in Network Model, the power flow solution doesn't converge and User views the following error.



### View and Analyze Plan Details

Plans are generated in this page



In this page, User can view the Plan Details with respect to Switching Steps and Feeder changes

**Suggested Switching Plan Details**

Switching Steps | **Feeder Changes**

Switching Steps and Feeder Changes:

**Step 1 - Close S3239**

**Feeder: 2022 Substation: SUB\_Nimishillen**

	Current (A)	kW / kVAr	kVA	Voltage (kV)
Before:	5 / 5 / 5	123 / 49	132	8.25 / 8.25 / 8.25
After:	15 / 14 / 15	283 / 224	360	8.24 / 8.25 / 8.24

Violations Before: 0    Violations After: 0

**Feeder: 2733 Substation: SUB\_Canton**

	Current (A)	kW / kVAr	kVA	Voltage (kV)
Before:	9 / 9 / 9	204 / 81	219	8.22 / 8.22 / 8.22
After:	4 / 4 / 4	44 / -92	102	8.22 / 8.22 / 8.22

Violations Before: 0    Violations After: 0

**Step 2 - Open S3243**

**Feeder: 2022 Substation: SUB\_Nimishillen**

Switching Step Violations:

View...

Isolate and Restore S3245P on Feeders 2022

Close    Help...

**Suggested Switching Plan Details**

Switching Steps | **Feeder Changes**

Feeder Status Before/After Switching:

**2022**

	Current (A)	kW / kVAR	kVA	Voltage (kV)
Before:	5 / 5 / 5	123 / 49	132	8.25 / 8.25 / 8.25
After:	2 / 2 / 2	41 / 16	44	8.25 / 8.25 / 8.25
Violations Before: 0		Violations After: 0		

**2733**

	Current (A)	kW / kVAR	kVA	Voltage (kV)
Before:	9 / 9 / 9	204 / 81	219	8.22 / 8.22 / 8.22
After:	11 / 11 / 11	244 / 98	263	8.22 / 8.22 / 8.22
Violations Before: 0		Violations After: 0		

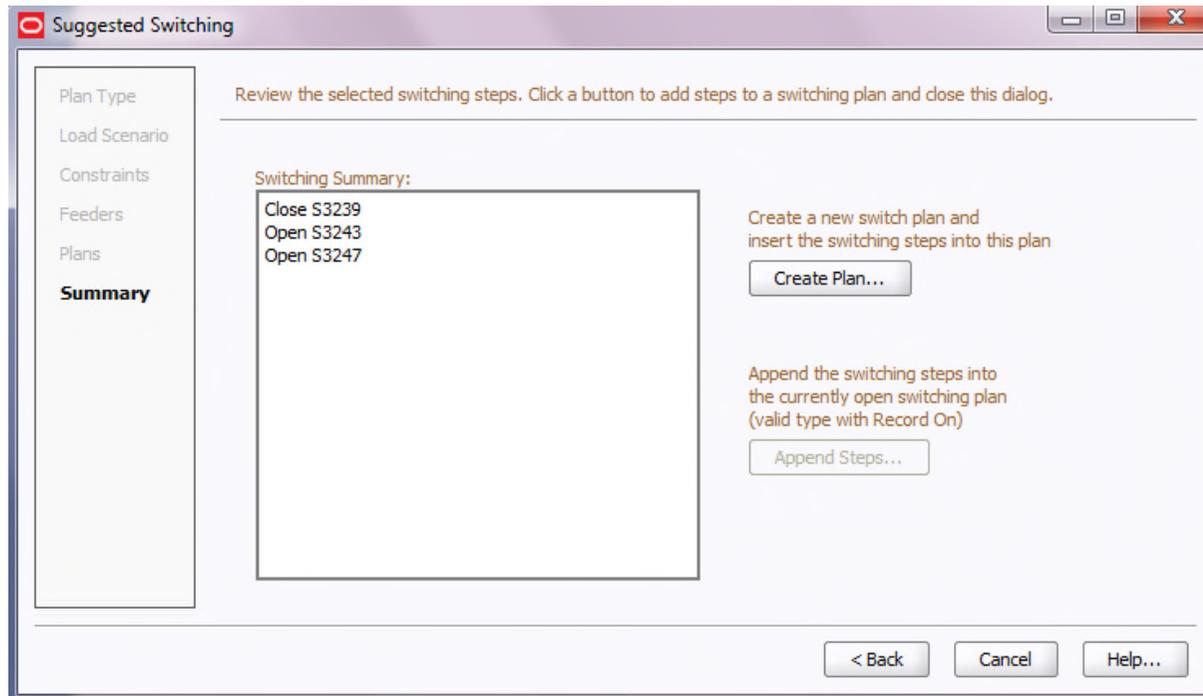
Feeder Violations:

View...

Isolate and Restore S3245P on Feeders 2022

Close Help...

## Review Switch Summary



## Review Switching Plan

A new switch plan is generated in the Web Workspace bottom right corner with the details shown in Switch Summary.

Step #	Version	Operation	Device	Phases
[-] Suggested Switcd	1			
[+] 1		1Close & Tag	S3239	ABC
[+] 2		1Open & Tag	S3243	ABC
[+] 3		1Open & Tag	S3247	ABC