What's New in Simulator Version 21

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What's New in Version 21

- Version 21 is a version with many, many, many small changes throughout
- Concentration has been on improving existing features
  - Transient Stability
  - Remedial Action Schemes (RAS) with Transient Stability
  - Difference Case Tool
- New features
  - Voltage Droop Control with power flow
  - Voltage Setpoint Tolerance with power flow
  - Contingency violation sensitivities
  - PV branch and interface violations
- These are the highlights

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64-bit Simulator

- This was introduced in Simulator 20
- 32-bit is no longer available
- Only 64-bit version is installed

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Auxiliary Files

- When loading a complete case in the auxiliary file format, only certain script commands that create or edit data or commands that do not directly affect data, such as log file manipulation, are allowed
  - Any script commands that do analysis, such as SolvePowerFlow, are not allowed and will be treated as a fatal case load error
  - A complete case load requires some additional checks that are not done when simply loading an auxiliary file and errors can occur if analysis is done prior to these checks
    - Loading a case that is in the auxiliary file format should always be done using an Open Case command and should never be done using a Load Auxiliary command

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Auxiliary Files

- An interface element will meet the Area/Zone/Owner filter if its interface meets the filter. An interface will meet the filter if at least one of its elements meets the filter.
- Added the ability to use @MODELFIELD syntax for the following fields
  - Transient_Options
    - ExpDirectory
  - PVCurve_Options
    - PVCOutFile, PVCQVOptionsFile, PVCStoreStatesWhere
  - QVCurve_Options
    - QVOutputDir
  - CTG_Options
    - CTGPostSolAuxFile, PostPostAuxFile, CTGResultStorageFile:1
  - Sim_Environment_Options
    - SEOSpecifiedAUXFile:0, SEOSpecfiedAUXFile:1, SEOSpecifiedAUXFile:2
  - MessLog_Options
    - LogAutoFileName

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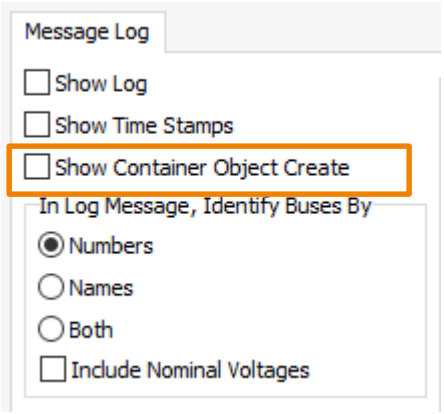
Auxiliary Files

- *Show Container Object Create* option for Message Log
  - There are several object types that are contained inside other object types, e.g. a ContingencyElement is contained in a Contingency or a ModelConditionCondition is contained in a ModelCondition
  - When the *contained* objects are found, the *container* objects will automatically be created
  - Red warning messages have been added to the log when this occurs and can be controlled by this option



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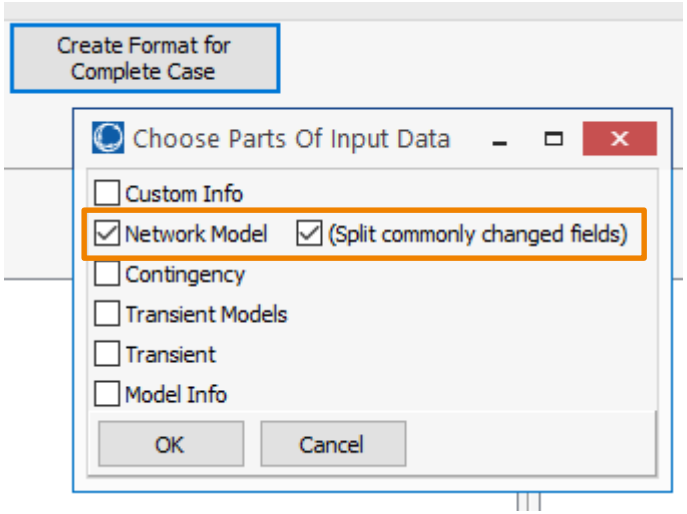
Auxiliary Files

- AUX Export Format Description definition has a new option to make it easier split out fields that can commonly change, e.g. bus voltage and angle, generator status and output, load status and output, etc.
  - This mimics what occurs when saving data from the Present Topological Differences from Base Case tool



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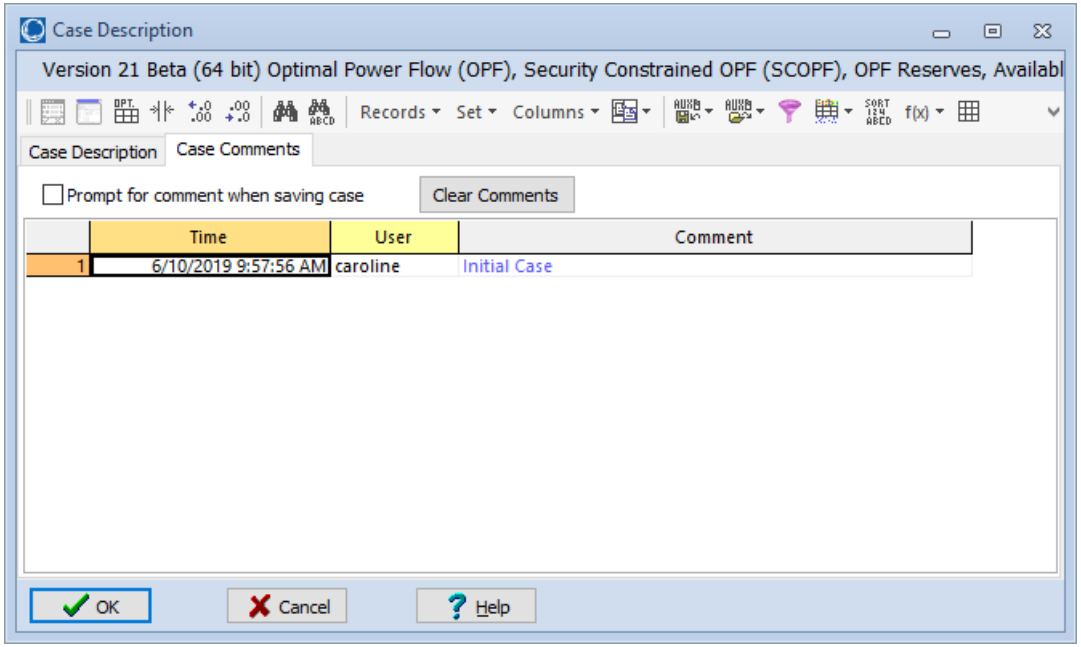
Auxiliary Files

- When creating a Case Comment through a script command or aux file, a blank *User* and *Time* can be specified to default to current user and time

```
CreateData(CaseComment, [DateTime, CaseCommentUser, CaseComment],
["", "", "Initial Case"],);
```



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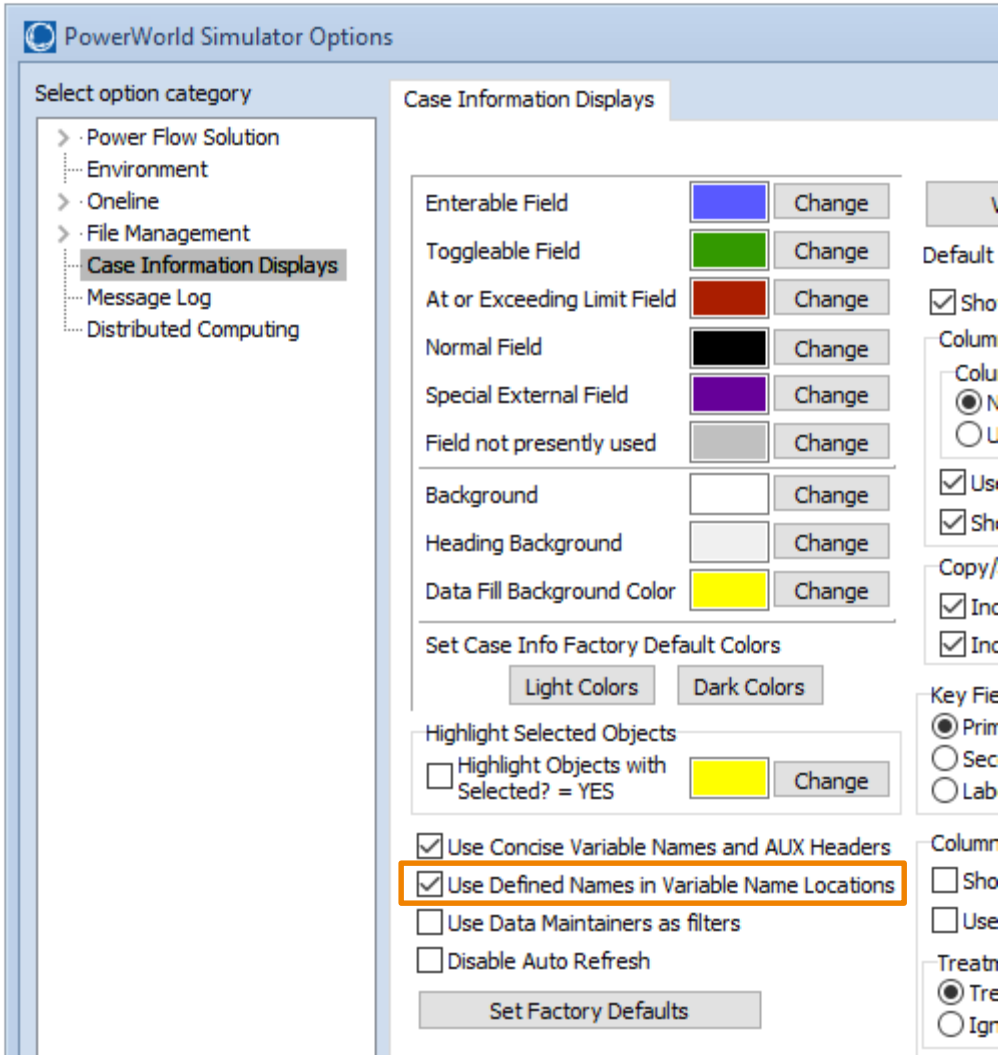
Auxiliary Files



- Added *Use Defined Names in Variable Name Locations* option to the Case Information Display options
  - Displays certain fields that can be user named (CustomFloat, CustomInteger, CustomString, CustomExpression, CustomExpressionStr, DataCheck, DataCheckAggr, and CalcField) to be shown with the name replacing the location number
    - *CustomFloat:1* will appear as *CustomFloat:MyName*

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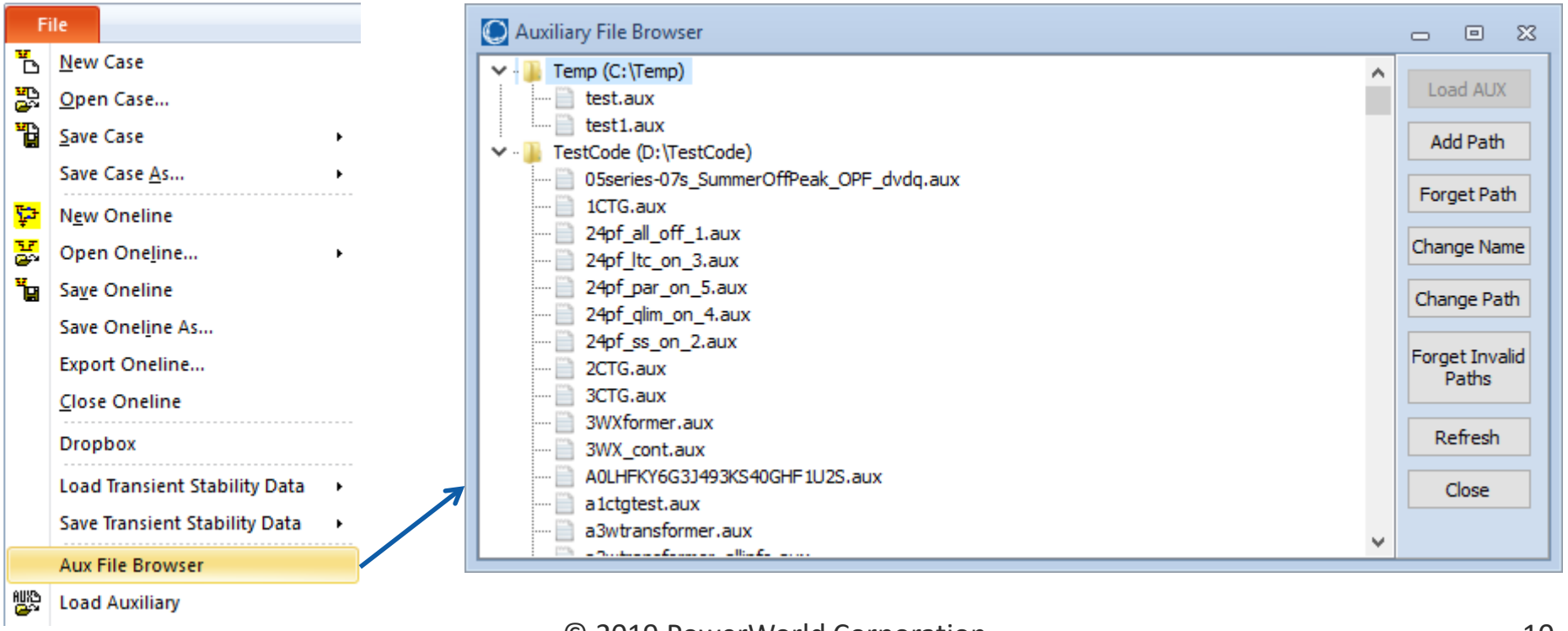
Auxiliary Files
Aux File Browser

- Allows quicker access to loading auxiliary files by allowing user specification of directories most used
- Dialog can remain open for repeated use



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New Script Commands

- ClearSmallIslands
- DeleteState
- DiffFlowShowPresentAndBase
- DiffFlowWriteBothEPC
- DiffFlowWriteCompleteModel
- DiffFlowWriteNewEPC
- GICLoad3DEField
- InterfaceCreate
- PanAndZoomToObject
- ScheduledActionSetReference
- TSClearAllModels
- TSSaveBPA
- TSSaveGE
- TSSavePTI
- TSWriteModels
- VerifyDistributedComputersAvailable

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Script Command Modifications

- OpenOneline
  - Added parameter Script to specify a script command to be executed on the newly opened oneline
- SendToExcel
  - Added three additional parameters
    - ClearExisting – YES means to clear the existing sheet
    - RowShift – Set to a positive integer to shift the paste of data down by that number of rows
    - ColShift – Set to a positive integer to shift the paste of data to the right by that number of columns

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Script Command Modifications

- The & syntax can now be used to reference a Model String Expression to specify the value of a field in a script command
- ZeroOutMismatches
  - Added parameter Load to indicate that fake loads should be created to zero out the mismatches instead of changing ShuntG and ShuntB of the bus
- CalculateLODFAdvanced
  - Added parameter IncludeIslandingCTG to allow exclusion of contingencies that create islands
- OpenCase
  - Added parameter MSDummyBus to be used when opening EPC files that indicates how to assign multi-section line dummy bus numbers
  - File type OPENNETEMS is now supported
- StoreState and RestoreState
  - Added StateName parameter to allow user-named system states

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Script Command Modifications

- <PROMPT…> feature
  - Added InitialDirectory parameter to allow specification of the directory in which the file dialog will open
  - Clicking Cancel on the file selection dialog will cancel the script command and any remaining commands in the auxiliary file

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Case Information Displays

- New functions for use in Custom Expressions and Model Expressions
  - Text(floatvalue, "formatstring") – returns a string with the floating point number converted to a date time string using the specified format
  - DateValue("datetimestring") – returns a floating point number representing only the integer part for the date/time floating point
  - TimeValue("datetimestring") – returns a floating point number representing only the fractional part for the date/time floating point
  - DateTimeValue(“datetimestring") – returns a floating point number representing the date/time floating point
- Data Maintainers can be specified as part of the filtering when setting the Area/Zone/Owner filter

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Case Information Displays

- On the Multi-Terminal DC Line and Two-Terminal DC Line case information displays added a right-click option on a selection of devices to *Remove Device and Convert to Equivalent Loads*
  - *A*dds new load objects, which replace the MW and Mvar injections coming from these devices, and then deletes the DC system device
- The local menu of the Mismatch case information display contains option to *Zero-out Mismatch Values with Loads*
- *Number* field has been added to Island objects so that islands be consistently identified for buses, generators, etc.
- Custom Expressions can now reference any model field

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Case Information Displays

- Added *AllowEdit* field with a Data Maintainer that if set to NO will not allow any fields to be modified for objects that belong to this Data Maintainer
- Added a new field *Unit Type EPC* for generators to translate the Unit Type into the integer turbine type documented in the WECC Data Preparation Manual
- Short-cut keys
  - Ctrl + Q → Open Quick Filter dialog
  - Shift + Alt + A → Save Auxiliary File for Selected Records All Columns
  - Ctrl + Shift + A → Save Auxiliary File for Selected Records Selected Columns
  - Ctrl + Alt + A → Save Auxiliary File for All Records All Columns

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Case Information Displays

- Added *Solution Detail* field with Case Information object that indicates whether or not the last power flow solution was successful
- Added *% of Amp Limit (Max), % of Amp Limit at From Bus*, and *% of Amp Limit at To Bus* field for a branch object to show flow based on the presently selected limit set with the Limit Monitoring Settings
- Added fields for showing the flow as a percent of the respective limits in Amps and MVA for all branch limits that are available

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Case Information Displays

- Added ability to compare DateTime values to fields in an Advanced Filter
- Branch has *Lockout* field when set to YES will prevent the status of the branch from being changed through the GUI

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File Formats

- PSLF DRW
  - Added ability to open these files as oneline diagrams
- OTGD file
  - Added ability to load this file that represents transient stability contingencies
- RAW file
  - Working on full support of version 34
  - Planning models can be read
- PTI CON
  - Added ability to write out three additional action types
    - BLOCK TWOTERMDC 'name' // Opens the DC line
    - SET TWOTERMDC 'name' to 12.34 MW
    - SET TWOTERMDC 'name' to 12.34 Amps
  - A VSC DC line OPEN action will be written as a BLOCK VSCDC action
- hdbexport CSV file
  - Added message to log when reading a file and the option to translate the DC system into multi-terminal DC systems is set to Always or Prompt and no DCLN records exist in the case
- ASPEN RAT file
  - Relay models can be created from this file
- CIM
  - Working on supporting this for CAISO but the files provided by CAISO do not contain bus voltages and angles
- OSI OpenNet
  - Added ability to open these files
- Comtrade
  - Added ability to save results shown in the Results from RAM case information displays for transient stability directly to this format

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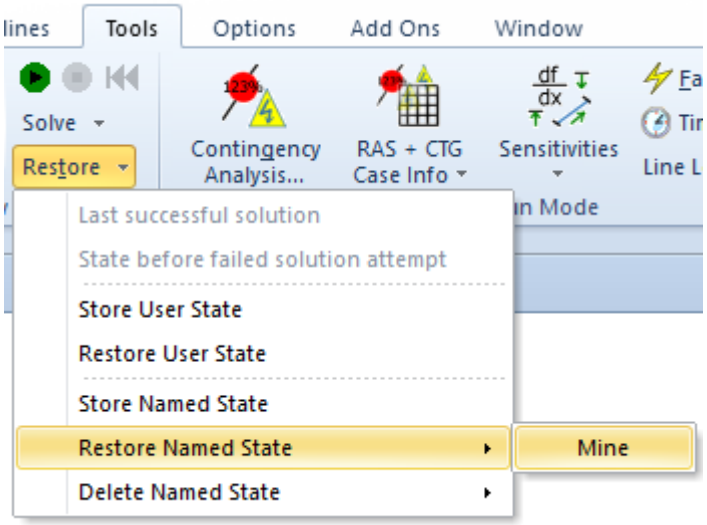
General

- User specified system state storage options on Tools tab
  - Store User State
  - Restore User State
  - Store Named State
  - Restore Named State
  - Delete Name State



- Case Information object
  - Calculated fields are now supported that will allow calculations on all objects in the case
  - New fields for high and low voltage and highest branch loading

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General

- Generator OPEN and Load OPEN elements can now be included in an interface
  - This has been integrated in the calculation of the AC power flow solution, linearized DC power flow solution, PTDF calculation, and the sensitivities and flows needed to perform the OPF solution
- *Clear Small Islands* option under Tools → Other
  - Opens all generators in the case that do not belong to the island with the largest number of buses

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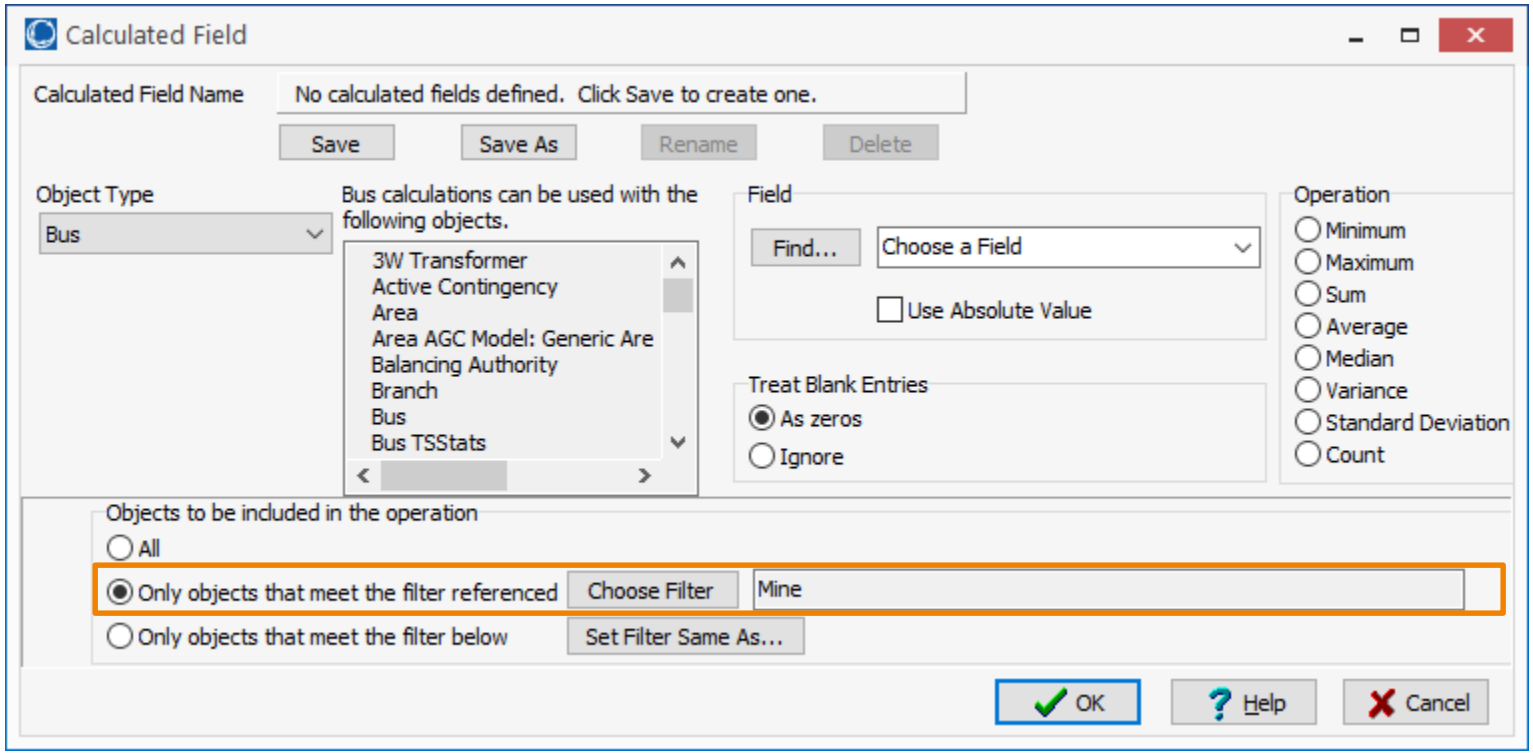
General

- Calculated Fields can more easily reference an Advanced Filter instead of requiring the advanced filter be embedded in another filter



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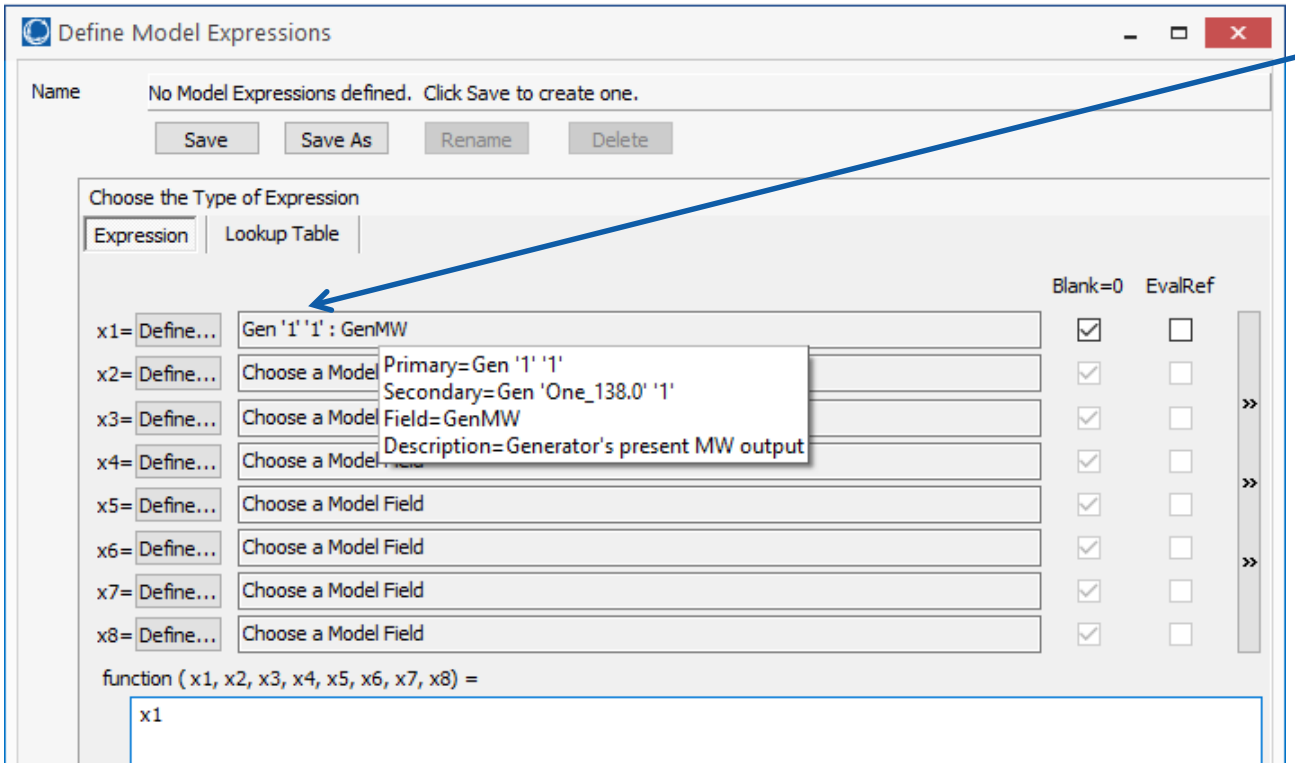
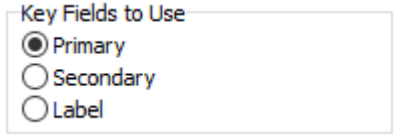
User Interface Dialogs

- Model Expression dialog hover hints provide more details about the variables



Identifier determined by the Key Fields to Use in Case Information Displays



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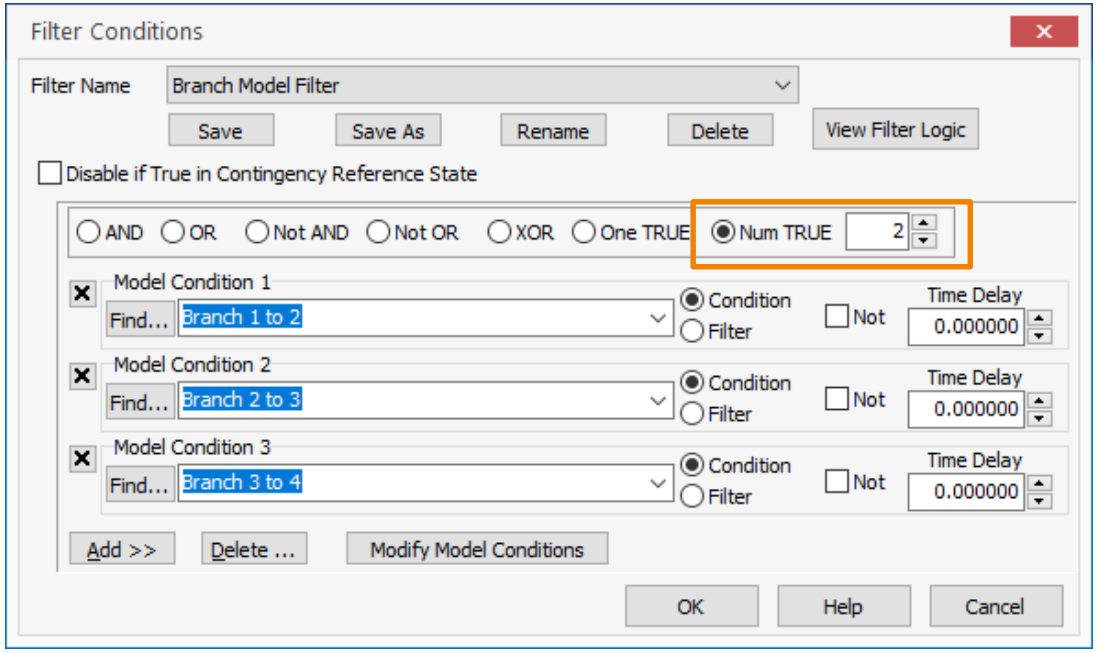
Filtering

- NumTrue logic
  - Specify the number of conditions that must be true for the logic to be true
  - GOR in hdbexport remedial action scheme definitions map to this
  - Available with Advanced Filters, Model Conditions, and Model Filters



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Difference Case Tool

- When saving case changes to an auxiliary file, a section is included to change the owner of buses in the following situations
  - Owner of bus has changed between the Present and the Base Case
  - A new device has been added that is attached to the bus and the owner of the new device is different than the owner of the bus in the Base Case
  - A new device has only one owner
- Owner filtering is now supported for the Removed objects in the Present Topological Differences from Base Case dialog
- Data Maintainer filtering can be used to specify which objects to write to file
- Case Info Customizations are available for all case information displays found on the Present Topological Differences from Base Case dialog
  - *Remove Field Customizations for All Differences Tables* button will remove any customizations and set all case info displays back to default

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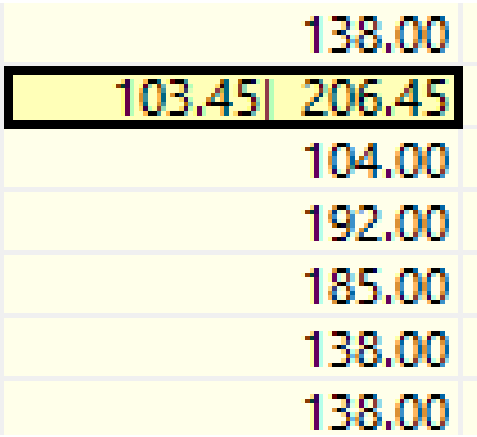
Difference Case Tool

- When showing some values in difference flows the Present Value is followed by a | character followed by the Base Value such as " 103.45| 206.45"
  - The | character may be truncated depending on the column width
  - Without the | character it is confusing as to whether the value has changed or not
  - To avoid this confusion, the background color of cells shown in difference flows that contain a | character with be slightly different to indicate the value has changed



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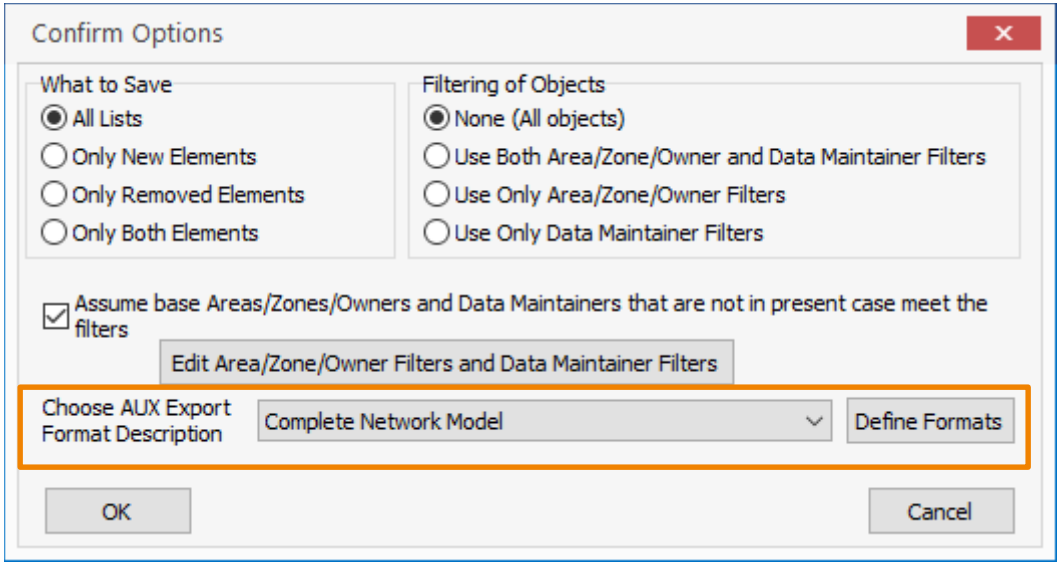
Difference Case Tool

- When saving differences to an auxiliary file for the Complete Model, an AUX Export Format Description can be specified
  - The format will determine the objects that are saved for NEW, BOTH (changed), and REMOVED types of objects
  - The format will determine the fields for NEW and BOTH (changed) types of objects, but any required fields will also be included with NEW objects



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Difference Case Tool

- DiffChangeTolerance object
  - Specify the tolerance used during Change model to determine if a floating point number has changed enough to be considered different
  - Some fields require a smaller tolerance
    - Bus
      - Angle, Per Unit Voltage, Radian Angle, Latitude, and Longitude
    - Substation
      - Latitude and Longitude
  - Default for all other fields is 0.0001% (6 significant digits)

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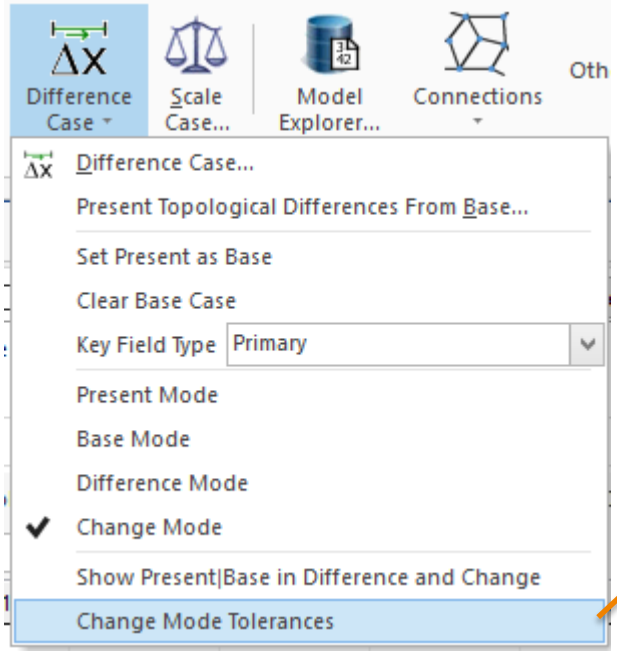
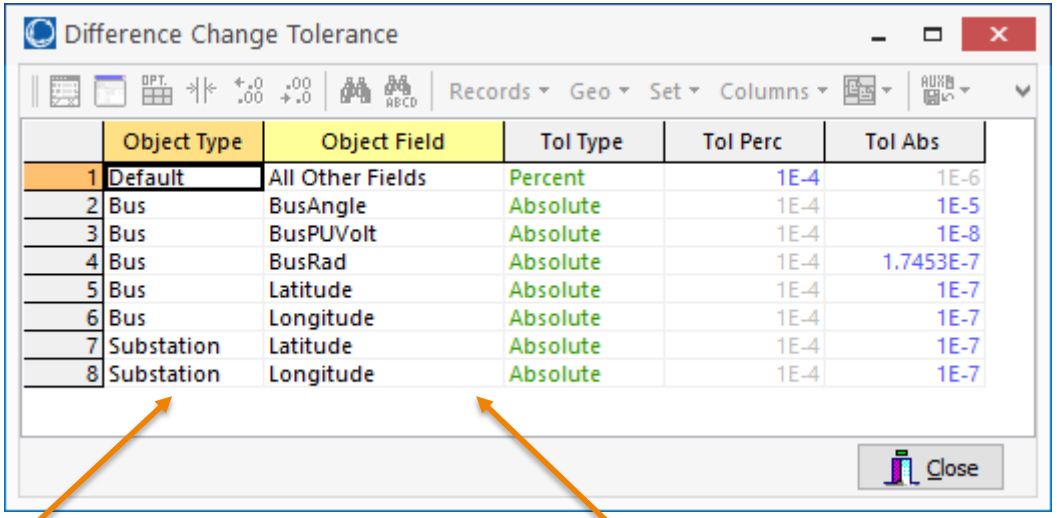
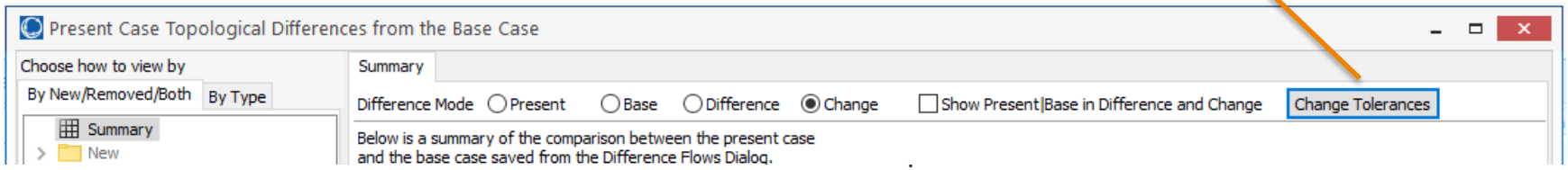
Difference Case Tool
Difference Change Tolerance

- Difference Change Tolerance Case Information display can be accessed from the Difference Case dropdown or from the Present Topological Difference Case dialog

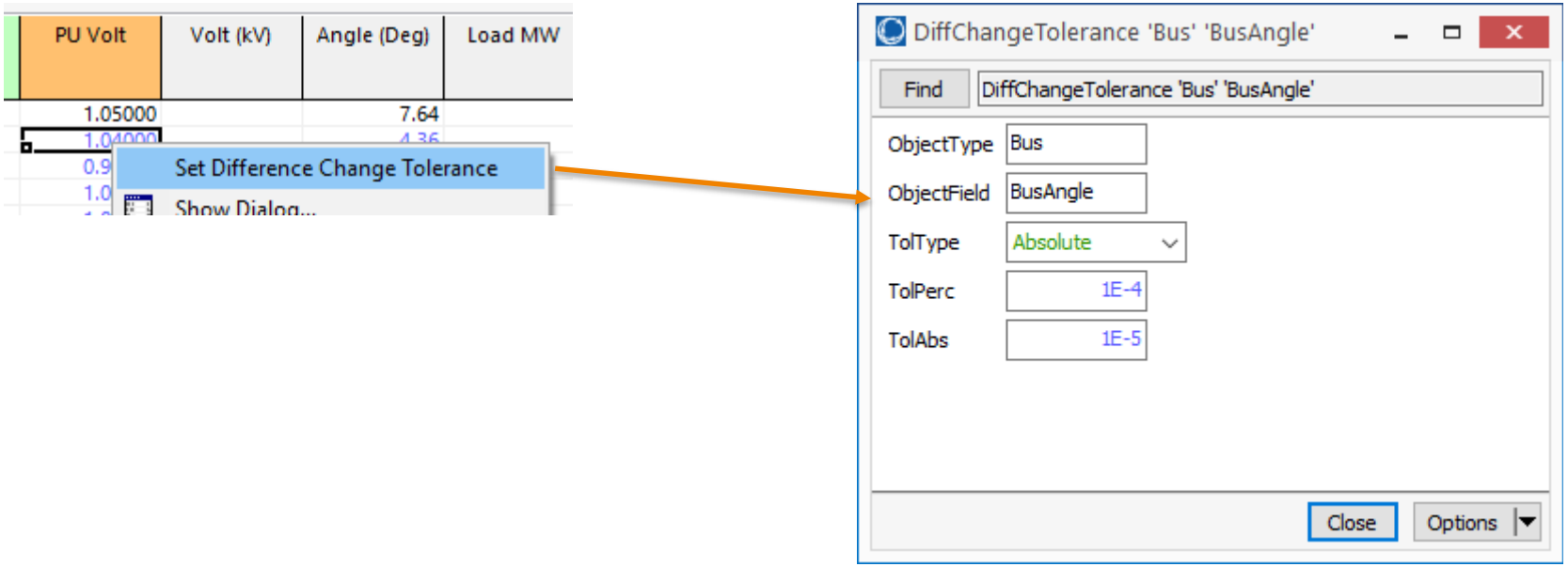






Difference Case Tool
Difference Change Tolerance

- While in Change mode can right-click on a field and select *Set Difference Change Tolerance*
- This will open a dialog that allows changing the tolerance for this particular field



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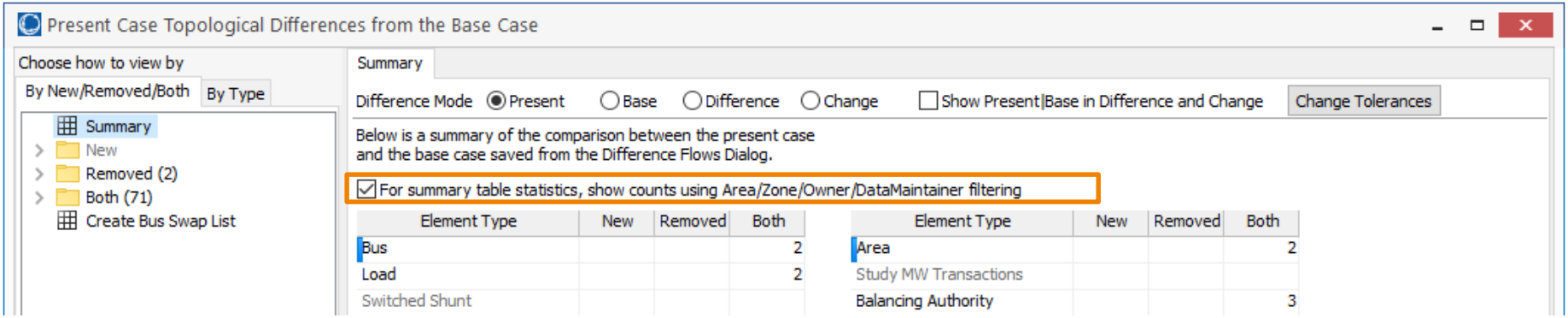
Difference Case Tool

- Area/Zone/Owner/Data Maintainer filtering can be applied to the summary table in the Present Topological Differences from Base Case dialog



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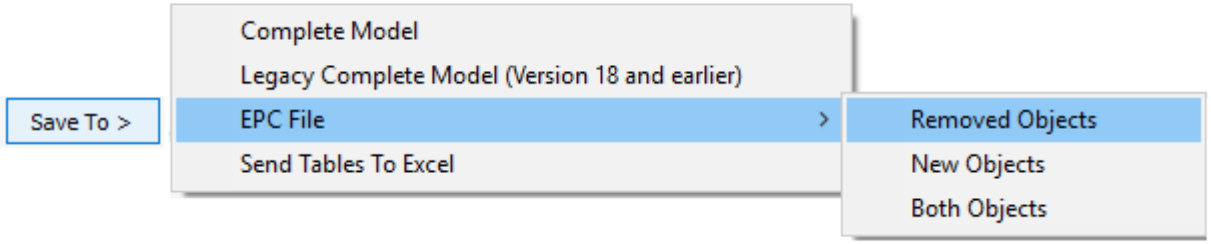
Difference Case Tool

- Added options on Present Topological Differences from Base Case dialog to save Both and New objects in EPC format



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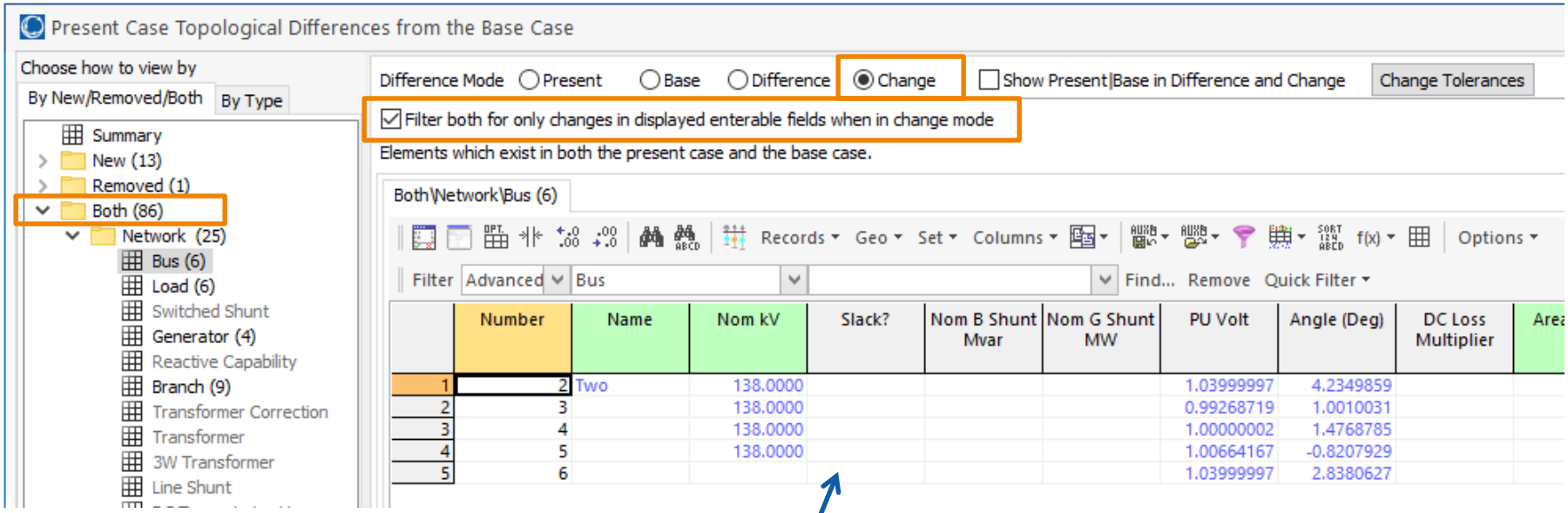
Difference Case Tool

- *Filter both for only changes in displayed enterable fields when in change mode*



This is only showing the objects that have fields that have changed

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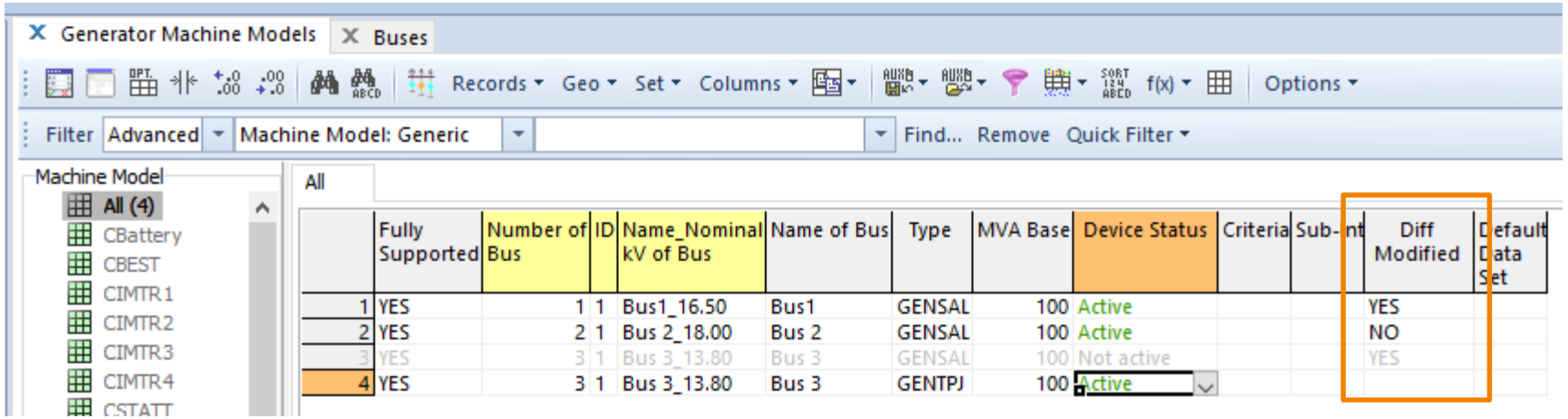
Difference Case Tool
Transient Stability Models

- *Diff Modified* field with all transient stability models
  - YES if a model parameter, *Device Status*, *Criteria,* or the reference to another object have changed between the Present and Base case
  - Blank if a model exists in the Present case that was not in the Base case



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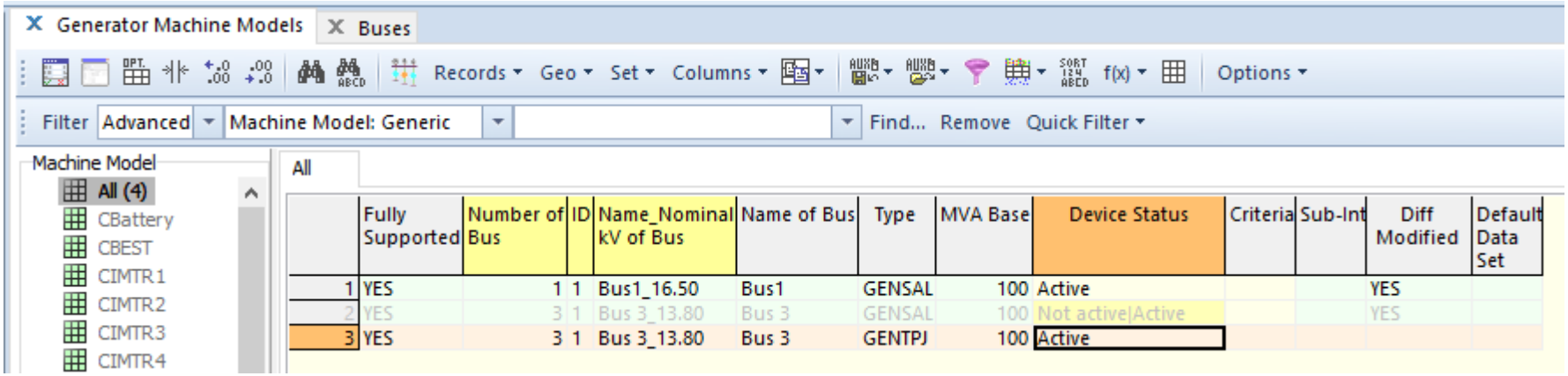
Difference Case Tool
Transient Stability Models

- When in Difference Case Mode of either Change or Difference, all case information displays showing transient stability models will only show stability models that have been modified (*Diff Modified* = YES or blank)



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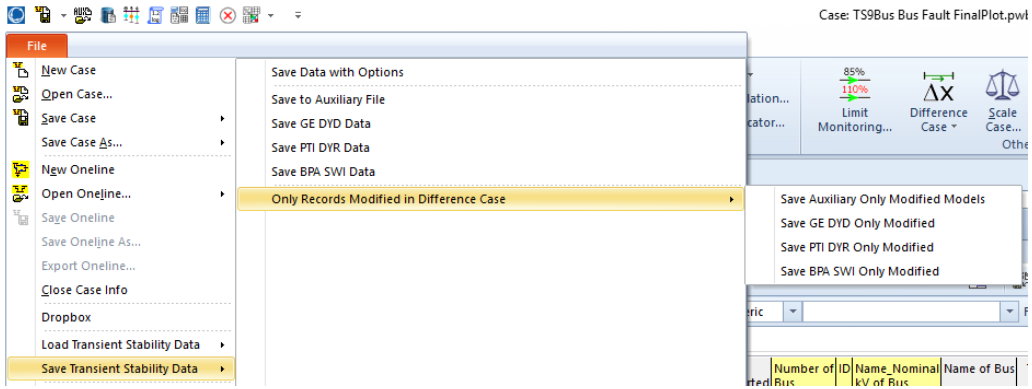
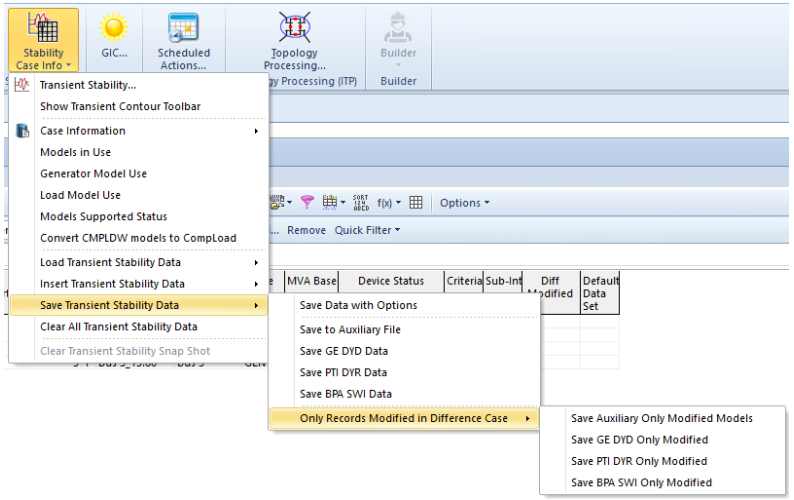
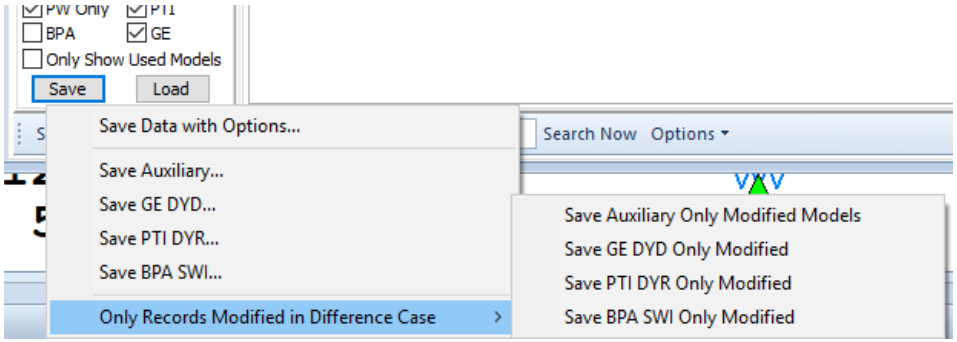
Difference Case Tool
Transient Stability Models

- Added the ability to use the Difference Case tool to save ONLY the changes in transient stability models to either an AUX, DYD, DYR, or SWI file







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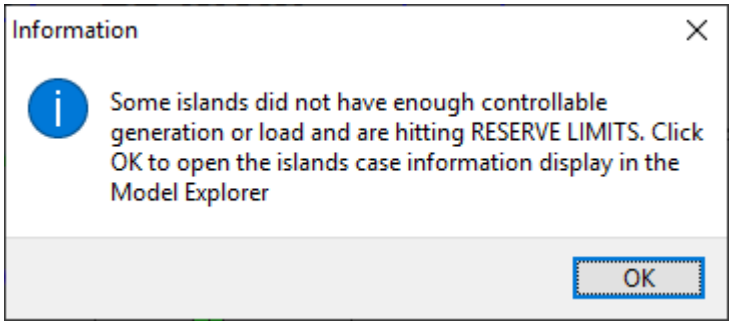
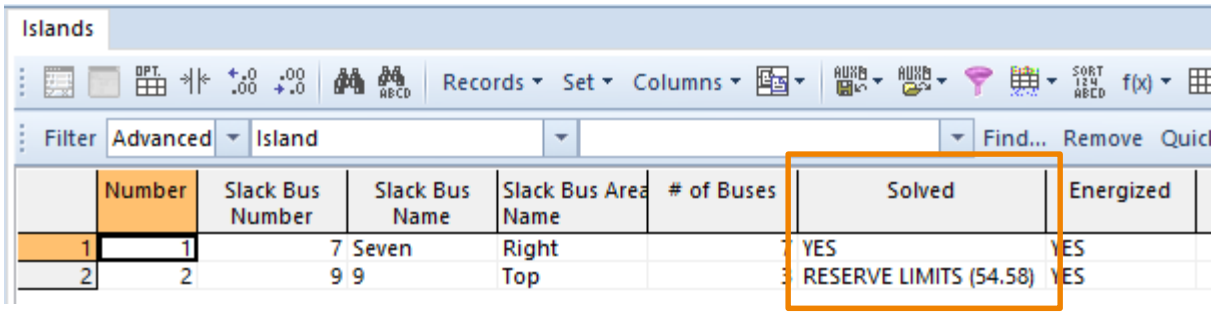
Power Flow Solution

- After solving the power flow a dialog might appear indicating that islands did not have enough controllable generation and are hitting reserve limits
  - The islands case information display can then be opened from this dialog and the *Solved* field will indicate if an island is at RESERVE LIMITS
  - This dialog will appear when solving the power flow using the following options
    - Through the GUI using the *Solve Power Flow* button
    - Using the advanced power flow solution option to *Evaluate Power Flow Solution for Each Island*
    - NOT using the option to *Disable Showing Blackouts*





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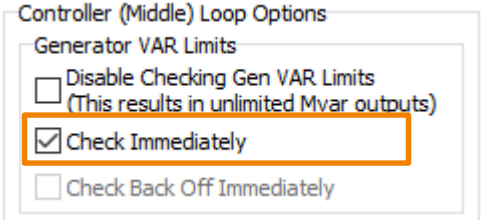
Power Flow Solution

- *Check Generator Mvar Limits Immediately*
  - Generators are allowed to hit limits only for the first two voltage control loop iterations



    - After that they will only be allowed to back off limits
  - Limits will only be enforced if the Mvar output goes outside of a Mvar limit PLUS a deadband of 10% of the total Mvar Range

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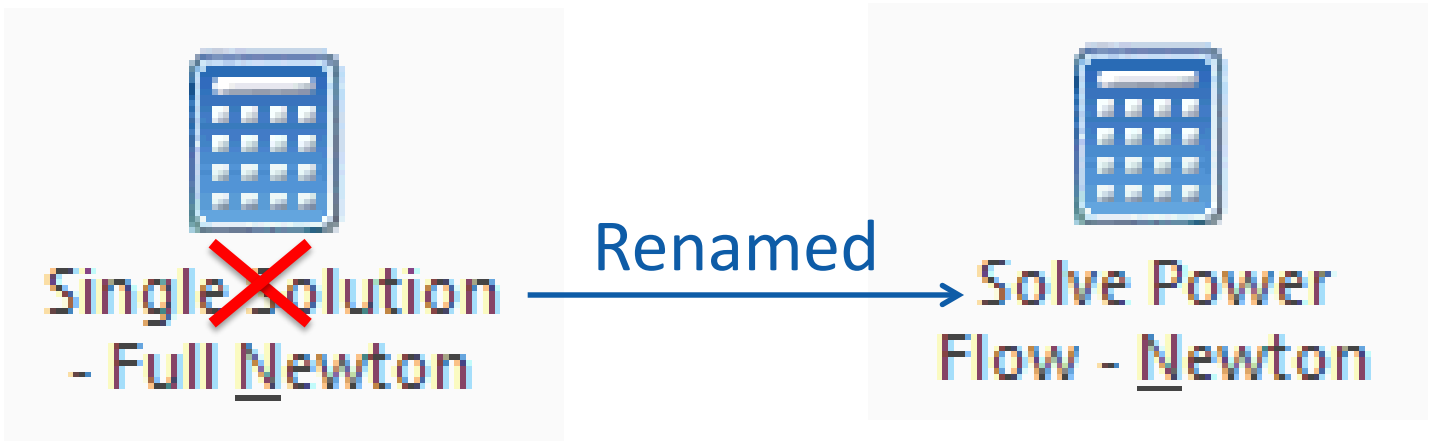
Power Flow Solution



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Power Flow Solution

- Voltage Droop Control
  - Allows specification of renewable plant Q-V characteristic at point of interconnection
  - See separate presentation
- Voltage Setpoint Tolerance
  - Allow generator voltage control closer to reality
  - See separate presentation

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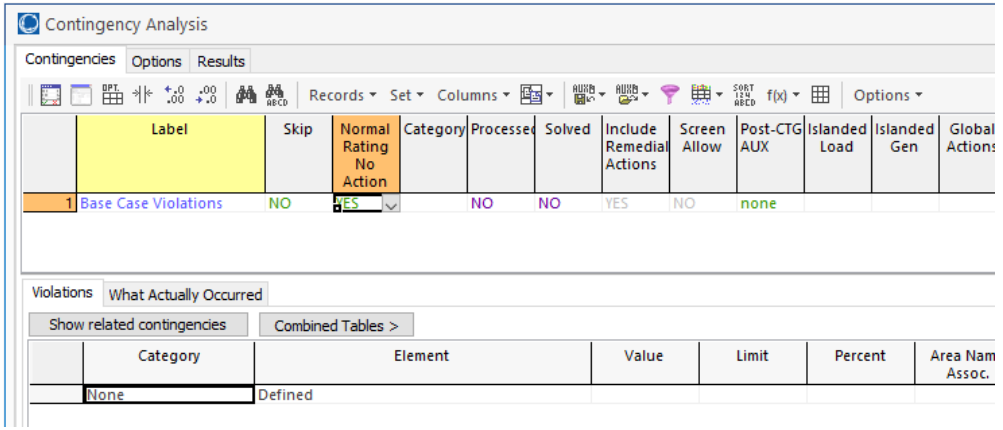
Contingency Analysis
Base Case Violations

- Base case (reference state) violations can be recorded in the same format (LimitViol and ViolationCTG objects) as contingency violations
  - *Normal Rating No Action* field must be set to YES with a contingency that has no elements defined
  - Violations will be determined using the Normal Rating Set specified with the Limit Monitoring Settings



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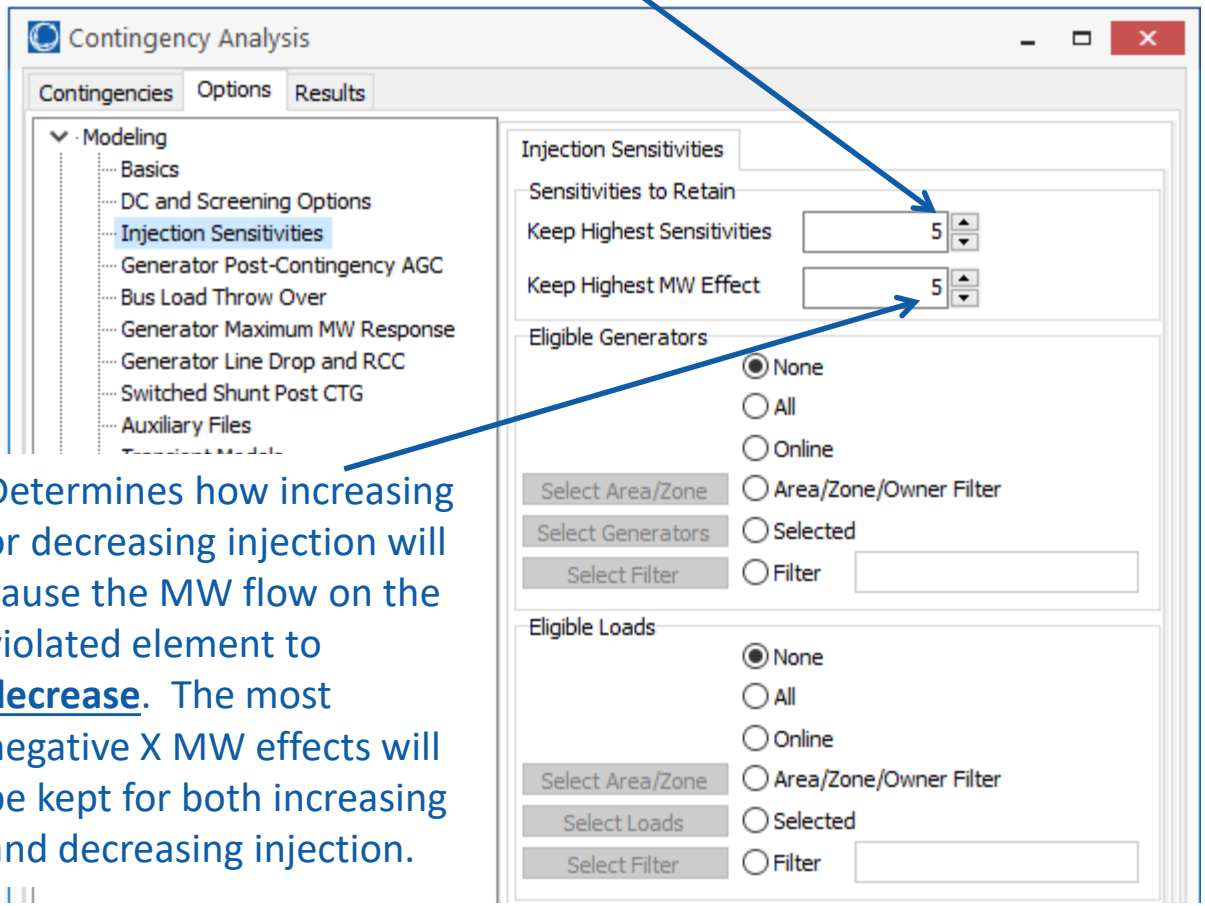
Contingency Analysis
Violation CTG Injection Sensitivities

- Sensitivities of generator and load injections on violated elements can be calculated for each contingency
- Options must be set prior to running contingency analysis for the sensitivities to be calculated

How the flow on the violated element changes due to MW injection at gen or load. The X maximum and X minimum sensitivities will be reported.



Determines how increasing or decreasing injection will cause the MW flow on the violated element to **decrease**. The most negative X MW effects will be kept for both increasing and decreasing injection.

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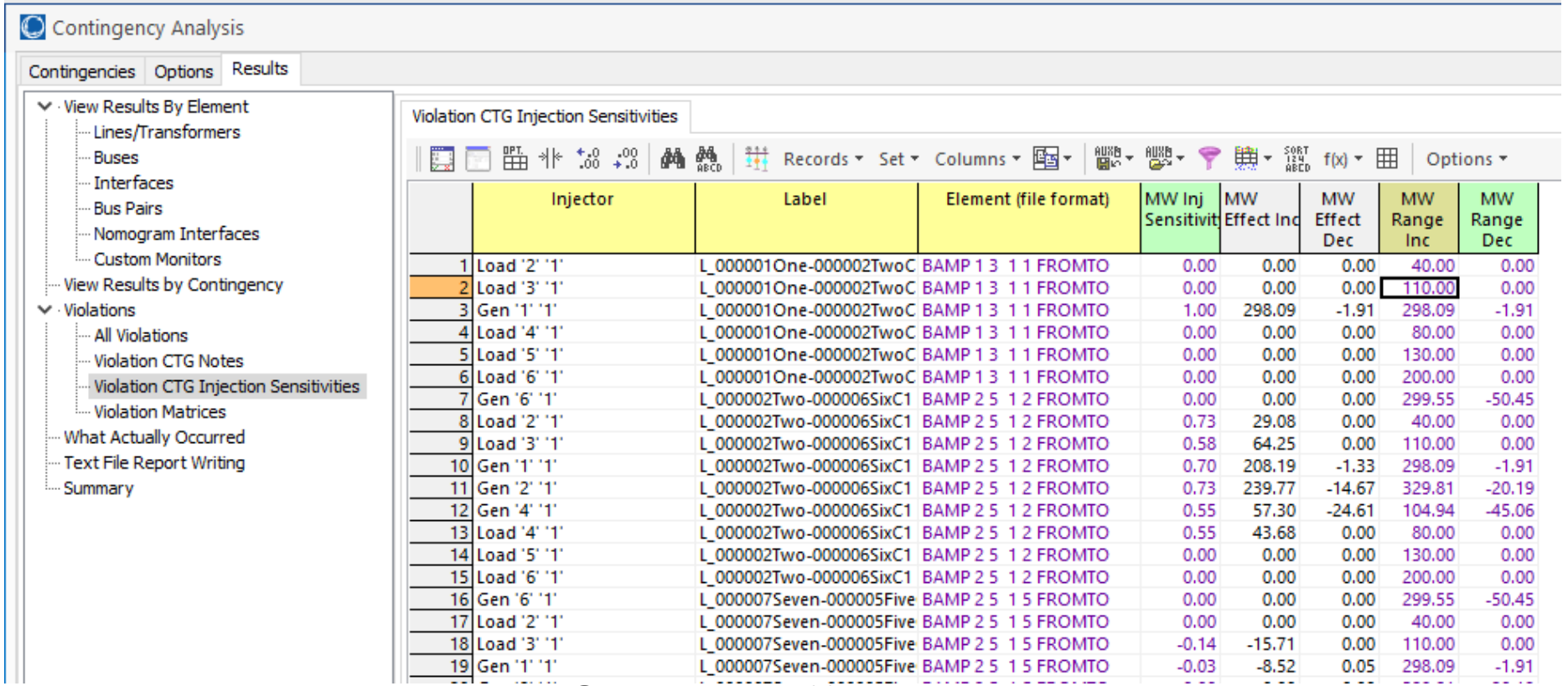
Contingency Analysis
Violation CTG Injection Sensitivities

- Results for all elements under all contingencies are available in the Violation CTG Injection Sensitivities case information display



	Injector	Label	Element (file format)	MW Inj Sensitivit	MW Effect Inc	MW Effect Dec	MW Range Inc	MW Range Dec
1	Load '2' '1'	L_000001One-000002TwoC	BAMP 1 3 1 1 FROMTO	0.00	0.00	0.00	40.00	0.00
2	Load '3' '1'	L_000001One-000002TwoC	BAMP 1 3 1 1 FROMTO	0.00	0.00	0.00	110.00	0.00
3	Gen '1' '1'	L_000001One-000002TwoC	BAMP 1 3 1 1 FROMTO	1.00	298.09	-1.91	298.09	-1.91
4	Load '4' '1'	L_000001One-000002TwoC	BAMP 1 3 1 1 FROMTO	0.00	0.00	0.00	80.00	0.00
5	Load '5' '1'	L_000001One-000002TwoC	BAMP 1 3 1 1 FROMTO	0.00	0.00	0.00	130.00	0.00
6	Load '6' '1'	L_000001One-000002TwoC	BAMP 1 3 1 1 FROMTO	0.00	0.00	0.00	200.00	0.00
7	Gen '6' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.00	0.00	0.00	299.55	-50.45
8	Load '2' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.73	29.08	0.00	40.00	0.00
9	Load '3' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.58	64.25	0.00	110.00	0.00
10	Gen '1' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.70	208.19	-1.33	298.09	-1.91
11	Gen '2' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.73	239.77	-14.67	329.81	-20.19
12	Gen '4' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.55	57.30	-24.61	104.94	-45.06
13	Load '4' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.55	43.68	0.00	80.00	0.00
14	Load '5' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.00	0.00	0.00	130.00	0.00
15	Load '6' '1'	L_000002Two-000006SixC1	BAMP 2 5 1 2 FROMTO	0.00	0.00	0.00	200.00	0.00
16	Gen '6' '1'	L_000007Seven-000005Five	BAMP 2 5 1 5 FROMTO	0.00	0.00	0.00	299.55	-50.45
17	Load '2' '1'	L_000007Seven-000005Five	BAMP 2 5 1 5 FROMTO	0.00	0.00	0.00	40.00	0.00
18	Load '3' '1'	L_000007Seven-000005Five	BAMP 2 5 1 5 FROMTO	-0.14	-15.71	0.00	110.00	0.00
19	Gen '1' '1'	L_000007Seven-000005Five	BAMP 2 5 1 5 FROMTO	-0.03	-8.52	0.05	298.09	-1.91

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Contingency Analysis
Violation CTG Injection Sensitivities

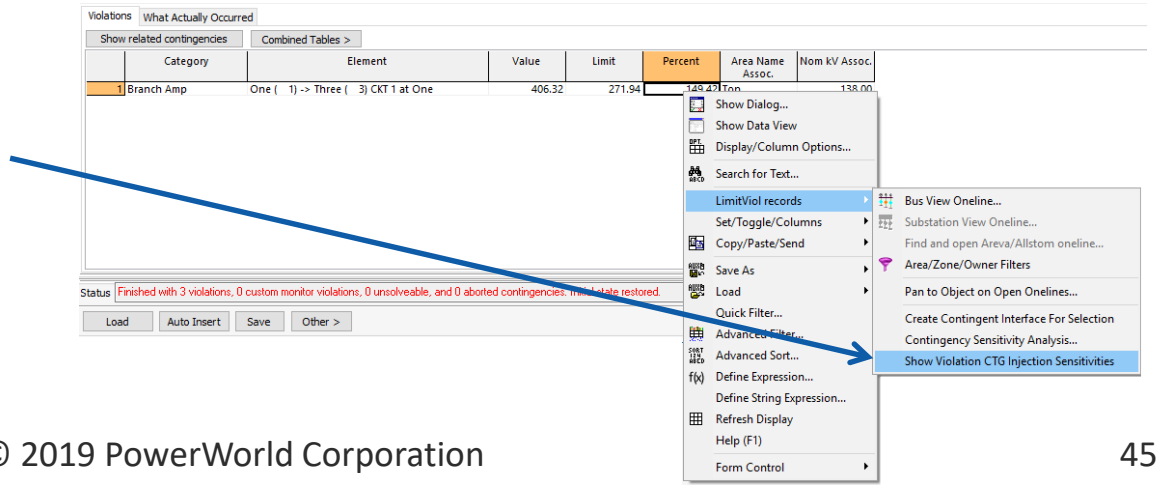
- Fields can be added to the violation case information display for individual contingencies to show the top X sensitivities and MW effect values for specific violations

Violations | What Actually Occurred

Show related contingencies | Combined Tables >

	Category	Element	Value	Limit	Percent	Area Name Assoc.	Nom kV Assoc.	Inj Injector Dec 1	Inj MWEffect Dec 1	Inj Injector Inc 1	Inj MWEffect Inc 1	Inj Injector Max 1	Inj Sens Max 1	Inj Injector Min
1	Branch Amp	Two (2) -> Five (5) CKT 1 at Two	435.08	418.37	103.99	Top	138.00	Gen '1' '1'	-0.01332	Gen '6' '1'	0.00	Gen '1' '1'	0.6984	Gen '6' '1'

Sensitivities for an individual violation can be viewed in the Violation CTG Injection Sensitivities format by using the local menu option



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Contingency Analysis
Violation CTG Injection Sensitivities

- MW Inj Sensitivity
  - The sensitivity of the MW flow on the violated element to a MW injection at the injector (either generator or load)
- MW Range Inc
  - The available range on the injector to increase injection
  - Pmax – Pnow
    - For a gen Pmax = *Max MW* and Pnow = *Gen MW*
    - For a load Pmax = 0 and Pnow = -*MW*
- MW Range Dec
  - The available range on the injector to decrease injection
  - Pmin – Pnow
    - For a gen Pmin = *Min MW* and Pnow = *Gen MW*
    - For a load Pmin = *MW* and Pnow = -*MW*
- MW Effect Inc
  - (MW Range Inc) * (MW Inj Sensitivity)
- MW Effect Dec
  - (MW Range Dec) * (MW Inj Sensitivity)

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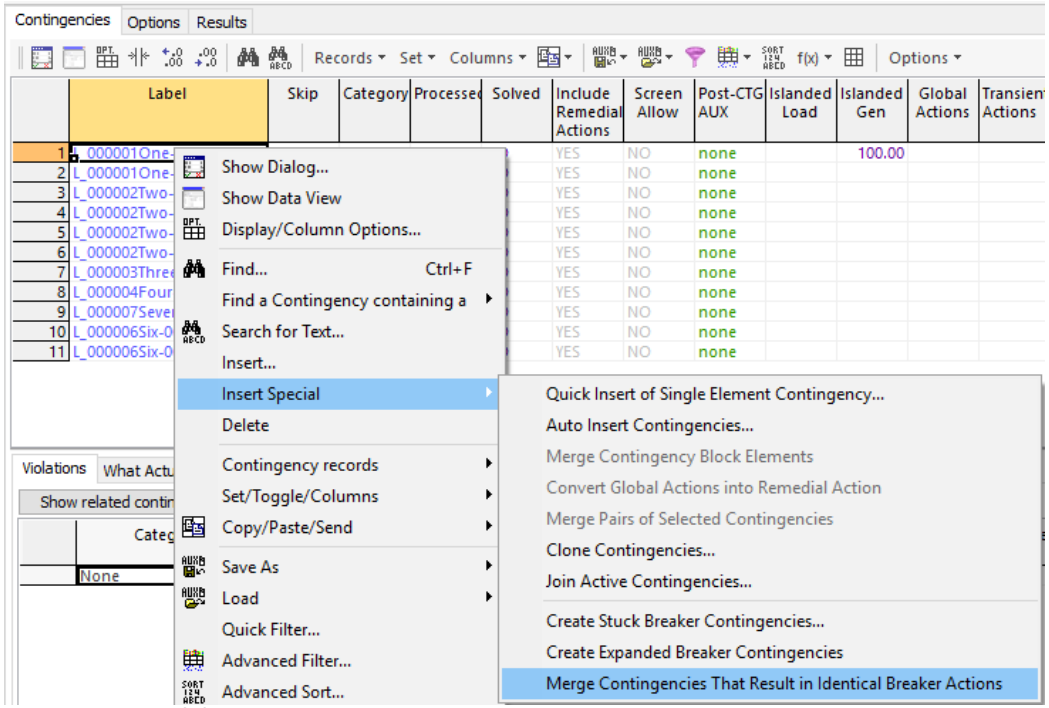
Contingency Analysis
New Options

- *Merge Contingencies That Result in Identical Breaker Actions*
  - Examines existing contingencies that contain Open With Breakers or Close With Breakers actions and determines breakers that will actually operate
  - If another contingency exists with breaker actions that would cause the same breakers to operate, both contingencies will be merged into a single contingency



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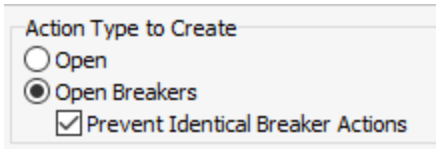
Contingency Analysis
Auto Inserting Contingencies



- *Prevent Identical Breaker Actions*
  - When auto inserting contingencies, if another contingency is found that will cause the same breakers to operate, the actions from both contingencies will be merged into a single contingency

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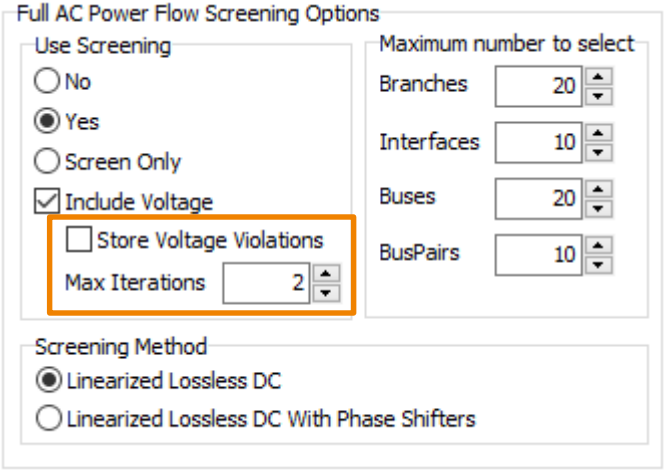
Contingency Analysis Screening Options

- *Store Voltage Violations*
  - The process for determining voltage violations is only an estimate and not determined from a full power flow solution
  - Can now store the violations with the screened results



- *Max Iterations*
  - Voltage violations are determined by an abbreviated inner power flow loop that only performs this number of iterations
  - Default is 2, which was the hardcoded value prior this option being added

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Contingency Analysis
New Actions and Action Changes

- New VSCDC Line actions
  - OPEN
  - OPEN BREAKERS
  - CLOSE and specify MW setpoint
  - CLOSE BREAKERS and specify MW setpoint
  - SETTO – R (in Ohms), Percent, MW
  - CHANGEBY – Percent, MW

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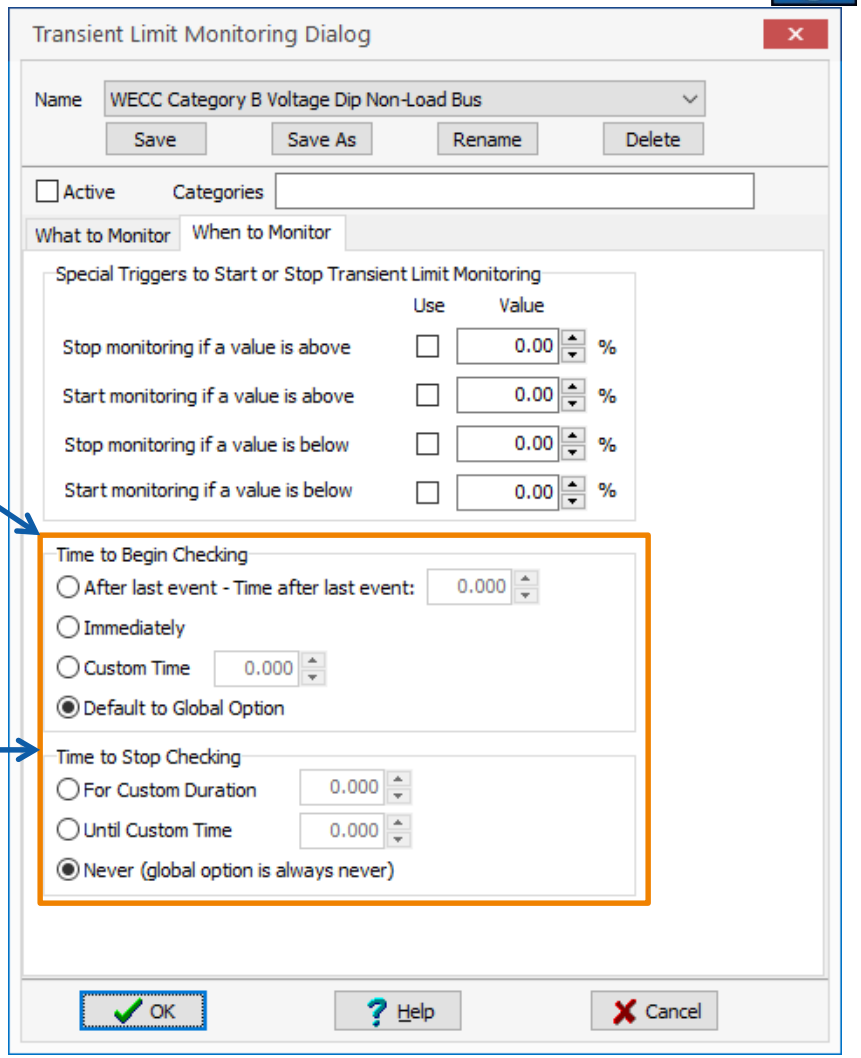
Transient Stability
Transient Limit Monitor

- *Time to Begin Checking* can be specified with individual transient limiter monitors
- By default will use the global option that had previously existed

- *Time to Stop Checking* can be specified with individual transient limit monitors
- No global option exists for this



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Transient Stability
Transient Limit Monitor – Limit Logic

- New object to combine Transient Limit Monitors in a logic expression
- Provide *Logic Variable* identifier with a Transient Limit Monitor to include that monitor in an expression
- Create Limit Logic object with a *Logic* expression that is a combination of Logic Variables
  - AND, OR, and NOT supported along with appropriate parentheses
- Limit Logic violations will report objects that meet the Logic expression at any point during the transient run
  - There is no time component to the logic
- Should only include Transient Limit Monitors of the same object type in a Limit Logic expression

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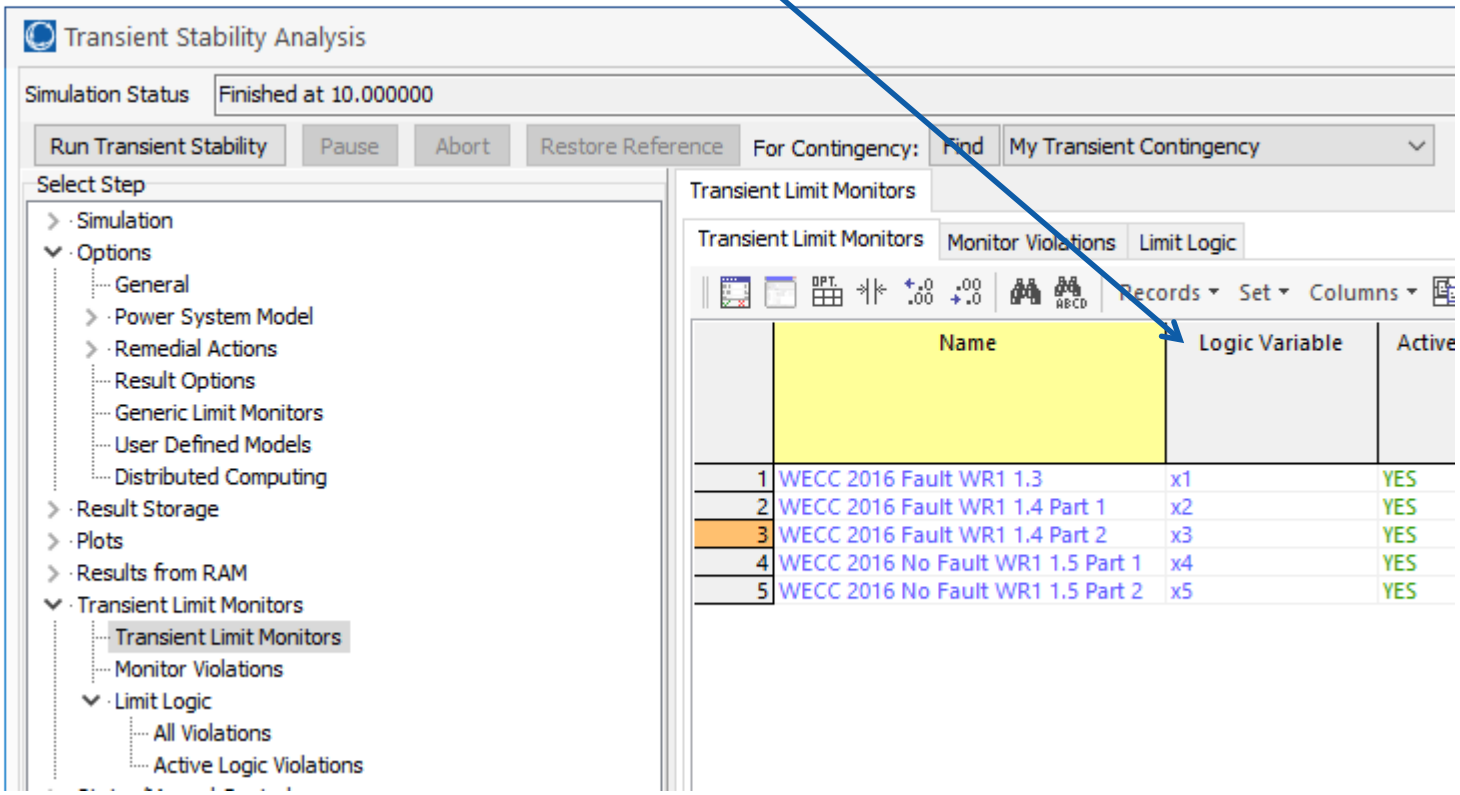
Transient Stability
Transient Limit Monitor – Limit Logic

Logic Variable must be assigned to a Transient Limit Monitor to include it in a Limit Logic. There are no other changes that need to be made to a Transient Limit Monitor.



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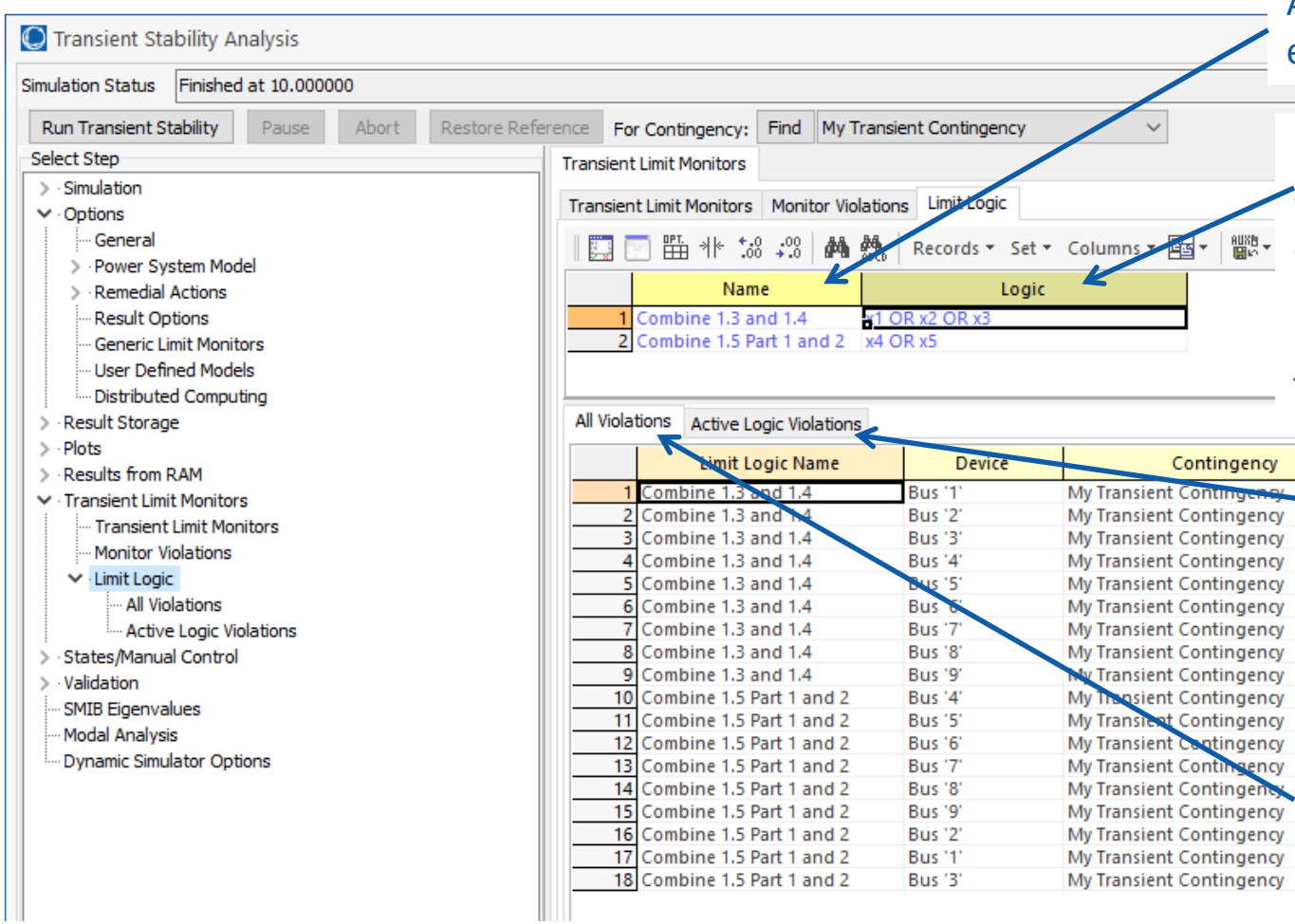
Transient Stability
Transient Limit Monitor – Limit Logic



Assign unique *Name* for each Limit Logic

Define *Logic* as a combination of AND, OR, and NOT logic that includes the *Logic Variable* assigned to Transient Limit Monitors

Violations for only the Limit Logic selected above will be shown in the *Active Logic Violations* tab

Violations for all Limit Logic objects will be shown in the *All Violations* tab

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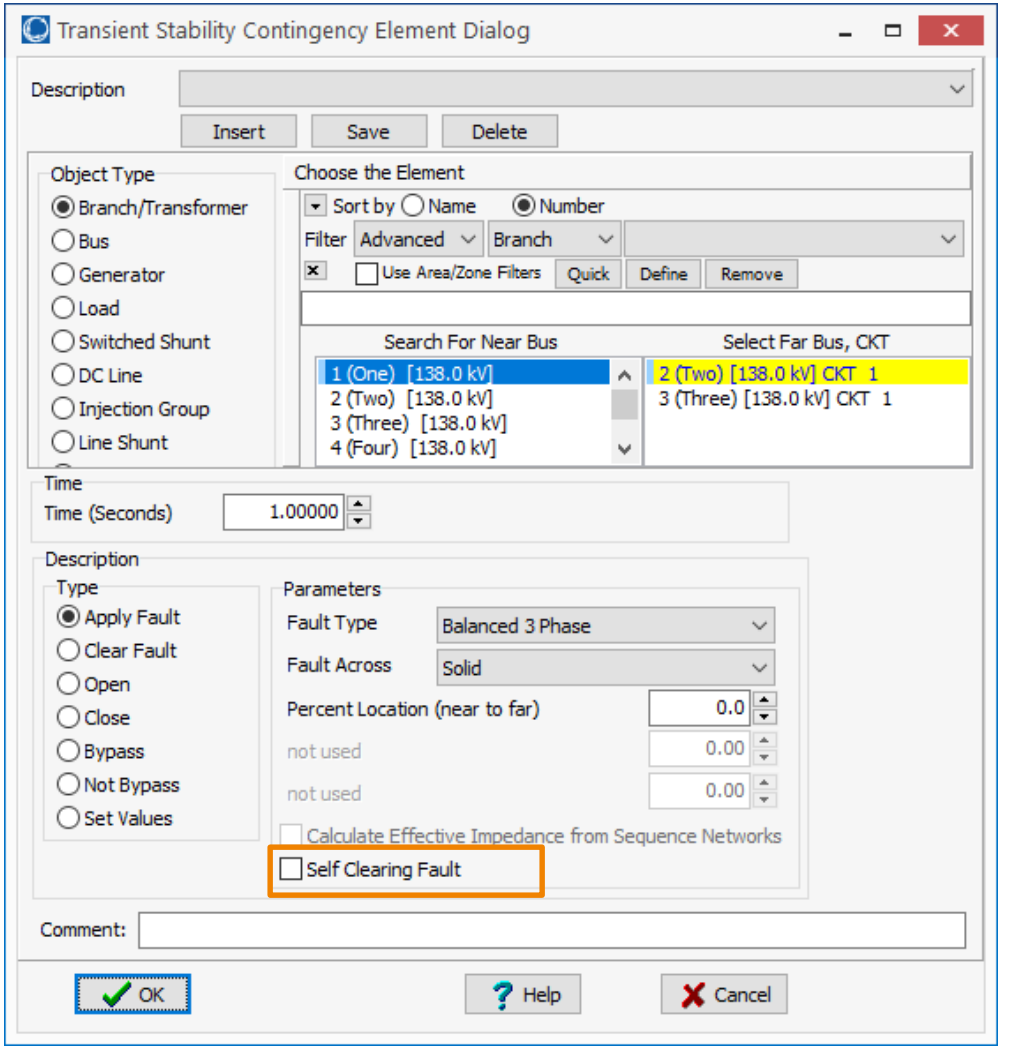
Transient Stability Contingencies

- Transient Contingency Elements now have a SELFCLEAR option that when used will automatically clear the fault when the fault point becomes isolated



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Transient Stability Models New and Changed

- DER_A
  - Added parameters Trf and Vpr
- REPC_A and REPC_B
  - Added more descriptive validation messages when the model does not have a measurement branch specified for measuring Qbranch, Pbranch, and/or Ibranch
  - This is considered a warning and all inputs of Qbranch, Pbranch, and Ibranch will be considered zero until the data is updated
- REPC_B100
  - Plant controller that is the same as REPC_B but allows referencing 100 generators instead of 50
- WT3G, WT4G, REG_A, PVD1
  - For reactive current management that prevents high voltages on voltage source converter machine models, high voltage limit will be set to the initial terminal voltage if the initial terminal voltage is above the high voltage limit instead of ignoring the limit

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Transient Stability Models New and Changed

- Load Characteristic Models
  - Fields added to prevent using the models for loads that do not meet specified criteria
    - Filter Pmin – Model will not be used for load with MW less than this
    - Filter PQmin – Model will not be used for a load with MW/Mvar ratio less than this
    - Filter Vmin – Model will not be used for a load if the per unit voltage at the load is less than this
- Load Distribution Equivalent has *XFMinkV* field to indicate the minimum nominal kV at which a distribution equivalent will include the transformer
  - If set to 0 the global option will be used

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Transient Stability Models New and Changed

- LOCTI, TIOCR1, and TIOCRS
  - Modified interpretation of the *Direct* parameter
    - 0 – no directional element
    - 1 – directional element and direction will be based upon current leaving the FROM end of the branch
    - 2 – directional element and direction will be based upon current leaving the TO end of the branch
- CMPLDWG
  - Ability to read from and write to a DYD file

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Transient Stability Models New and Changed

- REPCTAU1 plant controller model in DYR is loaded as REPCTA1
- CCOMP4U1 voltage compensator model in DYR is loaded as CCOMP4U
- Translate HYGOV4 USRMDL seen in Eastern Interconnect cases to HYGOV4
- New governors with deadbands on the speed inputs
  - DEGOV1D, GASTD, GAST2AD, GASTWDD, IEEEG1D, PIDGOVD, IEEEG3D, WPIDHYD, HYGOVD, HYGOV2D, IEEESGOD, GOV1D, GOV3D, WESGOVD
  - USRMDL in DYR for these models will be loaded
- USAC6AU USRMDL in DYR translated to new AC6A exciter

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Transient Stability Models
New IEEE 421.5 - 2016

- New Exciters (Following have been added)
  - AC1C, AC2C, AC3C, AC4C, AC5C, AC6C, AC7C, AC8C, AC9C, AC10C, AC11C
  - DC1C, DC2C, DC4C
  - ST1C, ST2C, ST3C, ST4C, ST5C, ST6C, ST7C, ST8C, ST9C, ST10C
- New Stabilizers
  - PSS2C, PSS3C, PSS4C, PSS4B, PSS5C, PSS6C, PSS7C
- Overexcitation Limiters
  - OEL1B, OEL2C, OEL3C, OEL5C
- Under Excitation Limiters
  - UEL2C, UEL
- Stator Current Limiters
  - SCL1C, SCL2C

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Transient Stability Models New

- Exciters
  - CELIN
- Governors
  - GGOV1DU
  - BBGOV1
  - TURCZT
  - HGBLEM
- Generator Relay
  - GP3
- Load Distributed Generation
  - DGDER_A

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Load Distributed Generation Modeling

- Modeling distributed generation inside the load record has existed since Version 19
- Continuing to improve ability to specify transient stability model data associated with this as it is being used more and more
  - Specification of the *TSDistGenMVABase* with each Load, LoadModelGroup, Bus, Owner, Zone, or Area
    - Allows you to assign a single DistGen model at aggregate levels and then just have it scaled by this parameter associated with each load that has distributed generation
    - MVABase used for the Load Distributed Generation model will be from the object from which the load is inheriting its model
    - *TSDistGenMVABase* assigned to a particular load will use that value regardless of the level at which the model is assigned
  - Added fields on Bus, Area, Zone, and Owner objects to show the presently assigned Load Distributed Generation model

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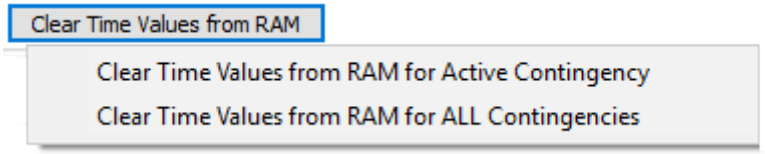
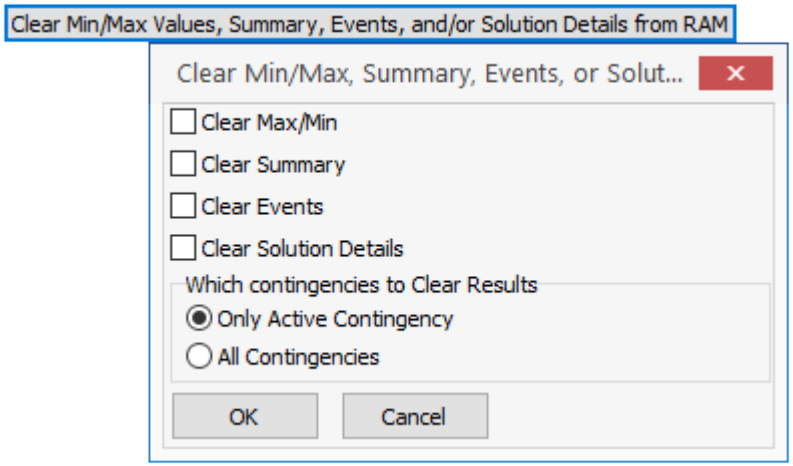
Transient Stability Options

- More flexibility in clearing results from RAM
  - Results can be cleared for only the active contingency or all contingencies





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Transient
Store to RAM Options

- Added substation field to store *ROCOF (Hz per Second)*
- Added branch field to store *Min Profile Vpu*
  - Calculates the minimum voltage along the length of the series R and X of a branch. This value is typically at one of the terminals but it can sometimes end up between the two buses.
  - It is possible for the voltage to approach zero even when both terminals are not zero, which is an indication of the system going out of step
- Added VFE of ESAC8b_PTI in Exciter Other Fields
- Added VFE of ESAC8B_GE in Exciter Other Fields

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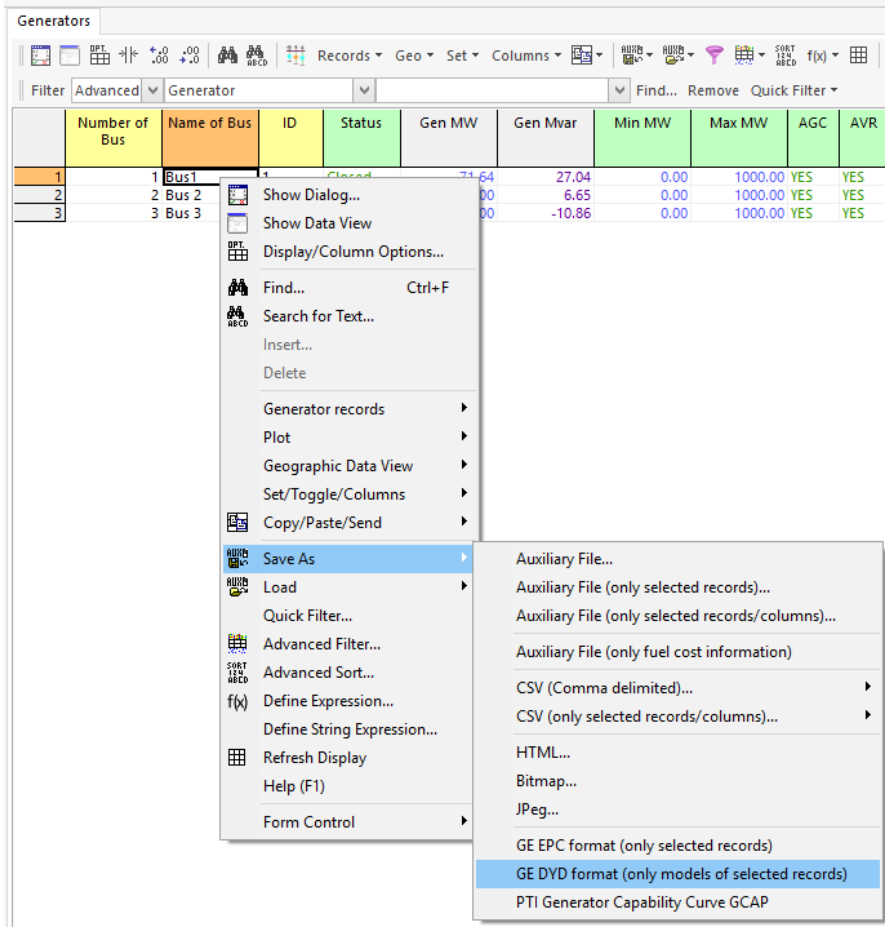
Transient Stability File Formats

- Case Information displays for objects that can have transient stability models defined have a local menu option *Save As > GE DYD format (only models of selected records)* that will store a DYD file snippet of the objects and models selected



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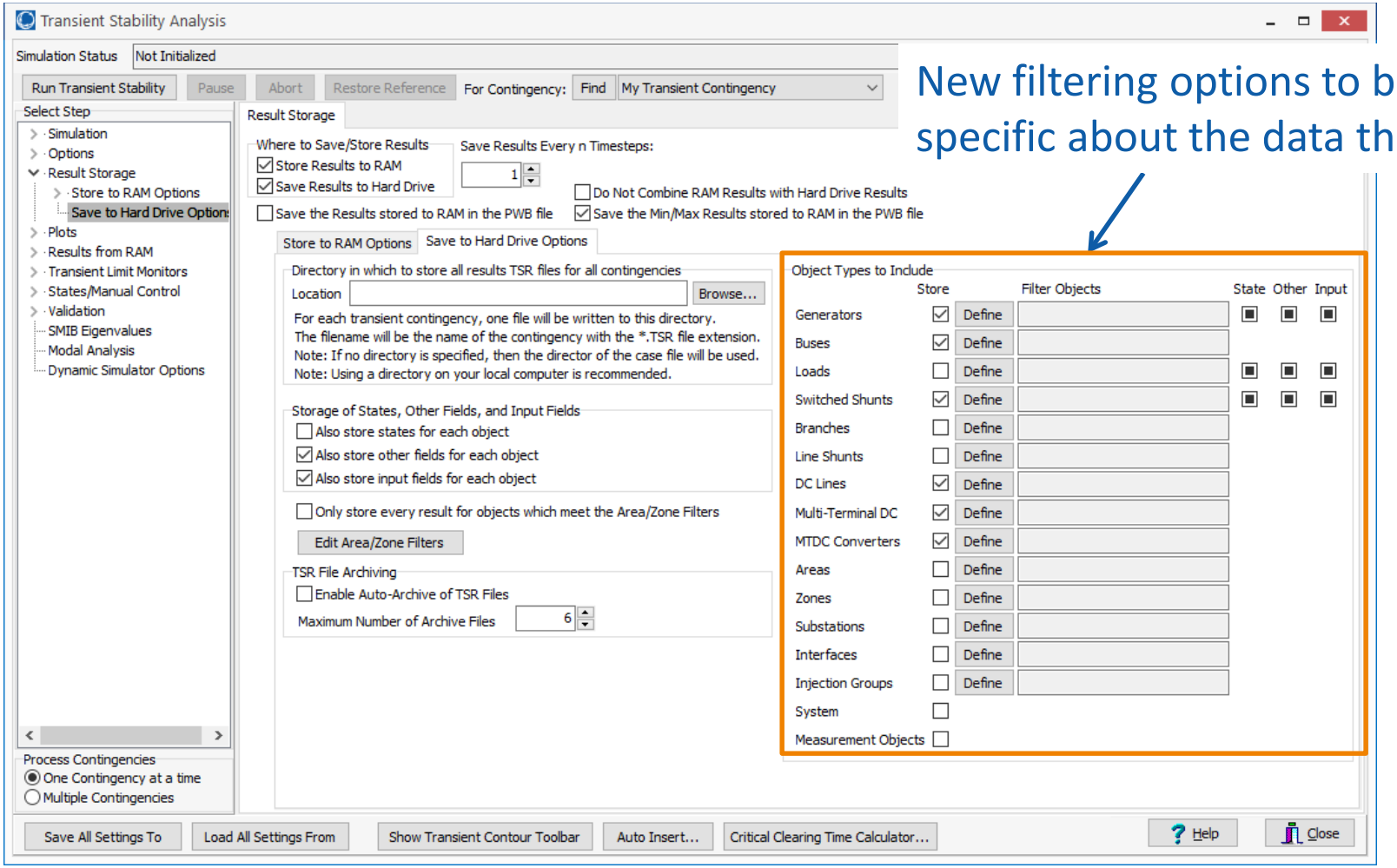
Transient Stability
Store to Hard Drive Options



New filtering options to be very specific about the data that is stored

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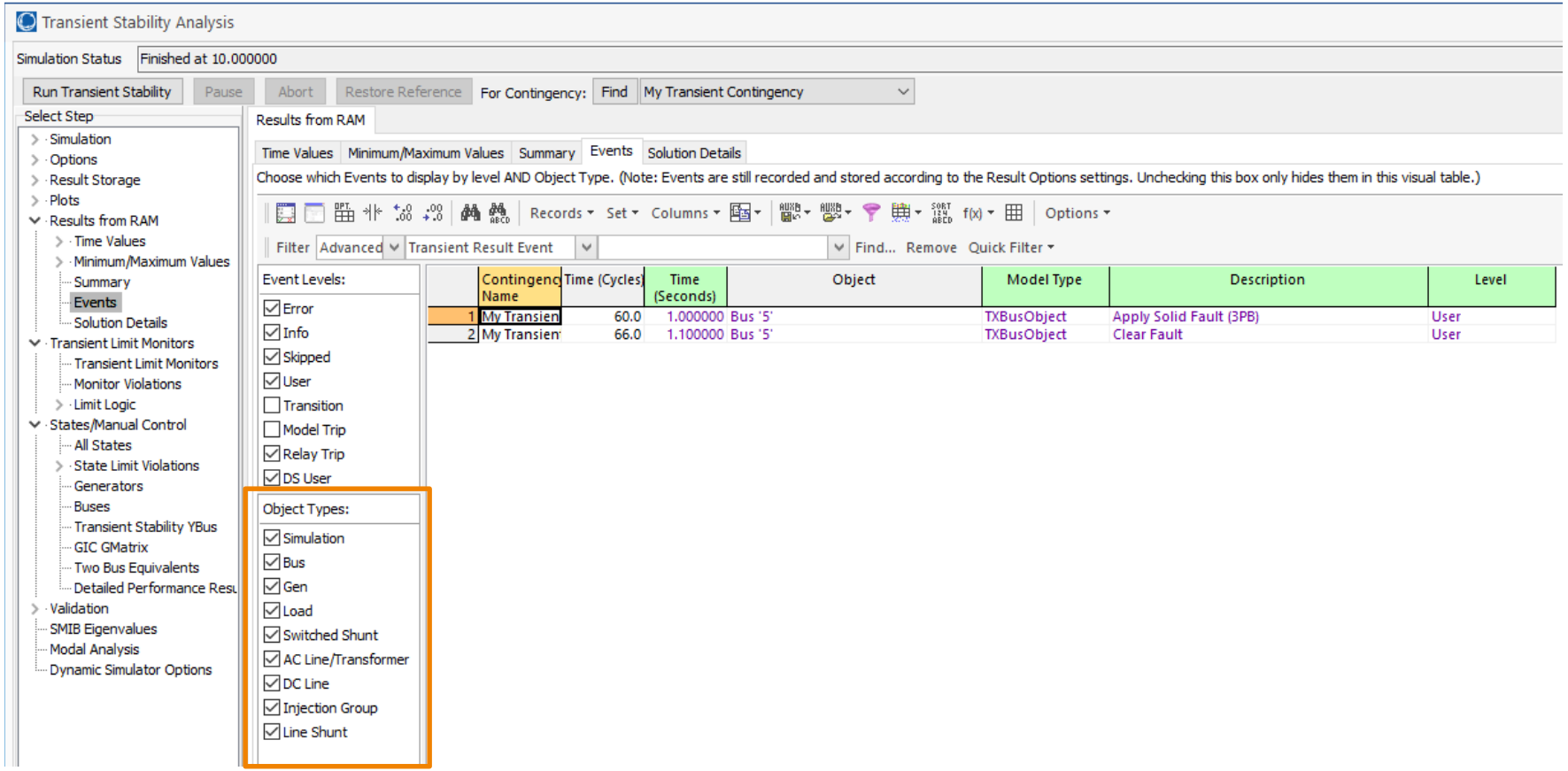
Transient Stability Events

- Options to filter by Object Types



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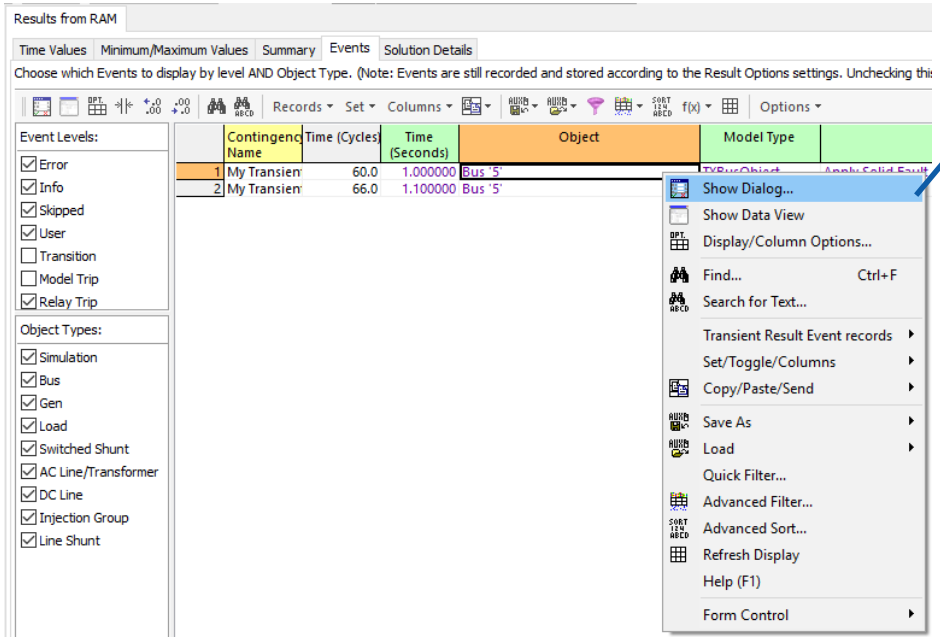
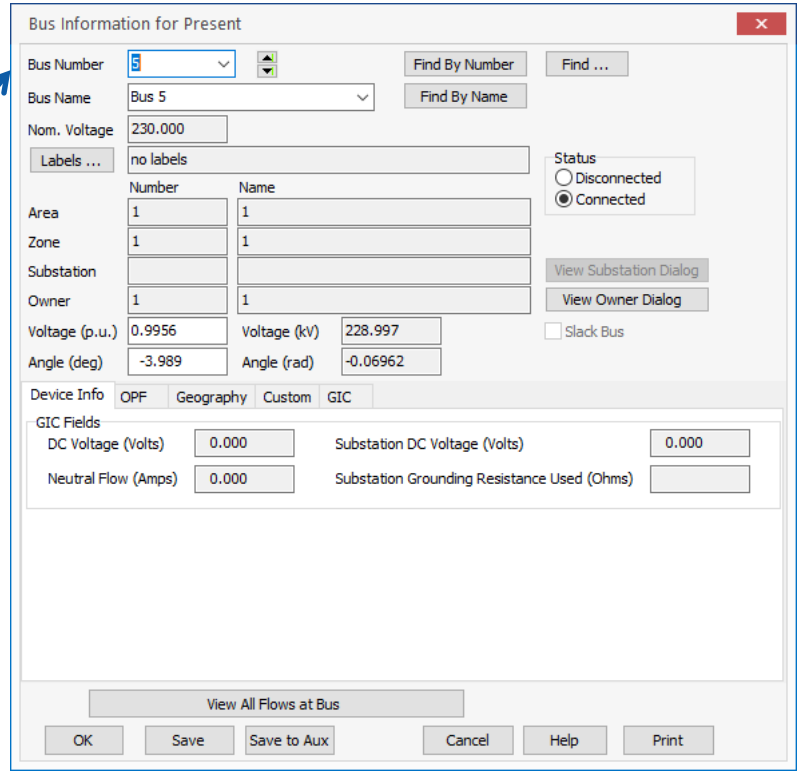
Transient Stability
Events

- Selecting Show Dialog from the local menu will open the dialog for the Object associated with the event





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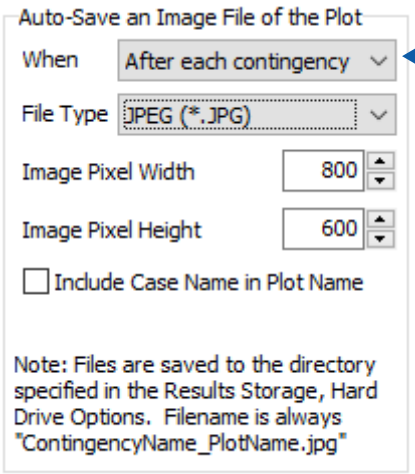
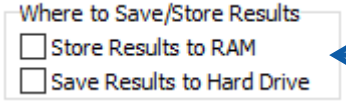
Transient Stability Plotting

- If choosing to *Auto-Save an Image File of the Plot* a plot AND the data is not selected to be stored to either the RAM or hard drive, after the plot file is generated the data will be deleted



Set to something other than *Never*



Neither of these options checked

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Transient Stability
Breaker Delays

- Breaker delays can be specified with branches, generators, loads, and switched shunts
- Used when implementing RAS with transient stability to open or close devices
- Branch relays might also use these object delays in place of delays specified with the relay model
  - Various rules apply to the type of relay model, location of the relay relative to the branch, communication delay, and transfer trip delay
- Should we include the generator, load, and switched shunt object delays in the transient models?

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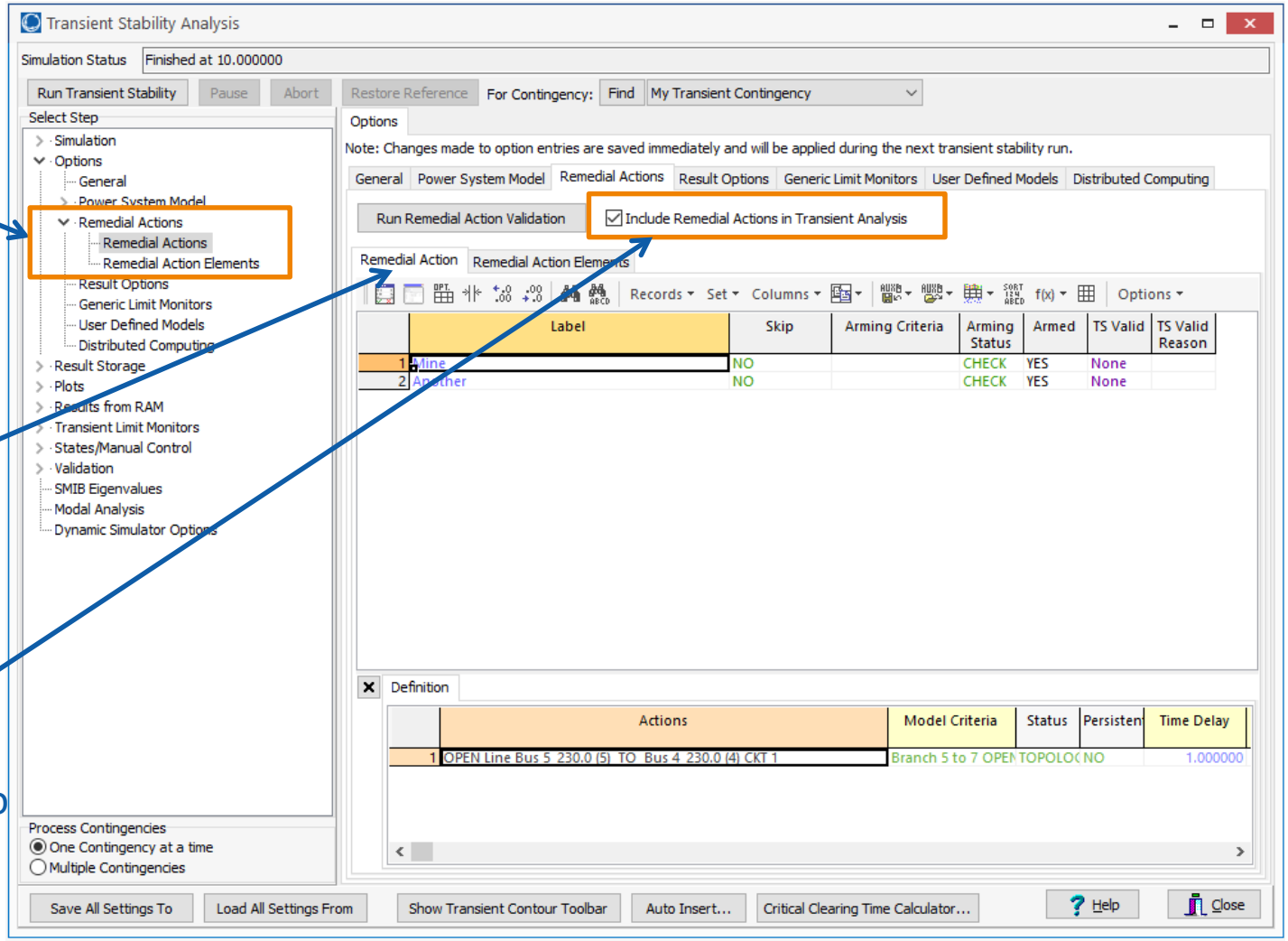
Including RAS with Transient Stability

Remedial Actions options added on the Transient Stability dialog

Same Remedial Action and Remedial Action Elements that are shown on the Contingency Analysis dialog

Include Remedial Actions in Transient Analysis checkbox needs to be checked to include the RAS in a transient stability run



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Transient RAS

- Currently only status fields are translated for evaluation at every transient time step
  - All other fields are evaluated in the transient stability initial condition
- For the most part, only those actions that involve breaker status changes are translated to the transient realm
  - Any actions that are not translated are never implemented
- See separate presentation for details

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Available Transfer Capability (ATC)

- Added new Iteratively Found values when using the (IL) then Full CTG Solution method
  - FULL_CTG_SELLER_LOST and FULL_CTG_BUYER_LOST to indicate that the Seller or Buyer has been completely disconnected because of implementing the contingency
  - Transfer limit that is reported is the total amount that could be ramped before the contingency caused the loss

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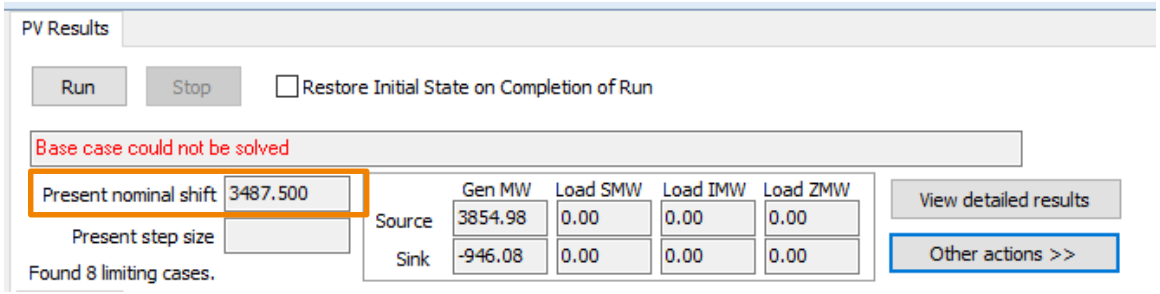
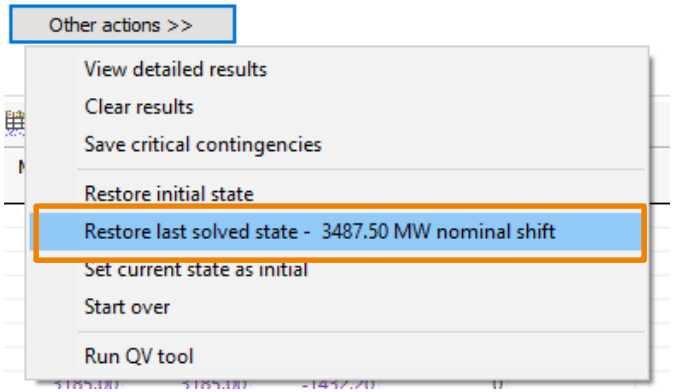
PV Curve Tool

- Updates to the PV dialog
  - Present Nominal Shift box shows the transfer that is in the current system state
  - Restore Last Solved State caption shows the transfer amount that is in that state





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PV Curve Tool

- Archiving system states will now work when using the Reverse Transfer option
  - When choosing to *Save only the base case for each critical contingency* the base case state will be saved at any reverse transfer level at which a contingency solved
  - When choosing to *Save all states* both the base case state and the contingency state will be saved at any reverse transfer level at which a contingency solved

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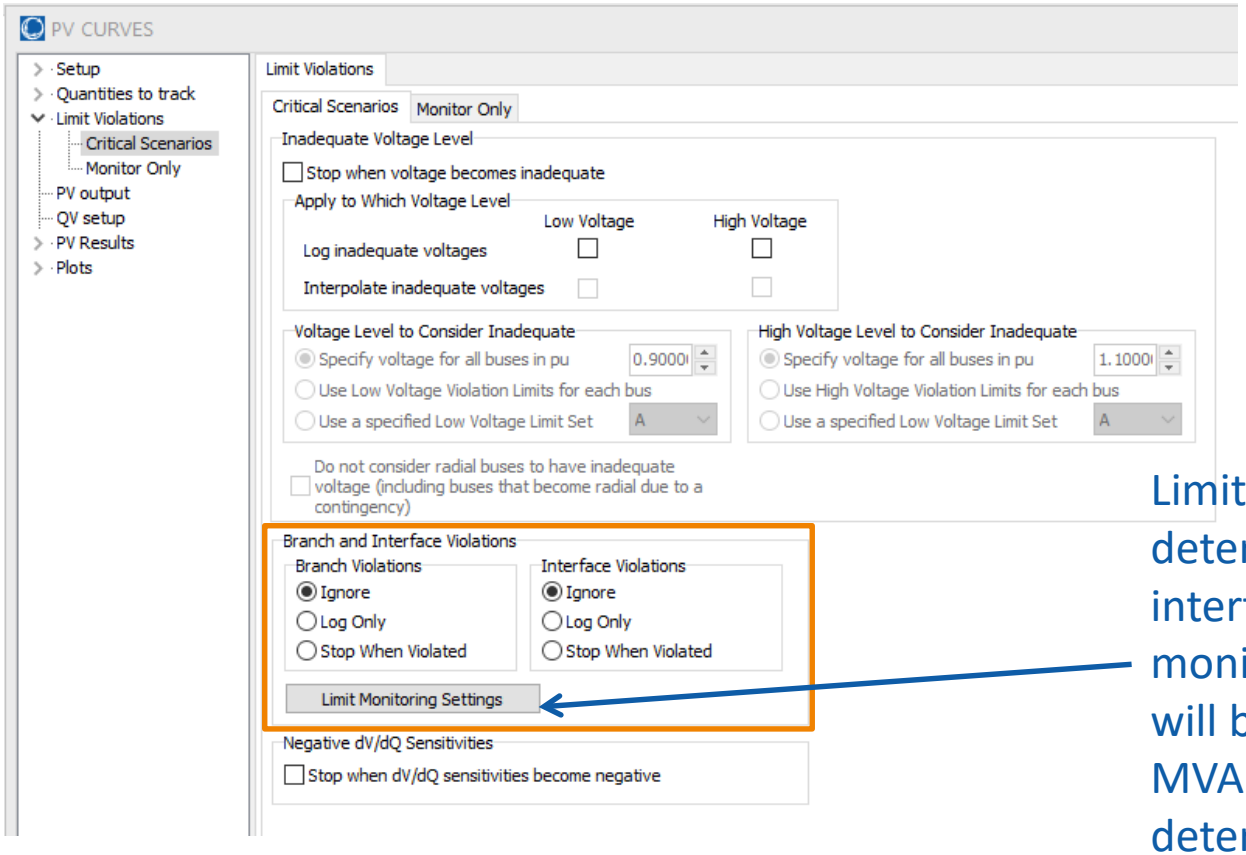
PV Curve Tool
Branch and Interface Violations

- Branch and interface violations can now be treated as critical scenarios



Limit Monitoring settings determine the branches and interfaces that will be monitored, the rating set that will be used, and whether MVA or Amp loadings determine the violation

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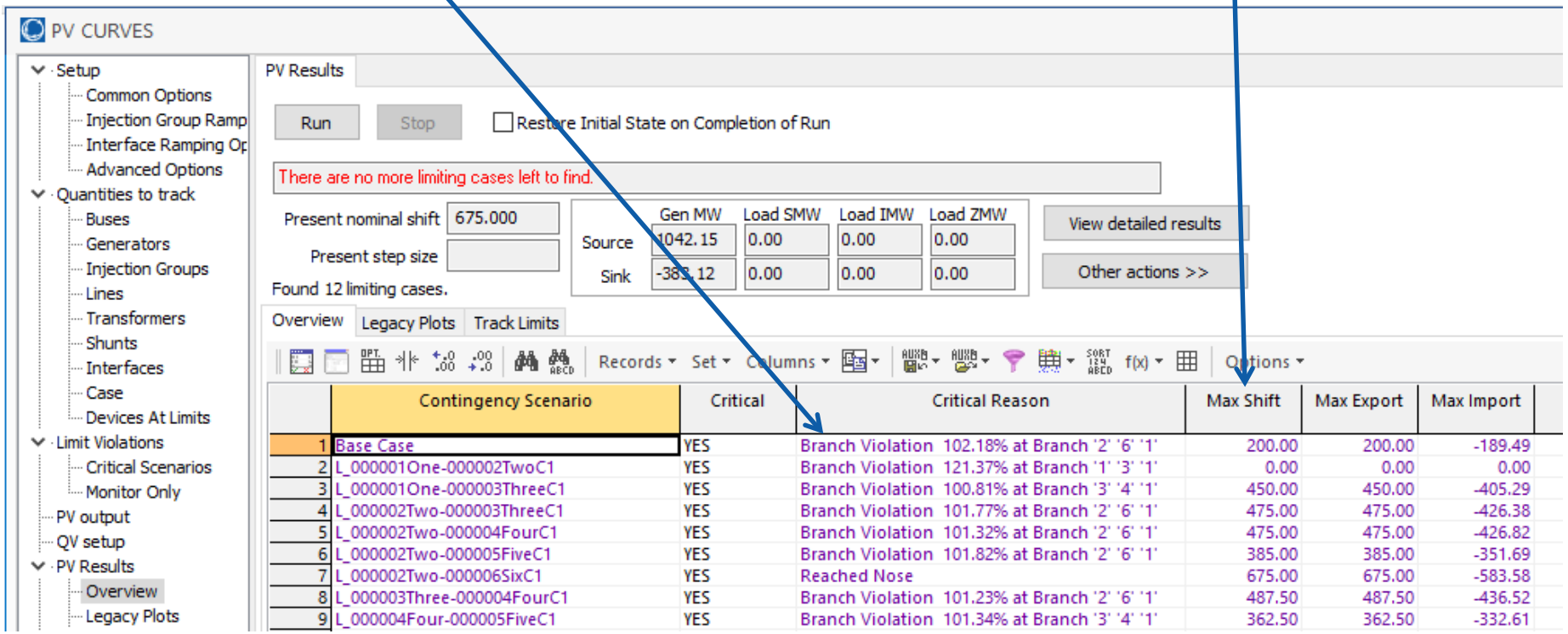
PV Curve Tool
Branch and Interface Violations

When using *Stop When Violated*, Critical Reason will show *Branch Violation* or *Interface Violation* and indicate the most overloaded branch or interface and percent loading

Max Shift will be the maximum transfer at which no violations occur



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PV Curve Tool
Branch and Interface Violations

When using *Log Only*, extra fields are available to show the lowest nominal shift at which a violation occurs, the element with the worst violation, and the maximum % loading for the worst violation

Overview | Legacy Plots | Track Limits

Records ▾ Set ▾ Columns ▾ f(x) ▾ Options ▾

	Contingency Scenario	Critical	Critical Reason	Max Shift	Max Export	Max Import	Branch Violation Nominal Shift	Branch Violation Worst Branch	Branch Violation Worst Percent
1	Base Case	YES	Reached Nose	3487.50	3487.50	-1148.19	300.00	Branch '2' '6' '1'	135.99
2	L_000001One-000002TwoC1	YES	Reached Nose	1162.50	1162.50	-913.25	0.00	Branch '1' '3' '1'	121.37
3	L_000001One-000003ThreeC1	NO					500.00	Branch '2' '6' '1'	105.02
4	L_000002Two-000003ThreeC1	NO					500.00	Branch '2' '6' '1'	104.33
5	L_000002Two-000004FourC1	NO					500.00	Branch '2' '6' '1'	103.86
6	L_000002Two-000005FiveC1	YES	Reached Nose	2737.50	2737.50	-1471.43	400.00	Branch '2' '6' '1'	102.76
7	L_000002Two-000006SixC1	YES	Reached Nose	675.00	675.00	-583.58			
8	L_000003Three-000004FourC1	YES	Reached Nose	3185.00	3185.00	-1432.52	500.00	Branch '2' '6' '1'	101.55
9	L_000004Four-000005FiveC1	NO					400.00	Branch '3' '4' '1'	105.91
10	L_000007Seven-000005FiveC1	YES	Reached Nose	2550.00	2550.00	-1459.66	500.00	Branch '2' '6' '1'	119.10
11	L_000006Six-000007SevenC1	YES	Reached Nose	2512.50	2512.50	-1443.66	500.00	Branch '2' '6' '1'	108.40
12	L_000006Six-000007SevenC2	YES	Reached Nose	2512.50	2512.50	-1443.66	500.00	Branch '2' '6' '1'	108.40

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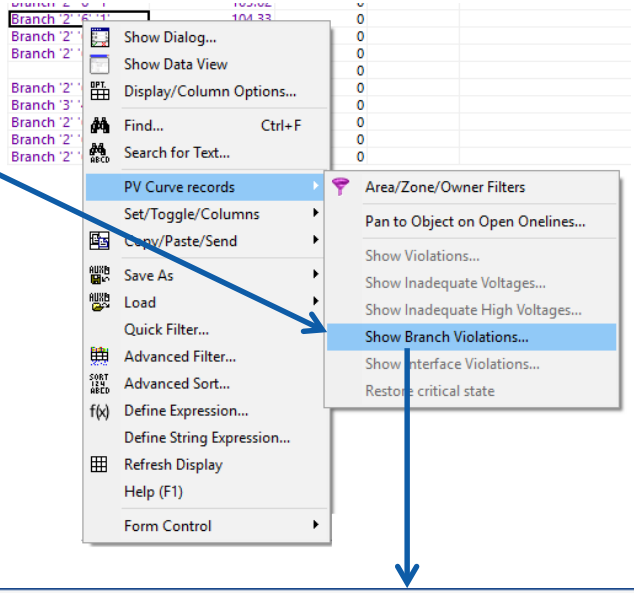
PV Curve Tool
Branch and Interface Violations

When using *Log Only* and violations exist, local menu for a scenario has option to show a case information display of all violations for that scenario at all transfer levels studied



PV Branch Violations - Scenario L_000002Two-000003ThreeC1

Records Geo Set Columns f(x) Options

	Object ID	0.00	100.00	200.00	300.00	400.00	500.00	600.00	700.00	800.00	900.00	1000.0
1	Branch '1' '2' '1'							102.56	116.49	130.36	144.19	158.03
2	Branch '1' '3' '1'											
3	Branch '2' '4' '1'										103.64	119.13
4	Branch '2' '6' '1'						104.33	121.92	139.22	156.26	173.07	190.17
5	Branch '3' '4' '1'											
6	Branch '4' '5' '1'											
7	Branch '7' '5' '1'											

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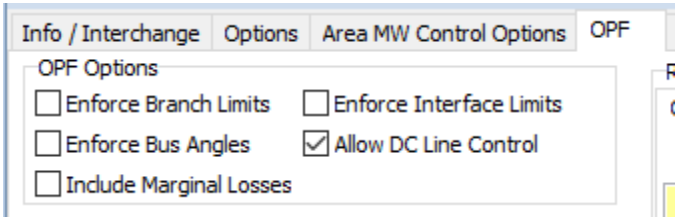
Optimal Power Flow (OPF)

- Added check boxes on the OPF tab of the Area dialog to specify *Enforce Branch Limits, Enforce Bus Angles, Enforce Interface Limits, Allow DC Line Control,* and *Include Marginal Losses*



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Security Constrained Optimal Power Flow (SCOPF)

- Added a column in the LPVariables grid to show the contingency name that corresponds to the variable
- Added the contingency name to the Bus Marginal Controls header to allow correlation between the controls and the LP Basic Variables

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Full Topology Features

- Anywhere that the close with breakers algorithm is used will now close breakers even if a branch is only open at one end
- In a Bus View in Full Topology mode when showing serial buses, Breakers and Load Break Disconnects will be biased to show as the prominent device over Disconnects
- When using the options to *Use Topology Processing* and *Close Breakers to Energize Switched Shunts,* breakers will be opened to isolate shunts at 0 Mvar output when the power flow is solved

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Oneline Features

- *Delta Per Mouse Click* value can now be specified for generator *Cost Multiplier* field
- *BranchCloseAngleThreshold* field specified with a branch object impacts the interaction with a branch through a oneline
  - An OPEN branch can only be closed through a oneline if the angle difference across the branch is less than the threshold
- Added a color map for showing integer values
- Oneline Link object can specify a left-click option and up to two right-click options

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Oneline Features

- Oneline menu accessed by right clicking in the background of a oneline has option to *Open oneline script command dialog* that will allow script commands to be performed on the oneline
- Added the ability to open Areva substation onelines from the local menus on case information displays
- Added a menu option when right-clicking on a substation object to copy the Latitude/Longitude of the substation to the system clipboard

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Oneline Features

- If a map projection has been specified, right-click menus will have an *Open Google Maps* option that will open google maps at that location and show the satellite view
- Added GIS option to *Move Display X,Y to match Lon, Lat* for use with bus and substation objects
- Bus display objects have right-click option to *Open Connected AC Branches* if the bus Status = Connected and *Close Connected AC Branches* if the bus Status = Disconnected
  - When closing branches only branches where the other terminal bus is connected will be closed
- After selecting a bus, generator, load, or switched shunt on a oneline, clicking the R key will rotate the object

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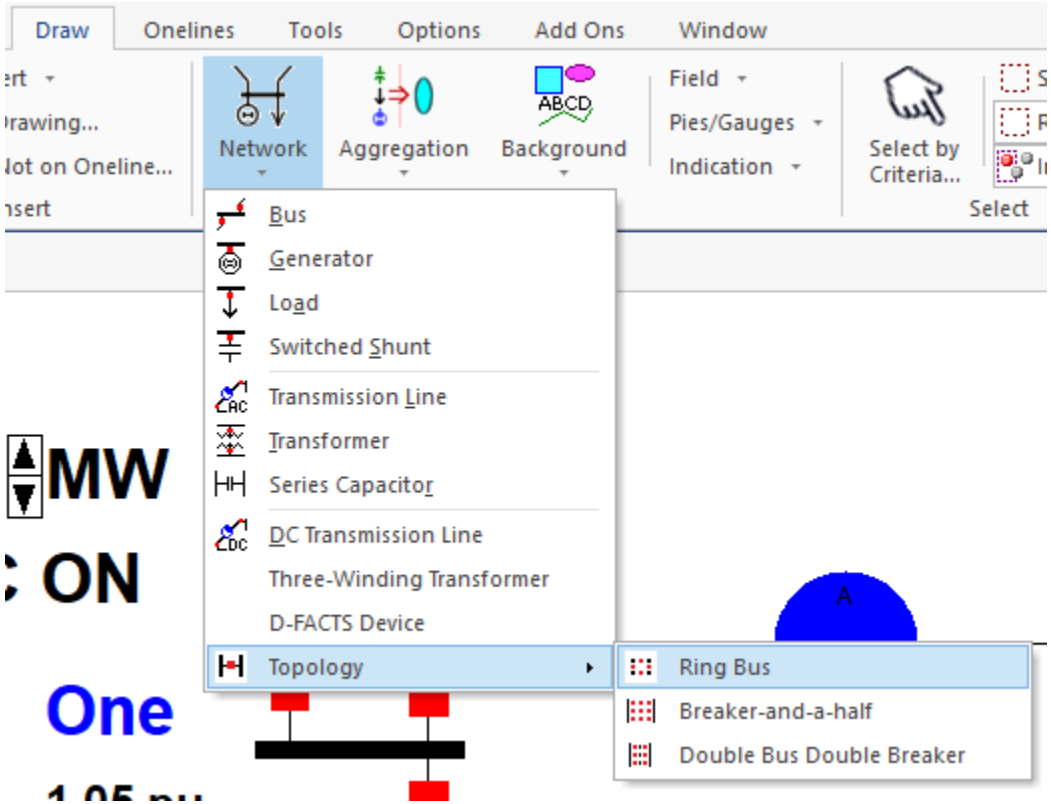
Oneline Features

- Added options to create new topology sections
  - Oneline and the case will both be modified



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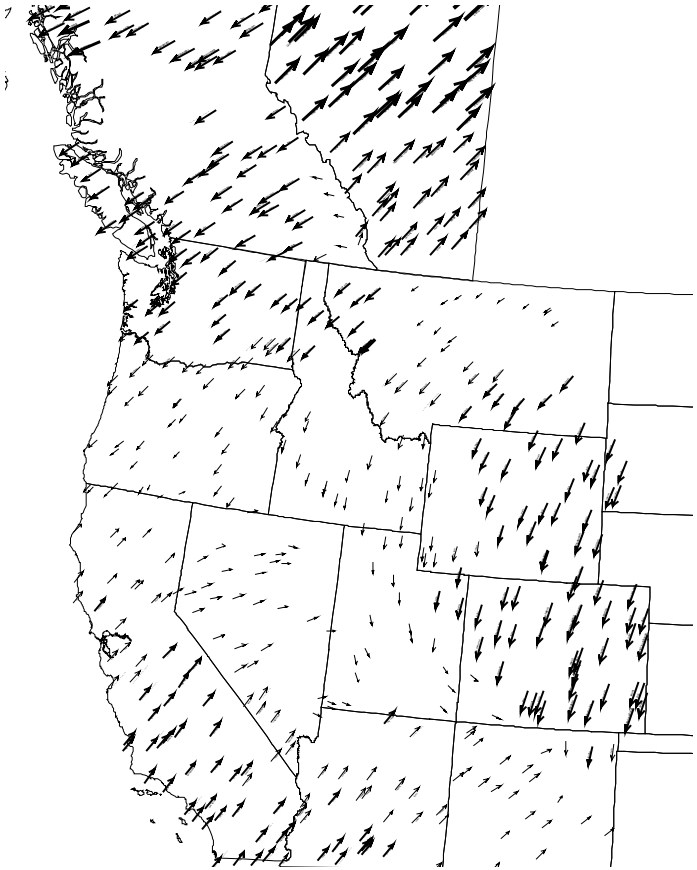
Geographic Data Views

- Added Arrow Style for showing vectors



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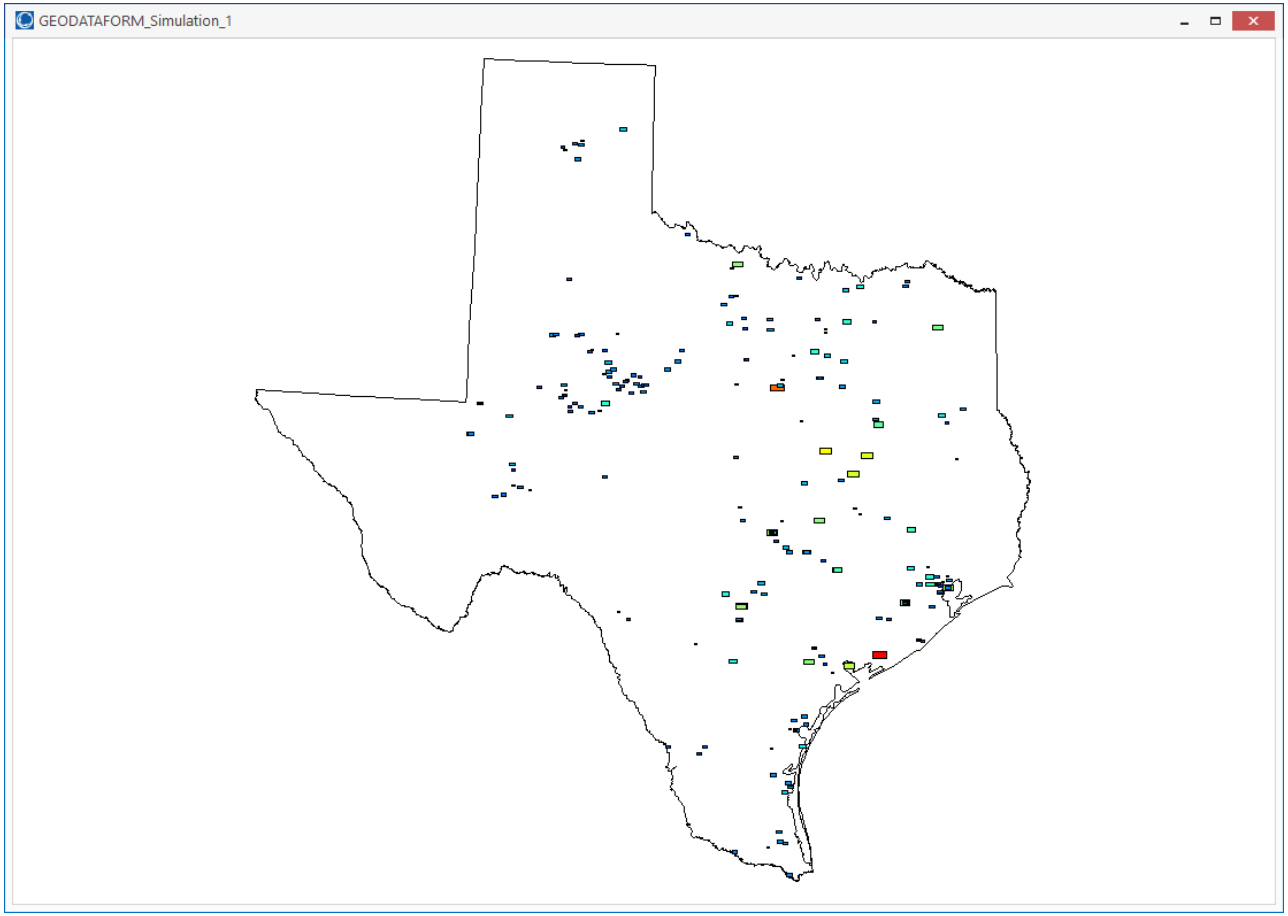
Geographic Data Views
Pseudo-Geographic Mosaic Display

- Standard geographic data view of generator maximum MW output



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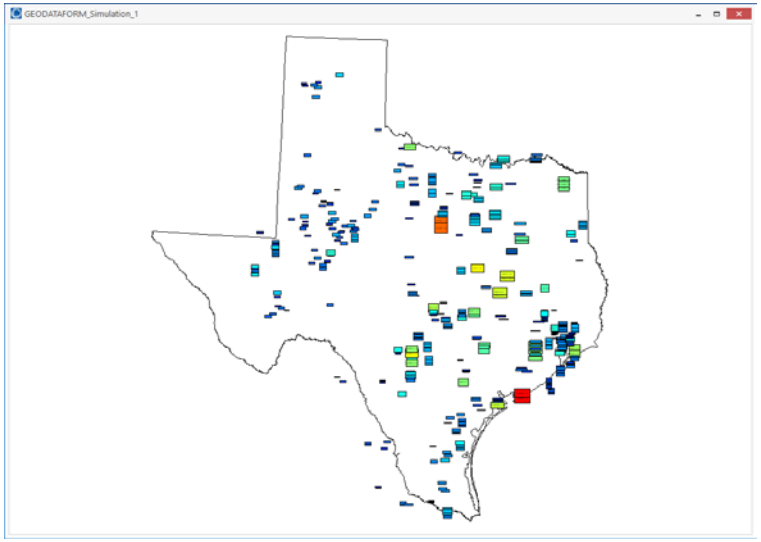
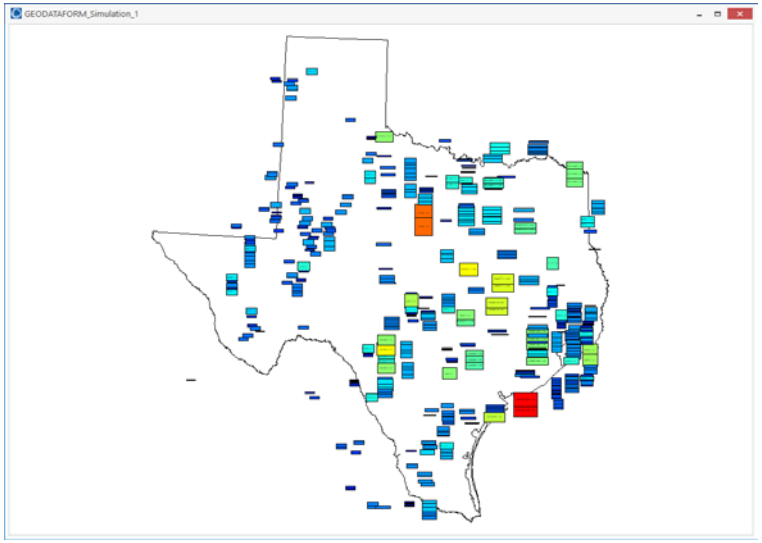
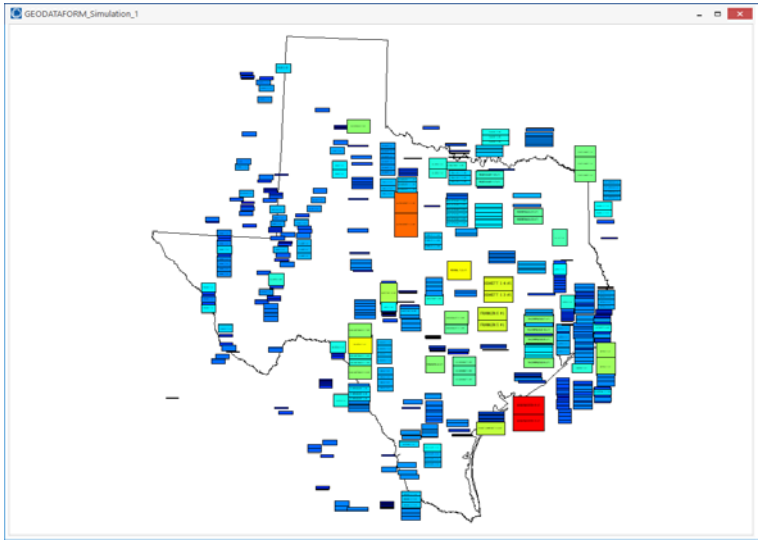
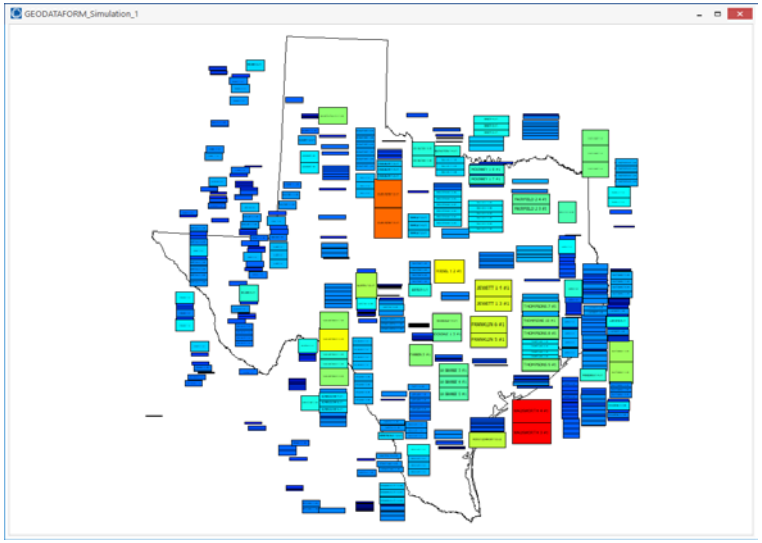
Geographic Data Views
Pseudo-Geographic Mosaic Display









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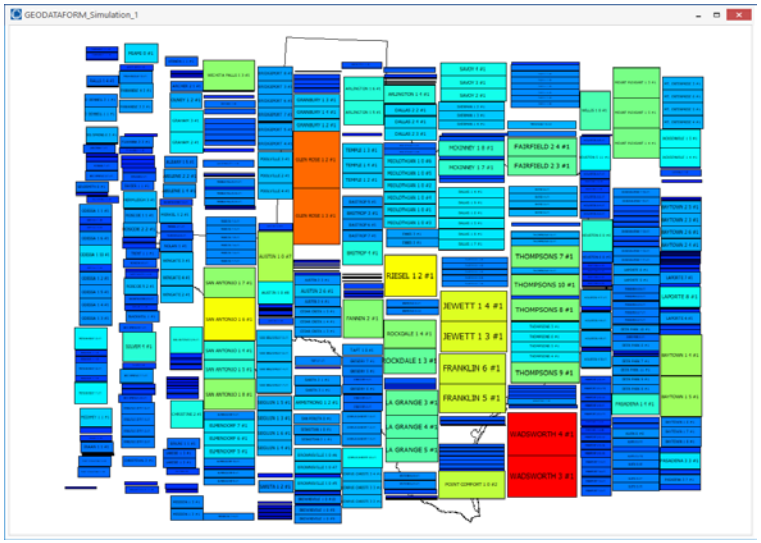
Geographic Data Views
Pseudo-Geographic Mosaic Display



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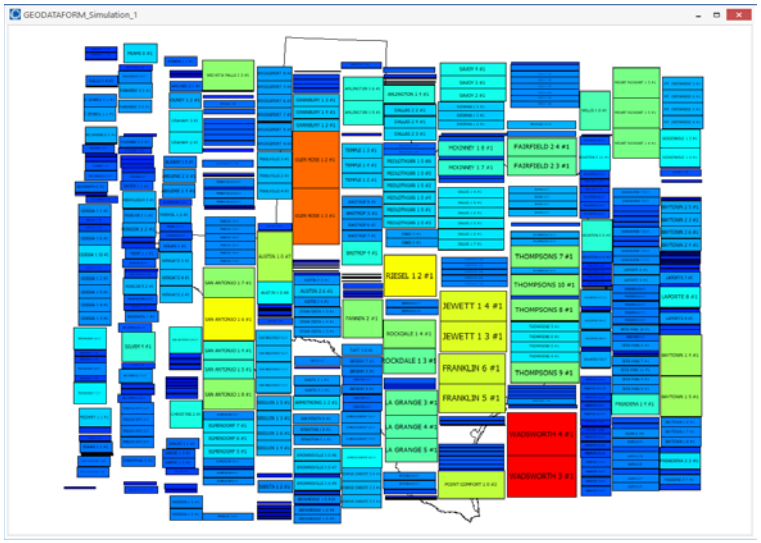
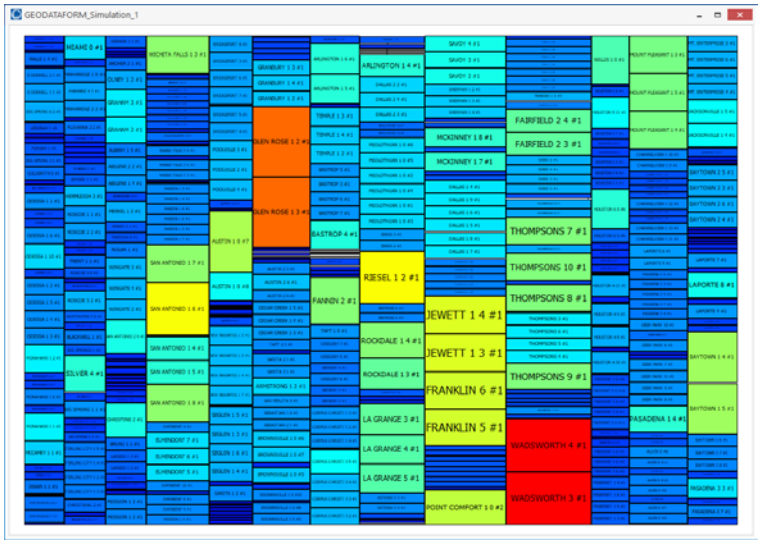
Geographic Data Views
Pseudo-Geographic Mosaic Display





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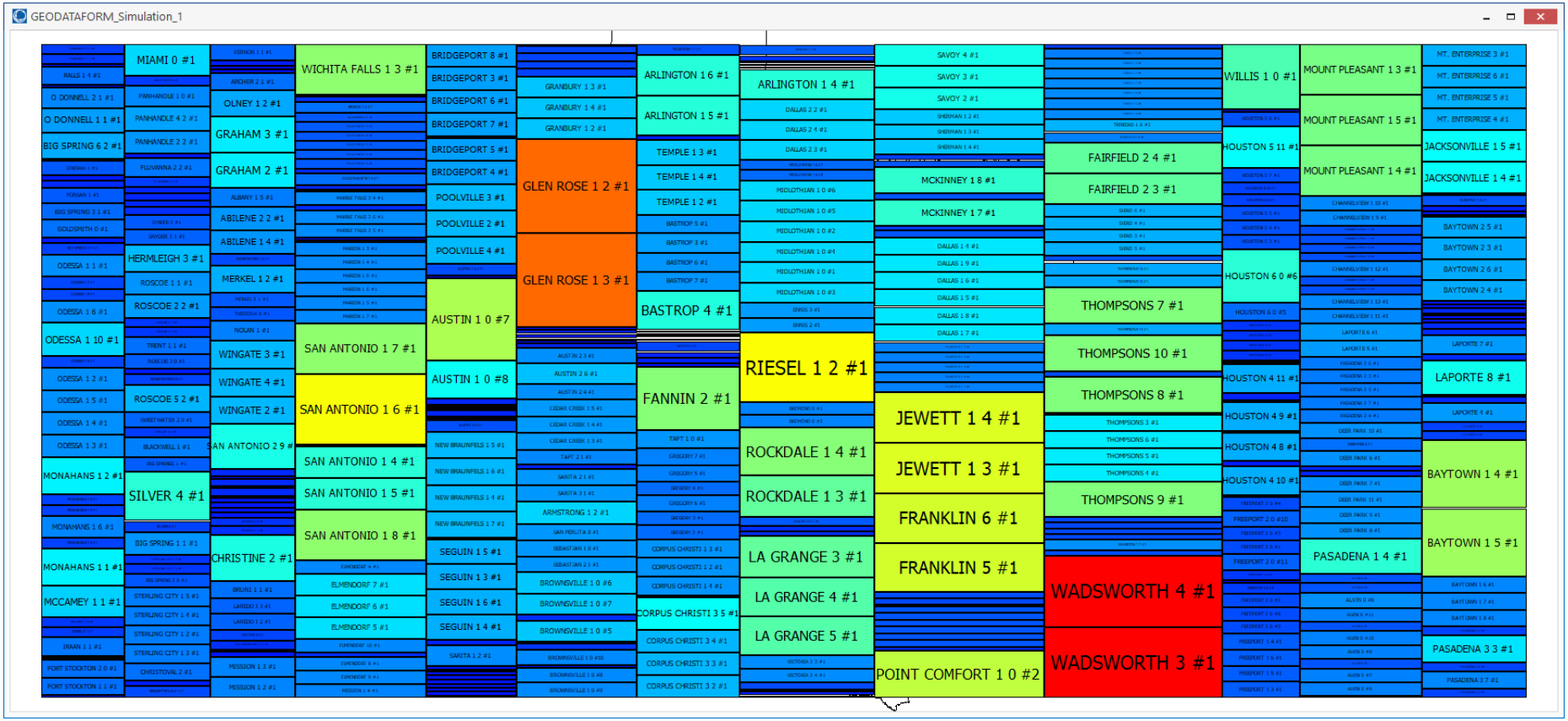
Geographic Data Views
Pseudo-Geographic Mosaic Display

- Geographic data view mosaic display of generator maximum MW output
- Animation is important here to see how the final image relates to the original image



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Scheduled Actions

- As part of the Use Normal Status option, when closing disconnects that are in series with breakers also close disconnects that are in series with Load Break Disconnects
- Added another check when the Use Normal Status option is in use to return disconnects that are in series with the branch that is being returned to service. If a branch is an Open Breaker action, any disconnects that are in series with it and are normally closed will be closed.
- Added Scheduled Actions tab to dialogs for generators, loads, branches, switched shunts, and interfaces that contains a case information display for Scheduled Actions that target the specific object
- Added options on the Scheduled Action case information display local menu to allow opening or closing the device using breakers
- Scheduled Actions with a Mapping Status of Unmapped can be loaded from a CROW file regardless of uniqueness
  - These actions are only accessible in the GUI and cannot be read from an auxiliary for PWB file

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GIC

- Electric fields can be read from or saved to a binary format (B3D), allowing time and spatially varying E-field specification
- Automated calculation of transformer I-Effective time series for a spatially uniform time-varying E-field
  - May be used for NERC Benchmark or Supplemental Geoelectric Field time series
  - Input E-field can also be converted to time-varying series voltage inputs
- Added modeling of DC Line terminal rectifier and inverter windings and grounding resistances (2-terminal, Multi-terminal, and VSC)
- GIC hotspot can now be modeled as a rectangle (previously only modeled as a square)

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GIC

- GIC geographic earth resistivity regions now have a *HotSpotScalar* field to model the supplemental event scalar as per NERC documents
- Support for TPL-007.1 and .2 geomagnetic latitude scaling function
- Support for PSS/E GIC Subsystem in reading PSS/E GIC files
- GIC results can be shown with Time Step Simulation tool
- Added default minimum high side voltage for assuming a transformer with a generator at one terminal bus is a GSU

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Sensitivity Calculations

- Advanced LODF calculation now has an option to *Include Contingencies Creating Islands*
  - Without this option these types of contingencies had always been reported with a very large result and now they can be excluded

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