Contingency Analysis Features for Modeling RAS

Matt Davis

matt@powerworld.com

217-384-6330 ext. 20

PowerWorld Corporation

WECC PowerWorld Users Group Meeting
October 15-16, 2012

Summary

- Existing Contingency Features
  - Contingency Blocks
  - Contingency Global Actions
  - Model Criteria
  - Model Conditions
  - Model Filters
  - Model Expressions
  - Contingency Element Status
  - What Actually Occurred

©2012 PowerWorld Corporation

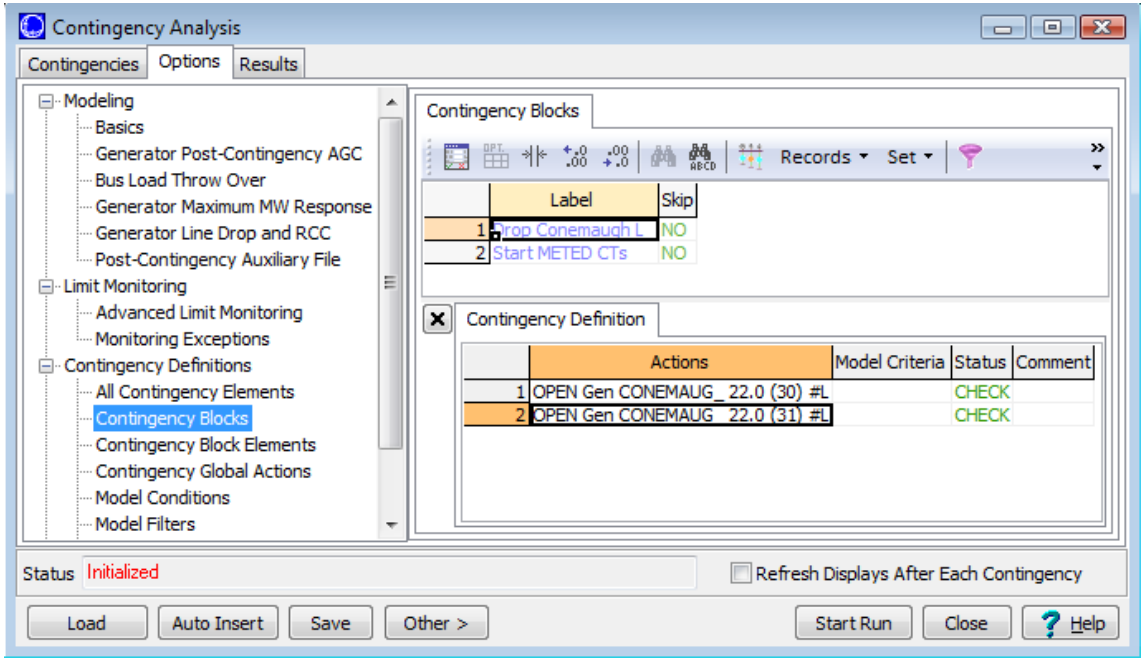
Summary

- Recent Contingency Feature Changes (mostly since version 16 release)
  - Global Action Inclusion Filter (in original 16 release)
  - Custom Monitoring (in original 16 release)
  - Filter Visualization (in original 16 release)
  - Model Filters (in original 16 release)
    - NOT condition
  - Model Expressions
    - Can reference Model Conditions and Model Filters
  - Model Conditions
    - *Disable if True in Contingency Reference State*
    - *Evaluate in Contingency Reference State*
  - Contingency Element
    - TOPOLOGYCHECK status
  - Contingency Element Action
    - *Evaluate in Reference State*
  - Accounting for overlapping generation drop
  - Model Conditions, Model Filters, and Model Expressions
    - Memo field
  - What Actually Occurred
    - Better explanation of what happened during the contingency

©2012 PowerWorld Corporation

Contingency Blocks

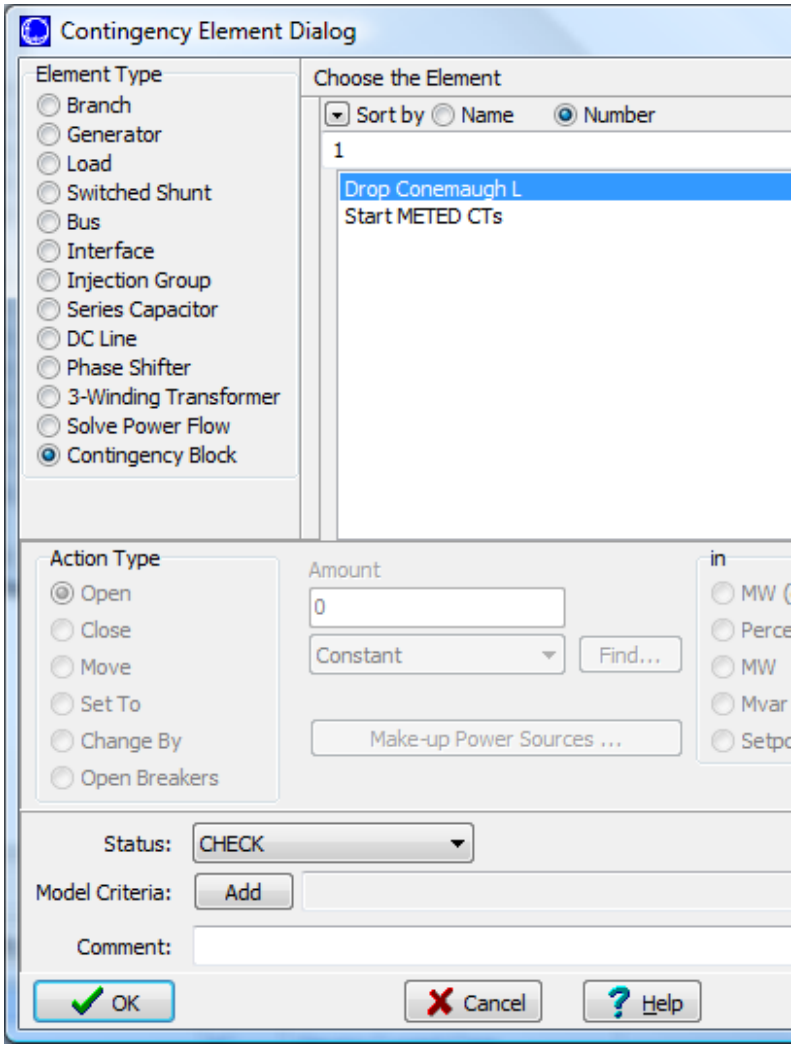
- Provide a way to group together a list of actions that frequently occur together
  - A large group of generators that all switch off together
- These are defined in the same manner as contingency records themselves are defined



©2012 PowerWorld Corporation

Using a Contingency Block

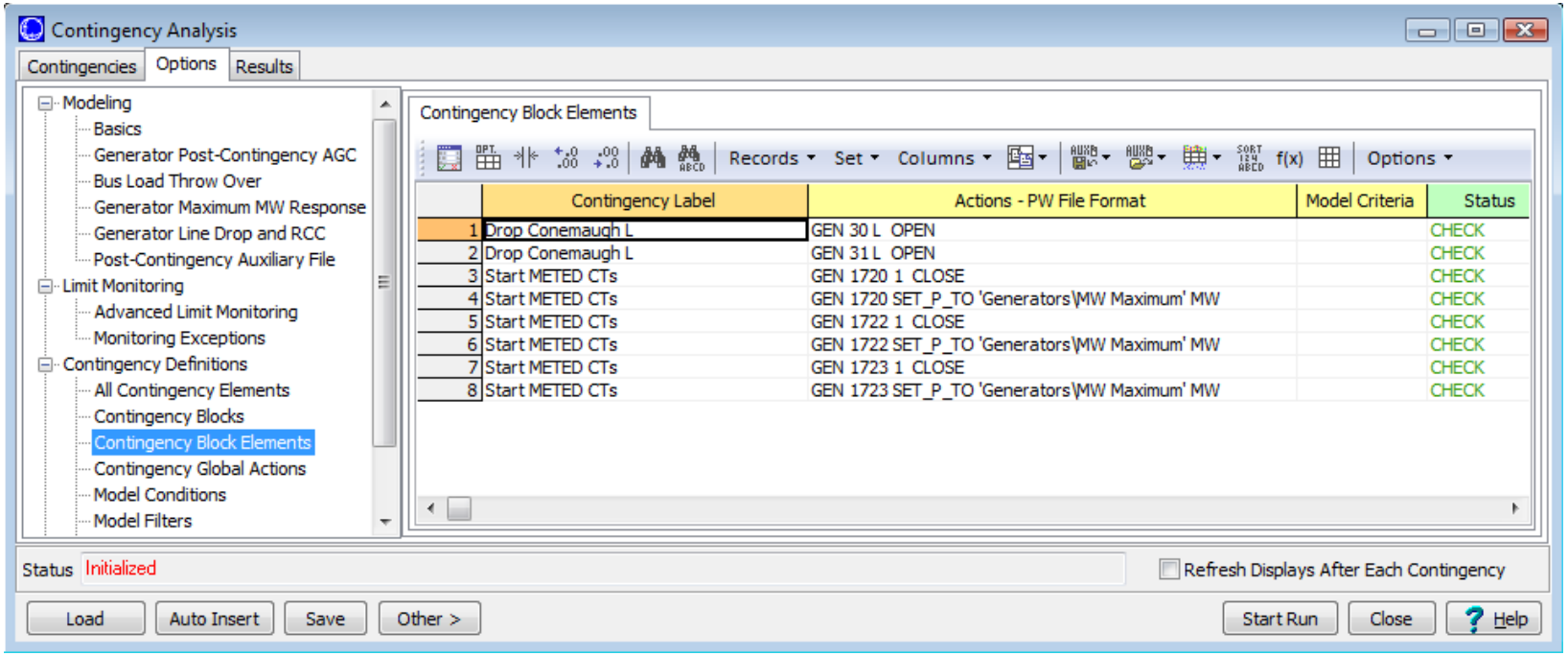
- To include a contingency block as part of a contingency record
  - Choose the **Element Type** to be *Contingency Block*
  - Specify the block
  - The contingency will then perform all the actions specified in the block



©2012 PowerWorld Corporation

Contingency Block Elements

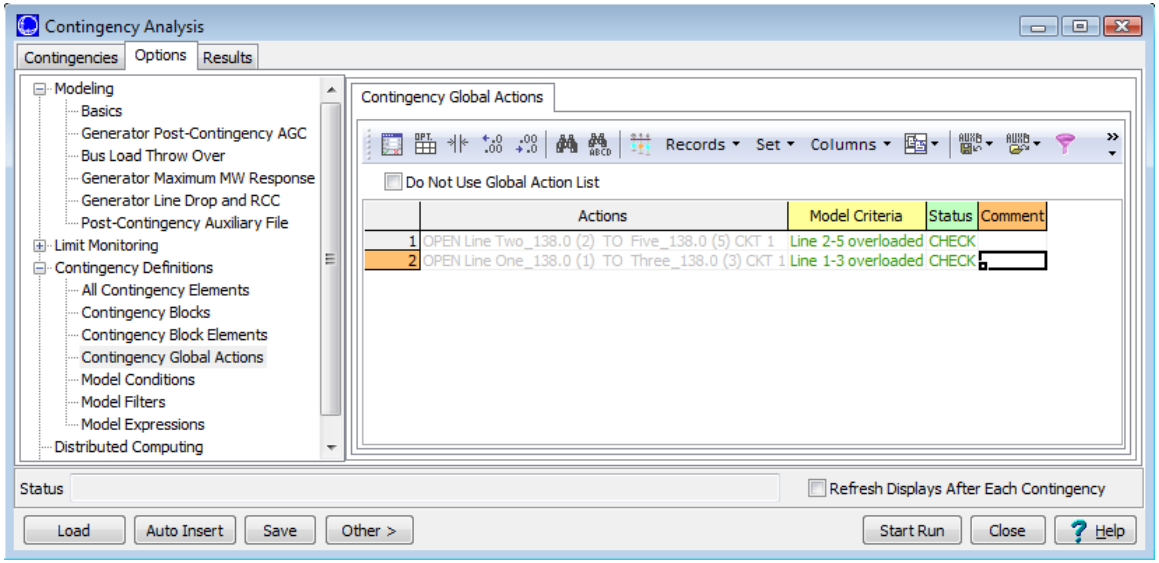
- This table shows a list of all contingency block elements in one table. Provides an alternative way to copy/paste or save this information using auxiliary files.



©2012 PowerWorld Corporation

Contingency Global Actions

- Provide a way to specify a list of actions which occur under EVERY contingency
  - Normally used with conditional actions
  - Very useful for defining RAS/SPS



©2012 PowerWorld Corporation

Conditional Contingency Actions using Model Criteria

- Specify actions that occur only if the system meets a Model Criteria
  - Model Criteria
    - Model Conditions
    - Model Filters
  - When a contingency is applied, these actions only occur if the Model Criteria is true
- Conditional actions are useful for realistic modeling of RAS or SPS that are armed or activated only under specific system conditions

©2012 PowerWorld Corporation

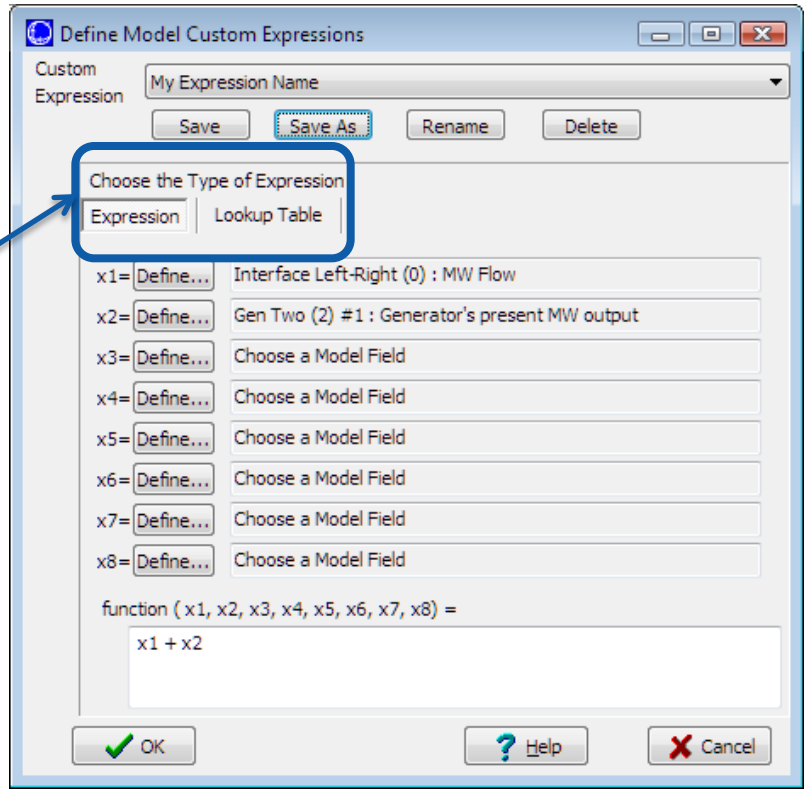
Model Expressions, Model Conditions, and Model Filters

- Model Expressions
  - Mathematic expression evaluated from one or more system parameters
  - Can define a function across many objects
  - Example: (MW output of Gen A) + (MVA Flow on Line B)
- Model Conditions
  - Combination of a specific system element and an advanced filter
  - Each Model Condition references only one element; the Model Condition is true if the element meets the filter
  - Can compare an element's parameter to a constant, another parameter of that element, or to the value of a Model Expression
  - Example: Bus 4 p.u. voltage < 0.95
- Model Filters
  - Logical comparison of one or more Model Conditions or Model Filters
  - Example: true if several Model Conditions are all true

©2012 PowerWorld Corporation

Model Expressions

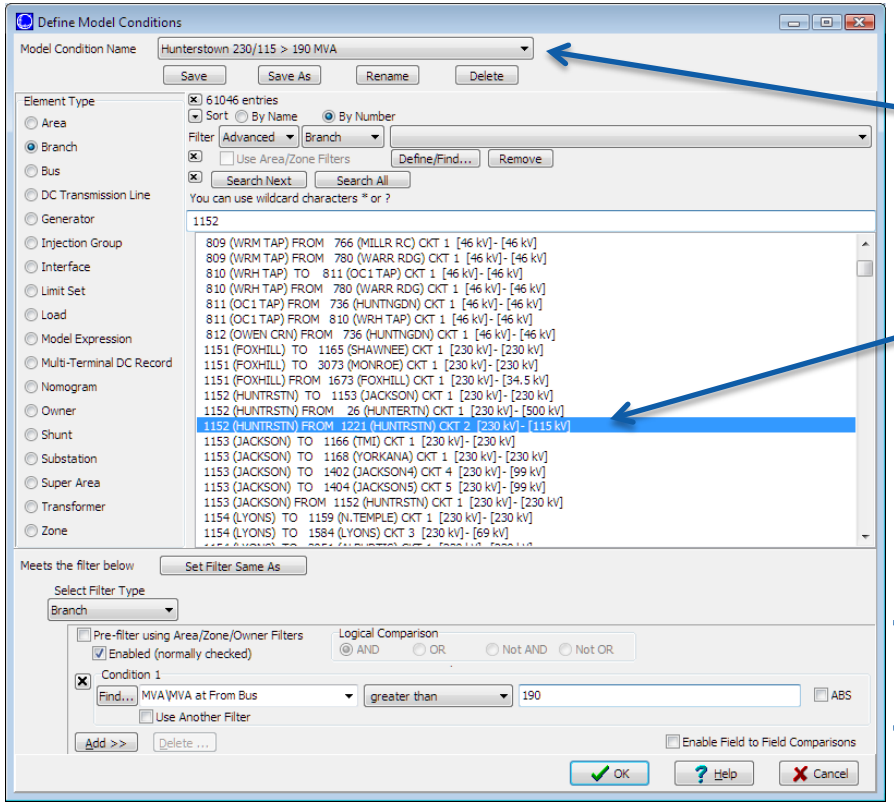
- Mathematic expression evaluated from one or more system parameters
- Can reference more than one object and object type
- Types
  - **Expressions**: mathematical expressions involving one or more model fields
  - **Lookup Tables**: return a value based on the values of one or two model fields
- May be used inside
  - Some kinds of contingency elements
    - Set Gen MW to *Model Expression*
  - Advanced Filters
  - Model Conditions



©2012 PowerWorld Corporation

Model Conditions

- Combination of a specific system element and an advanced filter
- Each Model Condition references only one element; the Model Condition is true if the element meets the filter
- Example: MVA flow > 190 on BRANCH 1152 1221 2



Choose the type of element (Branch)

Give the Model Condition a name

Choose the specific element (1152 1221 2)

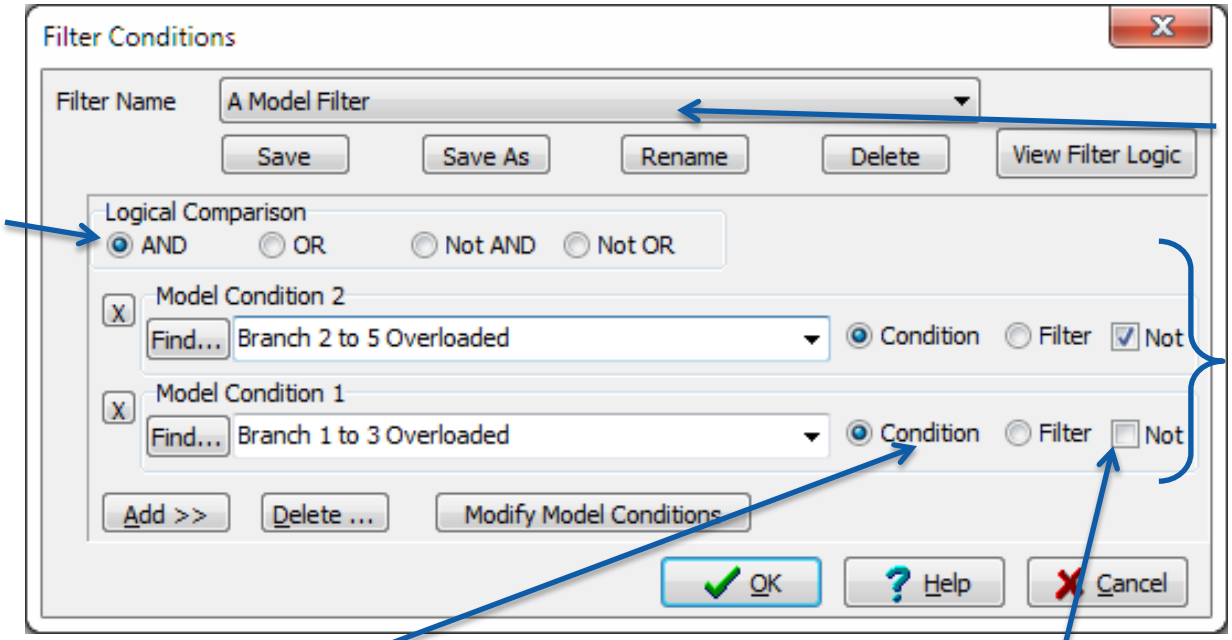
Define the criteria (MVA/MVA (maximum) > 190)

Works the same as the Advanced Filter Dialog

©2012 PowerWorld Corporation

Model Filters

- Logical comparison of one or more Model Conditions or Model Filters



Logical comparison for the Model Conditions

Give the Model Filter a name

Similar to the Advanced Filter Dialog

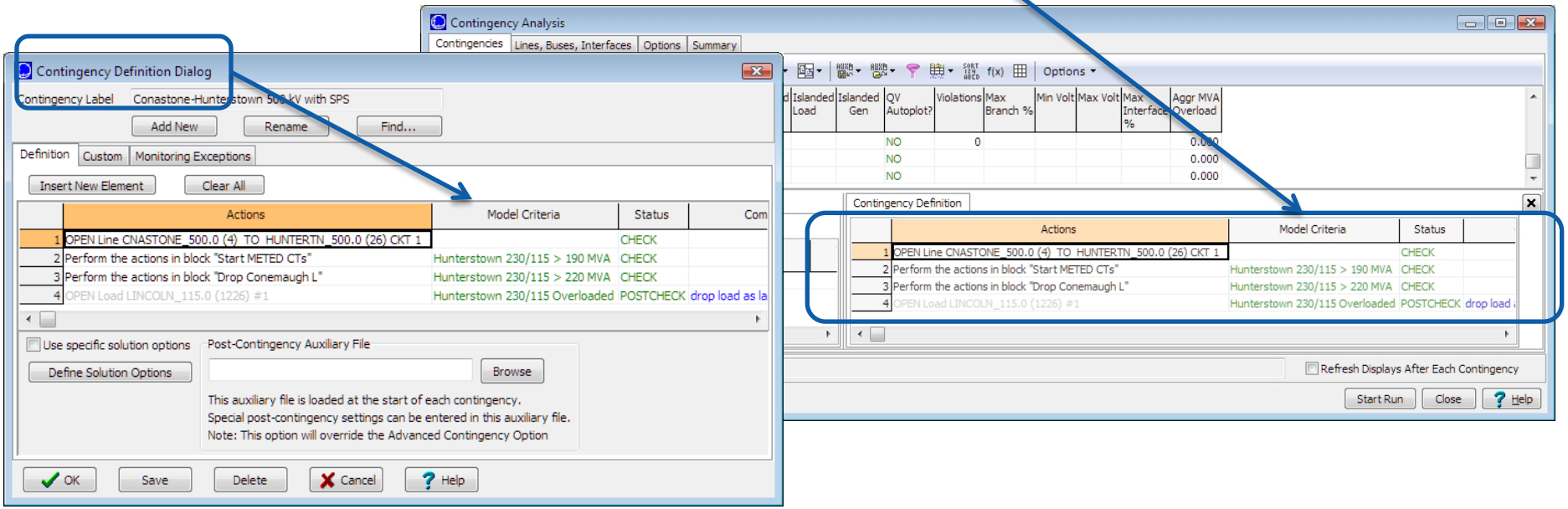
Model Filters may contain Model Conditions or other Model Filters

NOT operator is a recent addition to prevent the need for creating two model conditions to achieve the same purpose

©2012 PowerWorld Corporation

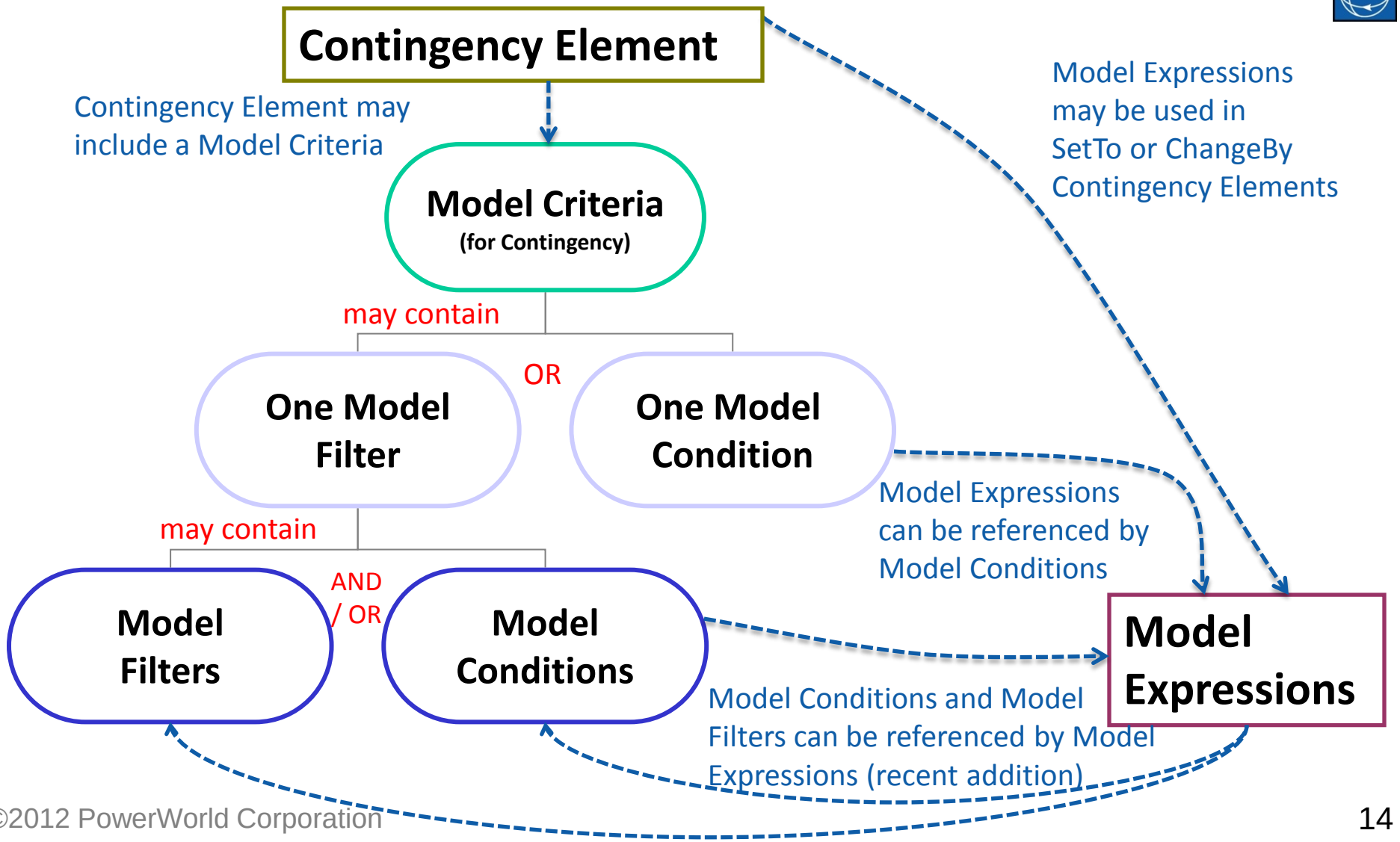
Assigning a Model Criteria to a Contingency Element

- Contingency Definition Dialog
- Contingency Definition portion of the Contingency Analysis dialog



©2012 PowerWorld Corporation

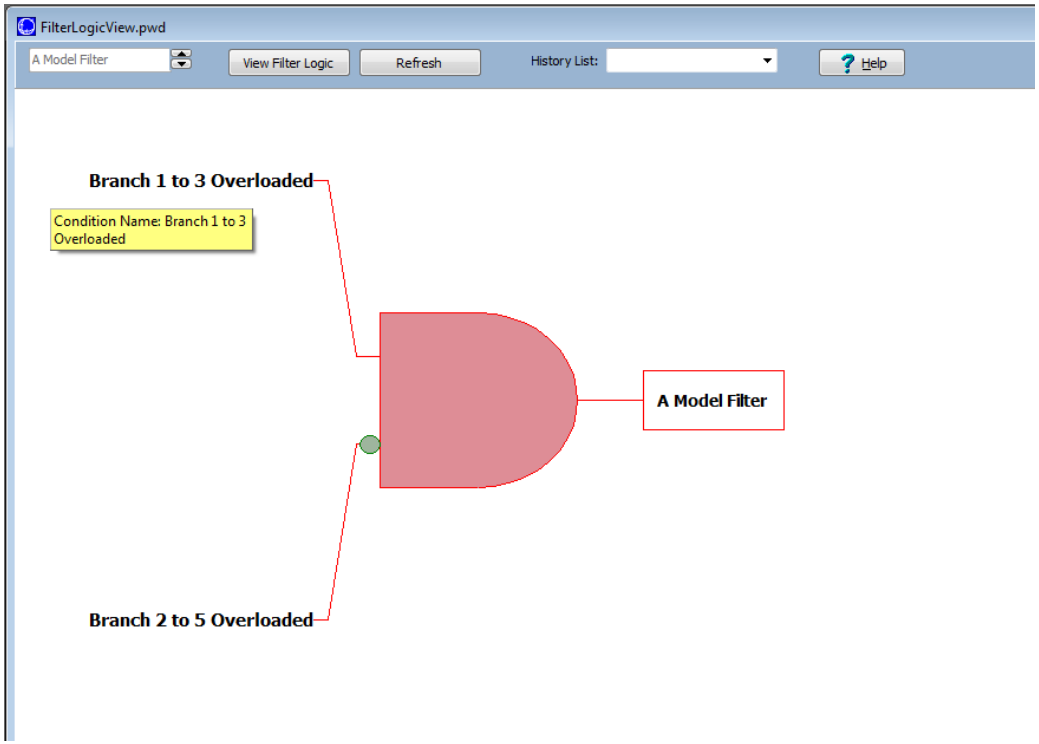
Relationship between Contingencies, Model Condition, Filters, Expressions



©2012 PowerWorld Corporation

Filter Visualization

- Available for Model Filters and Advanced Filters
- Provides logic diagram of the filter
- Provides a means to sort out the often complicated structure of a filter
- Allows navigation to other Model Filters
- Can view the details of a Model Condition or Model Filter from the diagram



©2012 PowerWorld Corporation

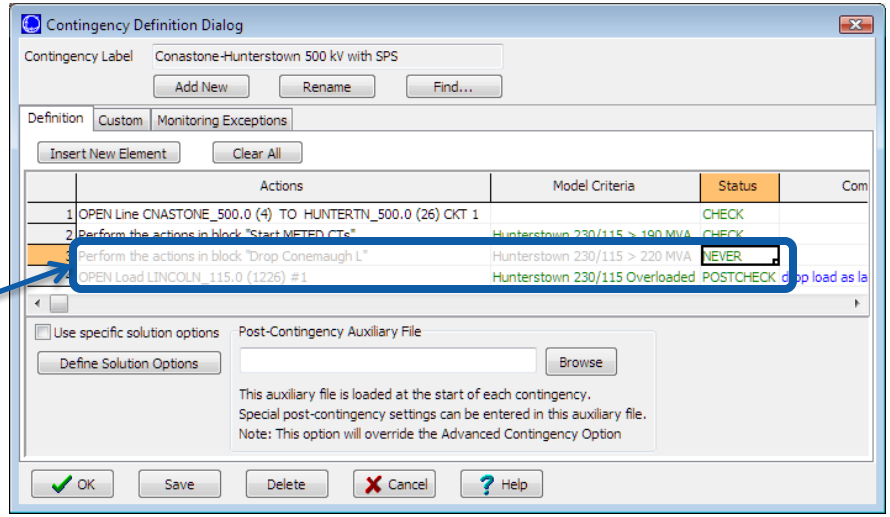
Contingency Element Status

- Along with assigning a Model Criteria, you can also assign an Element Status
  - CHECK – means the action will be done only if the Model Criteria is true. (Note if there is no model criteria, then it will also be done)
  - ALWAYS – means the action will always be done regardless of the Model Criteria
  - NEVER – means the action will never be done regardless of the Model Criteria
  - POSTCHECK – described on the next page
  - TOPOLOGYCHECK – described in detail in later slides. Recent addition.

Appear "inactive"

because of

Model Criteria and Status



©2012 PowerWorld Corporation

POSTCHECK Element Status

- The POSTCHECK allows you to make an action conditional on the *post-contingent* system
  - Example: If Branch X is overloaded, then Open it
- When POSTCHECK actions exist, the processing of the contingency occurs as follows:
  - Process All “non POSTCHECK” actions
  - Solve Power Flow
  - Look through POSTCHECK actions and process any which meet their criteria
  - If any new POSTCHECK actions are done, then go to Step 2 and repeat; otherwise stop
- Criteria for POSTCHECK actions can only be evaluated when the *Full Power Flow* Calculation Method is used
  - POSTCHECK actions will act as CHECK actions when one of the linear calculation methods is used

©2012 PowerWorld Corporation

Contingency Global Action Inclusion Filter

- Provides a means of limiting the contingencies and conditions under which a particular action can be implemented
  - Drop generation if a specific branch is out of service due to a contingency and NOT if it is out in base case
- Specified with a Contingency Global Action
  - Maintain RAS as global actions to ease data burden

©2012 PowerWorld Corporation

Contingency Global Action Inclusion Filter

- Filter can be an Advanced Filter or Device Filter that can be applied to a Contingency
  - Contingency, ContingencyElement, Branch, Bus, Gen, Load, Switched Shunt, Interface, Injection Group, DC Line
- Checked against all contingencies to determine if the Global Action should be included with a particular contingency

©2012 PowerWorld Corporation

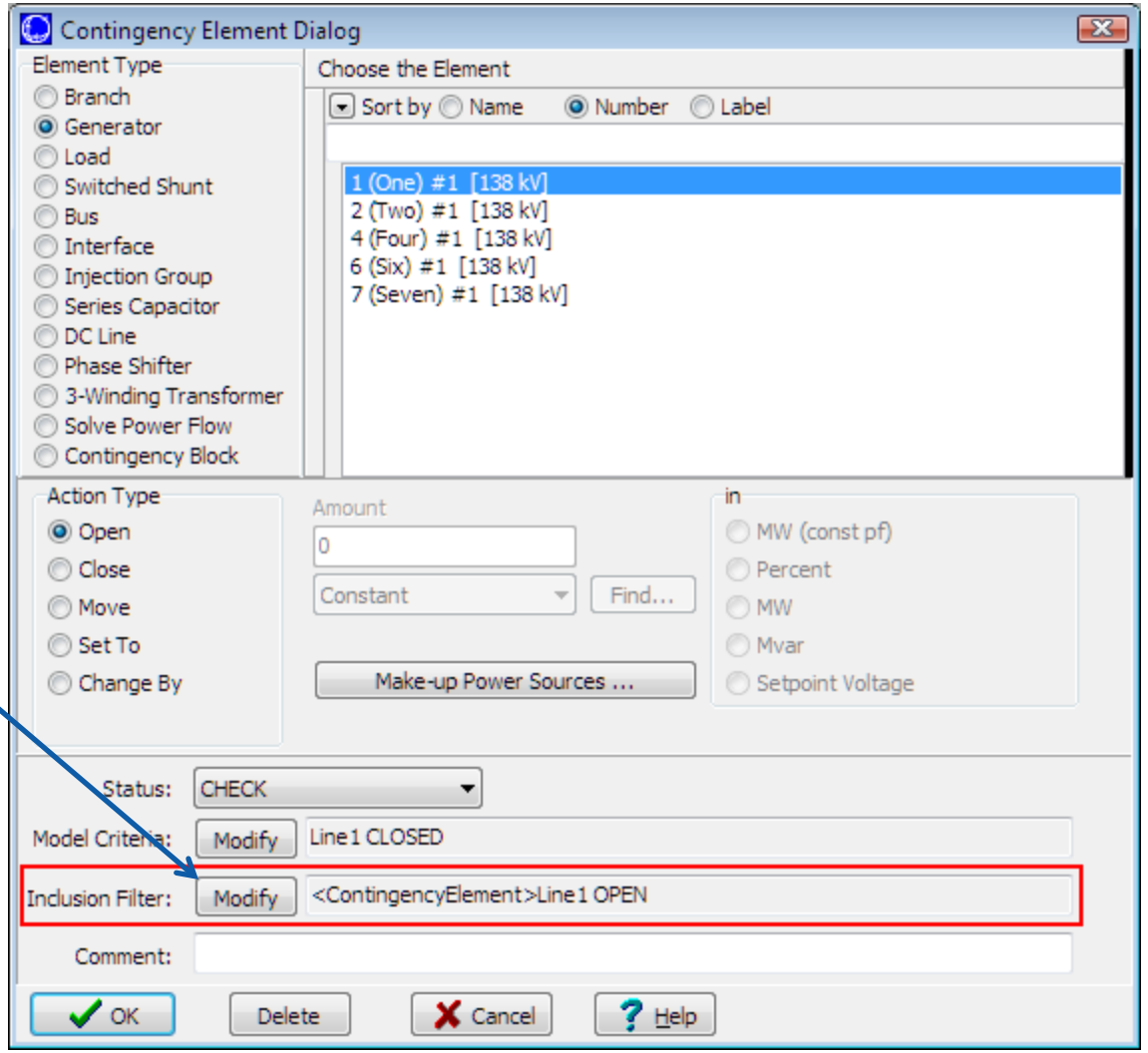
Contingency Global Action Inclusion Filter

- Evaluated in the base case before any contingency actions are implemented
- Leave blank for a Global Action to be included with ALL contingencies

©2012 PowerWorld Corporation

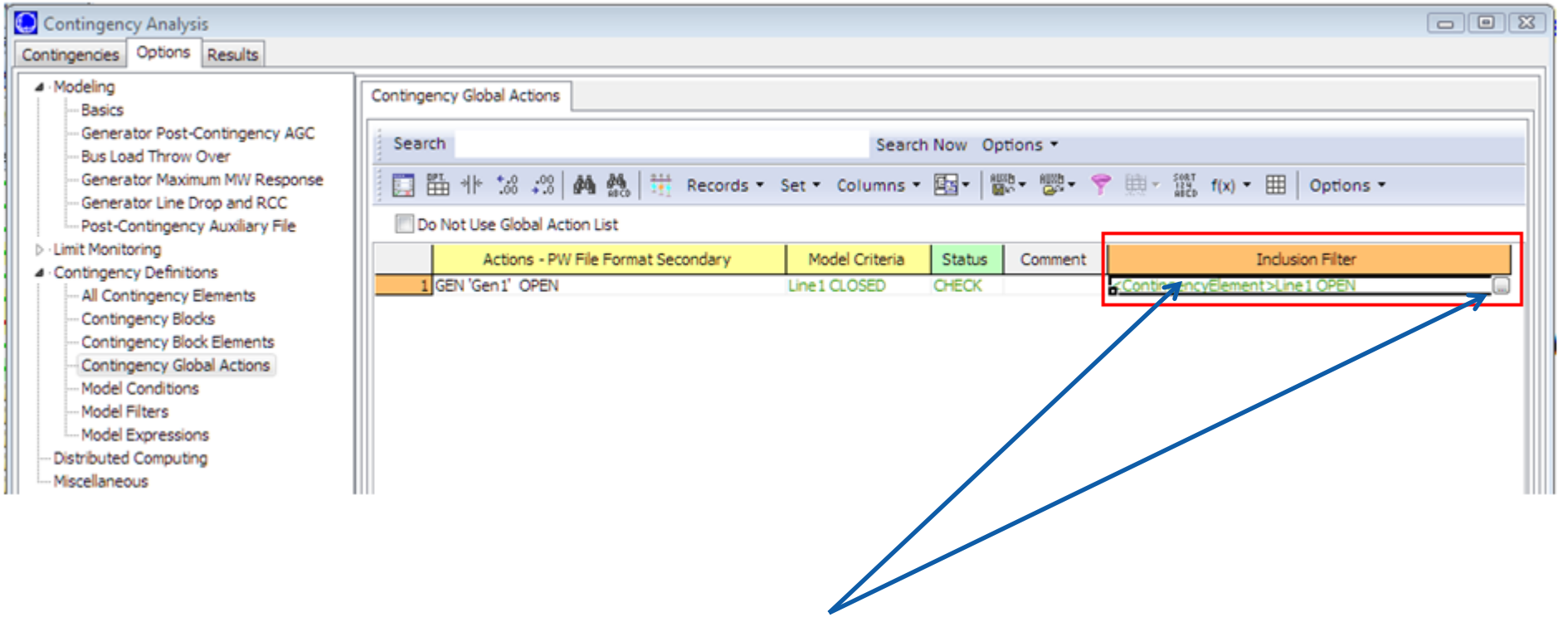
Contingency Element Dialog

Click Add/Modify to specify Inclusion Filter



©2012 PowerWorld Corporation

Contingency Global Actions Case Info



Manually enter OR click button to open dialog and specify Inclusion Filter

©2012 PowerWorld Corporation

Inclusion Filter Example

- Drop generation if a particular branch is outaged due to a contingency
  - Create ContingencyElement filter to identify the branch to be outaged and include the OPEN action
    - Create Branch filter first to identify the branch and combine with filter condition on the OPEN action
- Do not drop generation if the branch is already out in the base case
  - Create Model Condition to check the status of the branch

©2012 PowerWorld Corporation

Inclusion Filter Example

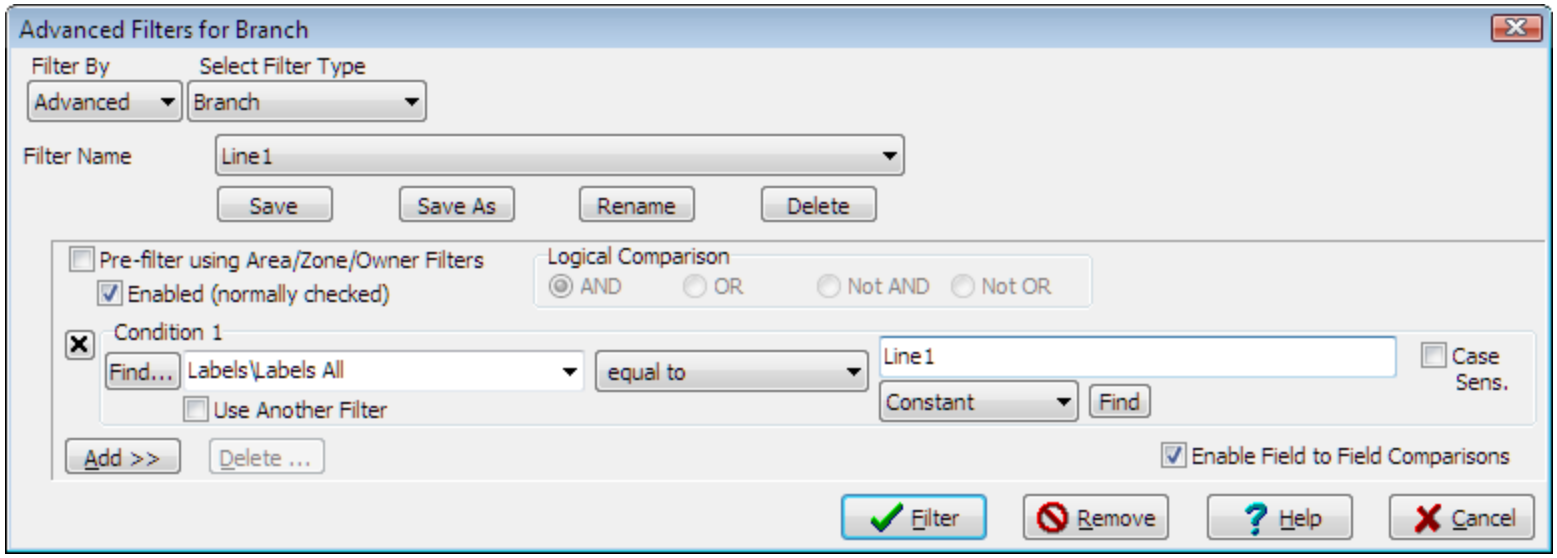
- Create Global Action to drop generation
  - Add ContingencyElement filter as Inclusion Filter
  - Include Model Condition as Model Criteria
  - Assign CHECK status to the Model Criteria so that the condition will be evaluated in the base case

©2012 PowerWorld Corporation

B7Flat Case Example ContingencyElement Filter

- Create ContingencyElement filter to identify the branch to be outaged and include the OPEN action
  - First create a Branch filter identifying the appropriate branch by label (*Labels/Labels All* field)

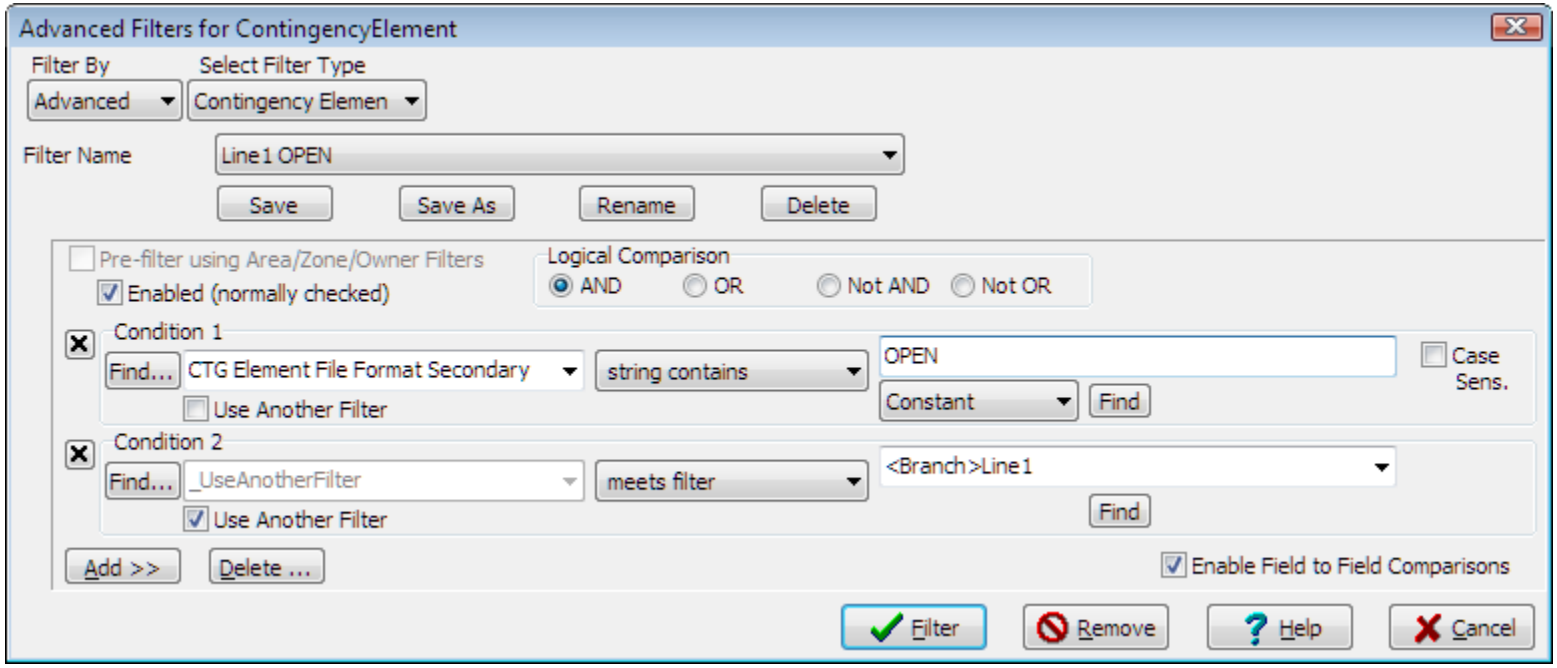
Labels are very useful with full-topology models and provide a unique identifier for objects when bus numbers might change



©2012 PowerWorld Corporation

B7Flat Case Example ContingencyElement Filter

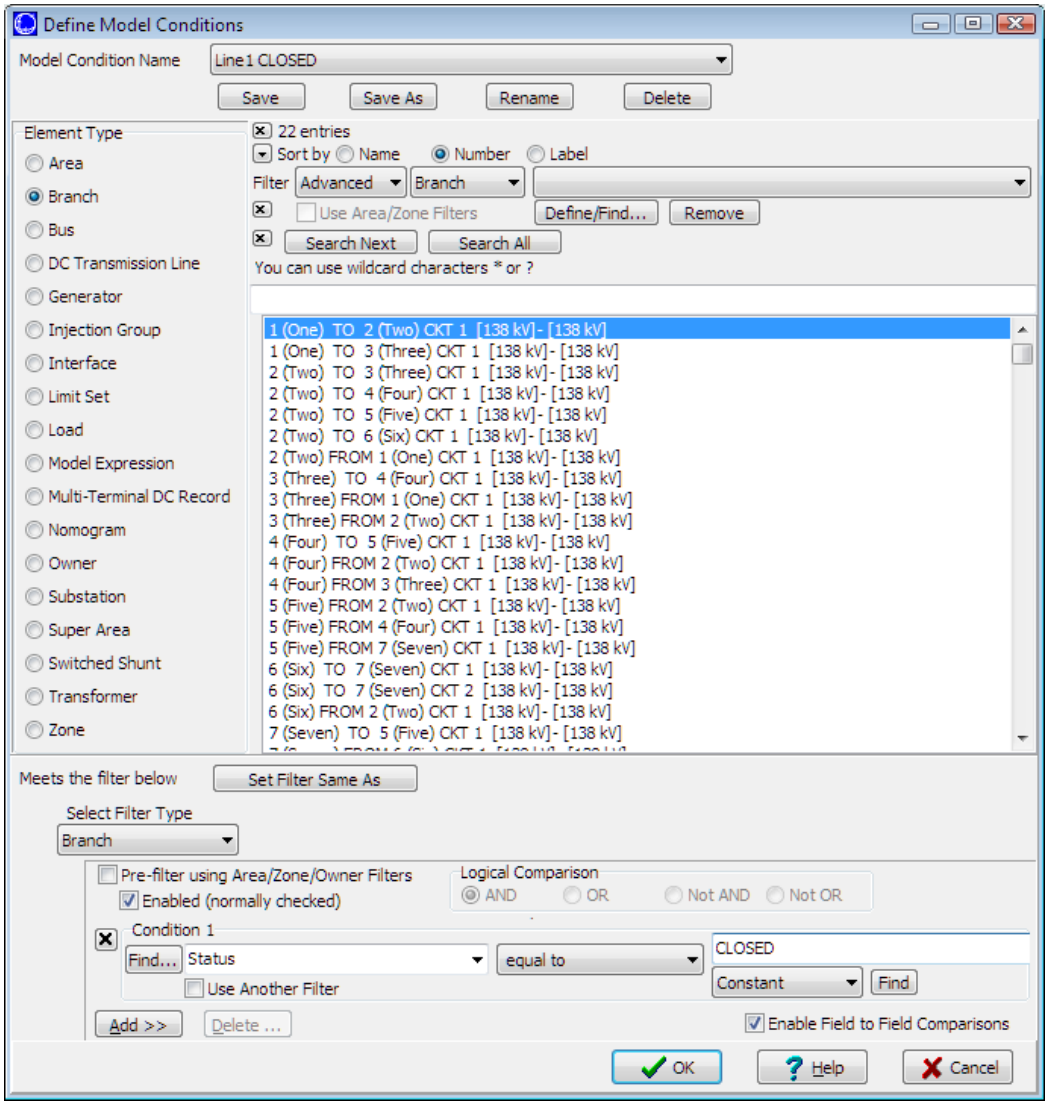
- Create ContingencyElement filter to identify the branch to be outaged and include the OPEN action
  - Combine Branch filter with OPEN action
  - *CTG Element File Format Secondary* will allow Actions identification by label. Could also use *CTG Element File Format*.



©2012 PowerWorld Corporation

B7Flat Case Example Model Condition

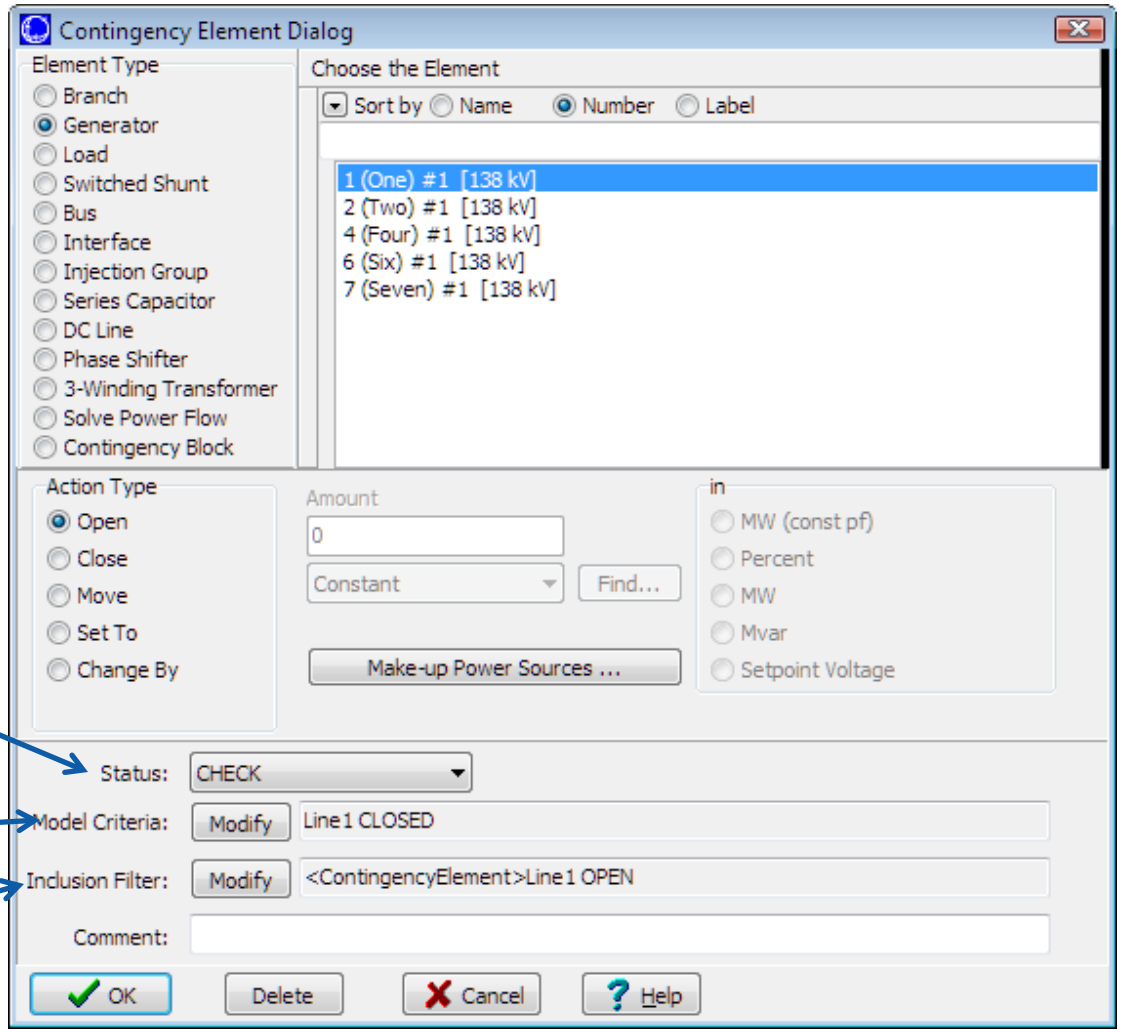
- Create Model Condition to check the status of the branch



©2012 PowerWorld Corporation

B7Flat Case Example Global Action

- Create Global Action to drop generation



Status must be CHECK to evaluate the line status in the base case

Assign Model Condition

Assign Inclusion Filter

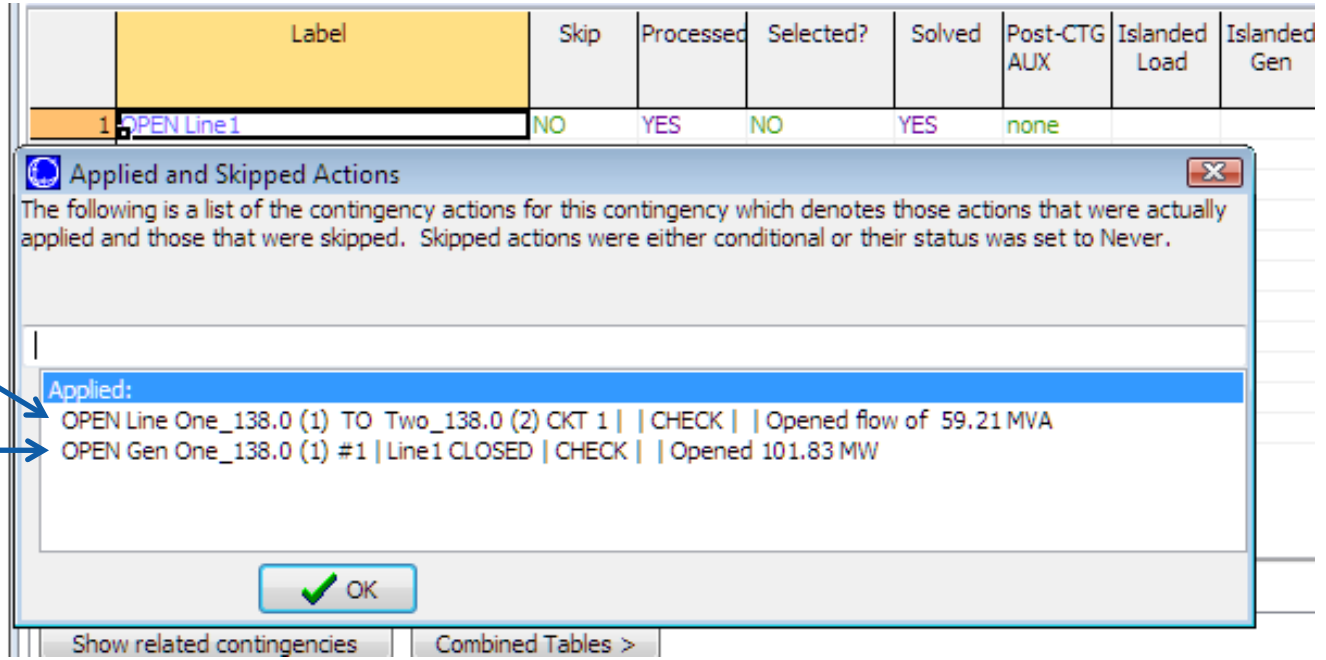
©2012 PowerWorld Corporation

Run Contingency Analysis *What Actually Occurred?*

Line1 is CLOSED in the base case

Contingency OPENs Line1

Contingency includes global action and implements the action

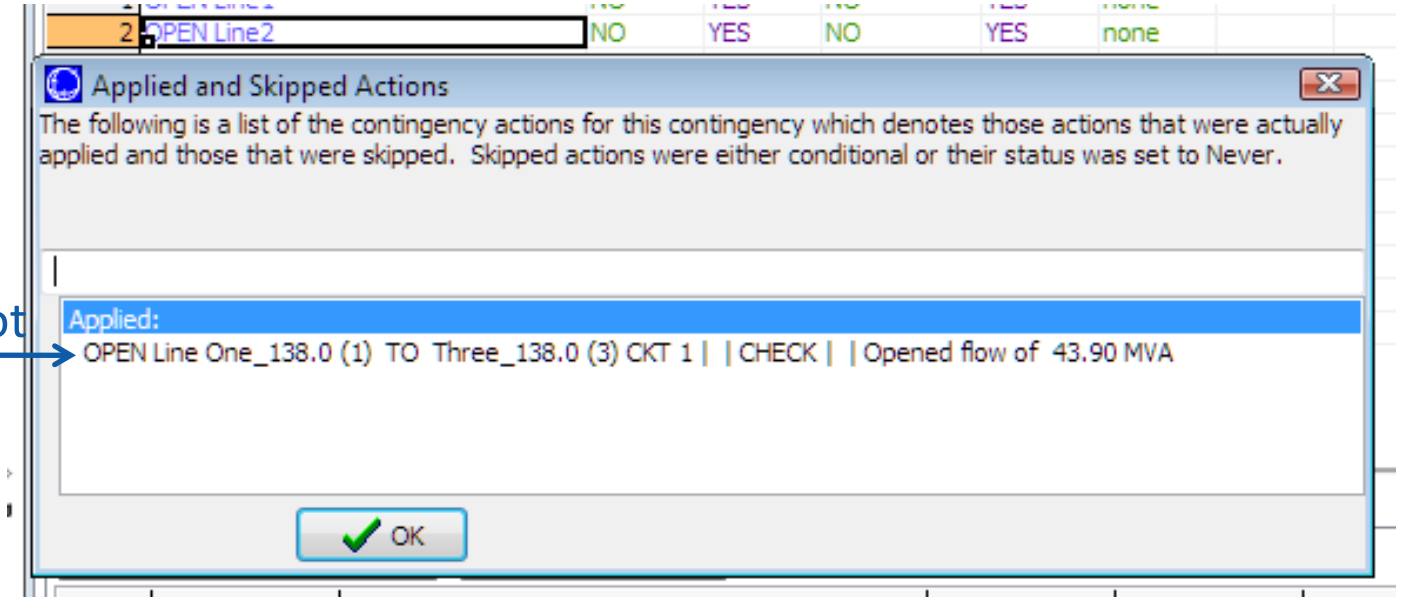


©2012 PowerWorld Corporation

Run Contingency Analysis *What Actually Occurred?*

Contingency OPEN Line2 does not meet the Inclusion Filter

Global Action for generation drop is not included



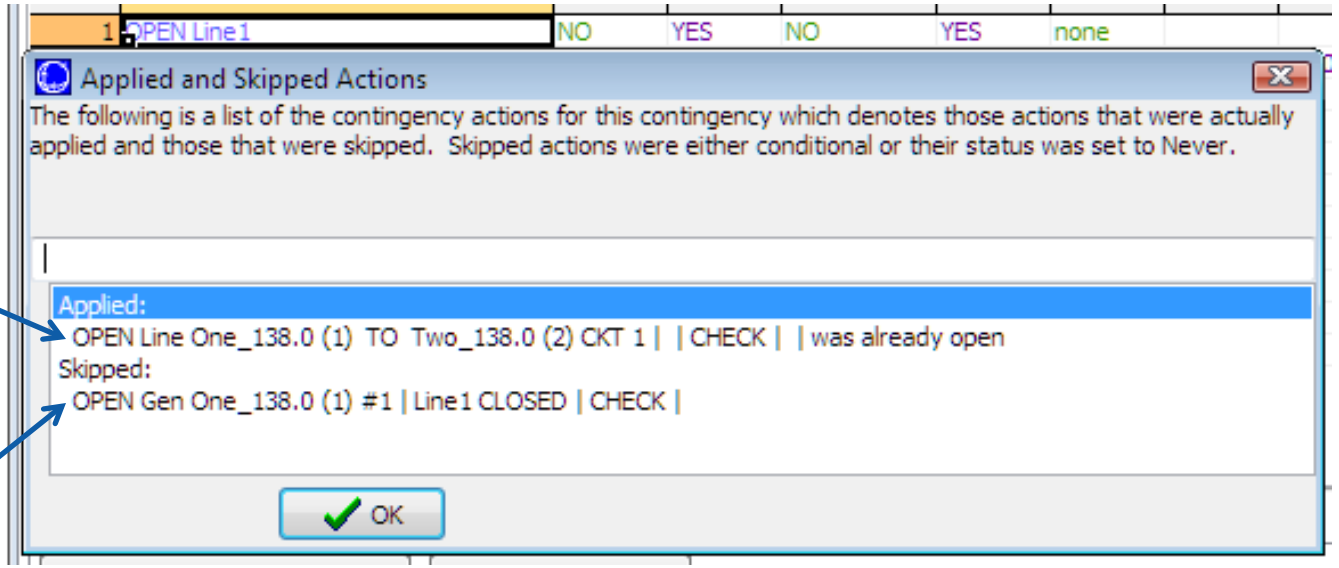
©2012 PowerWorld Corporation

Run Contingency Analysis *What Actually Occurred?*

Line1 is OPEN in the base case

Contingency recognizes OPEN line

Contingency includes the global action but it is not implemented because the Model Criteria is not met



©2012 PowerWorld Corporation

Custom Monitoring

- Provides a means of tracking values other than line flow or bus voltage during contingency analysis
- Useful with remedial action schemes for determining what was implemented
  - Monitor injection group that represents the generation in the RAS to determine total amount of generation that may have been dropped

©2012 PowerWorld Corporation

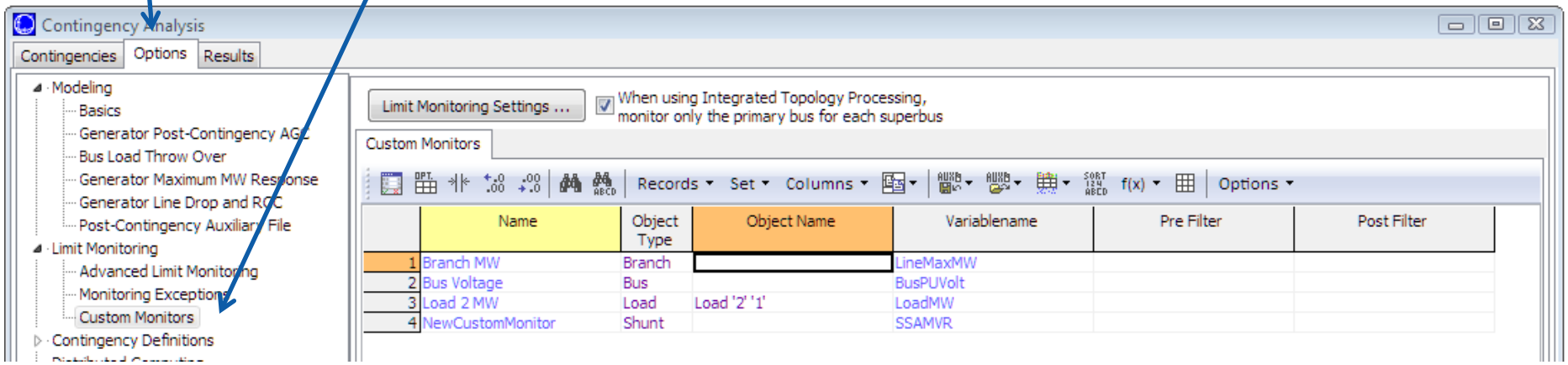
Custom Monitoring

- Custom Monitor object
  - Specify object type or specific object to be monitored
  - Specify the field to be monitored
  - Optionally specify a Pre-Filter that gets checked in the base case
  - Optionally specify a Post-Filter that gets checked after the contingency implementation
  - Results show up with Limit Violations
  - Custom Monitors apply to ALL contingencies

©2012 PowerWorld Corporation

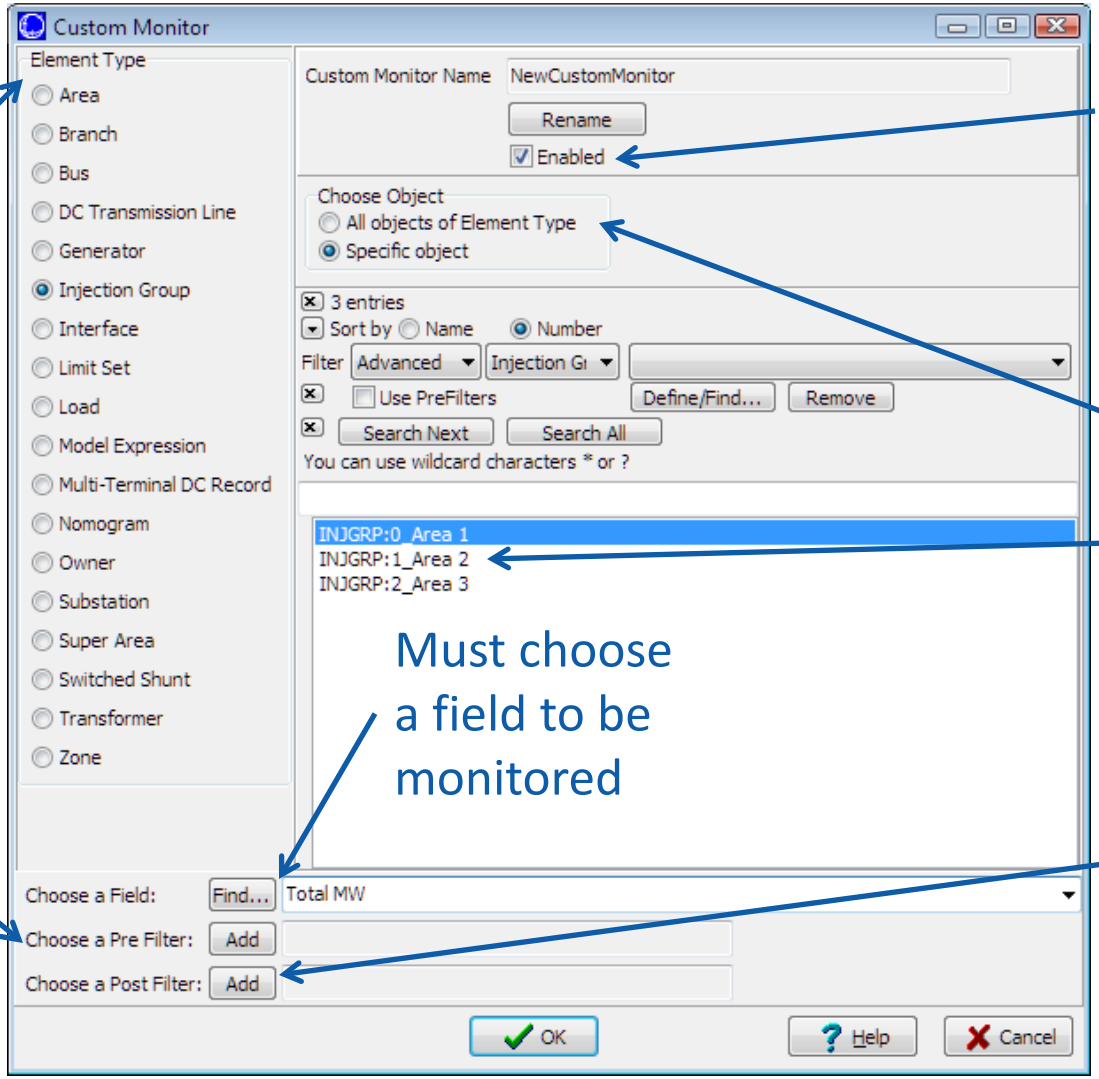
Defining Custom Monitors

Options page under Limit Monitoring



©2012 PowerWorld Corporation

Defining Custom Monitors



Must choose an Element Type to monitor

Must be Enabled to include in monitoring

Choose all objects of a particular Element Type or a specific object of that type

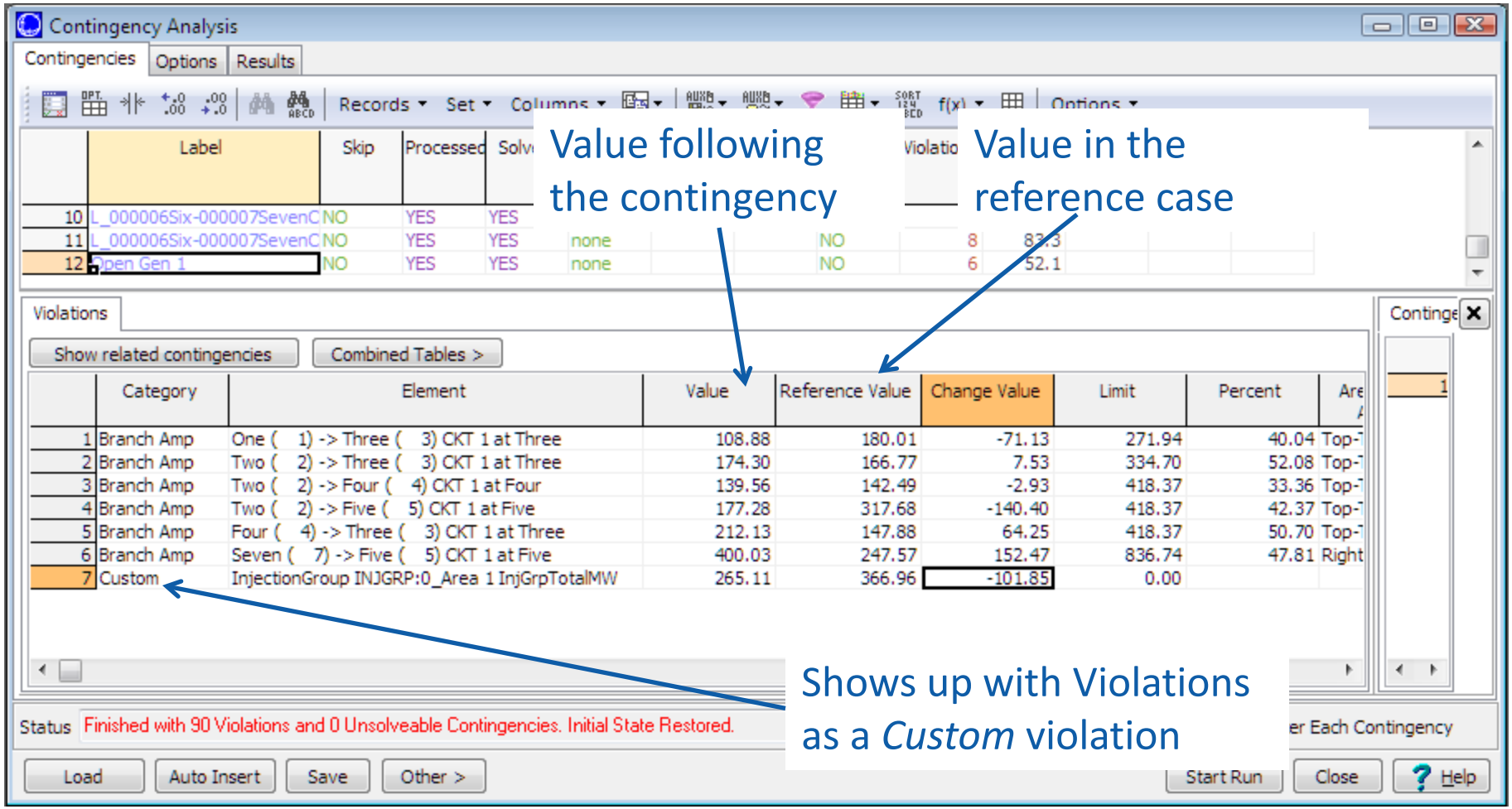
Must choose a field to be monitored

Optional Pre Filter checked against the reference case

Optional Post Filter checked against the contingency case

©2012 PowerWorld Corporation

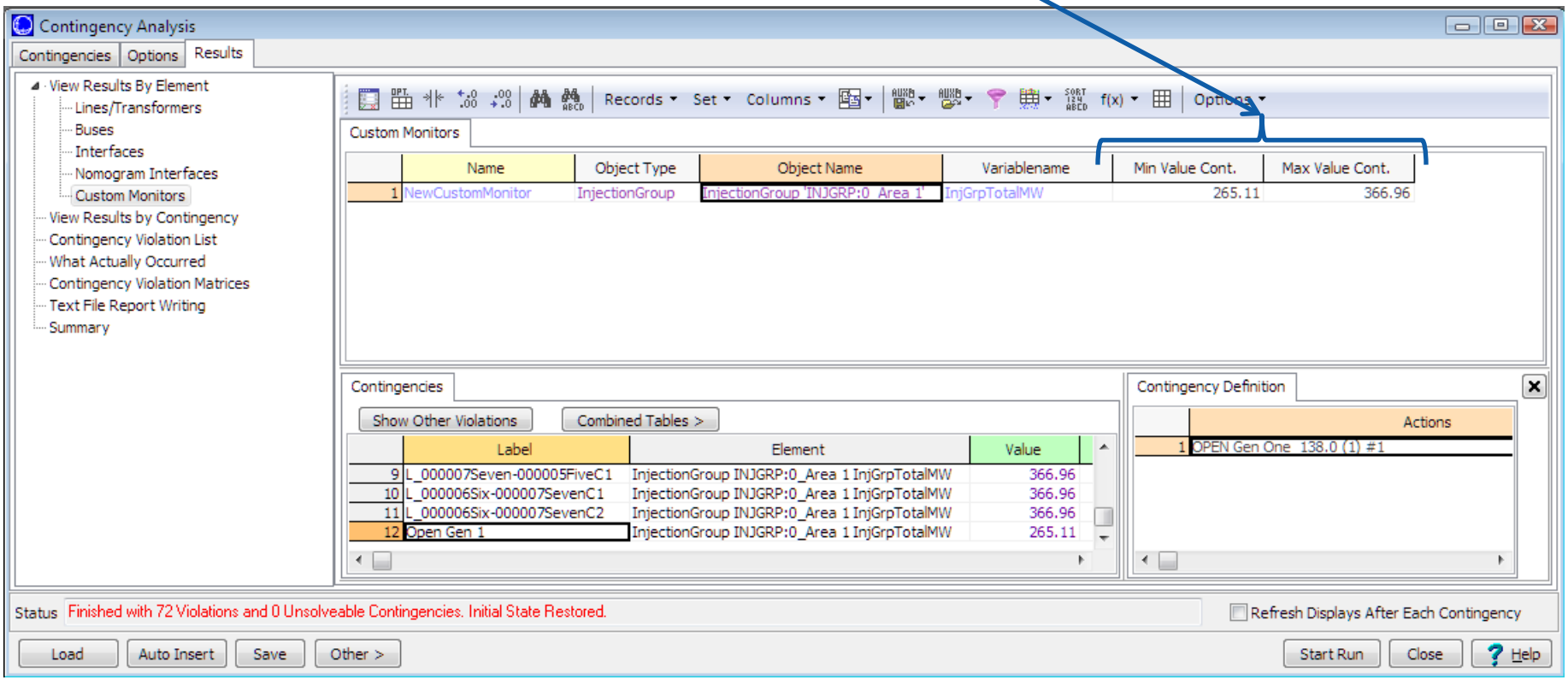
Viewing Custom Monitor Results



©2012 PowerWorld Corporation

Viewing Results by Element

Minimum and maximum values over all contingencies



©2012 PowerWorld Corporation

RAS Modeling Problem

- Remedial action schemes (RAS) are implemented only if certain branches are out of service due to a contingency and NOT if they are out in the base case
- RAS arming is determined from base case conditions and implementation is based on contingency conditions
- Implementation of RAS could be necessary prior to solving the power flow in order for the solution to converge
- RAS cannot be properly modeled, and to get as close as possible to correct modeling, it is necessary to define RAS actions with each individual contingency making data maintenance prone to errors

©2012 PowerWorld Corporation

RAS Modeling Solution

- Add TOPOLOGYCHECK status with conditional contingency actions
  - Provides a way to implement RAS due to contingency actions before the power flow is solved
- Add *Disable if True in contingency reference state* option with Model Conditions
  - Will not allow implementation of conditional actions if the conditions are met in the base case

©2012 PowerWorld Corporation

RAS Modeling Solution

- Add *Evaluate in Reference State* option with Contingency Element
  - Allows RAS arming determined by base case conditions

©2012 PowerWorld Corporation

RAS Modeling Solution

- Allow Model Conditions and Model Filters to be part of Model Expressions
  - Makes RAS arming determined by base case conditions easier to manage
- Define RAS as part of Contingency Global Actions

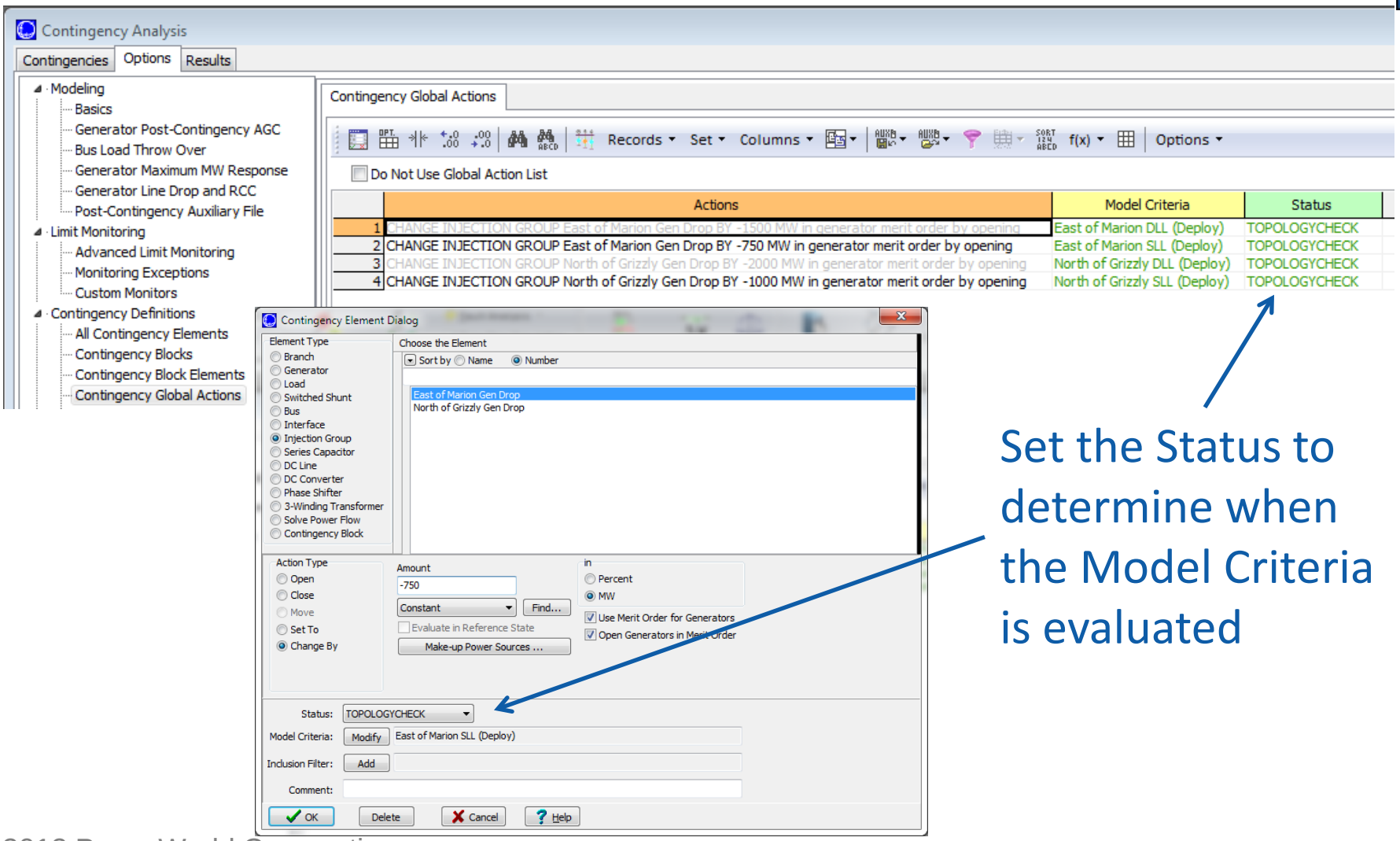
©2012 PowerWorld Corporation

TOPOLOGYCHECK Status

- Used to determine when to evaluate Model Criteria for conditional contingency actions
- Provides a way to implement RAS due to contingency actions **before** the power flow is solved
  - Evaluated after CHECK and unconditional actions are applied
  - Only useful with topology changes
    - Flow and voltage changes due to contingency won't take affect until after the power flow

©2012 PowerWorld Corporation

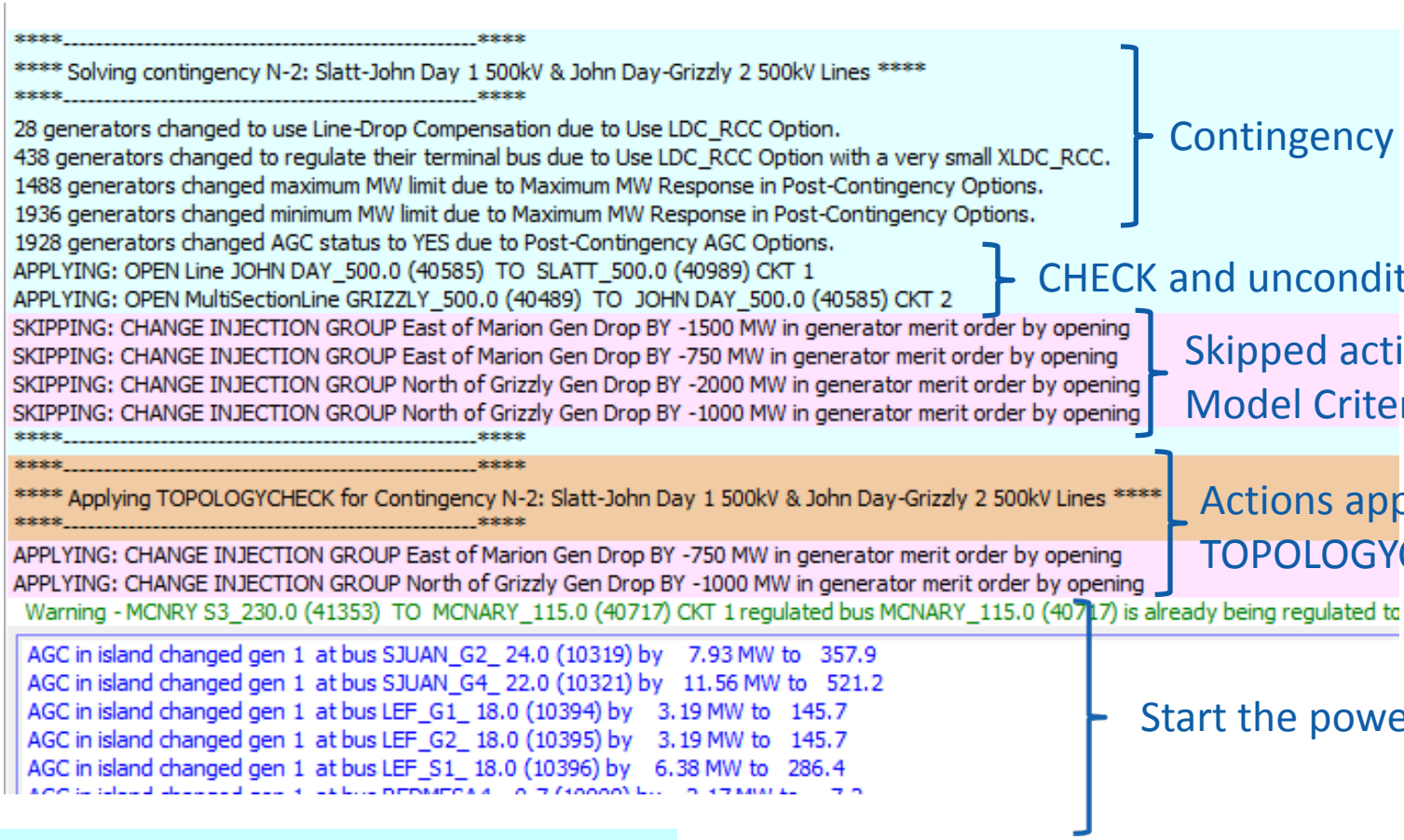
TOPOLOGYCHECK Status Setup



Set the Status to determine when the Model Criteria is evaluated

©2012 PowerWorld Corporation

TOPOLOGYCHECK Status Message Log



Light blue indicates contingency element

Pink indicates Global Action

©2012 PowerWorld Corporation

Disable if true in contingency reference state

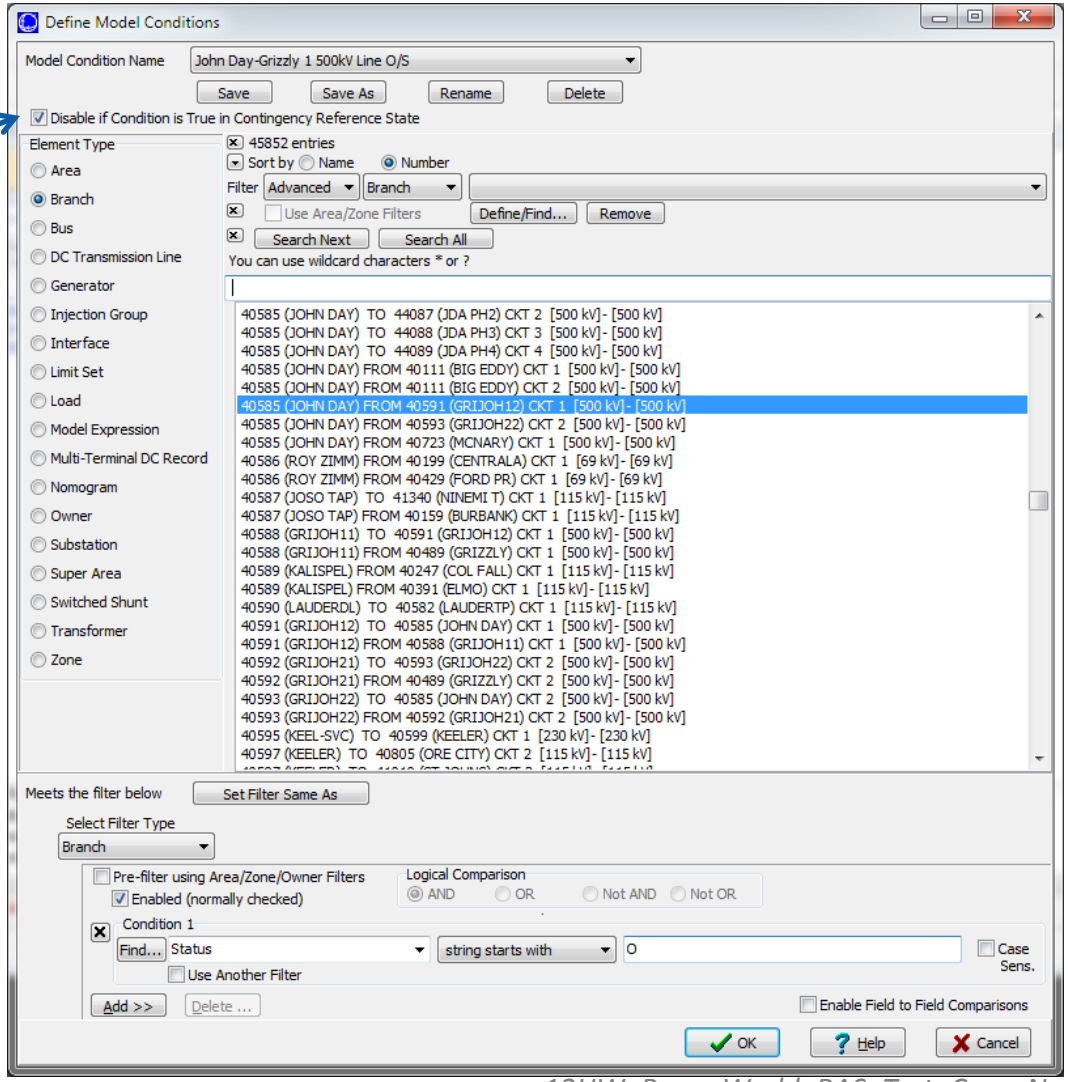
- Option specified with Model Conditions
- Will not allow implementation of conditional actions if the conditions are met in the base case
- Model Filters will be disabled if all component Model Conditions or Model Filters are disabled
  - Individual Model Conditions or Filters that are disabled will be ignored

©2012 PowerWorld Corporation

Disable if true in contingency…

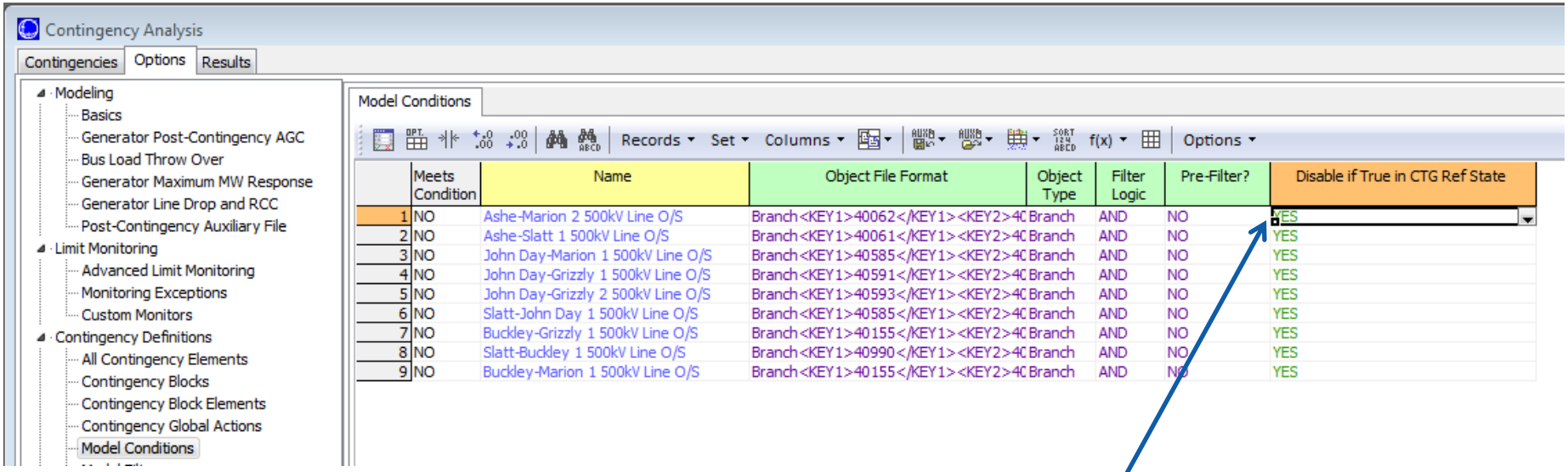
Setup

Check the box on the dialog



©2012 PowerWorld Corporation

Disable if true in contingency… Setup



OR set the field in the table

©2012 PowerWorld Corporation

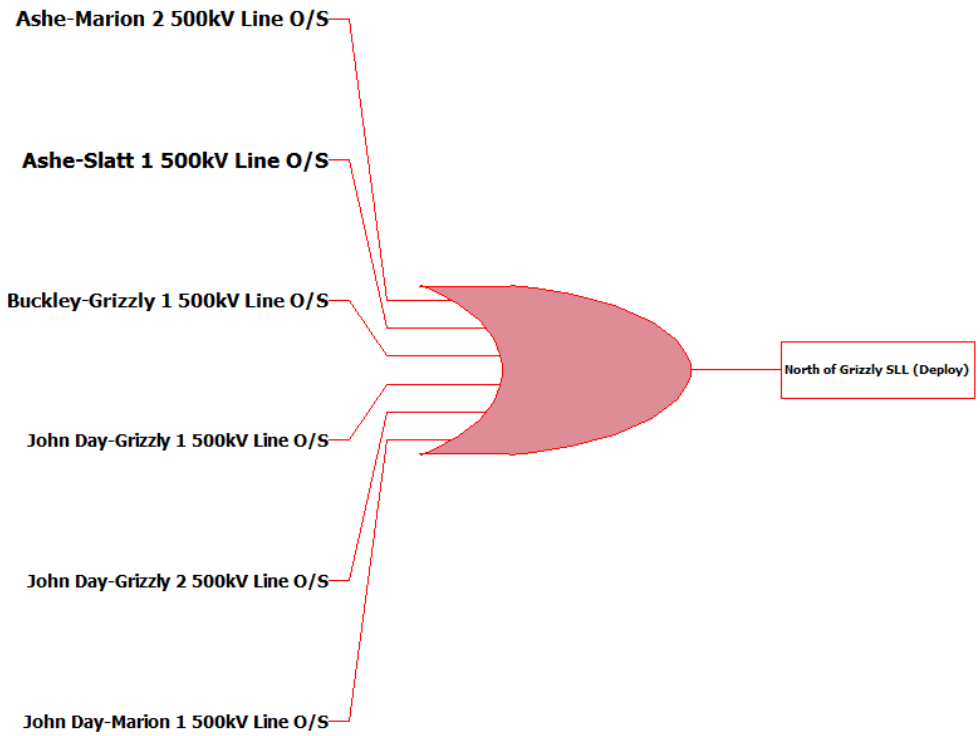
Disable if true in contingency… Example

ASHE to SLATT outage with North of Grizzly SLL (Deploy) applied

```
Applied:
  OPEN Line ASHE_500.0 (40061)  TO  SLATT_500.0 (40989) CKT 1 |  | CHECK |  | Opened flow of 1571.22 MVA | ELEMENT
  CHANGE INJECTION GROUP North of Grizzly Gen Drop BY -1000 MW in generator merit order by opening | North of Grizzly SLL (Deploy) | TOPOLOGYCHECK |  | Changed from 2685.00 to
Skipped:
  CHANGE INJECTION GROUP East of Marion Gen Drop BY -1500 MW in generator merit order by opening | East of Marion DLL (Deploy) | TOPOLOGYCHECK |  |  | GLOBAL
  CHANGE INJECTION GROUP East of Marion Gen Drop BY -750 MW in generator merit order by opening | East of Marion SLL (Deploy) | TOPOLOGYCHECK |  |  | GLOBAL
  CHANGE INJECTION GROUP North of Grizzly Gen Drop BY -2000 MW in generator merit order by opening | North of Grizzly DLL (Deploy) | TOPOLOGYCHECK |  |  | GLOBAL
```

North of Grizzly SLL (Deploy) applied

Reference case evaluation of North of Grizzly SLL (Deploy) model filter → all conditions are false



©2012 PowerWorld Corporation

Disable if true in contingency… Example

ASHE to SLATT outage with ASHE to SLATT already open in base case

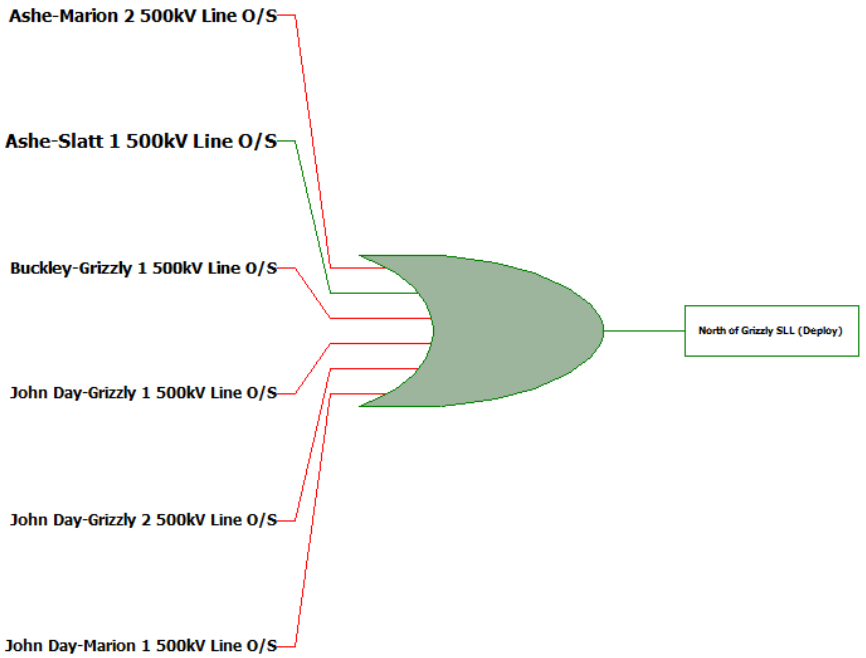
Disable if true in contingency … in use for all Model Conditions

Applied:
OPEN Line ASHE_500.0 (40061) TO SLATT_500.0 (40989) CKT 1 | | CHECK | | was already open | ELEMENT

Skipped:
CHANGE INJECTION GROUP East of Marion Gen Drop BY -1500 MW in generator merit order by opening | East of Marion DLL (Deploy) | TOPOLOGYCHECK | | | GLOBAL
CHANGE INJECTION GROUP East of Marion Gen Drop BY -750 MW in generator merit order by opening | East of Marion SLL (Deploy) | TOPOLOGYCHECK | | | GLOBAL
CHANGE INJECTION GROUP North of Grizzly Gen Drop BY -2000 MW in generator merit order by opening | North of Grizzly DLL (Deploy) | TOPOLOGYCHECK | | | GLOBAL
CHANGE INJECTION GROUP North of Grizzly Gen Drop BY -1000 MW in generator merit order by opening | North of Grizzly SLL (Deploy) | TOPOLOGYCHECK | | | GLOBAL

North of Grizzly SLL (Deploy) NOT applied

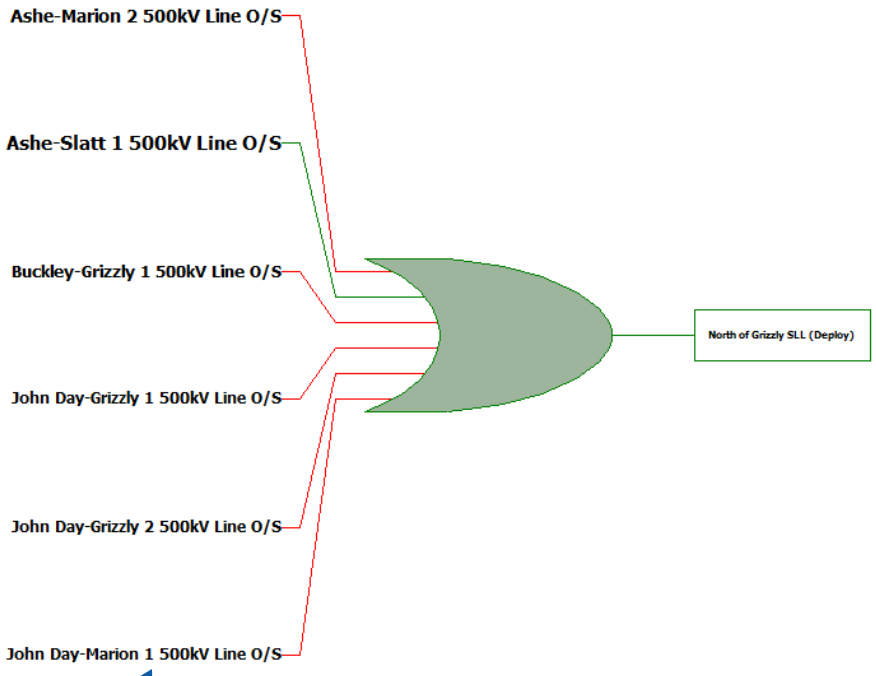
Reference case evaluation of North of Grizzly SLL (Deploy) model filter → Ashe-Slatt condition is true



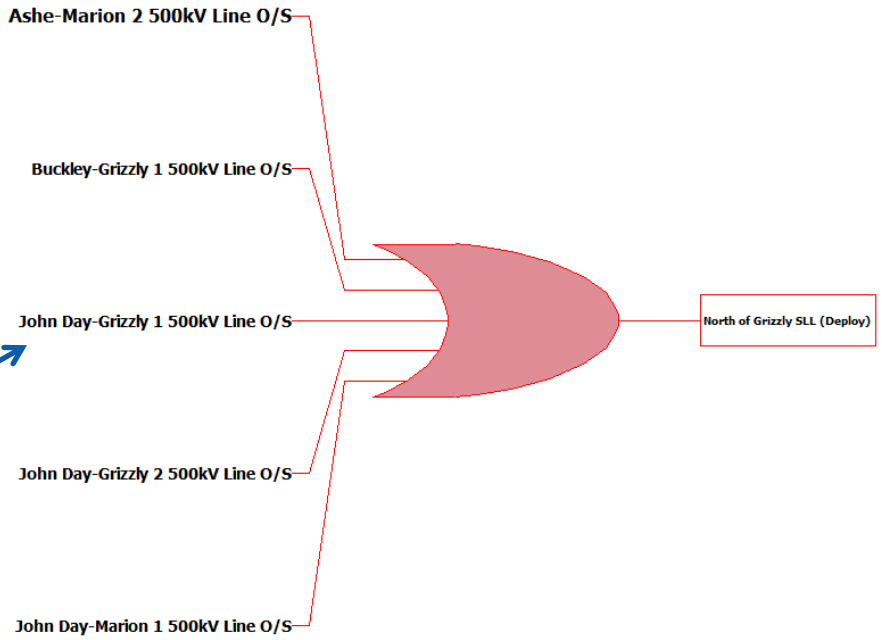
©2012 PowerWorld Corporation

Disable if true in contingency…

Example



When option in use, true Model Conditions are ignored and Model Filters are treated as if those conditions do not exist



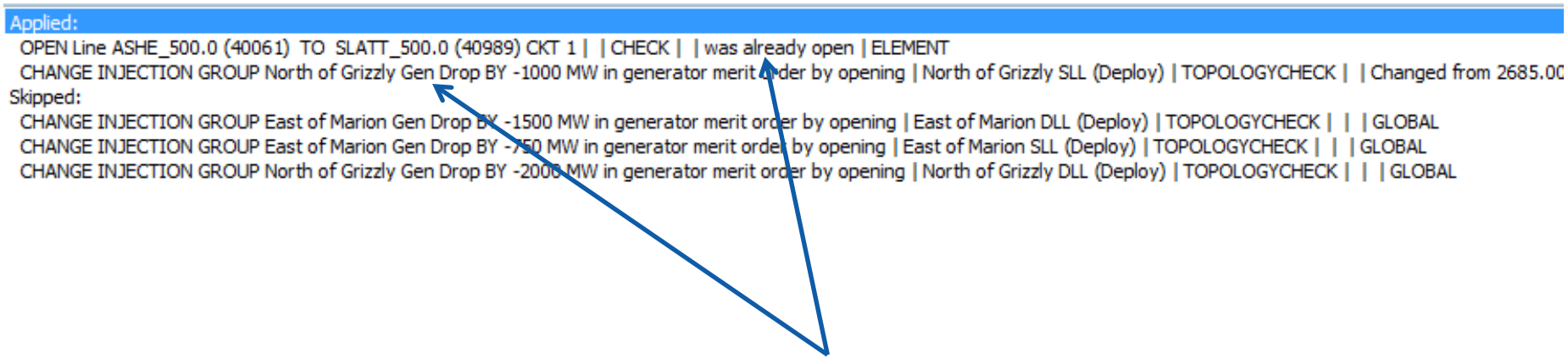
This effectively becomes this

©2012 PowerWorld Corporation

Disable if true in contingency… Example

ASHE to SLATT outage with ASHE to SLATT already open in base case

Disable if true in contingency … **NOT** in use for all Model Conditions



North of Grizzly SLL (Deploy) applied even though the line is out in the base case

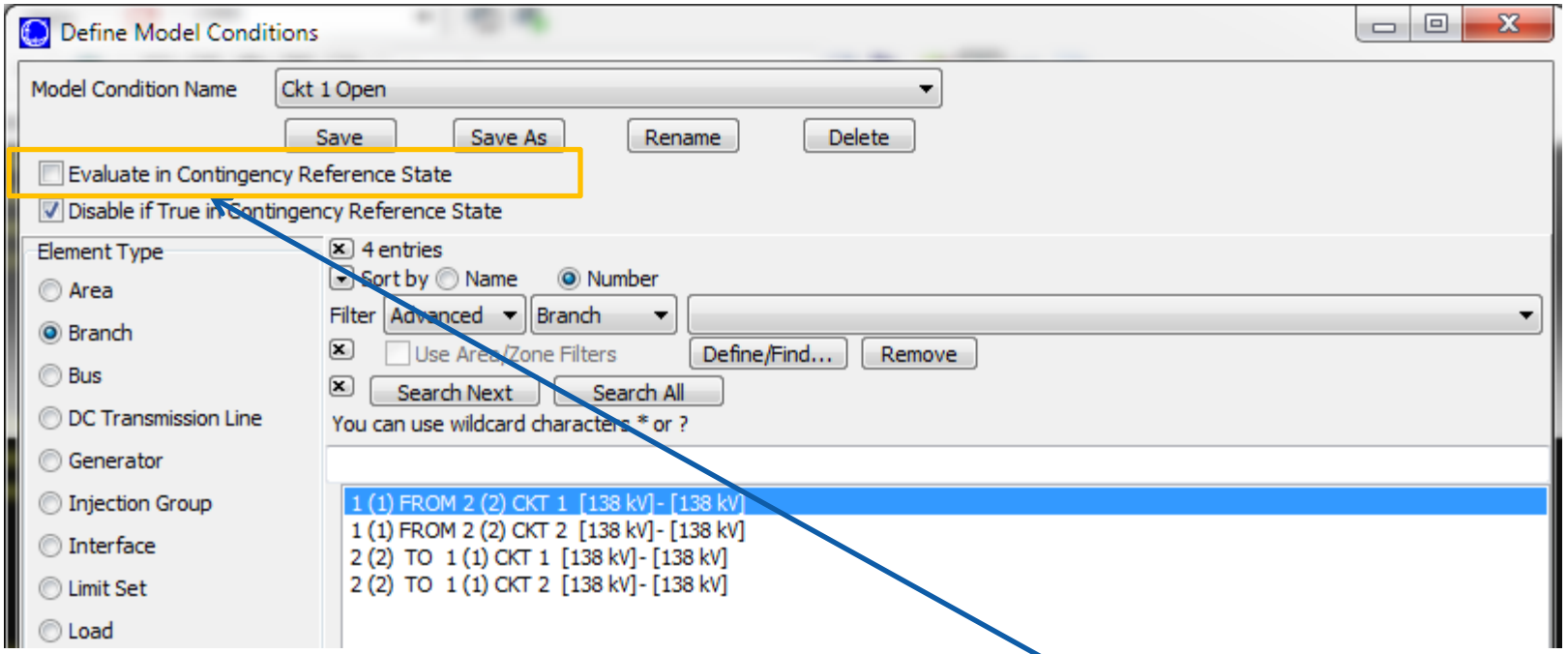
©2012 PowerWorld Corporation

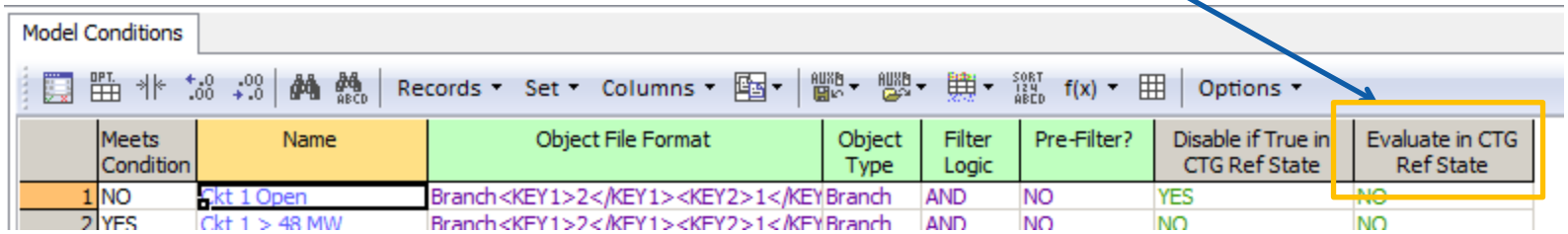
Evaluate in Contingency Reference State

- Option specified with Model Conditions
  - When true, a model condition will evaluate to its reference state result when evaluated as part of a contingency Model Criteria
  - This option is only used when a contingency is being implemented
  - When this option is not used, a model condition will always be evaluated in the present system state

©2012 PowerWorld Corporation

Evaluate in Contingency Reference State





©2012 PowerWorld Corporation

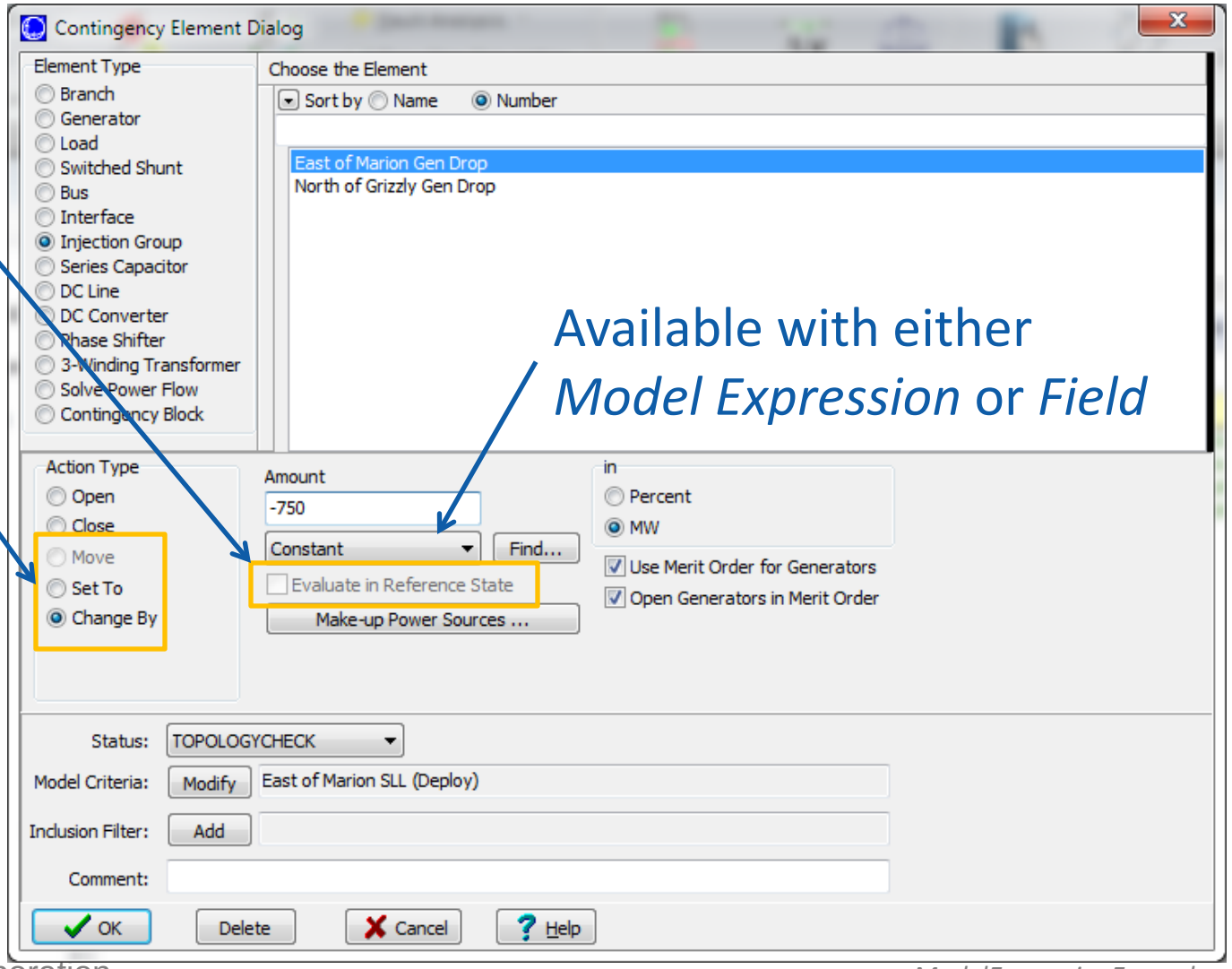
Evaluate in Reference State Contingency Element Action

- Option applied to *Model Expression* or *Field* selected to determine the **Amount** to *Move*, *Set To*, or *Change By*
- Useful with Model Expressions to model RAS arming depending on base case conditions

©2012 PowerWorld Corporation

Evaluate in Reference State Setup

Option is available when using *Move*, *Set To*, or *Change By* **Action Type**



Available with either *Model Expression* or *Field*

©2012 PowerWorld Corporation

Model Expressions

- Can now use Model Conditions and Model Filters as part of Model Expression
  - Only makes sense to use a check on the result of the filter or condition
    - x1 = *Meets Condition* for Model Condition
    - x1 = *Meets Filter* for Model Filter
    - iif(x1=="YES",*value if true*, *value if false*)
- Useful with *Evaluate in Reference State* option for contingency actions

©2012 PowerWorld Corporation

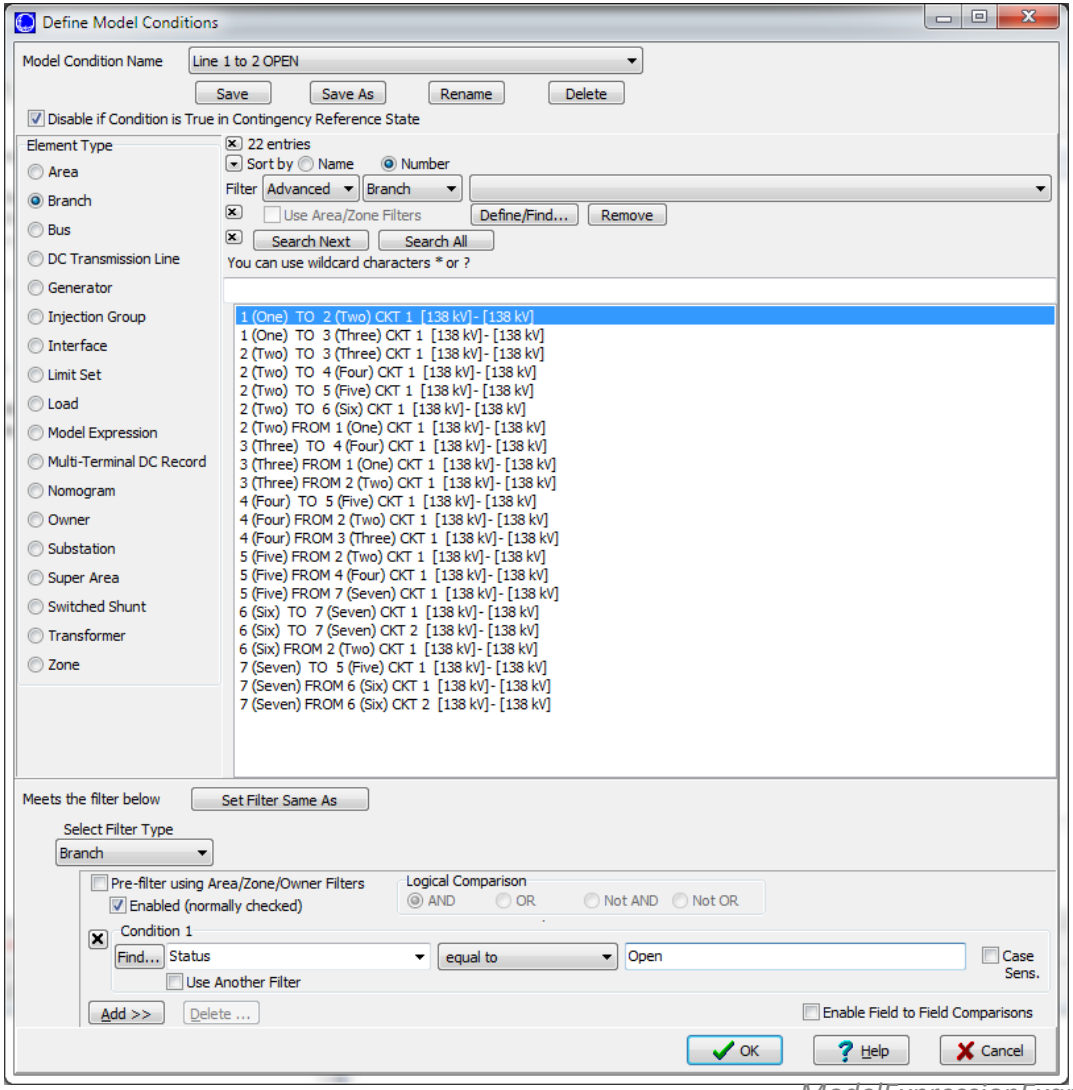
Evaluate in Reference State and Model Expressions Example

- 7 bus sample system
  - If Line 1 to 2 open in the base case → drop generation at bus 1 by 50%, otherwise drop by 100%
    - Line 1 to 2 is NOT open in the base case
  - Only implement generation 1 drop if Line 1 to 2 or Line 1 to 3 is open due to the contingency
    - Use TOPOLOGYCHECK status to implement gen drop before power flow solution
  - Contingency will open Line 1 to 2

©2012 PowerWorld Corporation

Model Condition Setup

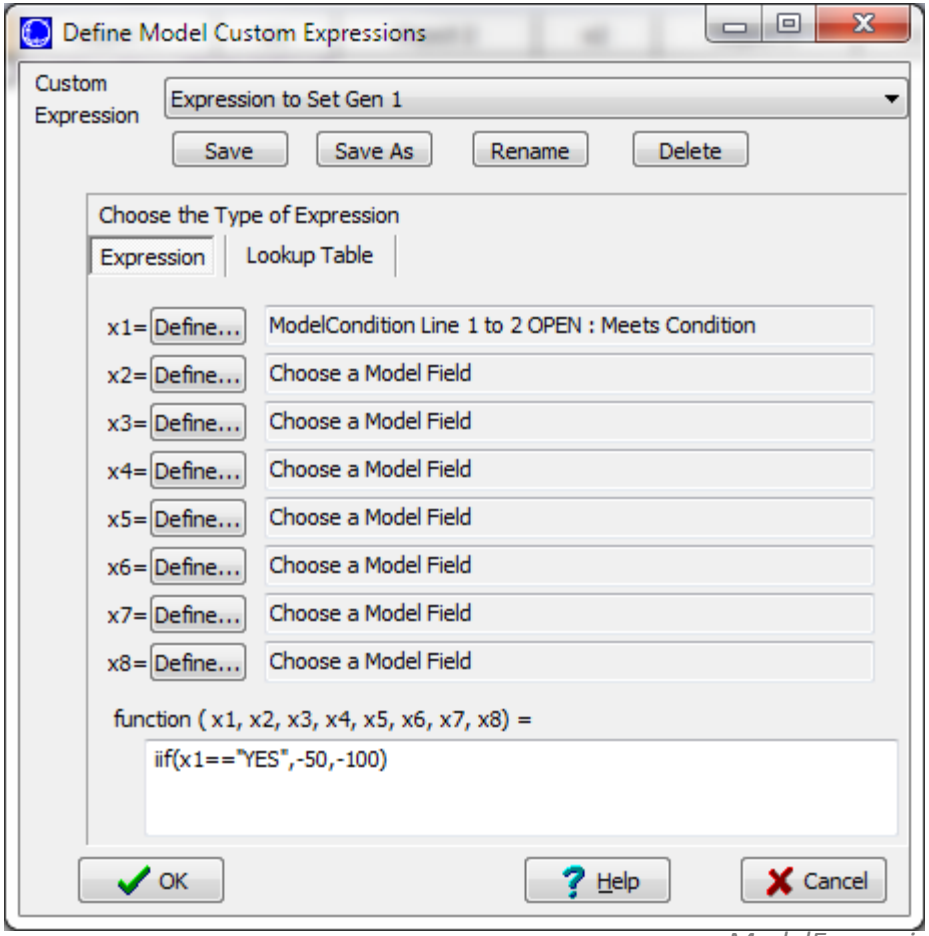
- Set up Model Condition for arming gen drop



©2012 PowerWorld Corporation

Model Expression Setup

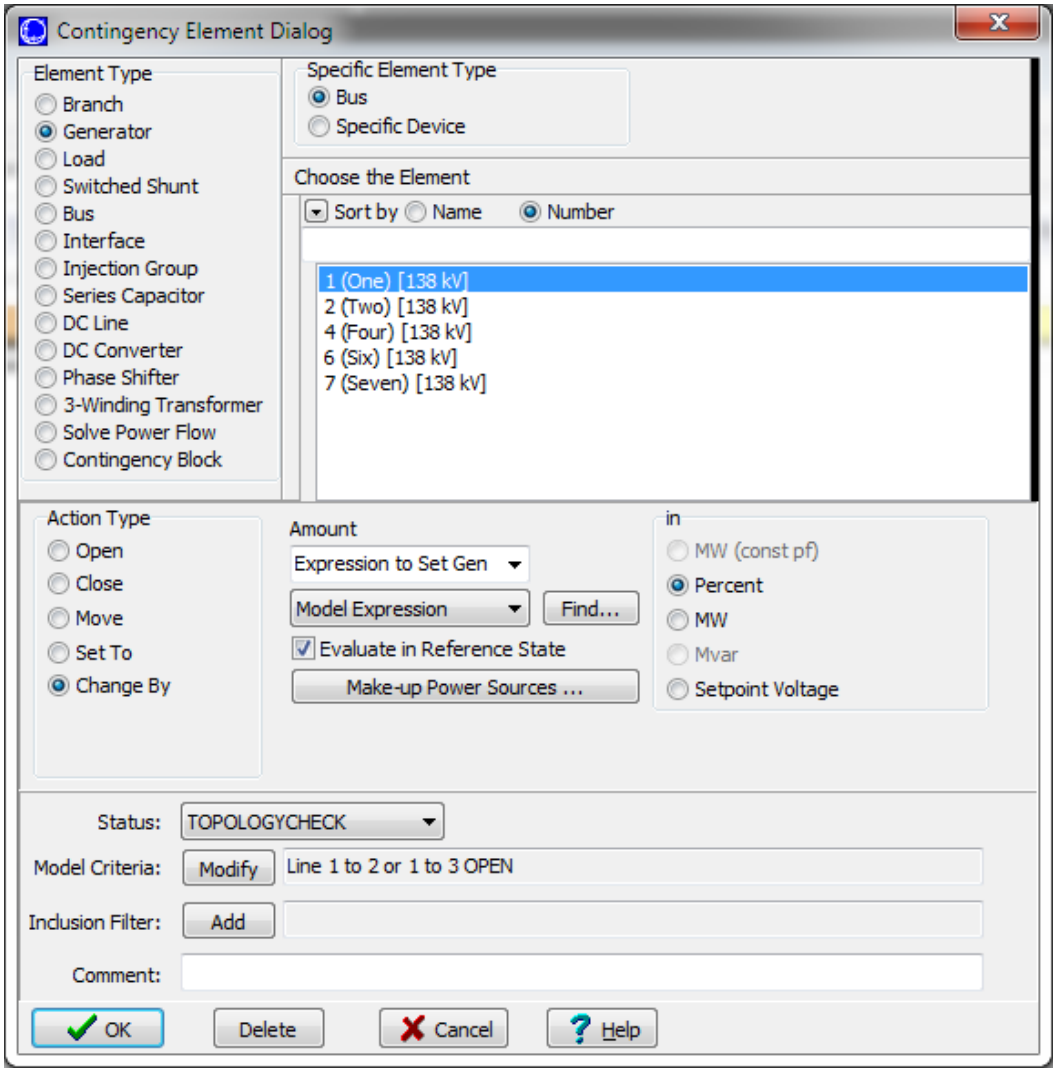
- Set up Model Expression for arming gen drop



©2012 PowerWorld Corporation

Global Action Setup

- Set up Global Action to implement gen drop

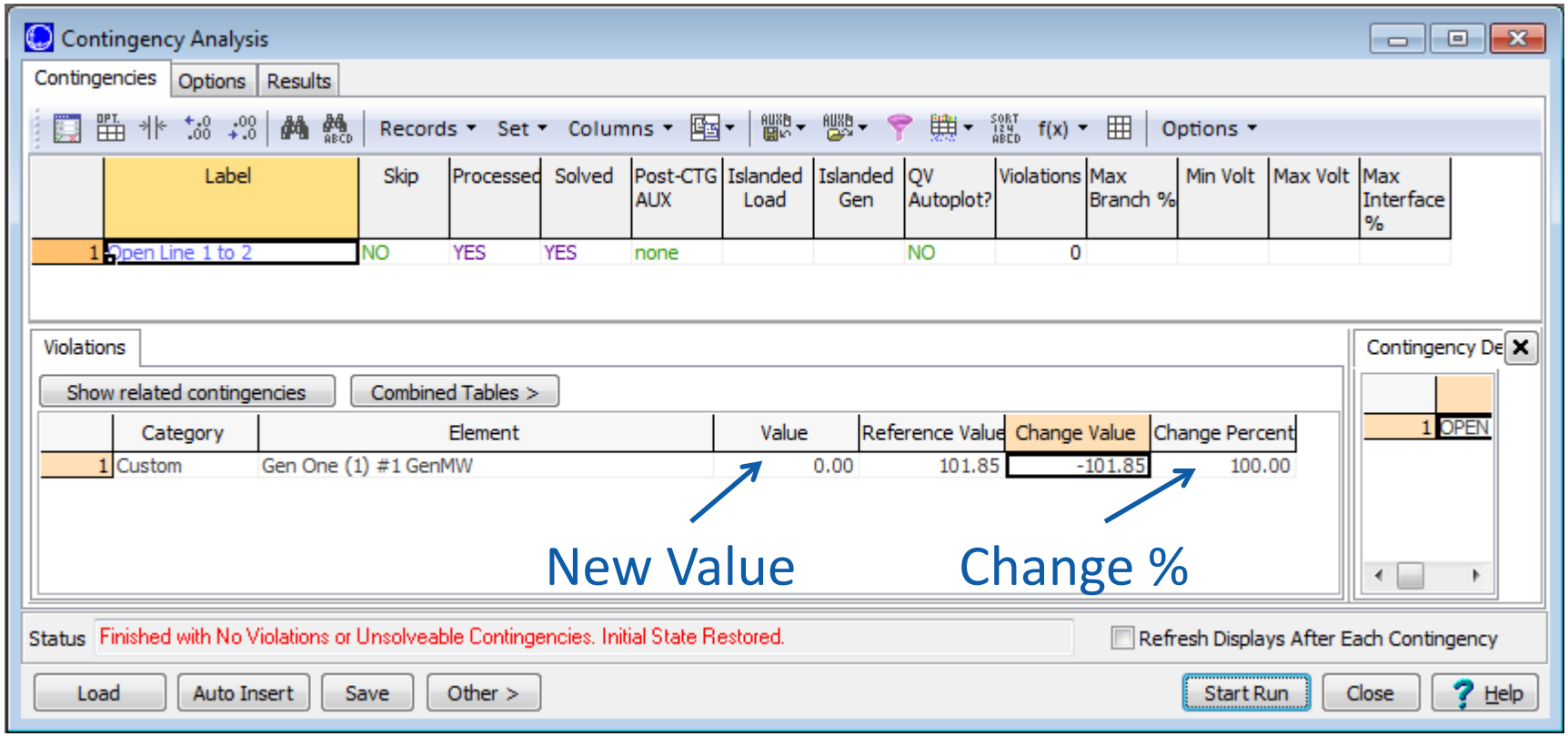


©2012 PowerWorld Corporation

Evaluate in Reference State Results

Results if using *Evaluate in Reference State*

Applied:
OPEN Line One_138.0 (1) TO Two_138.0 (2) CKT 1 | | CHECK | | Opened flow of 59.22 MVA | ELEMENT
CHANGE GENERATION AT BUS One_138.0 (1) BY 'Expression to Set Gen 1' (in Ref. State) % of present MW | Line 1 to 2 or 1 to 3 OPEN | TOPOLOGYCHECK | | Bus Output changed from 101.85 to 0.00 MW

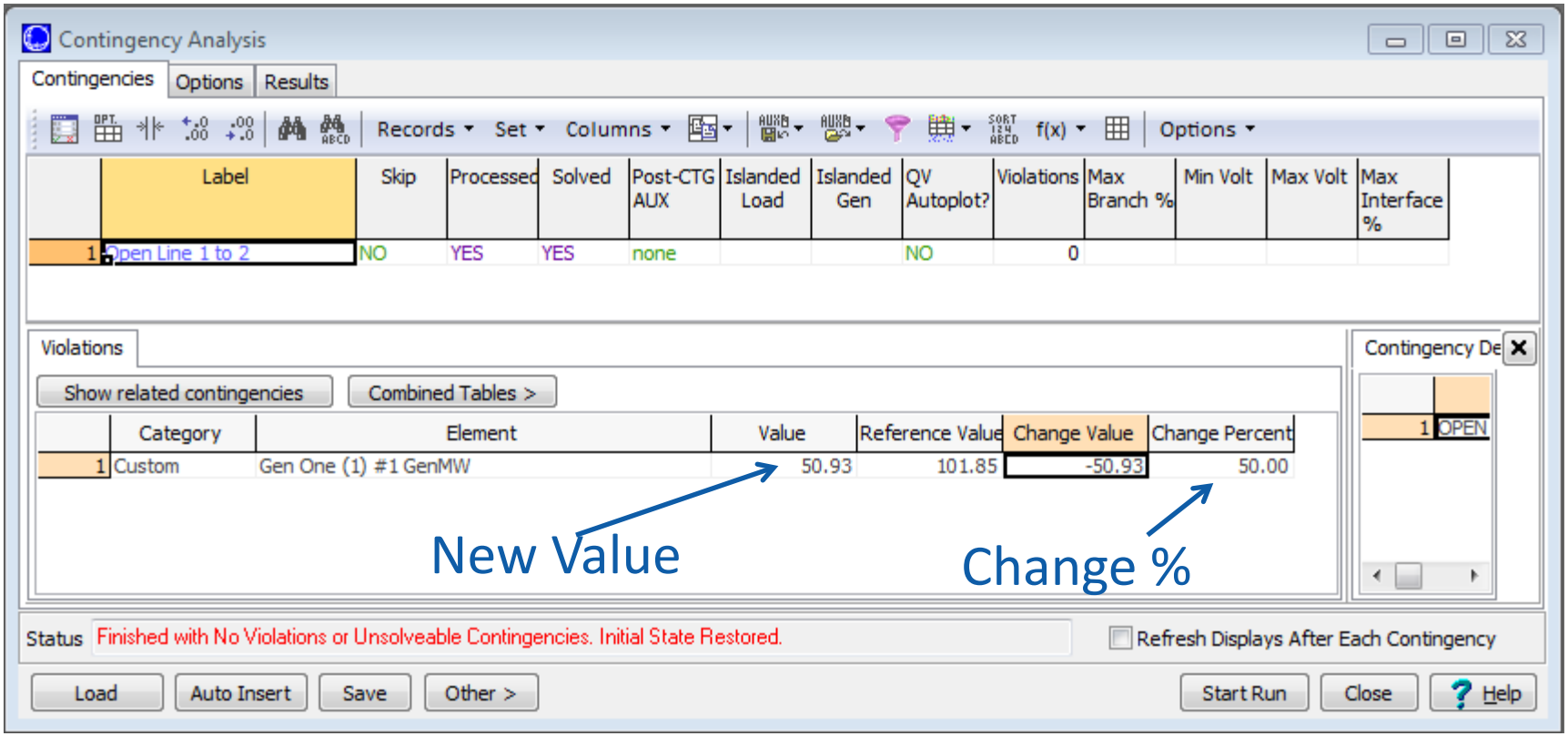


©2012 PowerWorld Corporation

Evaluate in Reference State Results

Results if **NOT** using *Evaluate in Reference State*

Applied:
OPEN Line One_138.0 (1) TO Two_138.0 (2) CKT 1 | | CHECK | | Opened flow of 59.22 MVA | ELEMENT
CHANGE GENERATION AT BUS One_138.0 (1) BY 'Expression to Set Gen 1' % of present MW | Line 1 to 2 or 1 to 3 OPEN | TOPOLOGYCHECK | | Bus Output changed from 101.85 to 50.93 MW



©2012 PowerWorld Corporation

Contingency Process Order

1. Evaluate and store Custom Model Expression results for the reference state
2. Evaluate Model Conditions and Filters in the reference state
3. Process contingency
   a) Apply unconditional actions and true CHECK actions
   b) Update topology
   c) Apply true TOPOLOGYCHECK actions
   d) Solve power flow
   e) Apply true POSTCHECK actions
   f) Update topology
   g) Solve power flow
   h) Repeat steps e-g until no more POSTCHECK actions
4. Restore reference state
5. Repeat steps 3 and 4 until no more contingencies

©2012 PowerWorld Corporation

Injection Group Overlapping RAS

- Problem
  - RAS may be made up of generation drop scenarios with the same generators being part of one or more RAS
  - Too much generation might be dropped because the amount of overlapping generation is not accounted for

©2012 PowerWorld Corporation

Injection Group Overlapping RAS

- Solution
  - Account for overlapping generation drops when using injection group contingency actions that drop generation by using a merit order opening of generators
  - Any generation that has already been dropped as part of another injection group action will be included as being dropped as part of the present injection group action

©2012 PowerWorld Corporation

Accounting for Gen Drop Overlap

RAS A Using Injection Group 1 – Target Gen Drop 300 MW			
Merit Order	Generator	MW Output	Comment
1	G1	100	Tripped via RAS A
2	G2	100	Tripped via RAS A
3	G3	100	Tripped via RAS A
4	G4	100	
5	G5	100	

RAS B Using Injection Group 2 – Target Gen Drop 400 MW			
Merit Order	Generator	MW Output	Comment
1	G5	100	Tripped via RAS B
2	G4	100	Tripped via RAS B
3	G3	100	Accounted by RAS B Tripped via RAS A
4	G7	200	Skipped
5	G8	100	Tripped via RAS B

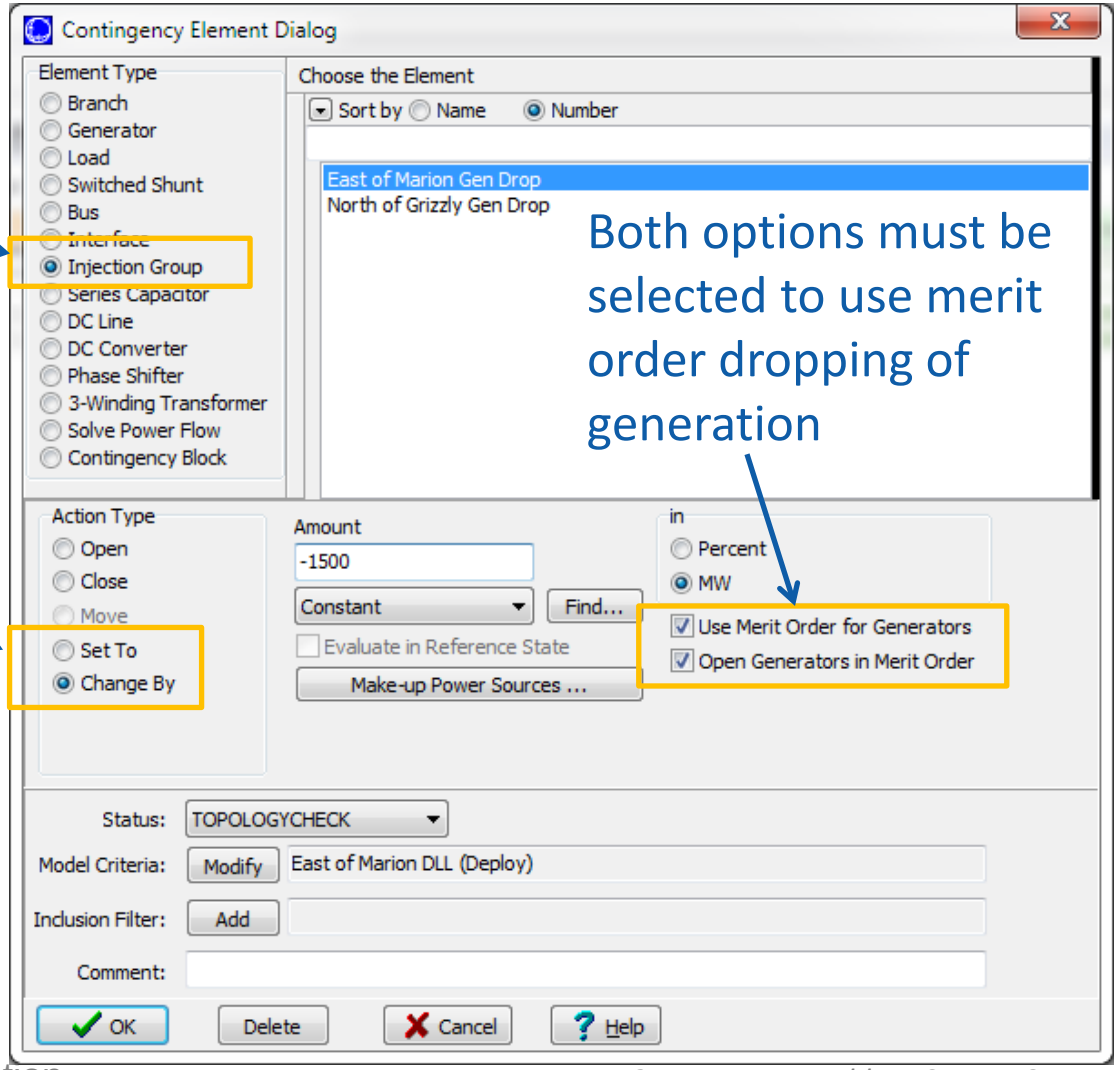
Drop gen so that we do not overshoot the desired amount

©2012 PowerWorld Corporation

Overlapping Gen RAS Setup

Element Type must be *Injection Group*

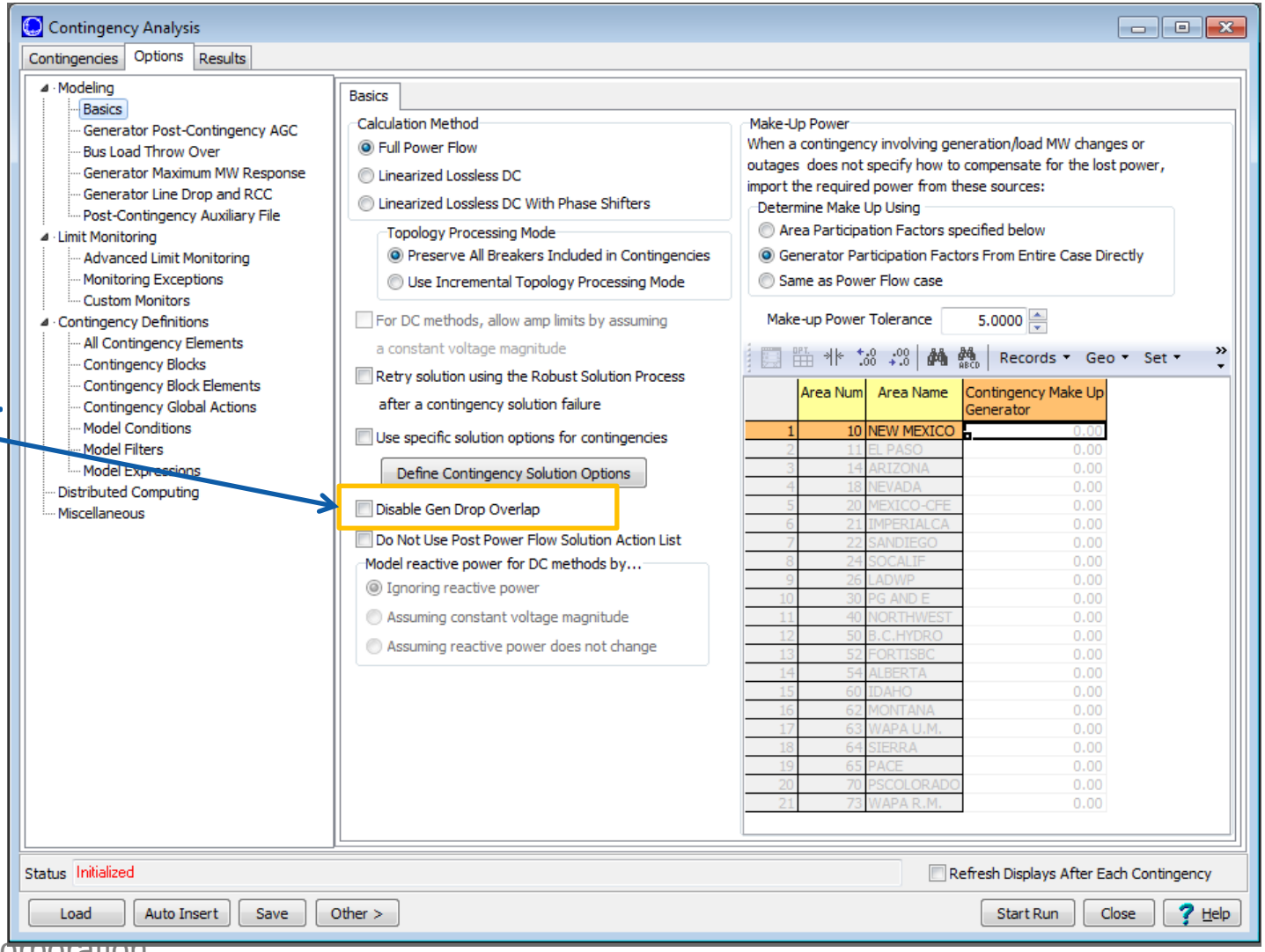
Action Type must be *Set To* or *Change By*



©2012 PowerWorld Corporation

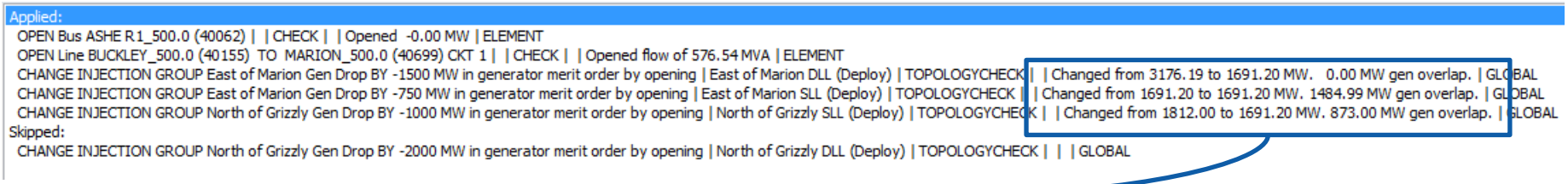
Overlapping Gen RAS Setup

Only check this option to NOT account for overlapping generation drop. Gen Drop Overlap accounting will be done by default.



©2012 PowerWorld Corporation

What Actually Occurred?



| Changed from 3176.19 to 1691.20 MW. 0.00 MW gen overlap. | GL(
Changed from 1691.20 to 1691.20 MW. 1484.99 MW gen overlap. | GL
| | Changed from 1812.00 to 1691.20 MW. 873.00 MW gen overlap. |

Starting injection
(accounts for changes made from other RAS)

Ending injection
(accounts for changes only made from this RAS)

Overlap with other injection groups

Total gen drop for single RAS = (Starting Injection – Ending Injection + Overlap)

Total gen drop for all RAS = $\sum_{i}^{n}(\text{Starting Injection}_i\text{-Ending Injection}_i)$

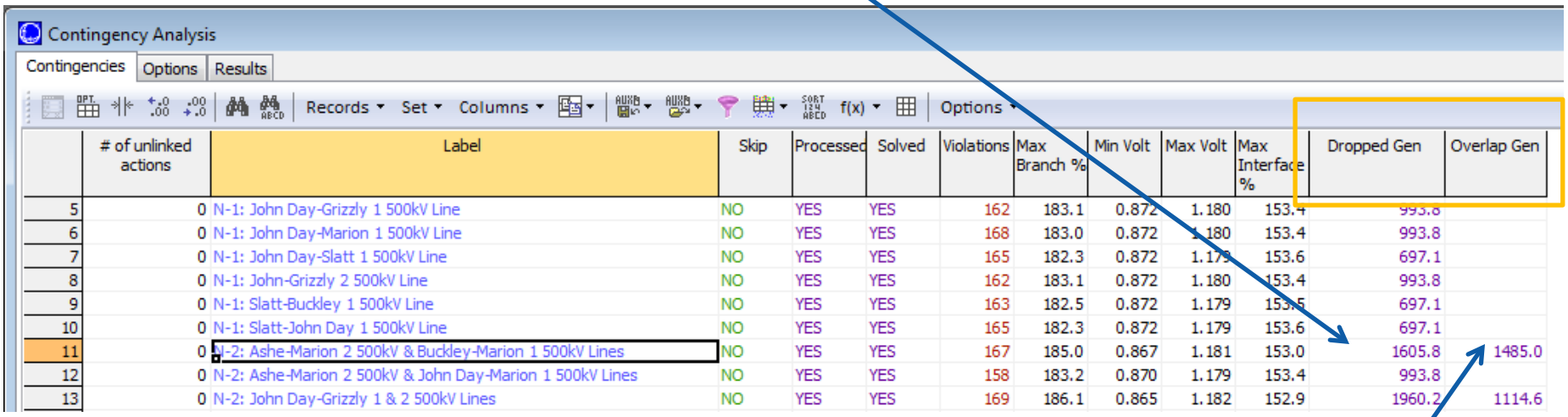
Total gen overlap for all RAS cannot be determined from these values. This is calculated internally so that overlap is only counted once.

©2012 PowerWorld Corporation

Dropped Gen and *Overlap Gen* Fields

Contingency fields provide access to the same information that is shown in *What Actually Occurred?*

Dropped Gen → Total gen drop for all RAS = $\sum_i^n$(Starting Injection$_i$-Ending Injection$_i$)



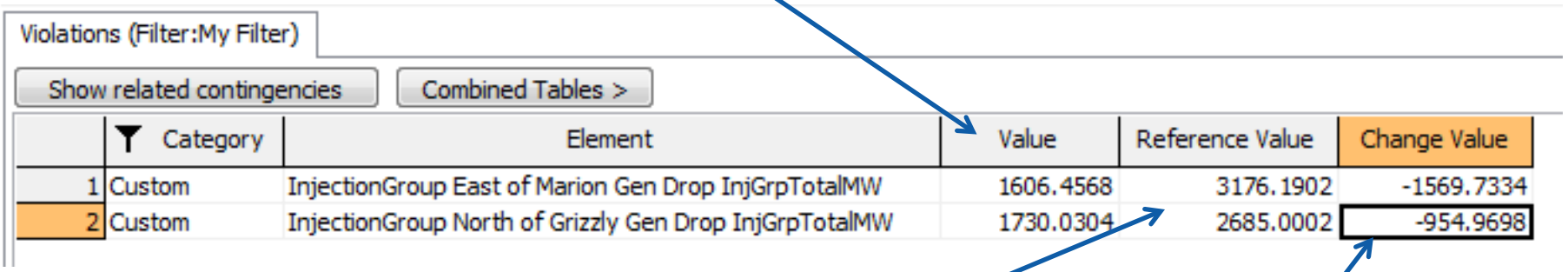
	# of unlinked actions	Label	Skip	Processed	Solved	Violations	Max Branch %	Min Volt	Max Volt	Max Interface %	Dropped Gen	Overlap Gen
5	0	N-1: John Day-Grizzly 1 500kV Line	NO	YES	YES	162	183.1	0.872	1.180	153.4	993.8	
6	0	N-1: John Day-Marion 1 500kV Line	NO	YES	YES	168	183.0	0.872	1.180	153.4	993.8	
7	0	N-1: John Day-Slatt 1 500kV Line	NO	YES	YES	165	182.3	0.872	1.179	153.6	697.1	
8	0	N-1: John-Grizzly 2 500kV Line	NO	YES	YES	162	183.1	0.872	1.180	153.4	993.8	
9	0	N-1: Slatt-Buckley 1 500kV Line	NO	YES	YES	163	182.5	0.872	1.179	153.5	697.1	
10	0	N-1: Slatt-John Day 1 500kV Line	NO	YES	YES	165	182.3	0.872	1.179	153.6	697.1	
11	0	N-2: Ashe-Marion 2 500kV & Buckley-Marion 1 500kV Lines	NO	YES	YES	167	185.0	0.867	1.181	153.0	1605.8	1485.0
12	0	N-2: Ashe-Marion 2 500kV & John Day-Marion 1 500kV Lines	NO	YES	YES	158	183.2	0.870	1.179	153.4	993.8	
13	0	N-2: John Day-Grizzly 1 & 2 500kV Lines	NO	YES	YES	169	186.1	0.865	1.182	152.9	1960.2	1114.6

***Overlap Gen* → Calculated internally so that overlap is only counted once**

©2012 PowerWorld Corporation

Determining Gen Drop Injection Group Custom Monitoring

Final MW injection of the group
(This could potentially include the impact of more than just the gen drop due to injection group contingency actions. This will also include any changes due to make-up power or other contingency actions.)



Value – Reference Value

MW injection of the group in the base case
(This is different than the Starting Injection that is shown with *What Actually Occurred?*)

©2012 PowerWorld Corporation

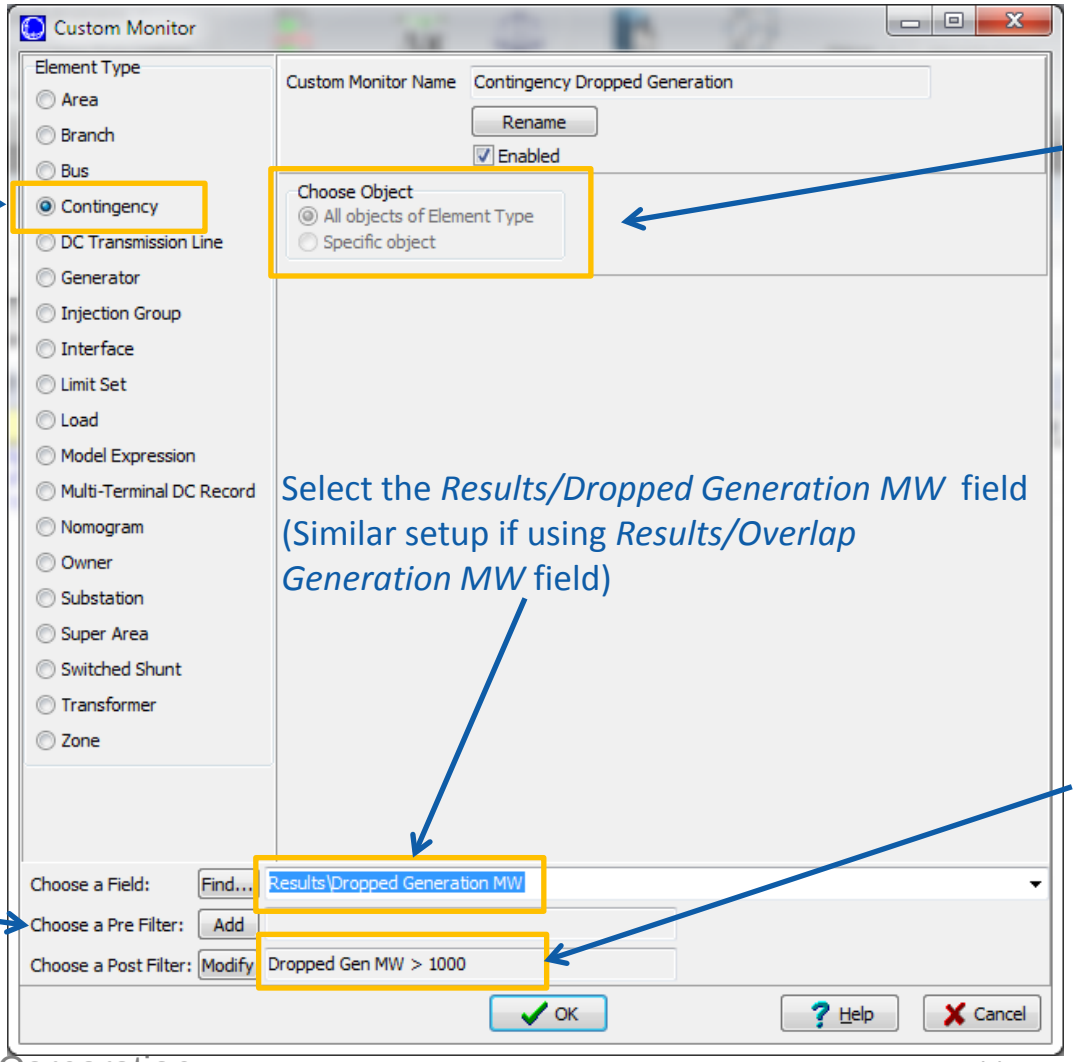
Determining Gen Drop Contingency Custom Monitoring

- Allows *Dropped Gen* and *Overlap Gen* amount to show up with contingency violations
- Allows for easier determination of when an contingency may have dropped too much generation
- Optionally only show a violation if the amount of gen that was dropped or overlapped due to RAS is greater than a specified threshold
  - Use Post Filter

©2012 PowerWorld Corporation

Contingency Custom Monitoring Setup

Element Type must be *Contingency*



Cannot choose a specific contingency. Can only monitor a contingency during that same contingency. (Does not make sense to monitor a contingency during a different contingency.)

Select the *Results/Dropped Generation MW* field (Similar setup if using *Results/Overlap Generation MW* field)

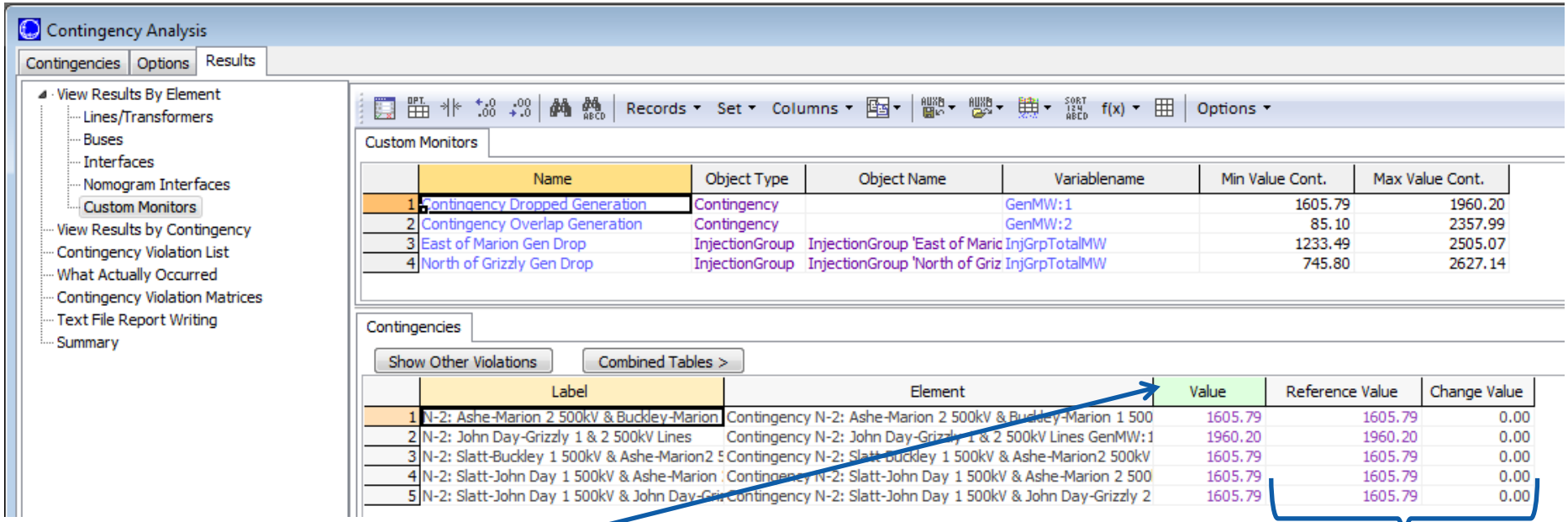
Pre Filter could be used to exclude certain contingencies from having violations reported. Most likely would not use this.

Create a **Post Filter** to only show a violation if the *Dropped Generation MW* value meets specified conditions

©2012 PowerWorld Corporation

Contingency Custom Monitoring Results: Custom Monitors

View all violations by Custom Monitor: *Dropped Gen* example (Similar setup when viewing *Overlap Gen*)



Value is the Dropped Gen MW due to the contingency. (Probably the only useful value field that is available.)

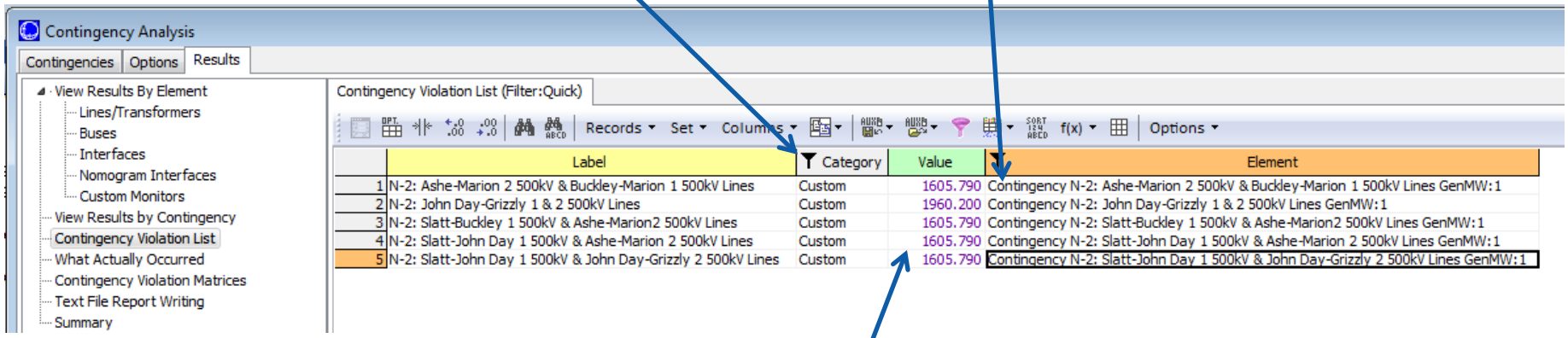
Value fields other than *Value* might not mean much because they are relative to what is in the reference state. This might depend on a previous contingency run.

©2012 PowerWorld Corporation

Contingency Custom Monitoring Results: Contingency Violation List

View all violations in the same table: *Dropped Gen* example

Category *Custom* and **Element** with *Contingency* identifies the violations due to monitoring contingencies



Again, *Value* is the Dropped Gen MW due to the contingency. (Probably the only useful value field that is available.)

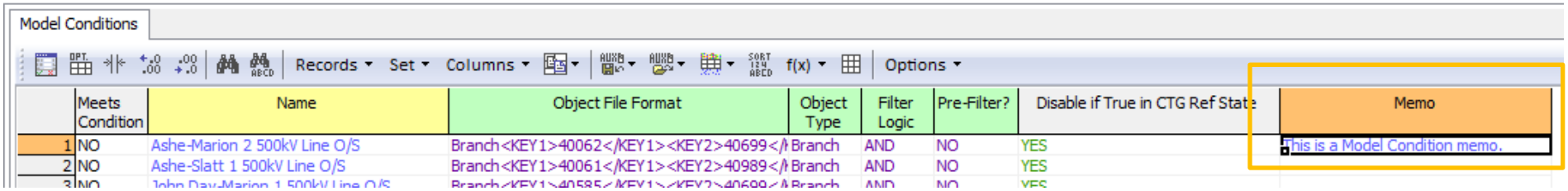
©2012 PowerWorld Corporation

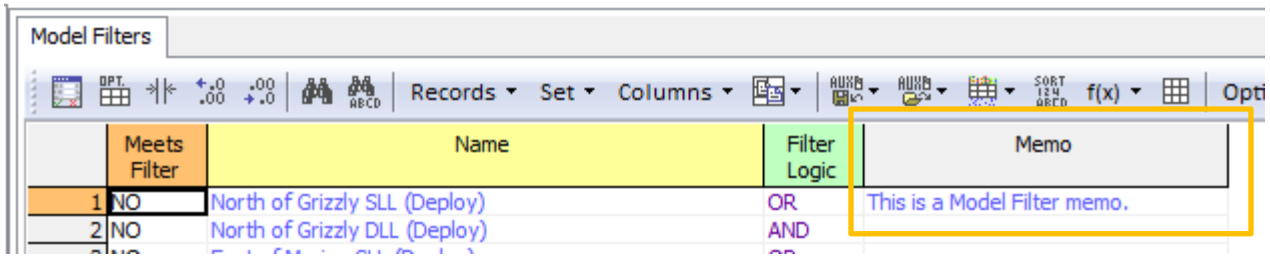
Memo Field

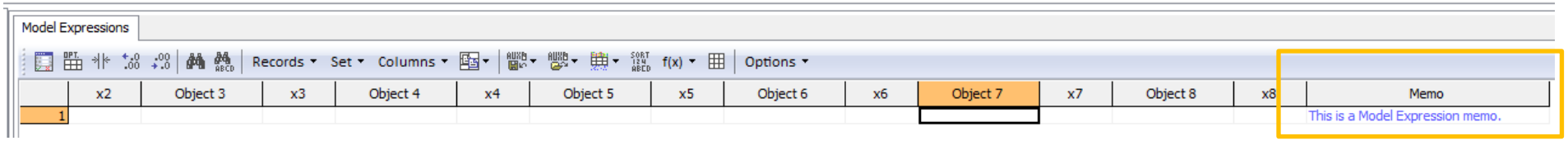
- Add *Memo* field to Model Conditions, Model Filters, and Model Expressions
- Useful for associating objects with particular RAS
- Can be used for filtering, sorting, etc.
- Only available from case information displays
- PWB storage
  - Fully supported for Model Conditions and Model Filters in Simulator version 16
  - Will be supported for Model Expressions in Simulator version 17
- Fully supported in auxiliary files

©2012 PowerWorld Corporation

Memo Field







©2012 PowerWorld Corporation

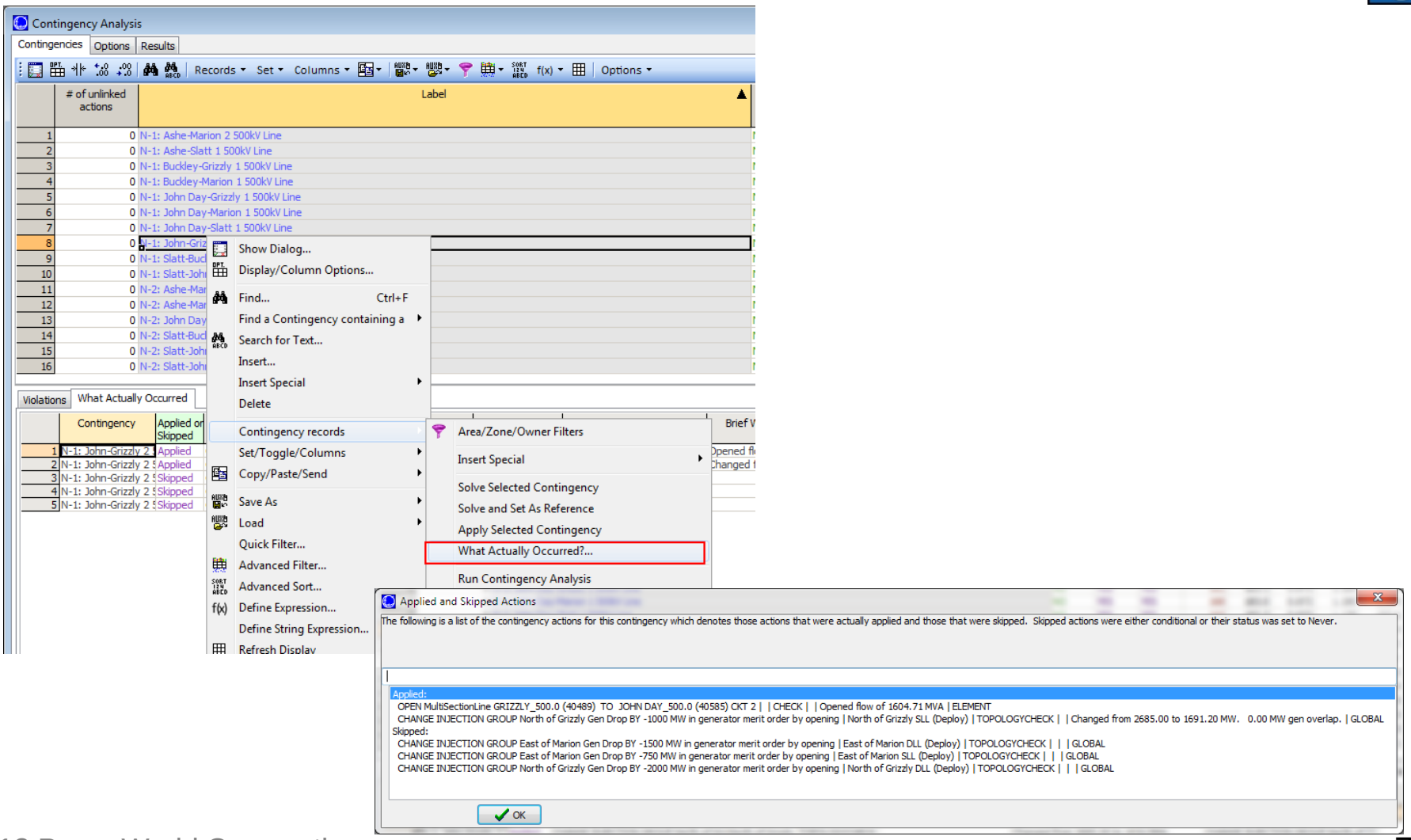
What Actually Occurred?

- Use this to determine if or how RAS was actually implemented
- Text format or table format
  - Text format available by right-click option on specific contingency
    - Examples have already been given in previous slides about the text format
  - Table format available for all contingencies or a single contingency

©2012 PowerWorld Corporation

What Actually Occurred?

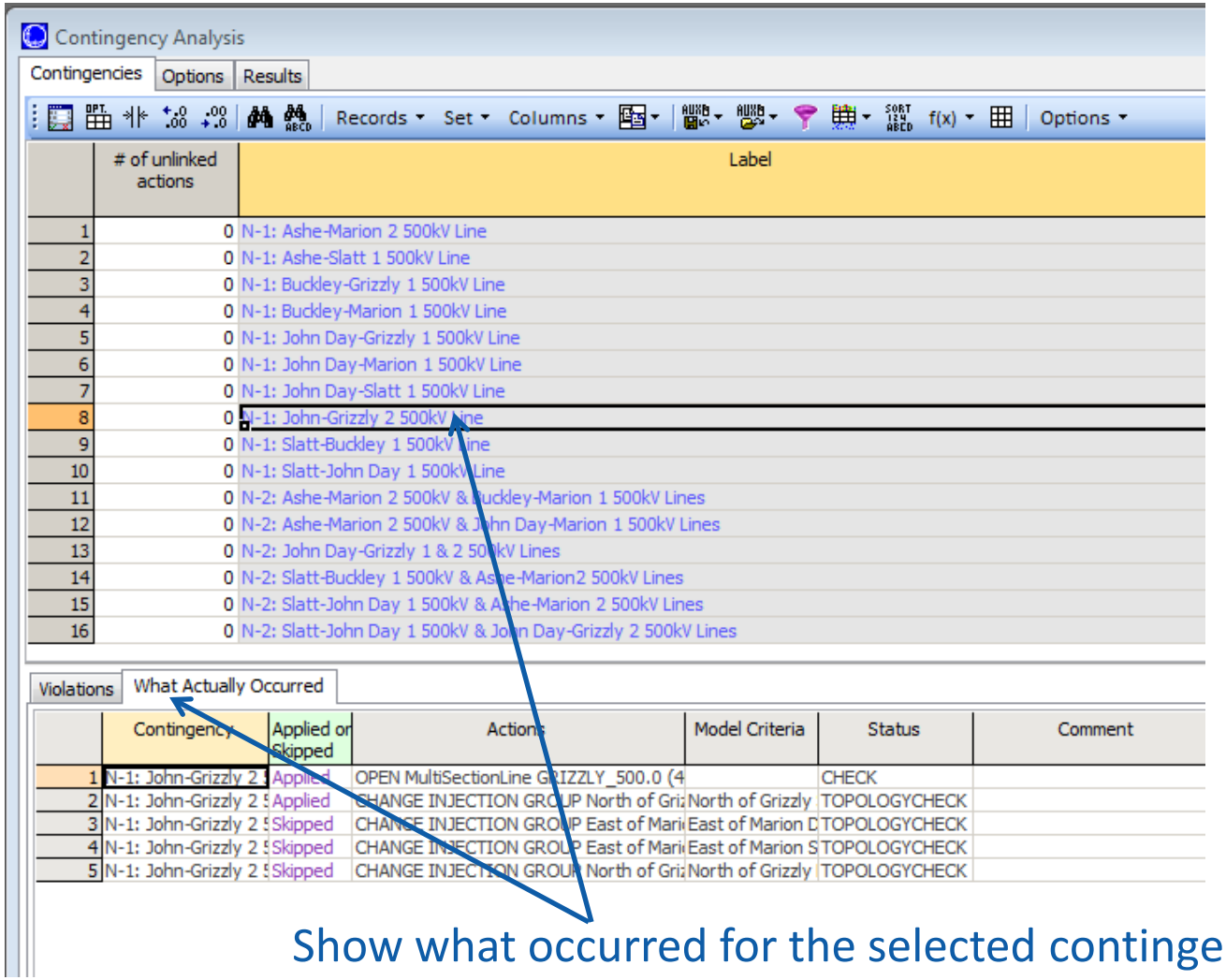
Text Format



©2012 PowerWorld Corporation

What Actually Occurred?

Table Format – One Contingency

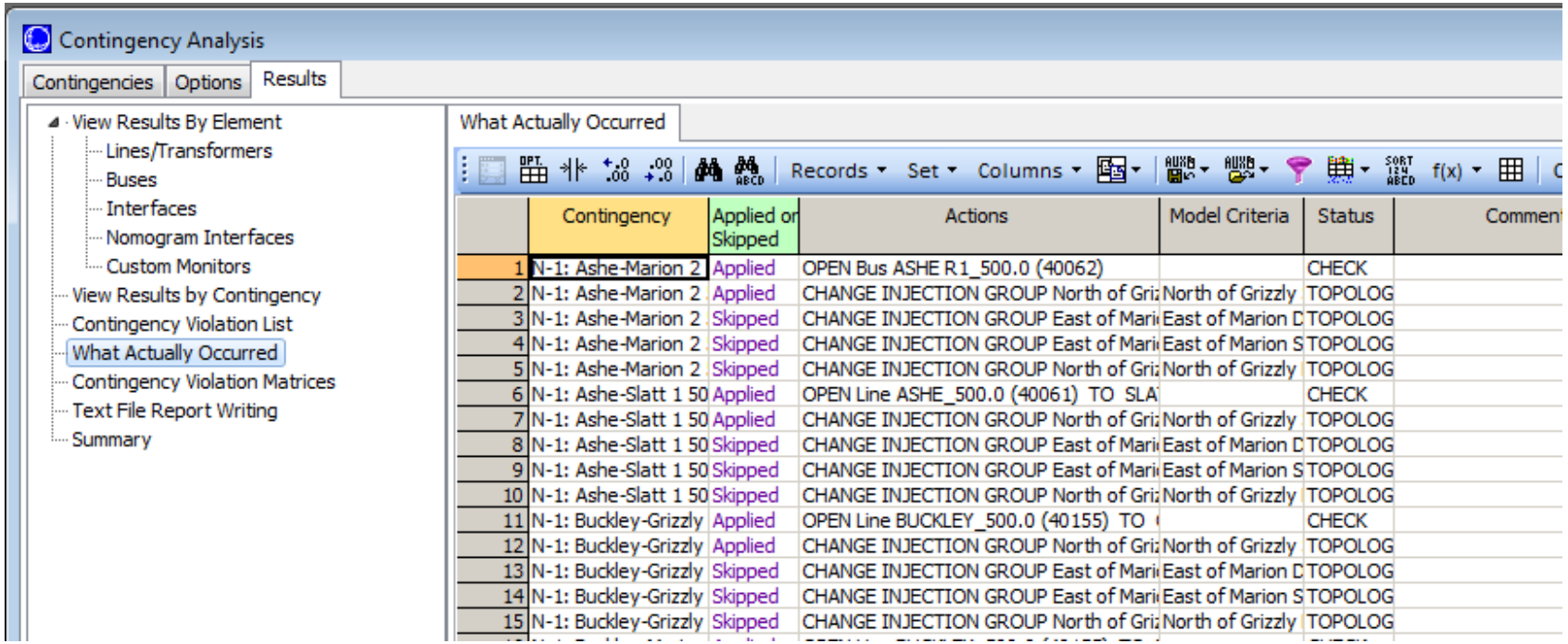


Show what occurred for the selected contingency.
(This option just added the week of Oct. 8, 2012.)

©2012 PowerWorld Corporation

What Actually Occurred?

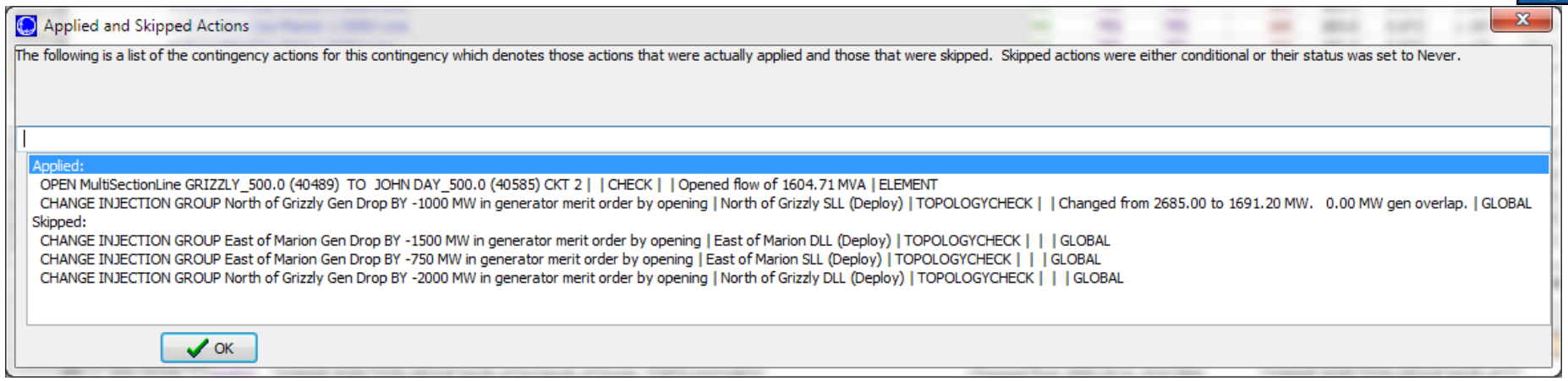
Table Format – All Contingencies



	Contingency	Applied or Skipped	Actions	Model Criteria	Status	Comment
1	N-1: Ashe-Marion 2	Applied	OPEN Bus ASHE R1_500.0 (40062)		CHECK	
2	N-1: Ashe-Marion 2	Applied	CHANGE INJECTION GROUP North of Gri	North of Grizzly	TOPOLOG	
3	N-1: Ashe-Marion 2	Skipped	CHANGE INJECTION GROUP East of Mari	East of Marion D	TOPOLOG	
4	N-1: Ashe-Marion 2	Skipped	CHANGE INJECTION GROUP East of Mari	East of Marion S	TOPOLOG	
5	N-1: Ashe-Marion 2	Skipped	CHANGE INJECTION GROUP North of Gri	North of Grizzly	TOPOLOG	
6	N-1: Ashe-Slatt 1 50	Applied	OPEN Line ASHE_500.0 (40061) TO SLA		CHECK	
7	N-1: Ashe-Slatt 1 50	Applied	CHANGE INJECTION GROUP North of Gri	North of Grizzly	TOPOLOG	
8	N-1: Ashe-Slatt 1 50	Skipped	CHANGE INJECTION GROUP East of Mari	East of Marion D	TOPOLOG	
9	N-1: Ashe-Slatt 1 50	Skipped	CHANGE INJECTION GROUP East of Mari	East of Marion S	TOPOLOG	
10	N-1: Ashe-Slatt 1 50	Skipped	CHANGE INJECTION GROUP North of Gri	North of Grizzly	TOPOLOG	
11	N-1: Buckley-Grizzly	Applied	OPEN Line BUCKLEY_500.0 (40155) TO		CHECK	
12	N-1: Buckley-Grizzly	Applied	CHANGE INJECTION GROUP North of Gri	North of Grizzly	TOPOLOG	
13	N-1: Buckley-Grizzly	Skipped	CHANGE INJECTION GROUP East of Mari	East of Marion D	TOPOLOG	
14	N-1: Buckley-Grizzly	Skipped	CHANGE INJECTION GROUP East of Mari	East of Marion S	TOPOLOG	
15	N-1: Buckley-Grizzly	Skipped	CHANGE INJECTION GROUP North of Gri	North of Grizzly	TOPOLOG	

©2012 PowerWorld Corporation

What Actually Occurred? Format



Relationship between text and table format:

Actions|Model Criteria|Status|Comment|Brief What Occurred|Origin of Action

Violations | What Actually Occurred

	Contingency	Applied or Skipped	Actions	Model Criteria	Status	Comment	Brief What Occurred	Origin of Action	What Occurred
1	N-1: John-Grizzly 2 500kV Line	Applied	OPEN MultiSectionLine GRIZZLY_500.0 (40489) TO		CHECK		Opened flow of 1604.71 MV/	ELEMENT	OPEN MultiSectionLine GRIZZLY_500.0 (40489) TO JOHN DA
2	N-1: John-Grizzly 2 500kV Line	Applied	CHANGE INJECTION GROUP North of Grizzly Gen Dr	North of Grizzly	TOPOLOGYCHECK		Changed from 2685.00 to 16	GLOBAL	CHANGE INJECTION GROUP North of Grizzly Gen Drop BY -10
3	N-1: John-Grizzly 2 500kV Line	Skipped	CHANGE INJECTION GROUP East of Marion Gen Dr	East of Marion D	TOPOLOGYCHECK			GLOBAL	CHANGE INJECTION GROUP East of Marion Gen Drop BY -150
4	N-1: John-Grizzly 2 500kV Line	Skipped	CHANGE INJECTION GROUP East of Marion Gen Dr	East of Marion S	TOPOLOGYCHECK			GLOBAL	CHANGE INJECTION GROUP East of Marion Gen Drop BY -750
5	N-1: John-Grizzly 2 500kV Line	Skipped	CHANGE INJECTION GROUP North of Grizzly Gen Dr	North of Grizzly	TOPOLOGYCHECK			GLOBAL	CHANGE INJECTION GROUP North of Grizzly Gen Drop BY -20

©2012 PowerWorld Corporation

What Actually Occurred?
Format

- Contingency
  - Name of the contingency to which the action belongs
- Applied or Skipped
  - Whether or not the action was actually implemented during the contingency
  - Skipped actions are most likely due to Model Criteria not being met
- Actions
  - Contingency action as provided with the contingency element definition
- Model Criteria
  - Model Criteria as defined with the contingency element definition
- Brief What Occurred
  - Provides details of what actually happened during action
  - Flow change, gen drop/change, load drop/change, gen drop overlap, etc.
- Origin of Action
  - ELEMENT – action is from the base contingency definition
  - BLOCK – action is from a contingency block
  - GLOBAL – action is from a global action (this will tell you if RAS is included assuming you are defining RAS as global actions)
- What Occurred
  - This is just a repeat of the entire what actually occurred in the text format
- Comment
  - Comment that can be specified with a contingency element

©2012 PowerWorld Corporation