

# Scheduled Actions Tool

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# Scheduled Actions Add-on Background

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- Feature requested by ISO New England
  - Used to visualize scheduled equipment outages
  - With specific formatting within a case
    - CROW CSV files can be loaded directly
    - CROW = (Control Room Operations Window)
- Implemented with the flexibility for other applications
  - Possible extension to replace current Time Step tool, or just use as another tool

# Additional Development (Summer 2016)

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- Return to Normal Status
  - Used between the application of time steps to update the status of scheduled actions that are not active
- Automatically Close Disconnects when Closing Breakers
  - Used in conjunction with option to return to normal status
  - Disconnects in series with breakers that are being closed will also be closed
- Validation on Device Outages in Scheduled Actions
  - Determines if specified actions are sufficient to isolate the specified device
- Filtering for Scheduled Actions Duration and Time
  - Added Duration field expressed in days with Scheduled Actions
  - Advanced Filtering modified to allow Start Time and End Time fields to be filtered on date/time

# Additional Development (Summer 2016)

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- Additional Calculated Fields for ScheduledAction Record
  - Normal Status, Derived Status, Derived Online, and Online
  - These show up in the Device Fields folder in the list of available fields
- Additional Stored Fields for ScheduledActionGroup
  - Reason/Comment, Outage Priority, CROW ID, Submitted By, Remote System ID, First Submitted Date/Time, Rev #, Last Modified Date/Time

# Additional Development (Fall 2016)

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- Auxiliary file support for Scheduled Actions settings
- Script command support for Scheduled Actions functionality
- Interface limit support in CROW file

# Additional Development (2017)

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- Normally open and normally closed disconnects
- Overlapping actions

# Scheduled Actions

## Case Objects



- **Scheduled Action**
  - Defines an action (Open, Close, Set To, Change By)
  - Specifies the target device (Branch, Shunt, Load, Generator, Interface)
  - Links to Scheduled Action Group for time data
- **Scheduled Action Group**
  - Defines the timeframe: Start Time and End Time
  - Specifies a Scheduled Action Status
  - Scheduled Actions link to the Action Group to determine their timeframe and status
- **Scheduled Action Status**
  - Provides organizational tags for action groups
  - Allows certain types of action groups to be view-only, never applying the actions to the system

# Scheduled Action Group



Scheduled Actions

Start Time: 10/12/2016 00:00  
View Time: 10/14/2016 00:00  
End Time: 10/29/2016 00:00  
Resolution: 1 Days  
Animation: 1 Seconds

Play Stop

Save Snapshot Set Reference

Schedule Groups Actions Statuses Gantt Chart Options

	Ticket Number	Description	Start Time	End Time	Status	Override Active
1	1-1		10/13/2016 00:00	10/14/2016 00:00	Preliminary	Inherit
2	1-2		10/13/2016 00:00	10/20/2016 00:00	Withdrawn	Inherit
3	1-3		09/01/2016 00:00	12/14/2016 00:00	Preliminary	Inherit
4	1-4		10/03/2016 00:00	11/04/2016 00:00	Negotiate	Inherit

Import Settings Identify Breakers Delete All OK Help Cancel

Group name, which uniquely identifies the group

Can set a group to be *Active* or *Inactive* regardless of its Status. If **Override Active = Inherit**, the Status will determine if active.



# Scheduled Action



Scheduled Actions

Start Time: 10/12/2016 00:00  
View Time: 10/14/2016 00:00  
End Time: 10/29/2016 00:00  
Resolution: 1 Days  
Animation: 1 Seconds

Play Stop

Save Snapshot Set Reference

Schedule Groups Actions Statuses Gantt Chart Options

	Ticket Number	Start Time	End Time	Device	Action	Field	Value	Allow Active	Conflicts
1	1-1	10/13/2016 00:00	10/14/2016 00:00	Branch '1' '2' '1'	Open	None	0	YES	
2	1-2	10/13/2016 00:00	10/20/2016 00:00	Branch '1' '3' '1'	Open	None	0	YES	
3	1-1	10/13/2016 00:00	10/14/2016 00:00	Gen '1' '1'	Open	None	0	YES	
4	1-3	09/01/2016 00:00	12/14/2016 00:00	Branch '3' '4' '1'	Open	None	0	YES	
5	1-4	10/03/2016 00:00	11/04/2016 00:00	Branch '6' '7' '1'	Open	None	0	YES	
6	1-4	10/03/2016 00:00	11/04/2016 00:00	Branch '6' '7' '2'	Open	None	0	YES	

Import Settings Identify Breakers Delete All OK ? Help X Cancel

Scheduled Action Group to which this action belongs

Setting **Allow Active = NO** will make this particular action not active regardless of its Group. For an action to be active its Group must also be active.

# Scheduled Action Status



Start Time: 10/12/2016 00:00

View Time: 10/14/2016 00:00

End Time: 10/29/2016 00:00

Resolution: 1 Days

Animation: 1 Seconds

Play Stop

Save Snapshot Set Reference

Schedule Groups Actions **Statuses** Gantt Chart Options

	Name	Active
1	Preliminary	YES
2	Submitted	YES
3	Withdrawn	NO
4	Negotiate	YES
5	Study	YES
6	Interim Approv	YES
7	Approved	YES
8	Denied	NO
9	Cancelled	NO
10	Implemented	YES
11	Completed	NO
12	Recalled	NO

Active determines if action will be applied. This can be overridden by options with the Schedule Group and Action.

Default Statuses are provided, but user can define whatever they want

Import Settings Identify Breakers Delete All OK Help Cancel

# Scheduled Actions GUI



- Gantt Chart
  - Customized case information display showing the interaction of Scheduled Action Groups over a specified timeframe
- Time control
  - Set the time window of interest with Start Time and End Time, set the display resolution, and set the specific time of interest
  - Scroll over the specified time frame with the slider and arrows, set a specific view time with the calendar control
  - Export a snapshot of the case at a specific point
  - Specify if active action groups should be applied to the case
- Animation control
  - Set Simulator to automatically scroll over the specified timeframe, holding each time step for a specified period

# Process Control



**Scheduled Actions**

Start Time: 10/12/2016 00:00 | View Time: 10/14/2016 00:00 | End Time: 10/29/2016 00:00 | Resolution: 1 Days | Animation: 1 Seconds

Buttons: Play, Stop, Save Snapshot, Set Reference

Schedule Groups | Actions | Statuses | Gantt Chart | Options

Ticket Number	Description	Start Time	End Time	10/12/2016 00:00	10/13/2016 00:00	10/14/2016 00:00	10/15/2016 00:00	10/16/2016 00:00	10/17/2016 00:00	10/18/2016 00:00	10/19/2016 00:00
1	1-1	10/13/2016 00:00	10/14/2016 00:00								
2	1-2	10/13/2016 00:00	10/20/2016 00:00								
3	1-3	09/01/2016 00:00	12/14/2016 00:00								
4	1-4	10/03/2016 00:00	11/04/2016 00:00								

Buttons: Import Settings, Identify Breakers, Delete All, **OK**, Help, Cancel

# Case Information Displays



- **In Outage?** field in case information displays indicates if an object is referenced by a current Scheduled Action
  - NONE – not referenced by a Scheduled Action
  - APPLIED – referenced and Apply Outages option is enabled. Highest priority.
  - INACTIVE – referenced and Scheduled Action Status has Active = NO
  - ACTIVE – referenced and Apply Outages option is not enabled
  - RESOLVED – previous view time the action was applied but in the current view time it is not applied. Lower priority than APPLIED.

	From Number	From Name	To Number	To Name	Circuit	In Outage?
1	1	One	2	Two	1	APPLIED
2	1	One	3	Three	1	APPLIED
3	2	Two	3	Three	1	NONE
4	2	Two	4	Four	1	NONE
5	2	Two	5	Five	1	NONE
6	2	Two	6	Six	1	NONE
7	3	Three	4	Four	1	NONE
8	4	Four	5	Five	1	NONE
9	7	Seven	5	Five	1	NONE
10	6	Six	7	Seven	1	INACTIVE
11	6	Six	7	Seven	2	INACTIVE

# CROW CSV Files



- Load into Scheduled Actions tables to create groups and actions
- Default options will read Trans\_Outage and Gen\_Outage file types
  - Specific fields must be available within the files
- Identify objects by Labels
  - Specific label format is required

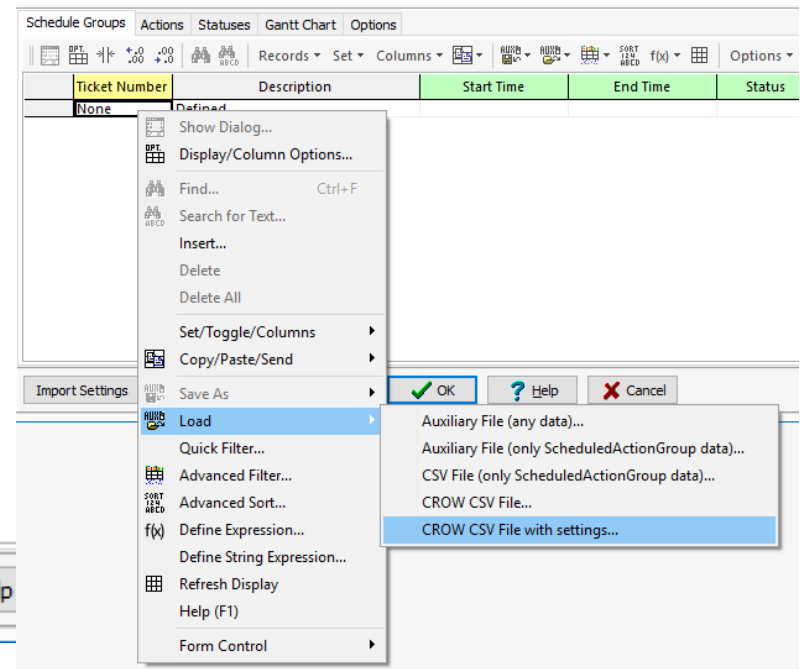
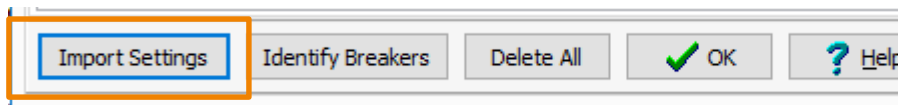
```
Trans_Outage,PROBENE,Version 101,Hour Beginning,20120616  
TICKETNUM,OUTAGE_NAME,CO_SHORT_NAME,STARTDT,ENDDT,STATUS,SUBMITDT,BPC_CUTOFF,EQUIPTYPE,STATION,VOLTAGE,EQUIPNAME,EVENTSTATUSCHANGE,EQUIPSTARTDT,EQUIPENDDT  
1-08000074,1-08000074C64,,9/3/2008 8:00,8/1/2012 0:00,Implemented,,,Line,SUB1,138,BRANCH_2_3,0,9/3/2008 8:00,8/1/2012 0:00
```

```
Gen_Outage,PROBENE,Version 101,Hour Beginning,20120616  
TICKETNUM,OUTAGE_NAME,STARTDT,ENDDT,UNITPNODEID,STATION,VOLTAGE,EQUIPNAME,OUTAGETYPE,PHYSICALREDUCTION,FCMEXEMPTMW  
1-12000209,1-12000209Lowd,6/1/2012 0:00,7/1/2012 0:00,1,SUB1,,GEN1,1,13.5,0
```

# CROW CSV File With Settings



- Allows non-default formats to be user-defined based on the headers in the file
- Specify file and Simulator will determine the headers
- Specify headers and field values to determine the action parameters



# Device Mapping



Specify the column within the CROW file that contains the device code that identifies the type of device

Map the devices within Simulator to the device codes within the file

Device Types	Device Code(s)	Preferred Label Format
Generators	UN	Unit
Branches	LN,ZBR	Line
Switched Shunts	CB	CB
Loads	LD,XF	XF
Interfaces		CB
Injection Groups		

Create label formats for different types of devices

Specify which label format should be used for each type of device



# Label Formats



Name of the label format

Specify columns from the CROW file to use as part of the label

Specify the format of the label using the columns identified above and any appropriate delimiter. Labels must match those that have been created with the case data.

# Action Definition



Specify the default action to take

Specify the column within the CROW file that contains the value of the action

Specify the column within the CROW file that contains the action to be done

Scheduled Action CSV Import Settings

Header line: First File: G:\Caroline\PowerWorld Training - Schedule Action Browse

Device Mapping Action Definition Outage Definition

Action Header: Eq Outage Status Default Action: Open Value Header: Deration

Action Mapping Values

- Open
- Close
- Open Breakers
- OpenCB
- Close Breakers
- Closed

Custom Actions

Custom Action Code	Action Type	Device Type	Target Field	Find
Derate to	Set To			Find
				Find
				Find
				Find

Save to AUX Load from AUX OK Help Cancel

Map the action string contained in the CROW file to the appropriate action within Simulator

More complicated actions can be mapped to Simulator actions through custom definitions

# Outage Definition



Specify columns from the CROW file to use for identifying the outage grouping to which the action belongs

Scheduled Action CSV Import Settings

Header line: First File: G:\Caroline\PowerWorld Training - Schedule Action Browse

Device Mapping Action Definition Outage Definition

Outage ID CROW ID

Description Description

**Start Time** Start Date & Time

**End Time** End Date & Time

Outage Status Outage Status

Default Status Preliminary

Save to AUX Load from AUX OK Help Cancel

# Options



- Apply Actions
  - Must be checked for actions to actually be implemented in the case
  - Immediately after checking this option system state is stored for use in restoring at beginning of a time step
  - Immediately after unchecking the stored system state is restored
  - When either checking or unchecking the currently selected time step is applied
- Use Normal Status
  - Restore normal status for any scheduled action that is not in range for the current view time

# Options



- Apply Within Resolution
  - *Resolution* defines how forward in time you are going to go
  - All actions within window from current instance in time (*View Time*) to the next possible time defined by the *Resolution* will be applied
  - Assume *View Time* = 5/20/17 1:00 PM and *Resolution* = 7 days
    - Any action that is active at ANY point during 5/20/17 1:00 PM and 5/27/17 1:00 PM will be applied

# Options



- Switch Disconnects to Normal Status in Open and Close Breakers Actions
  - This attempts to handle power flow cases that might have *Disconnects* at a status other than their normal status and *Disconnects* are not explicitly defined as part of the scheduled actions
  - Typically only *Breakers* are opened or closed when using the breaker actions, which could cause the final topology to be incorrect if disconnects are not in their normal status
  - *Action Type = Open Breakers*
    - Any *Disconnects* that are currently closed but normally open will be opened, and the search for *Breakers* will terminate
  - *Action Type = Close Breakers*
    - Any *Disconnects* that are currently open but presently closed will be closed, and the search for *Breakers* will continue looking for open *Breakers*

# Conflicts



- *Check Conflicts* button populates *Conflicts* field for a Scheduled Action with a string indicating that there is another action for the same device being applied at the same time
- Conflicts are also checked for Set To actions when attempting to apply actions
  - Limits on interfaces must be lower than their current value
  - Gen minimum limit must be greater than current value
  - Gen maximum limit must be less than current value

# Applying a Time Step

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- **Apply Actions** option

- TRUE

- Restore stored system state
    - If **Use Normal Status** option is TRUE
      - Restore normal status for any scheduled action that is not in range for the current time
    - Apply actions that are active for the current time

- FALSE

- No actual changes are made to the system
    - Only GUI and other formatting changes are made



# Return to Normal Status Process

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- Only branches are affected
  - Breakers must be explicitly defined with a scheduled action to be included
  - If a scheduled action is defined using the *Open Breakers* action, those breakers are not identified in this process
- Only branches that are part of scheduled actions that are in range for the current time
  - Branches that are not part of a defined scheduled action will not be considered
- If the **Status** of the branch does not match its **Normal Status** the Status will be changed to reflect the Normal Status
- If **Branch Device Type** = *Disconnect* and is open but normally closed, it will be closed if it is within the confines of the defined outage without being explicitly defined with the outage

# Identify Breakers Functionality

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- Determines if specified actions are sufficient to isolate or connect the specified device
- Possible starting points
  - Present system topology
  - Topology with all branches set to normal status
- **Origin** field with Scheduled Action
  - User
    - Action was defined by the user
  - Added
    - Breaker action was added by the validation process
  - Extra
    - Object was identified as also being isolated/connected by breaker actions
    - *Allow Active* field set to NO to indicate that this is for information only

# Identify Breakers Process



- Store present system state for restoration at end of process
- Optionally, set all branches to Normal Status
  - This is done for all branches and not just switching devices
- All scheduled actions in a schedule group are processed together
  - Identify all switching and non-switching devices
    - Switching devices are those with Branch Device Type = *Breaker, Load Break Disconnect, Disconnect, Fuse, Ground Disconnect*
  - For any switching device, open or close it if its action is OPEN or CLOSE (not OPEN BREAKERS or CLOSE BREAKERS)
    - Do the close actions first and then the opens

# Identify Breakers Process



- Update system topology
- For any non-switching device, determine if it should be either connected or disconnected based on its action of OPEN BREAKERS or CLOSE BREAKERS
  - Identify the *Breakers* and *Load Break Disconnects* necessary to either connect or disconnect the device
  - Actually change the status of the newly identified switching devices
    - Do the close actions first and then the opens
  - Add new scheduled actions for the new switching devices
    - Mark these as **Origin** = *Added*
  - Update system topology

# Identify Breakers Process

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- Go through all devices and determine if any new ones have been identified that either open or close because of switching device changes
  - Add new scheduled actions for these extra devices
  - Mark these as **Origin** = *Extra*
- Restore status of changed switching devices
- Repeat for new schedule group
- Restore system state to state stored at beginning of validation process

# Script Commands

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- IdentifyBreakersForScheduledActions(IdentifyFromNormalStatus)
- SetScheduleView(ViewTime, ApplyActions, UseNormalStatus, ApplyWindow)
- SetScheduleWindow(StartTime, EndTime, Resolution, ResolutionUnits)