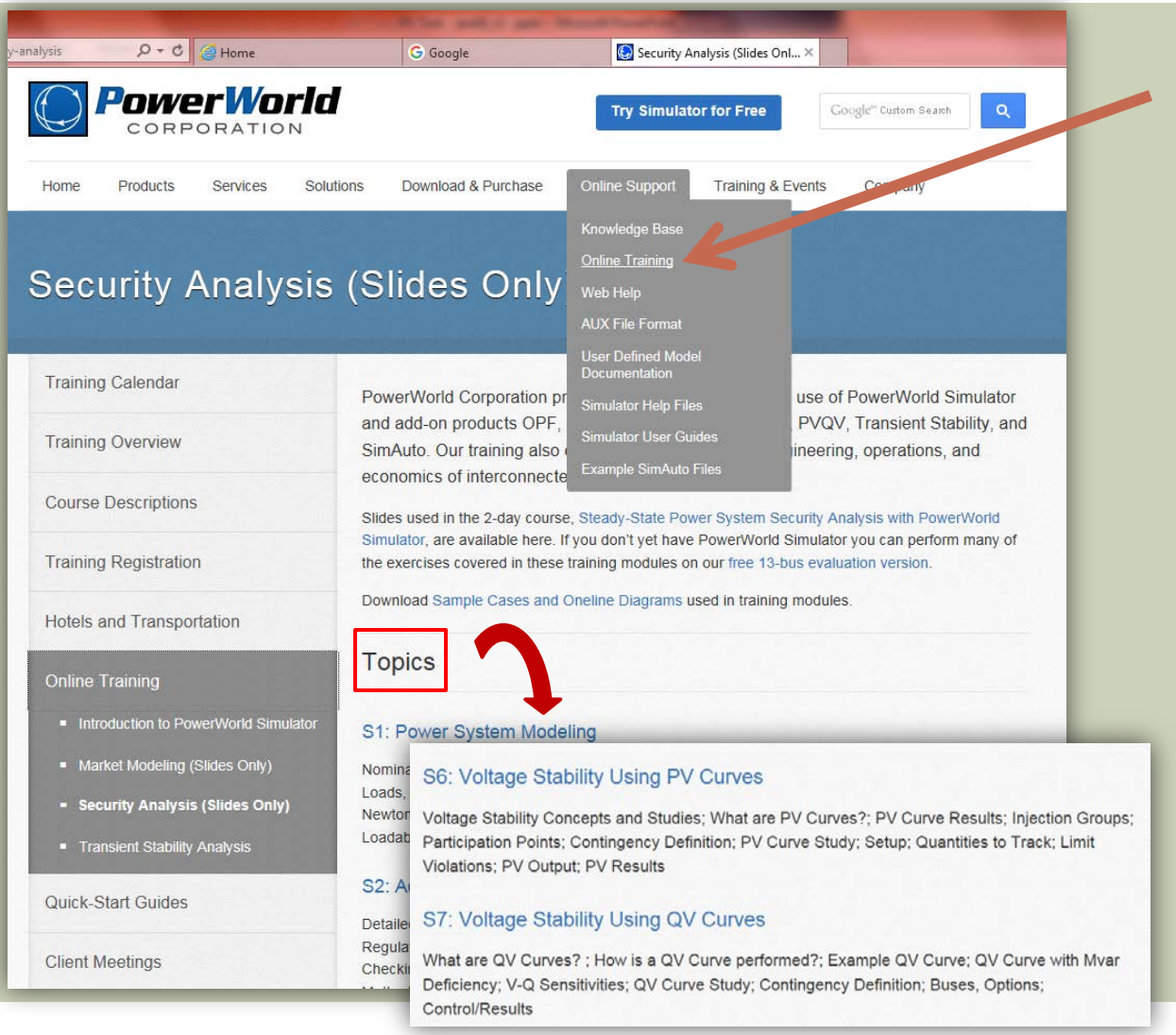
PV TOOL / QV TOOL
PW 19

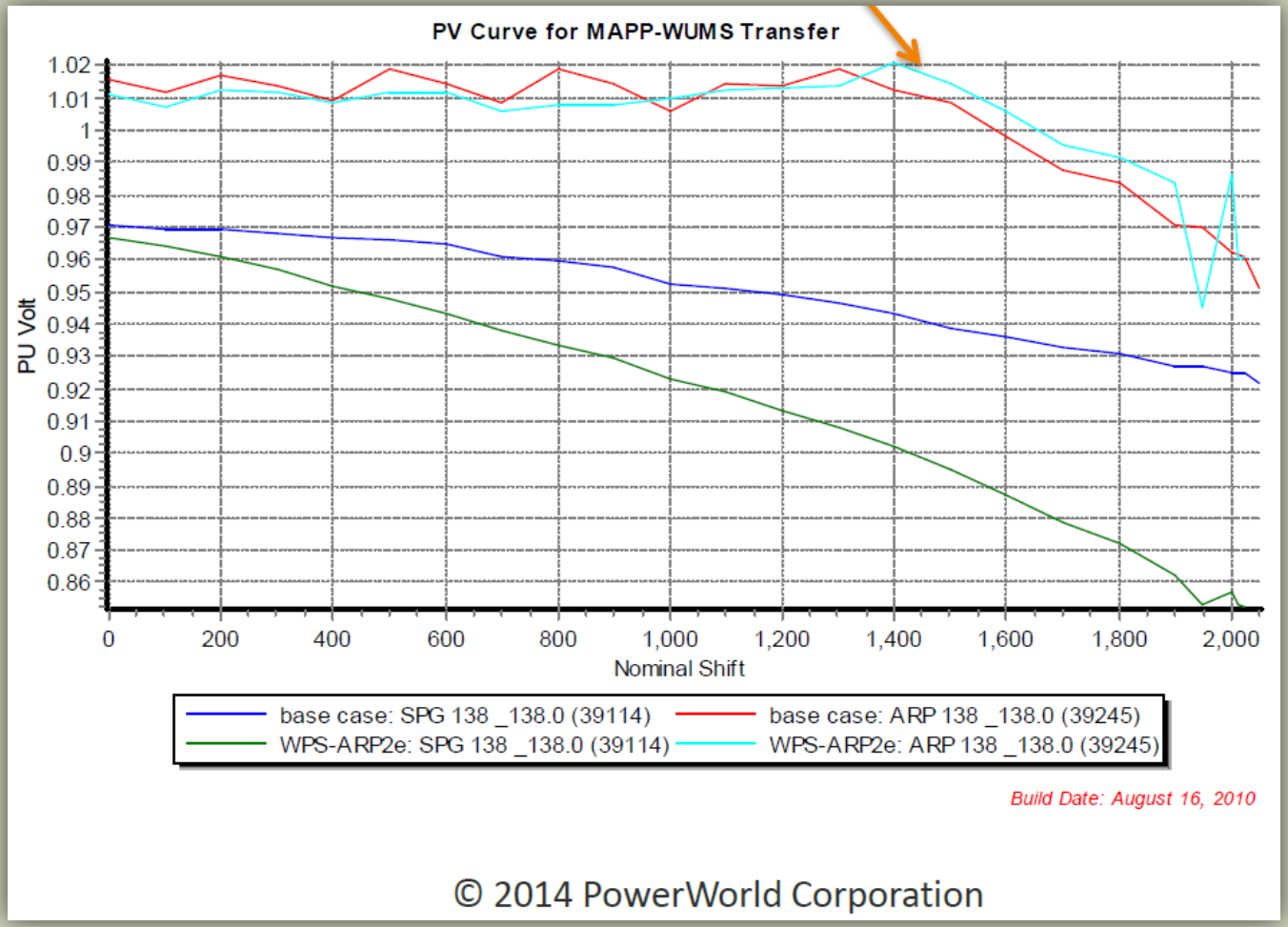
Daniel Kuraspediani

BPA Technical Operations

POWER WORLD *SLIDES*



PV TOOL



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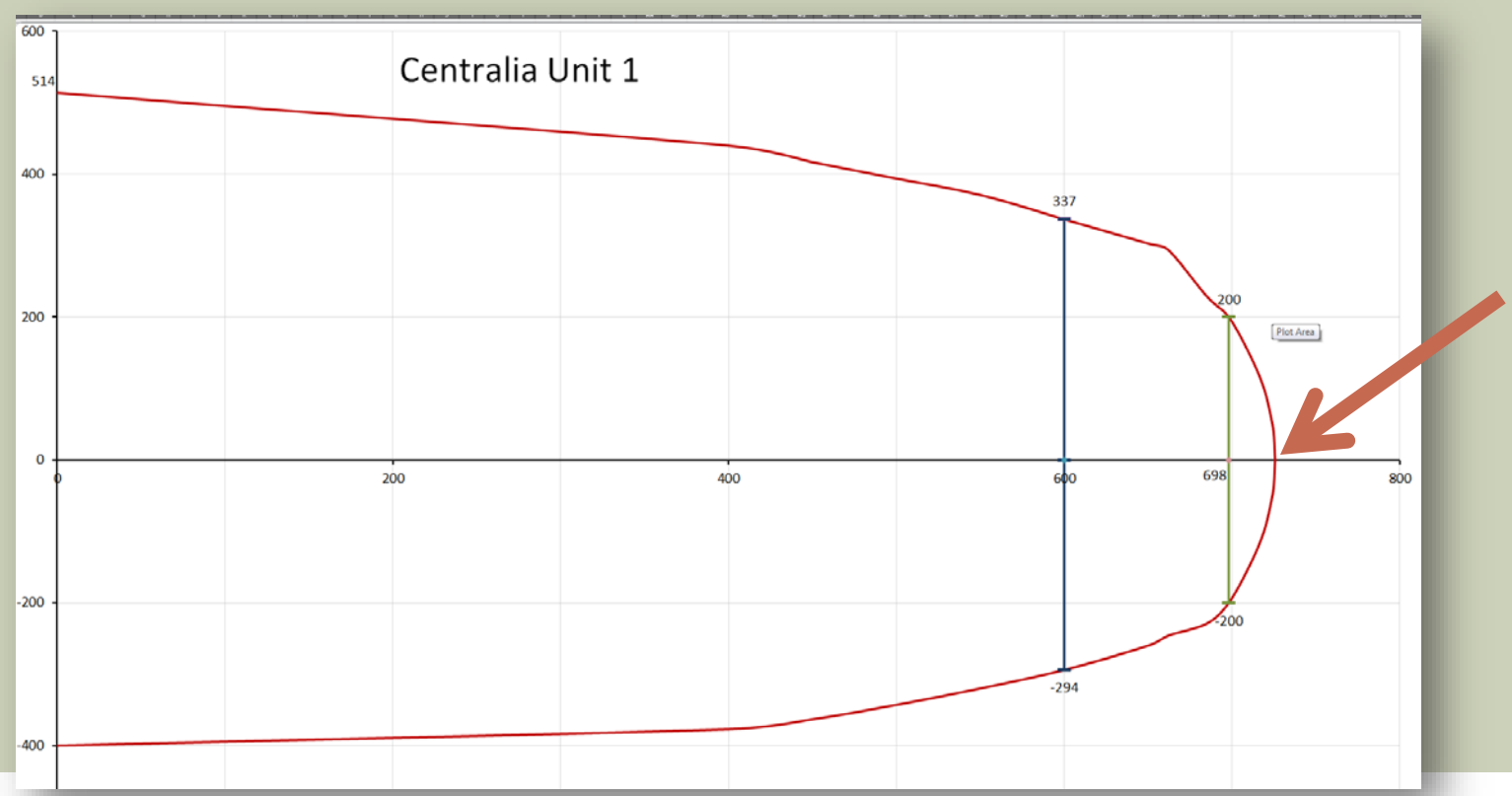
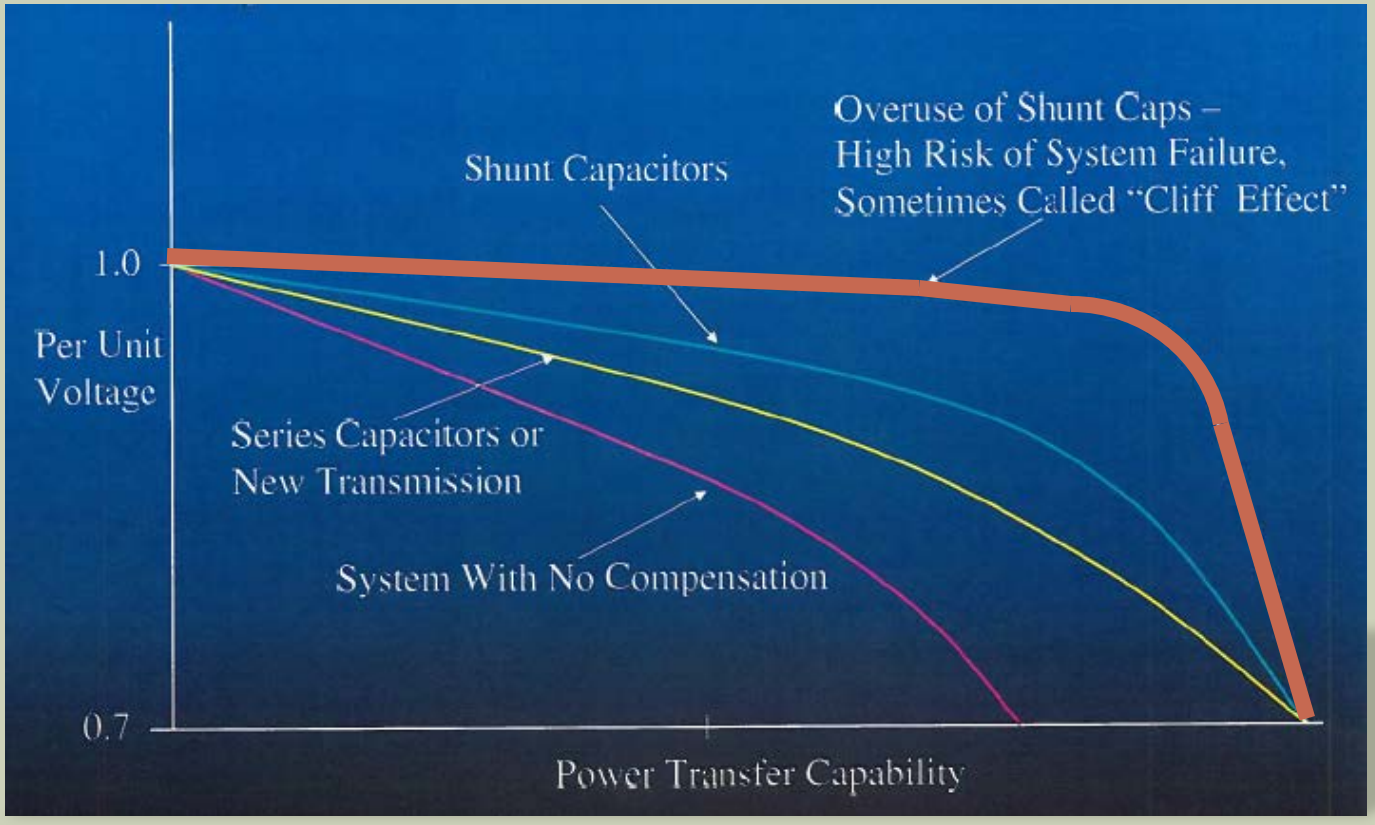
ECONOMIC DISPATCH

- Eliminates fictitious reactive reserve limitations
  - DO NOT WANT TO RAMP GEN = 100% loading



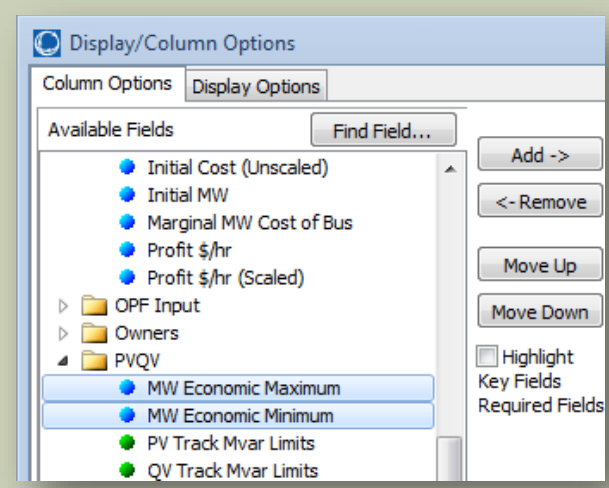
ECONOMIC DISPATCH

- No reactive reserve leads to “cliff effect” PV simulation

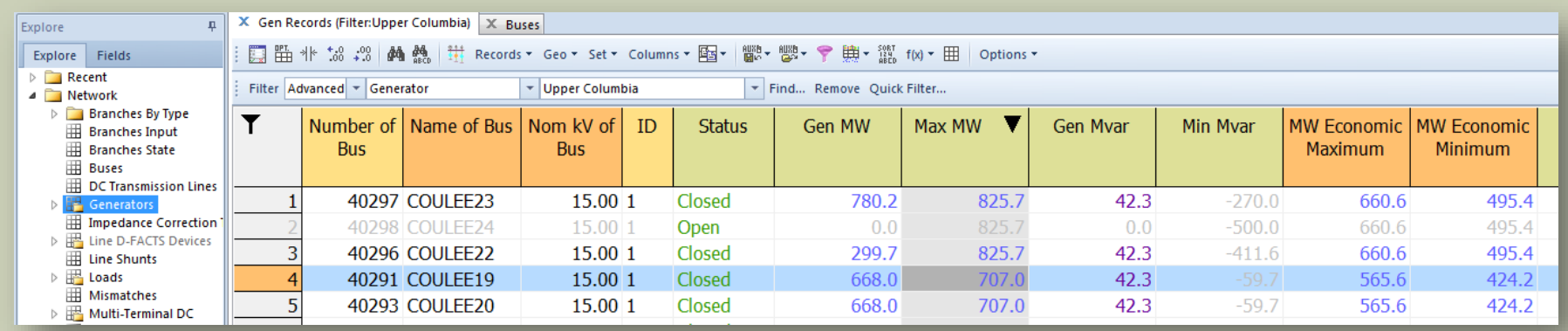


ECONOMIC DISPATCH

- Create Economic Dispatch for gen
  - Add column options in Model Explr



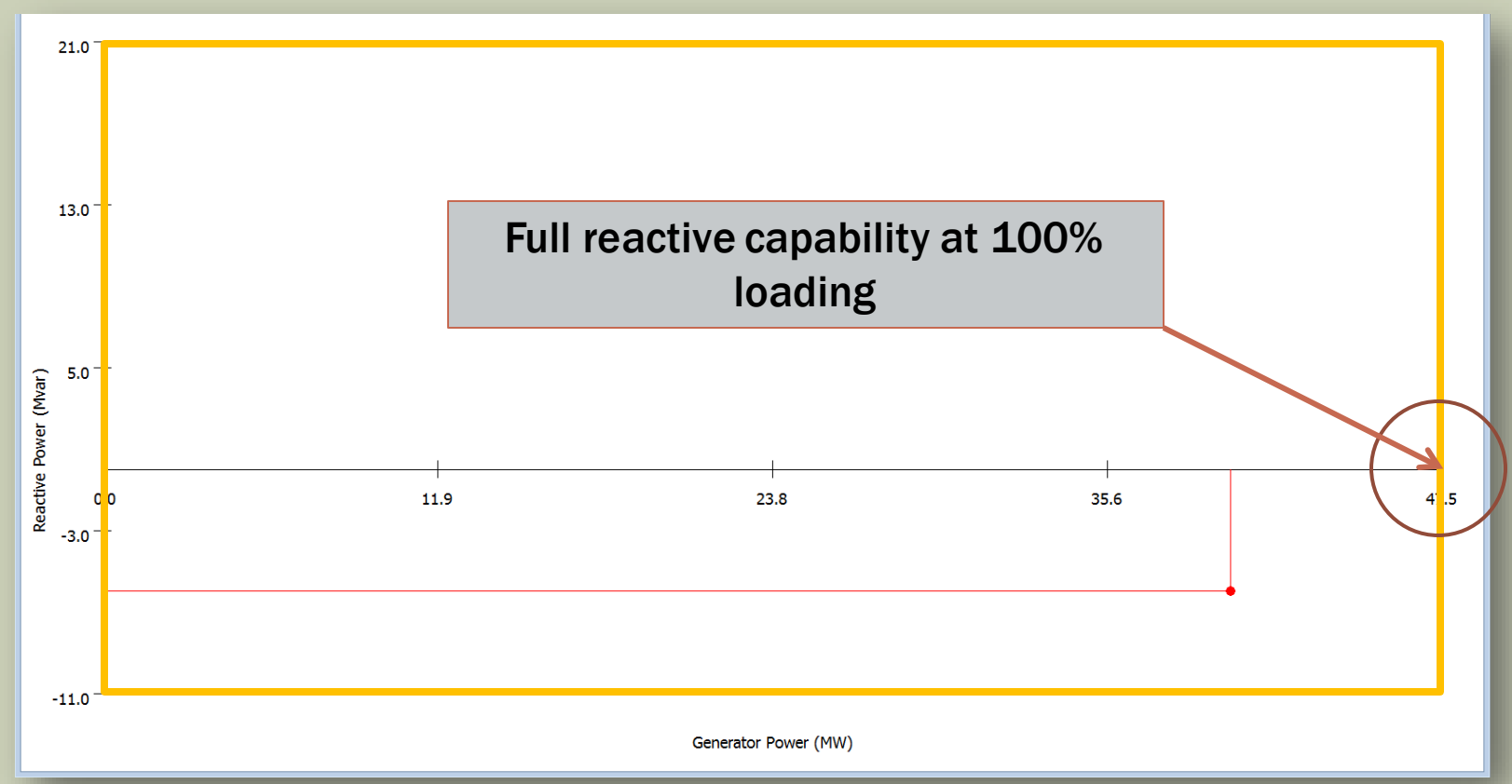
- Specify "economic range"
  - 60 – 80% loading works well



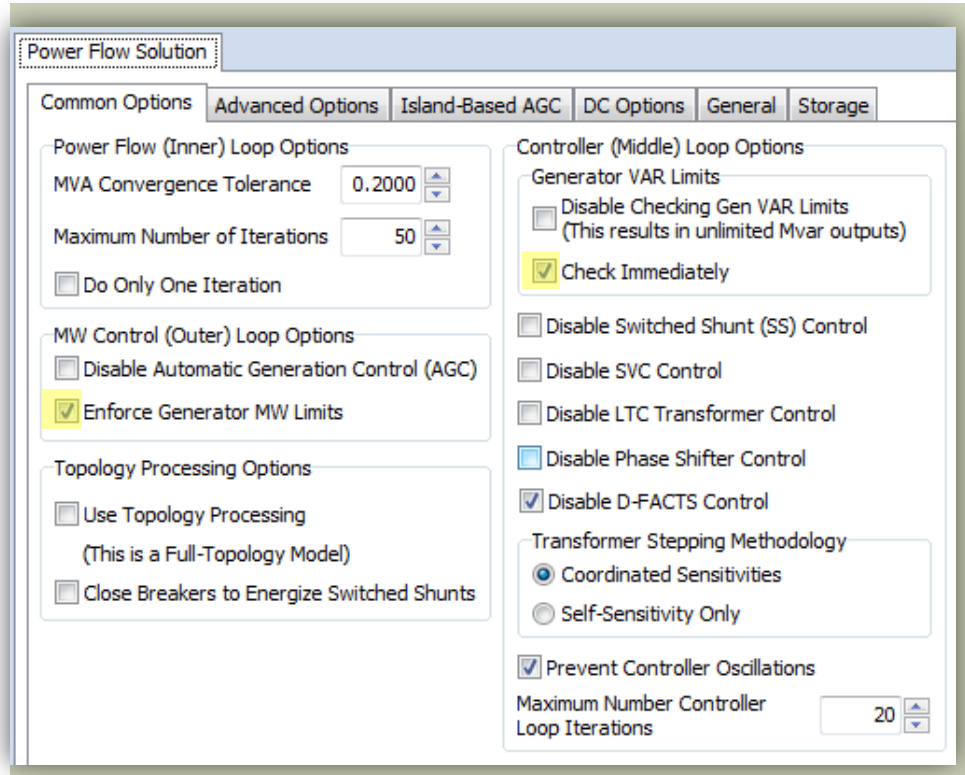
	Number of Bus	Name of Bus	Nom kV of Bus	ID	Status	Gen MW	Max MW	Gen Mvar	Min Mvar	MW Economic Maximum	MW Economic Minimum
1	40297	COULEE23	15.00	1	Closed	780.2	825.7	42.3	-270.0	660.6	495.4
2	40298	COULEE24	15.00	1	Open	0.0	825.7	0.0	-500.0	660.6	495.4
3	40296	COULEE22	15.00	1	Closed	299.7	825.7	42.3	-411.6	660.6	495.4
4	40291	COULEE19	15.00	1	Closed	668.0	707.0	42.3	-59.7	565.6	424.2
5	40293	COULEE20	15.00	1	Closed	668.0	707.0	42.3	-59.7	565.6	424.2

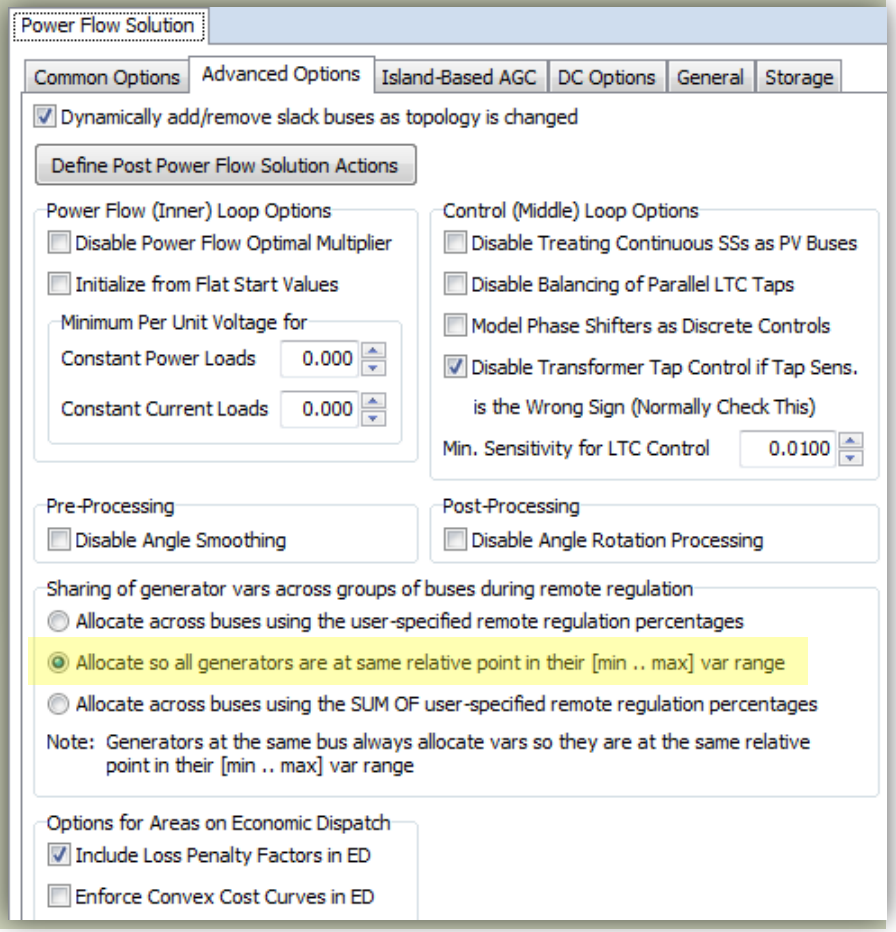
GEN REACTIVE CAPABILITY CURVES

- Need accurate gen reactive capability curves
  - Fictitiously optimistic results otherwise

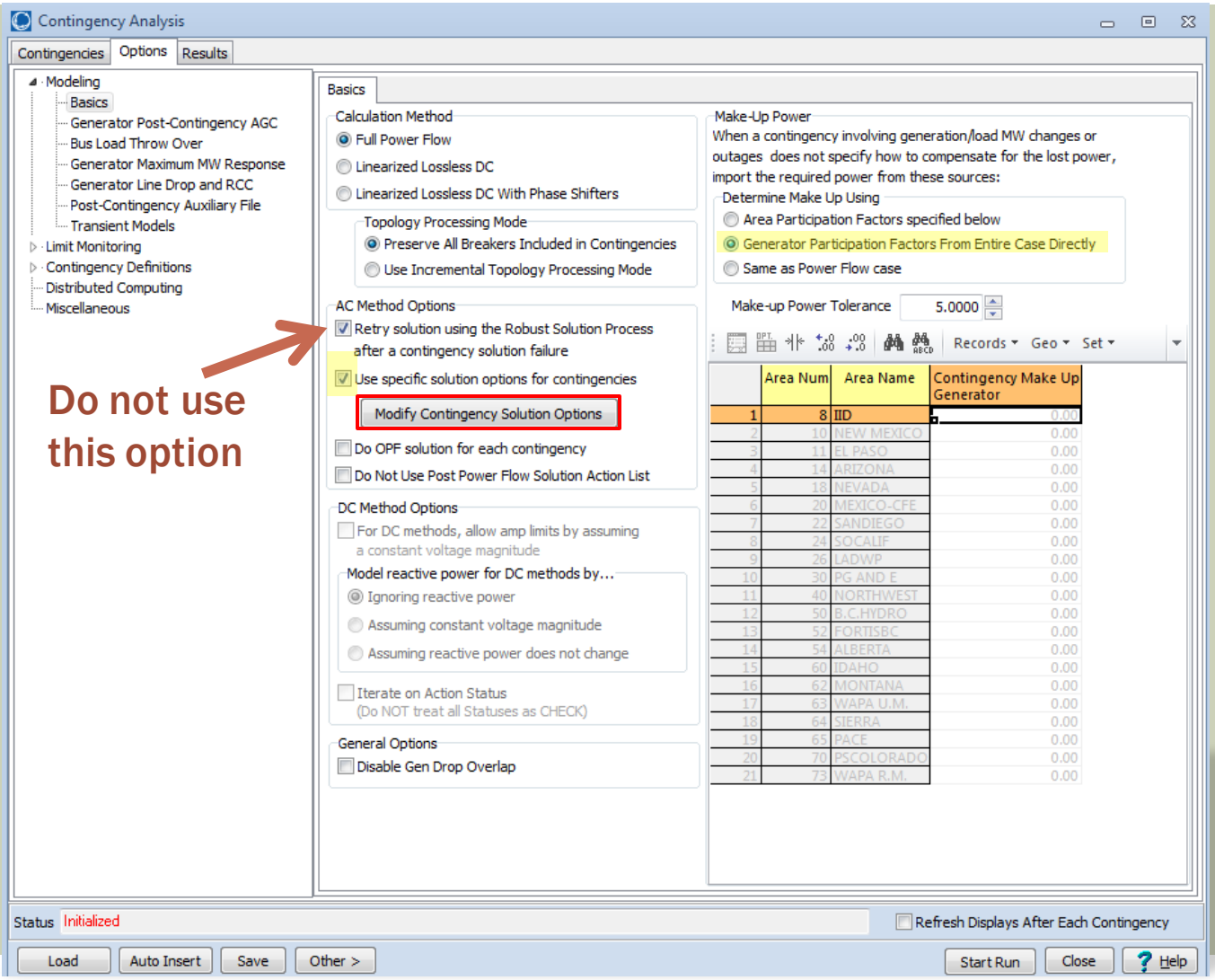


POWERFLOW SETTINGS



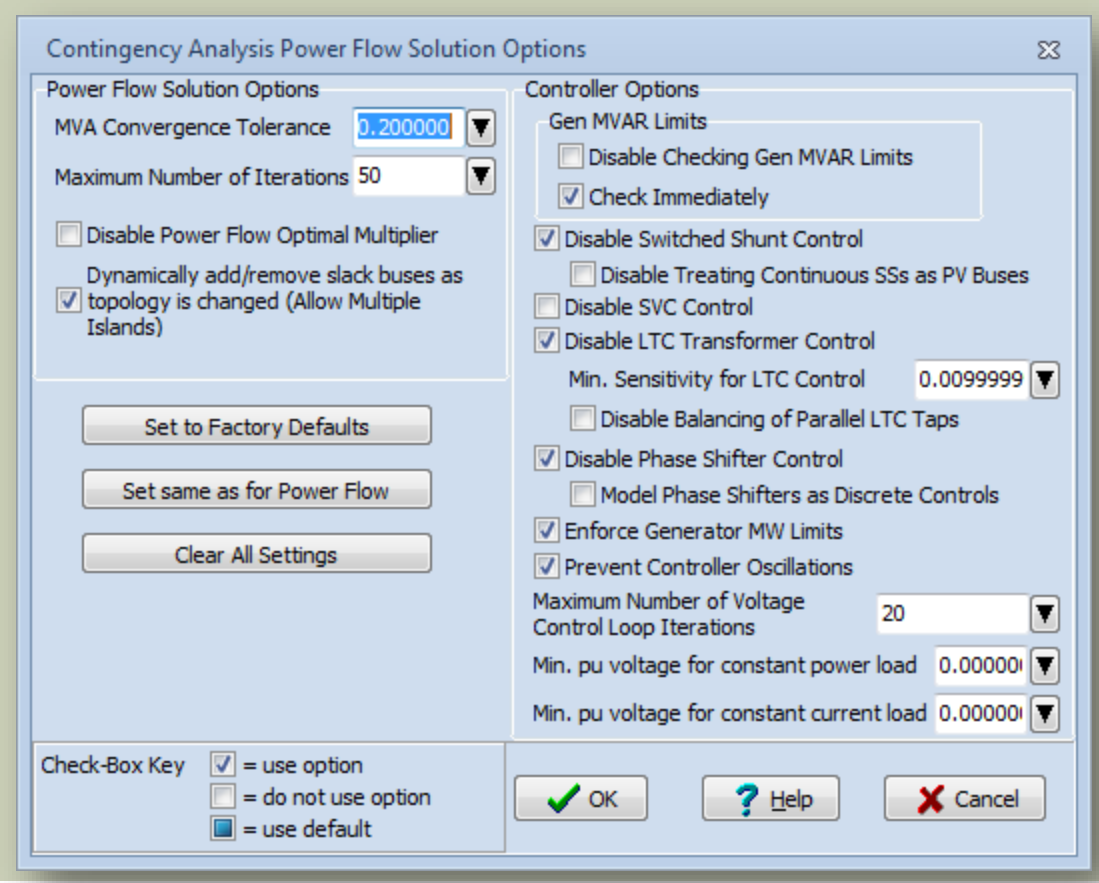


CONTINGENCY SETTINGS

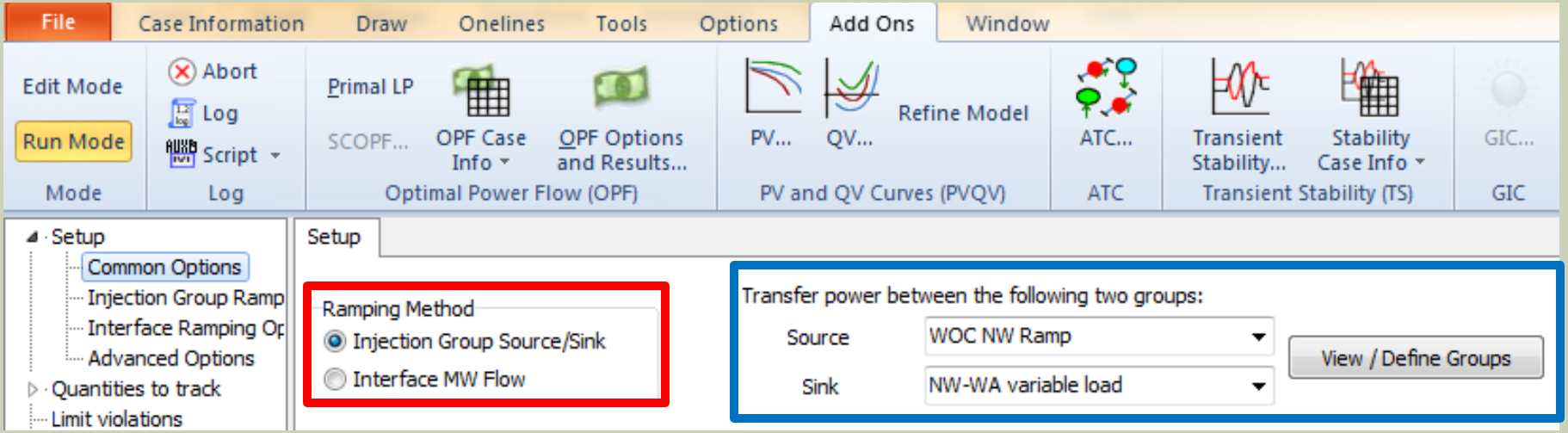


CONTINGENCY SETTINGS

- Set up post contingency assumptions
  - Example: ***NO POST CTG REACTIVE SWITCHING***

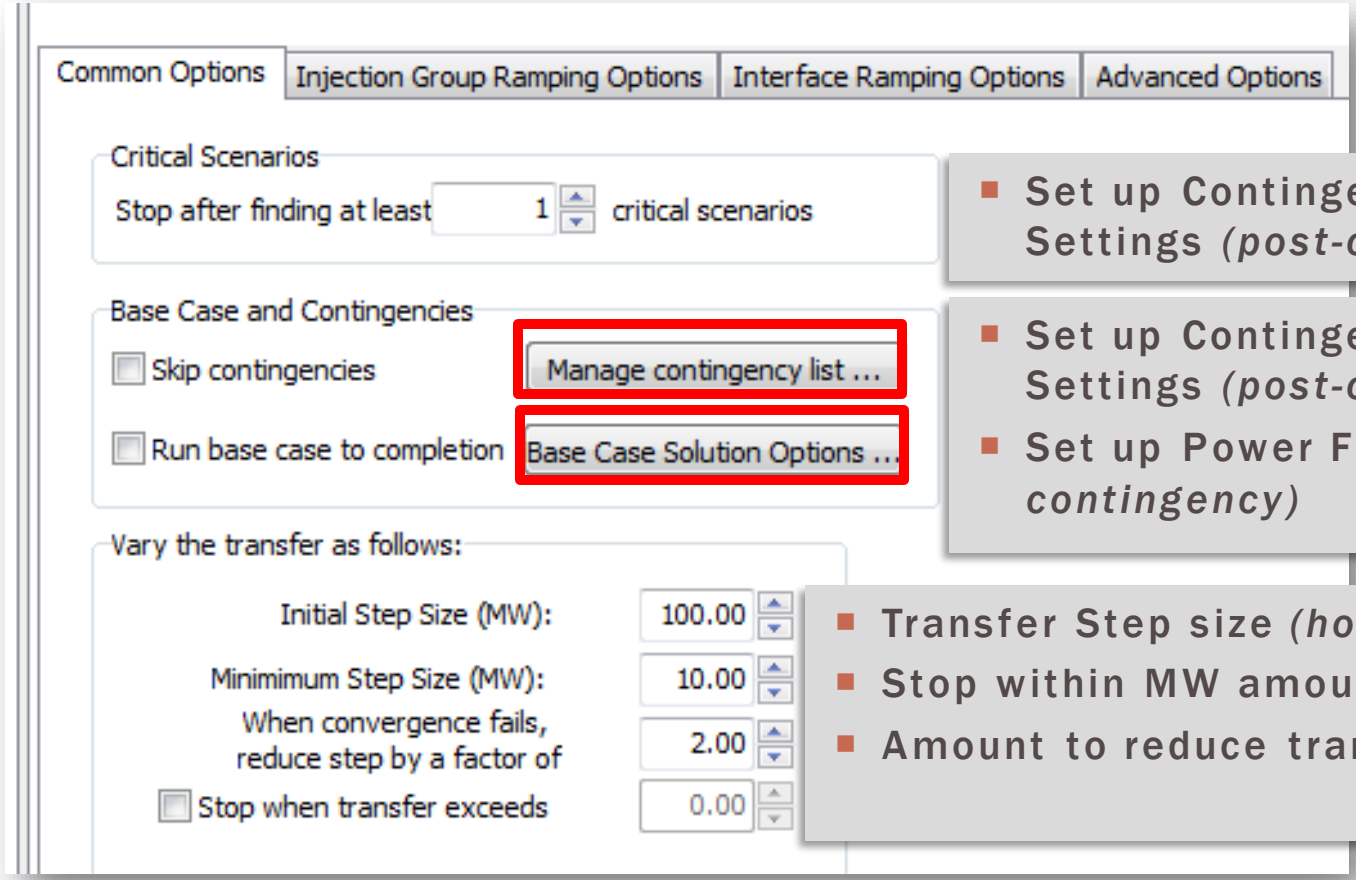


PV TOOL– *SETUP – SOURCE/SINK*



- Specify ***SOURCE*** and ***SINK*** injection groups
  - Ramps ***SOURCE*** and ***SINK*** until unsolved contingency or base case

PV TOOL – *COMMON OPTIONS* -

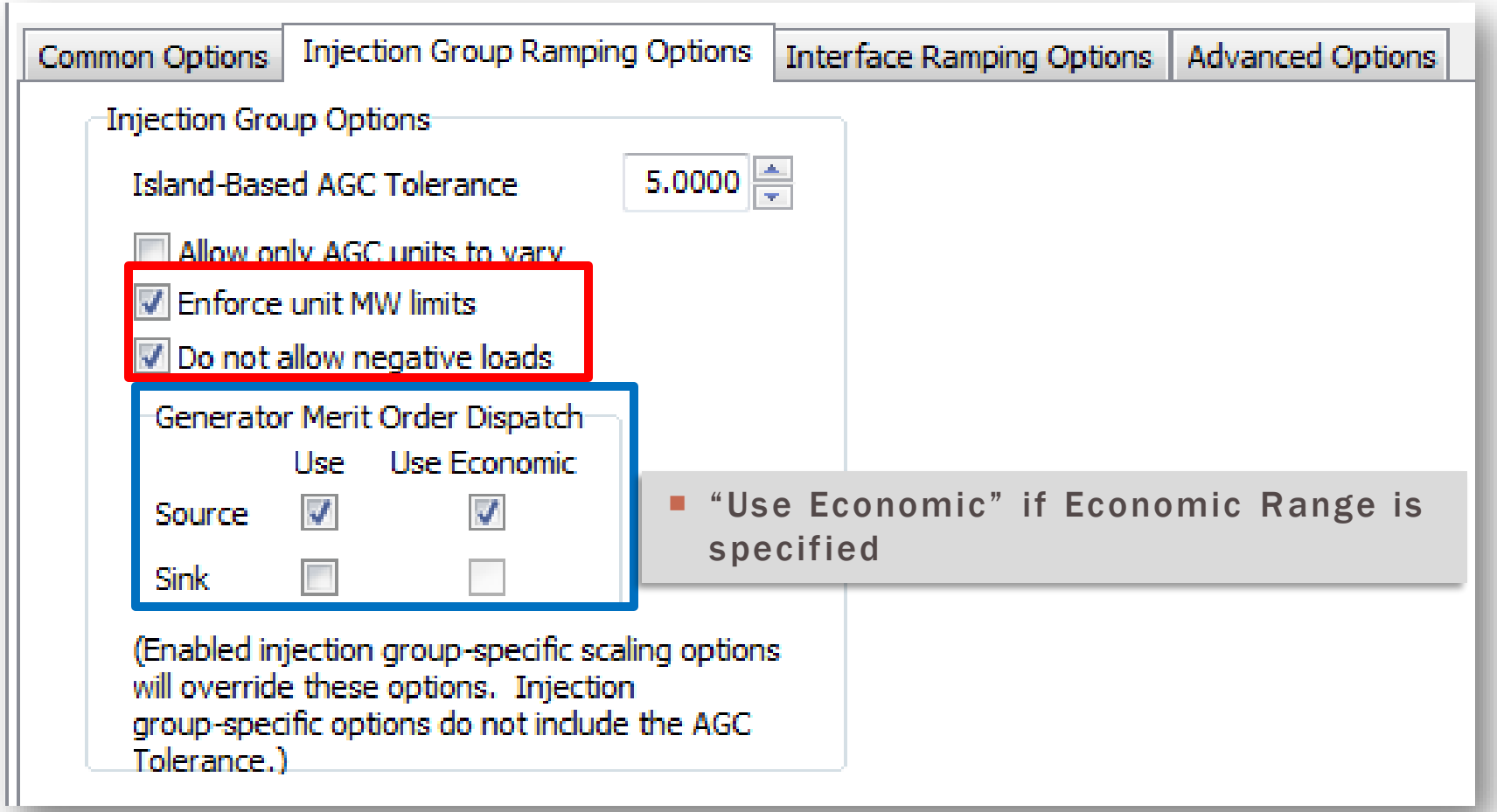


- Set up Contingency Analysis Settings *(post-contingency)*

- Set up Contingency Analysis Settings *(post-contingency)*
- Set up Power Flow Settings (*pre-contingency*)

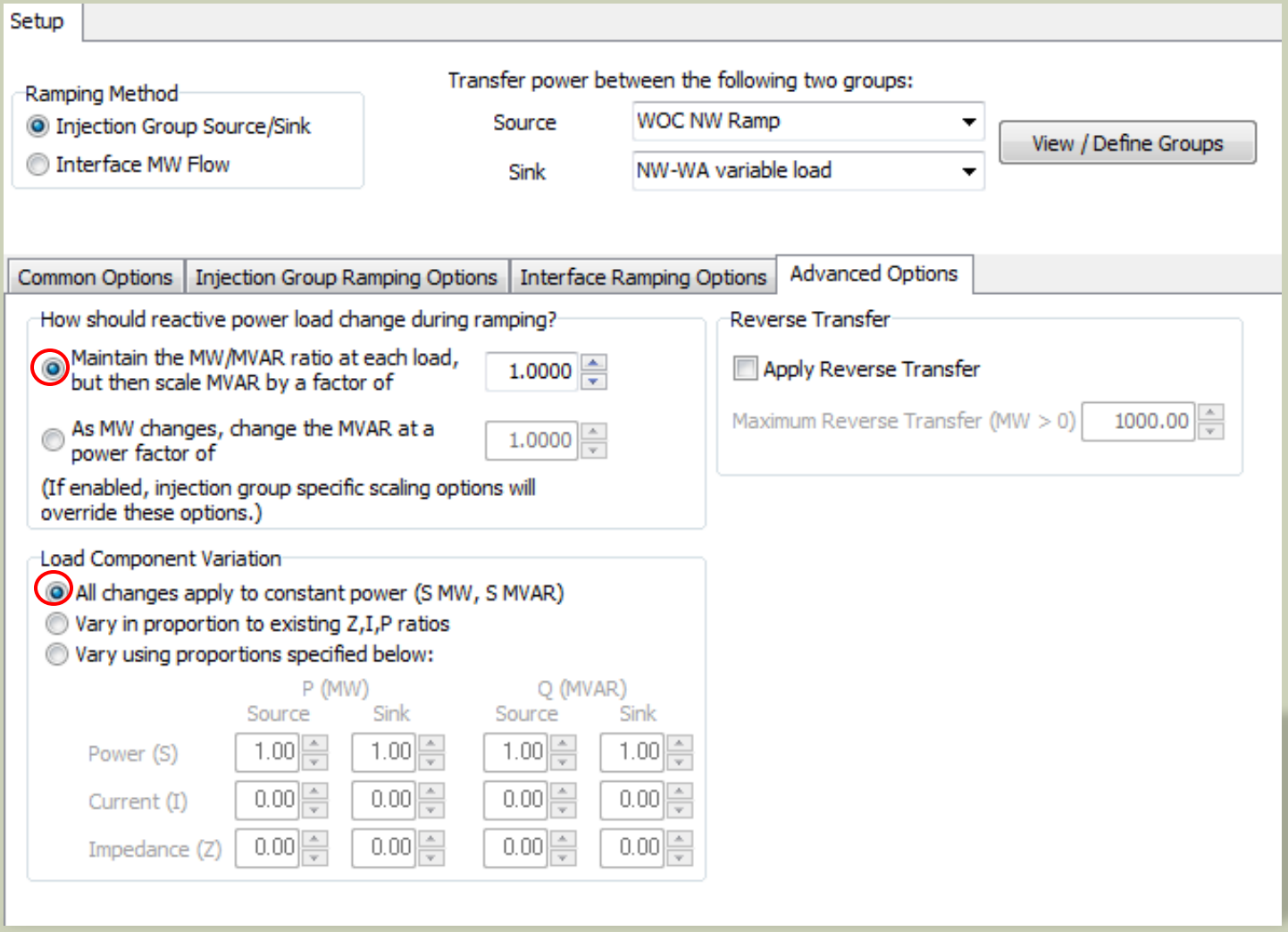
- Transfer Step size *(how much to ramp)*
- Stop within MW amount of unsolved soln
- Amount to reduce transfer step size by

PV TOOL – *INJ. GROUP RAMP OPTIONS -*



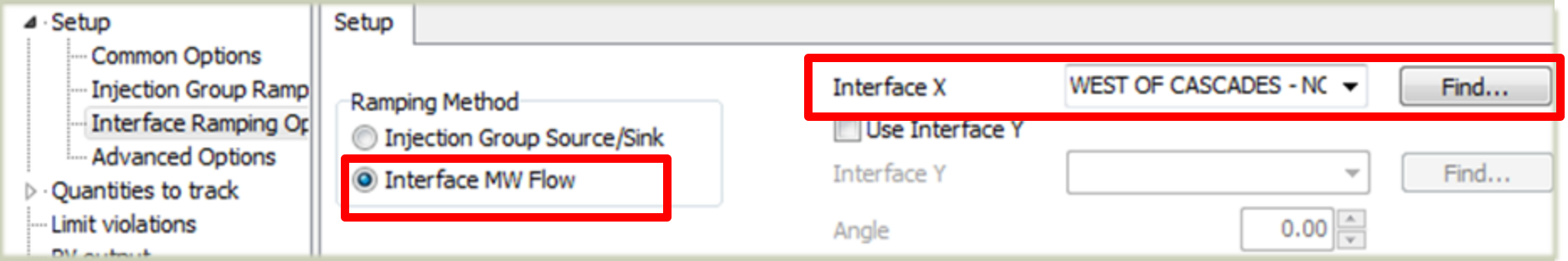
- "Use Economic" if Economic Range is specified

PV TOOL – *ADVANCED OPTIONS*



PV TOOL – *SETUP –INTERFACE RAMP*

- Specify an *interface* to ramp instead of specific *source/sink*



- Interface ramp constrained by user-defined ***OPF* Options**
  - **See *PW HELP* – "PV Curves setup: Interface Ramping Options"**

PV TOOL– *SETUP –RAMPING INTERFACES*

1. Ramp *interface* ***X*** and *interface* ***Y***
2. Maintain relationship of **X** to **Y** by *angle* ***θ°***
3. ****Optional**:** Maintain interface **Z** flow by $Z_{setpoint}$

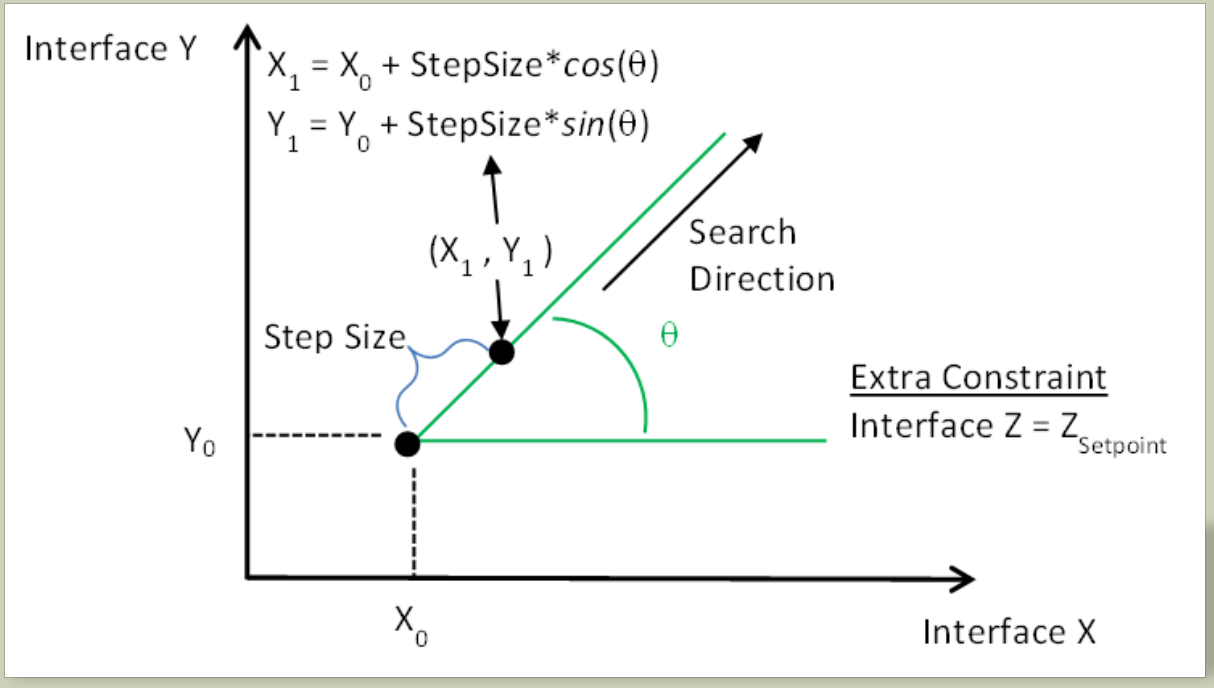


Diagram from Power World HELP document

EXAMPLES:

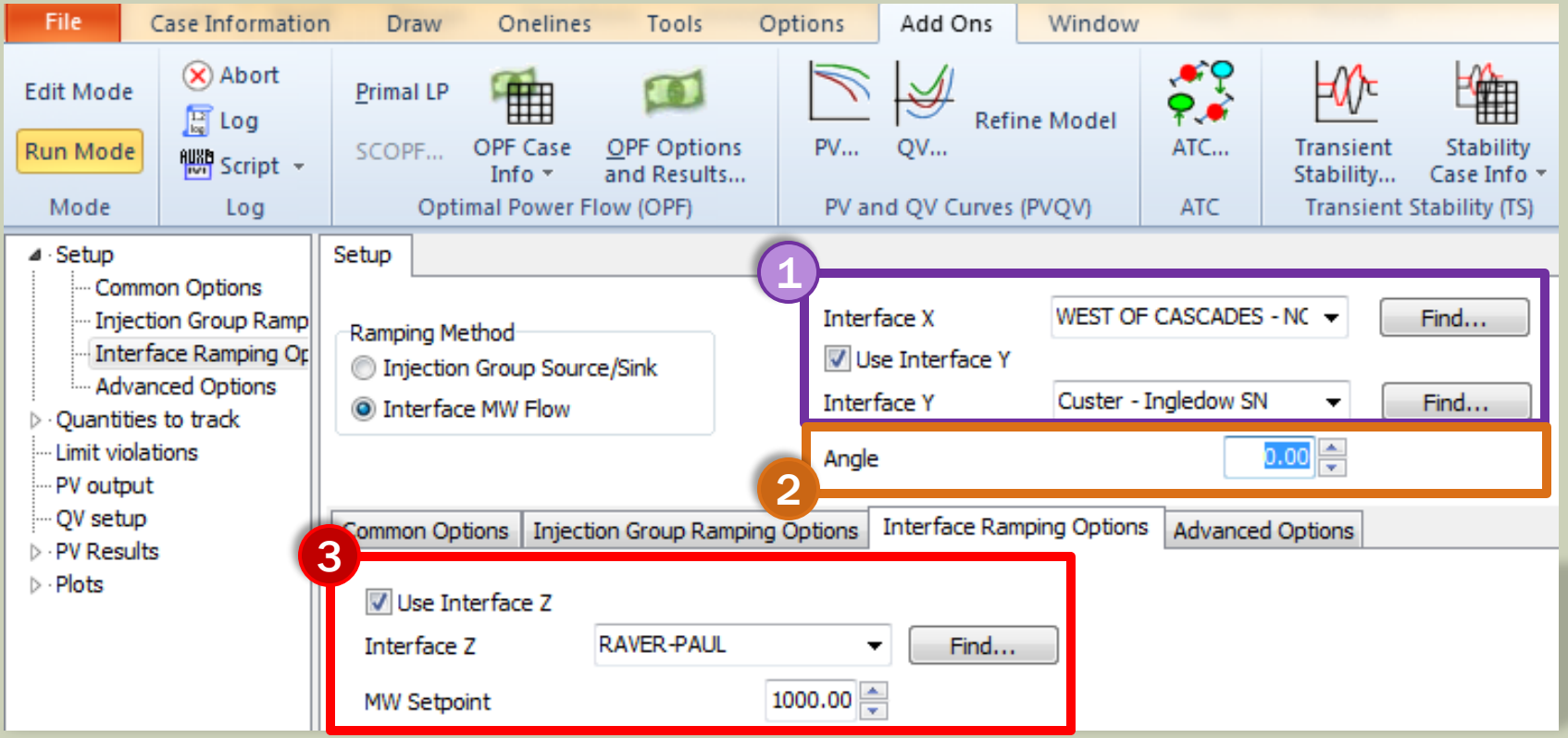
0° = *Ramp **X** only*

45° = *Ramp **X** & **Y** equally*

90° = *Ramp **Y** only*

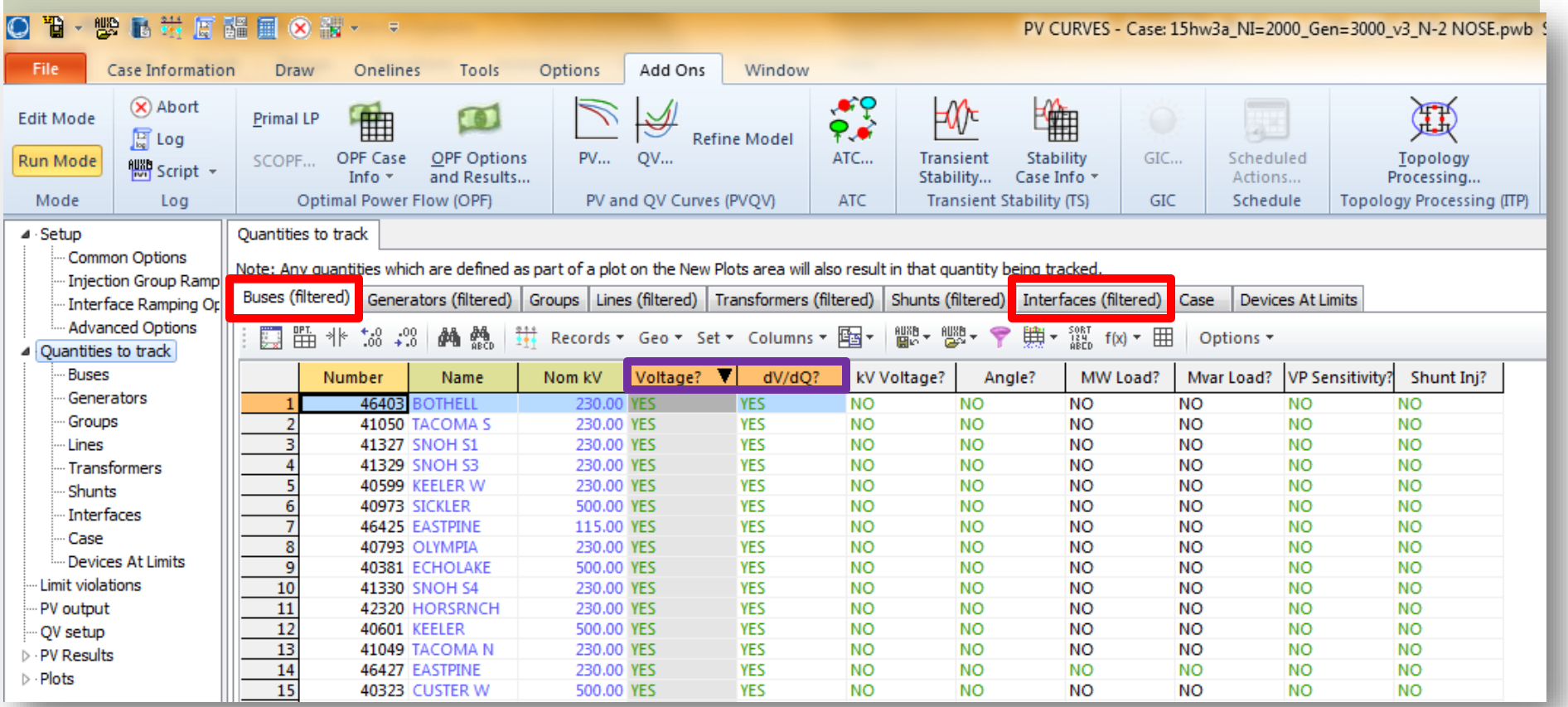
PV TOOL– *SETUP –RAMPING INTERFACES*

1. Ramp *interface* ***X*** and *interface* ***Y***
2. Maintain relationship of **X** to **Y** by *angle* $\theta°$
3. ***Optional***: Maintain interface **Z** flow by $Z_{setpoint}$

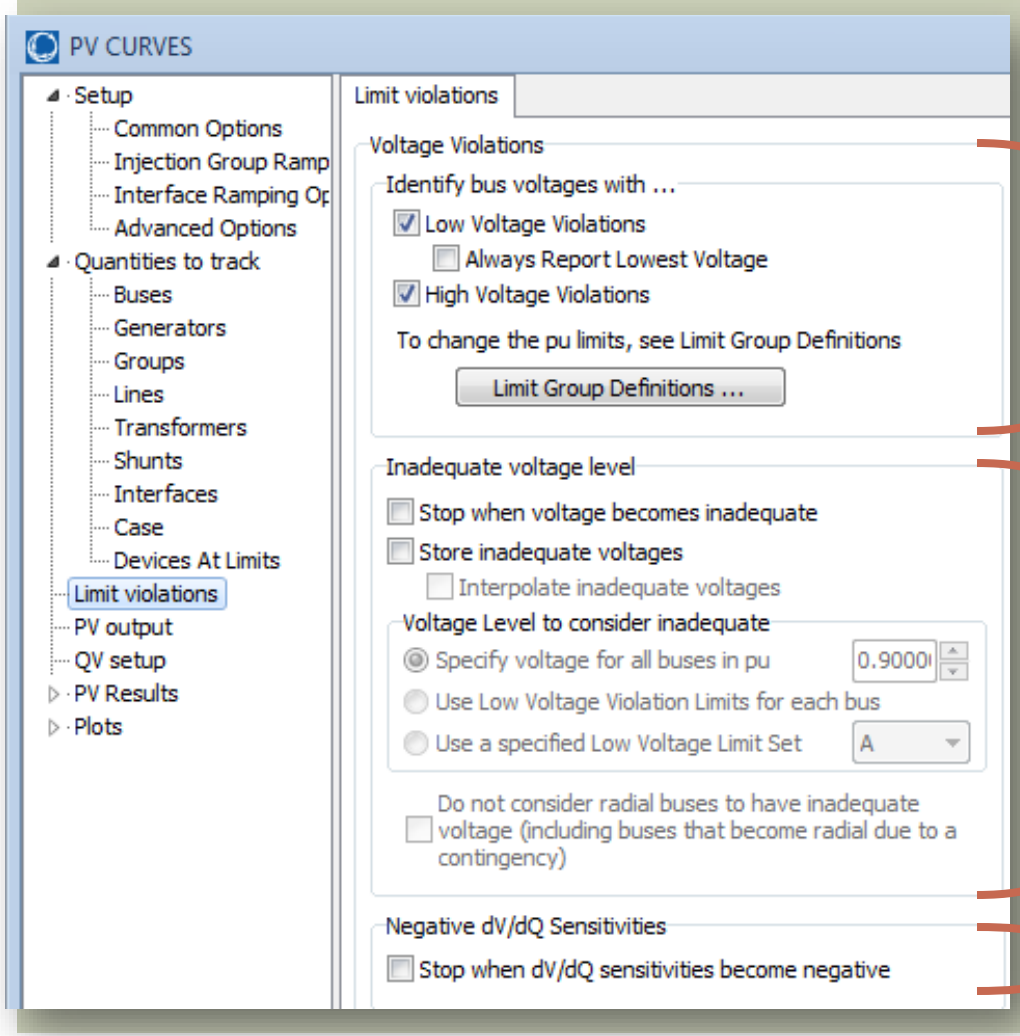


PV TOOL– *QUANTITIES TO TRACK*

- Select *elements* to track during run
  - Ex: *Buses, Interfaces*
  - *Elements can be plotted at the end of the PV run*

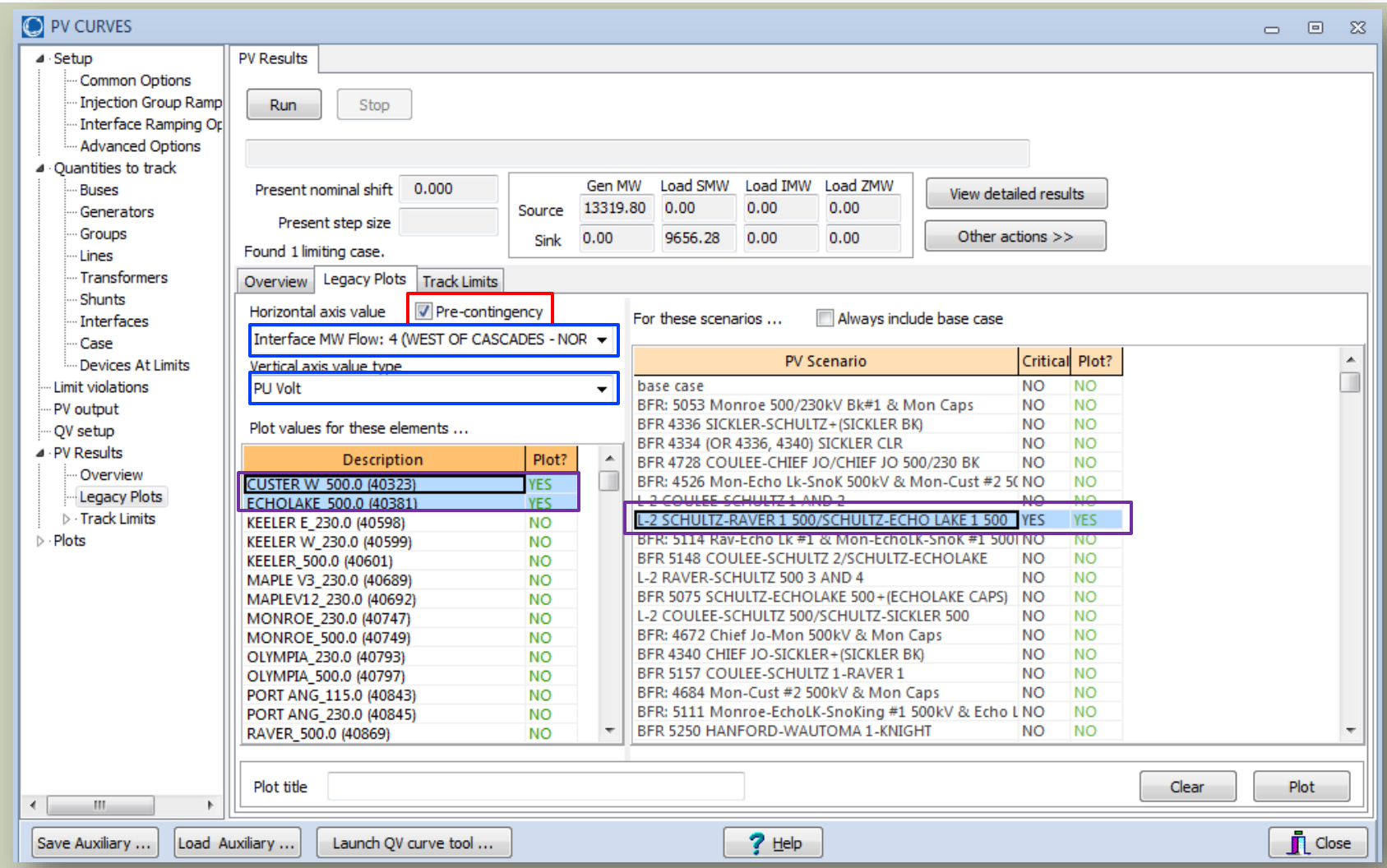


PV TOOL – *LIMIT VIOLATIONS*

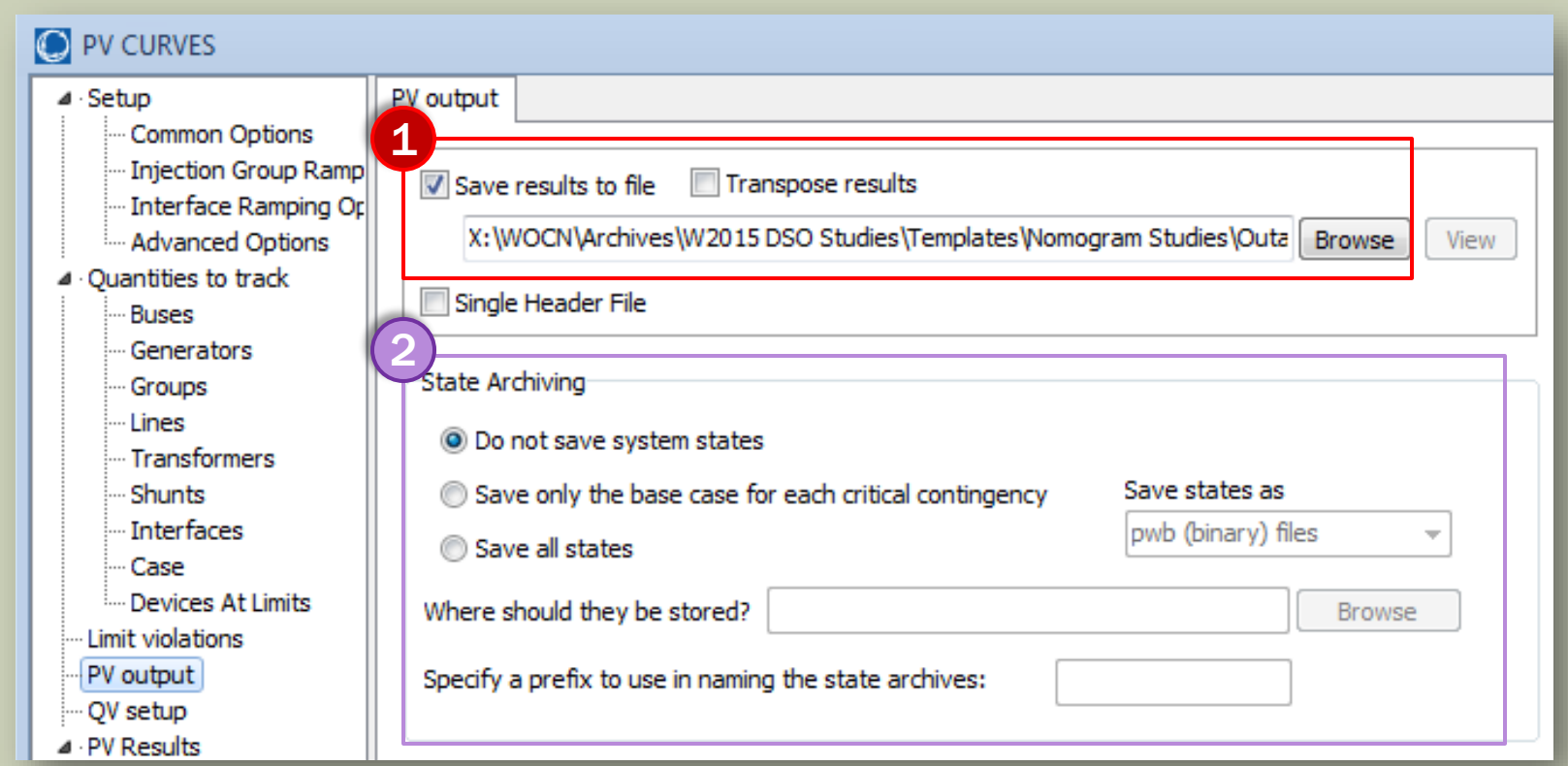


- Define monitored elements in ***LIMIT MONITORING SETTINGS***
  - Track bus voltage violations
  - **STOP** PV run when bus voltage limit is violated
  - **END** PV run when buses set to monitor dv/dq are negative.

PV TOOL – *RESULTS (PLOT)*

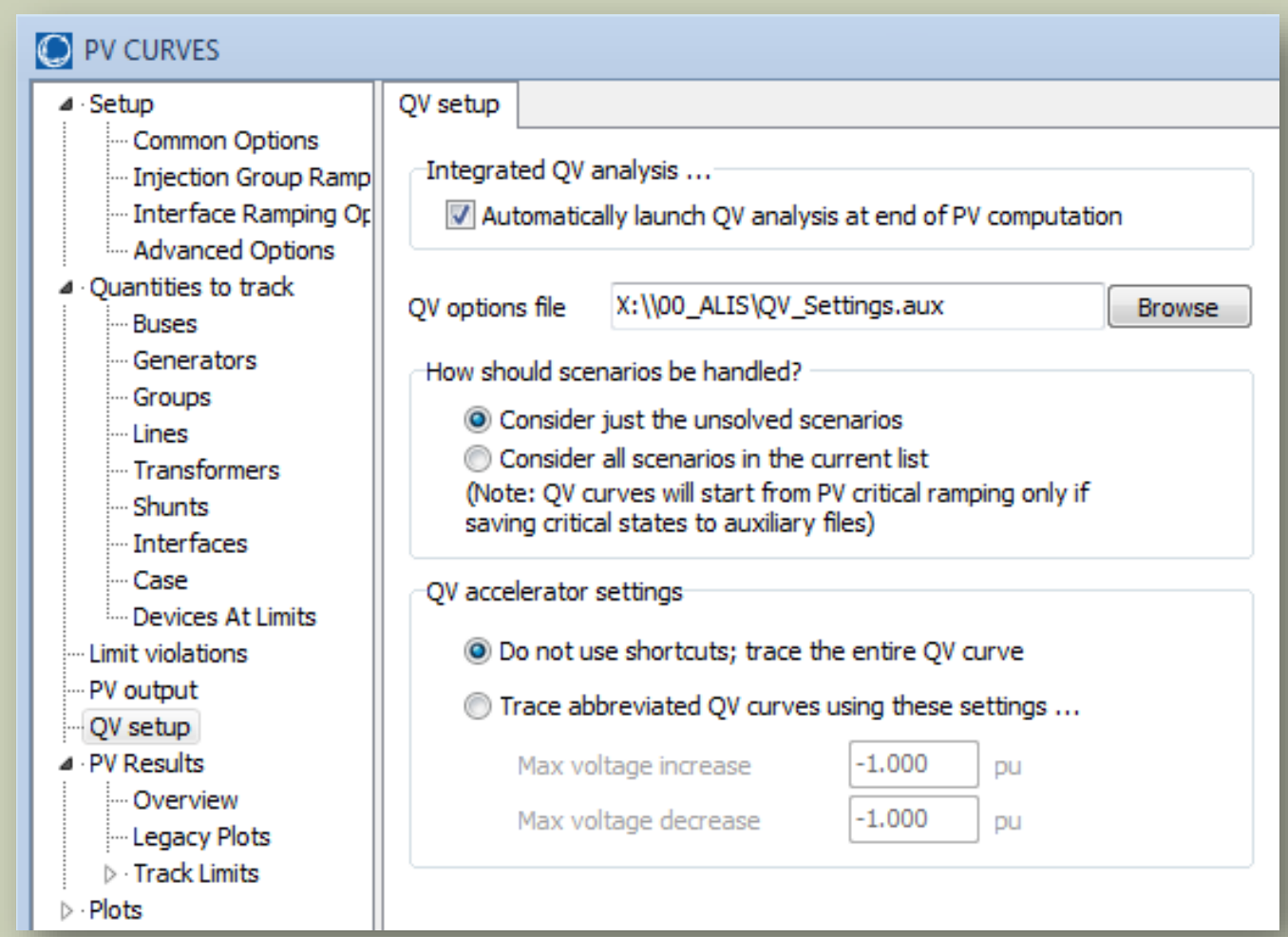


PV TOOL – *SAVE RESULTS*

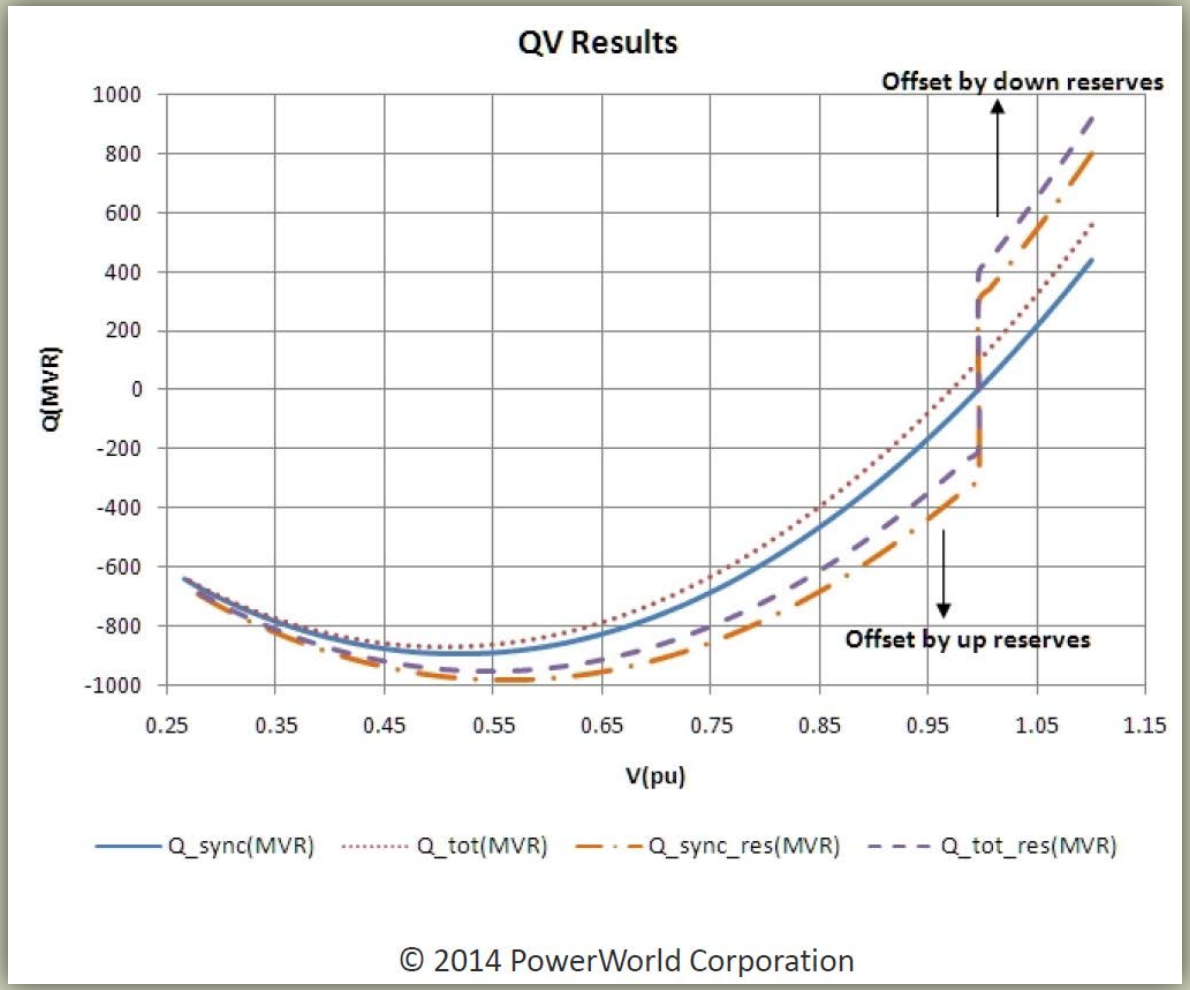


1. Save PV run results
2. Save Base Cases at different states during ramp

RUN QV AT PV LIMIT



QV TOOL



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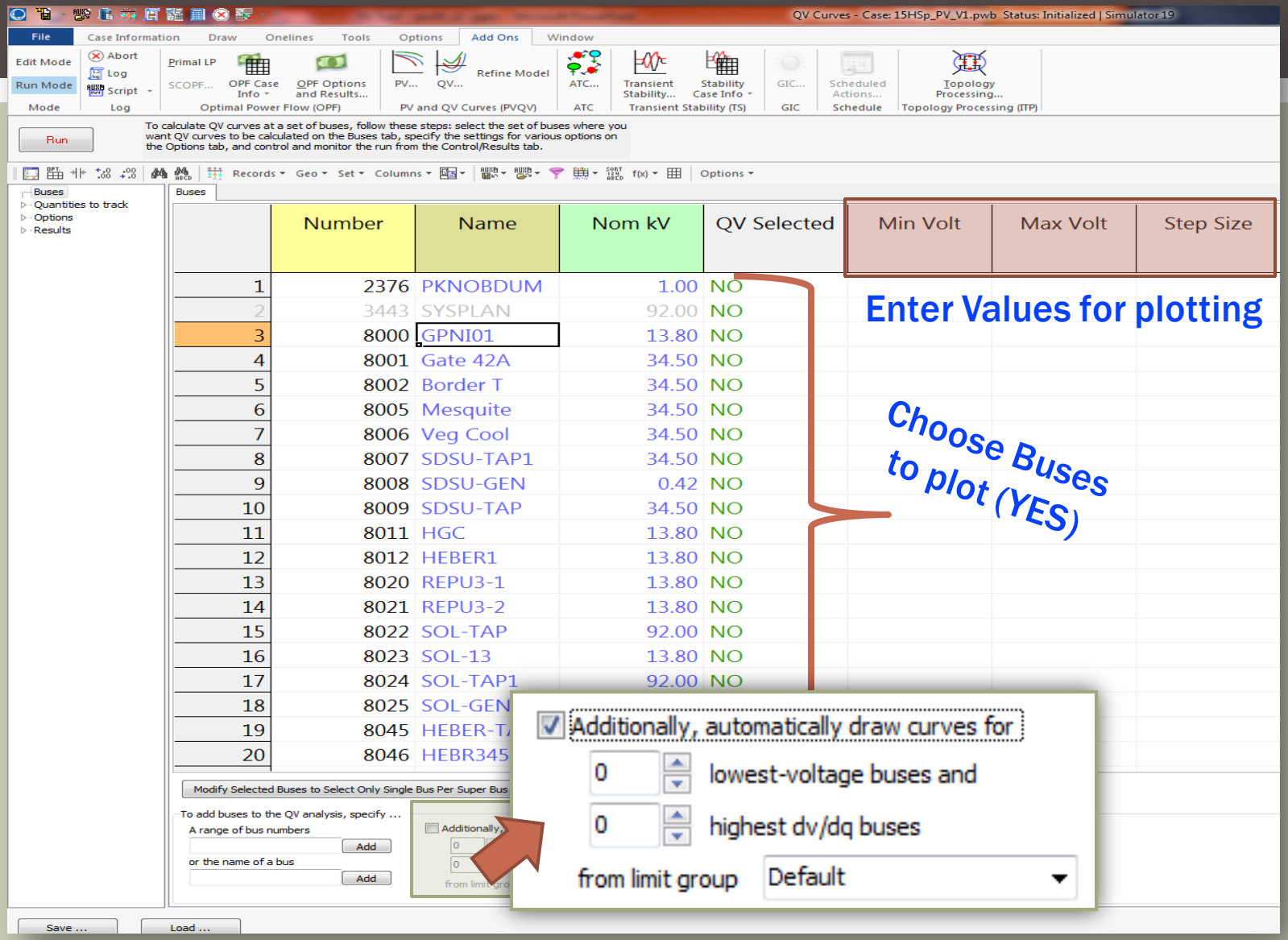
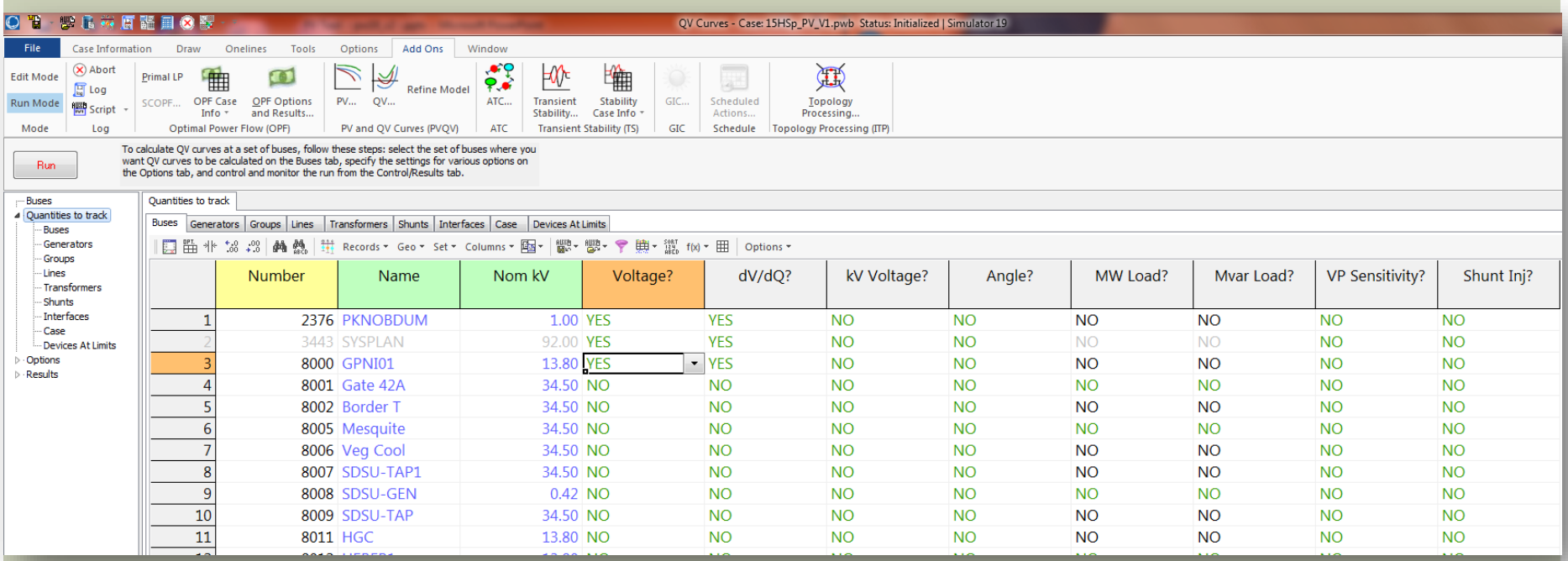
QV TOOL: SPECIFY WHAT TO PLOT



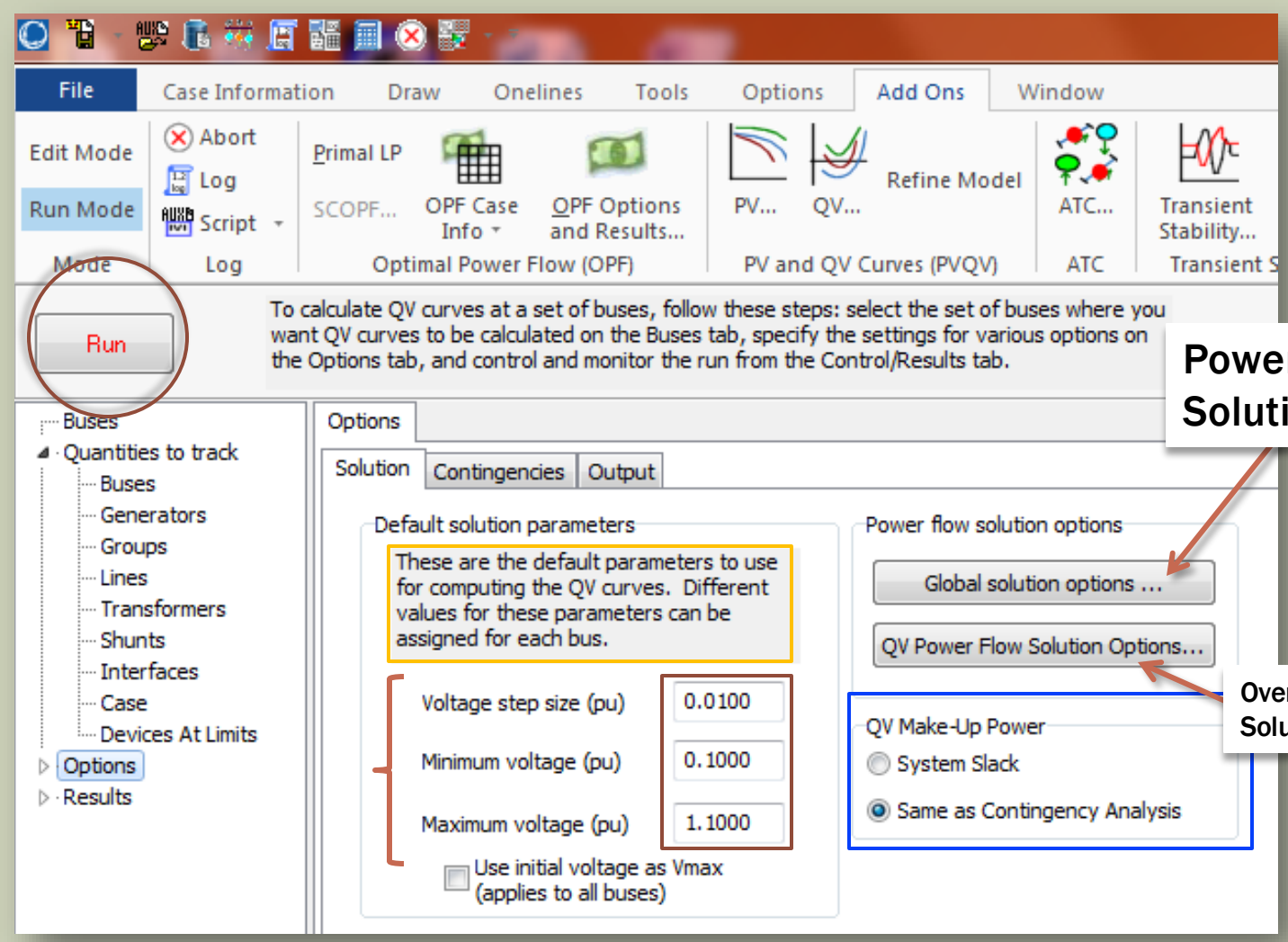
SPECIFY EQUIP TO MONITOR



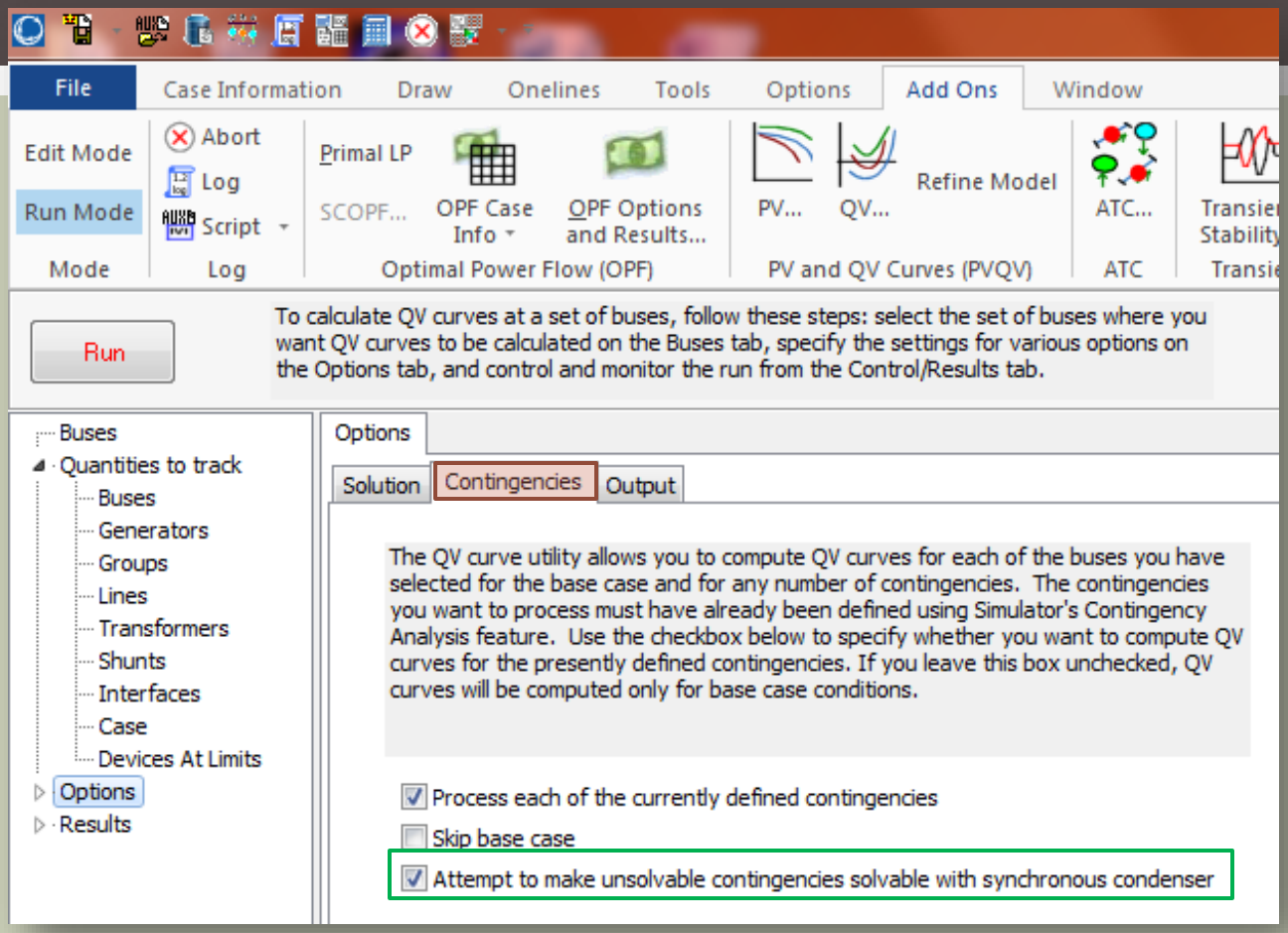
	Number	Name	Nom kV	Voltage?	dV/dQ?	kV Voltage?	Angle?	MW Load?	Mvar Load?	VP Sensitivity?	Shunt Inj?
1	2376	PKNOBDUM	1.00	YES	YES	NO	NO	NO	NO	NO	NO
2	3443	SYSPLAN	92.00	YES	YES	NO	NO	NO	NO	NO	NO
3	8000	GPNI01	13.80	YES	YES	NO	NO	NO	NO	NO	NO
4	8001	Gate 42A	34.50	NO	NO	NO	NO	NO	NO	NO	NO
5	8002	Border T	34.50	NO	NO	NO	NO	NO	NO	NO	NO
6	8005	Mesquite	34.50	NO	NO	NO	NO	NO	NO	NO	NO
7	8006	Veg Cool	34.50	NO	NO	NO	NO	NO	NO	NO	NO
8	8007	SDSU-TAP1	34.50	NO	NO	NO	NO	NO	NO	NO	NO
9	8008	SDSU-GEN	0.42	NO	NO	NO	NO	NO	NO	NO	NO
10	8009	SDSU-TAP	34.50	NO	NO	NO	NO	NO	NO	NO	NO
11	8011	HGC	13.80	NO	NO	NO	NO	NO	NO	NO	NO

- Choose <u>Equipment</u> to monitor
  - *BUS Voltage
  - *BUS DVDQ

GENERAL OPTIONS / RUN

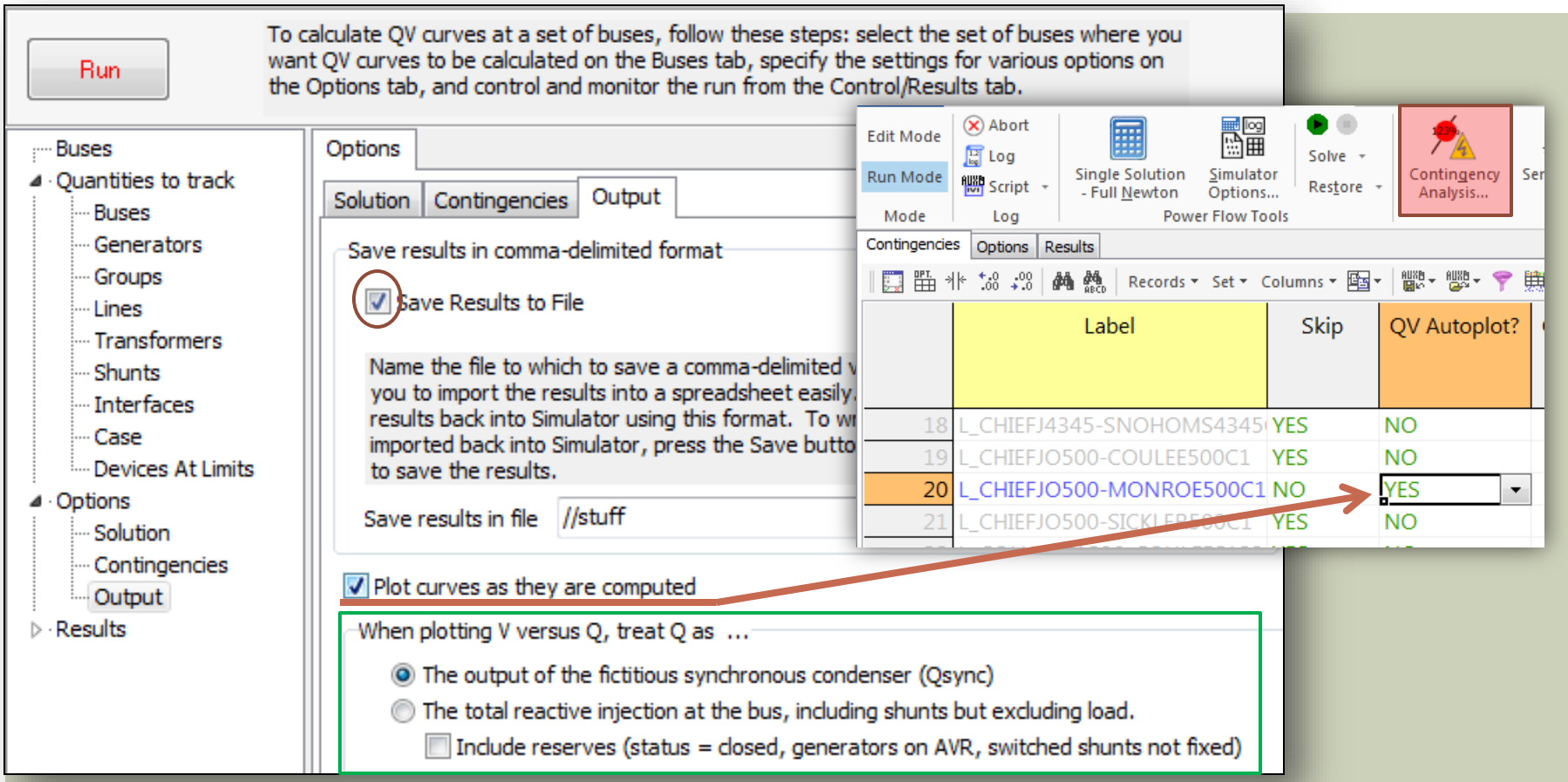


OPTIONS – CTG'S

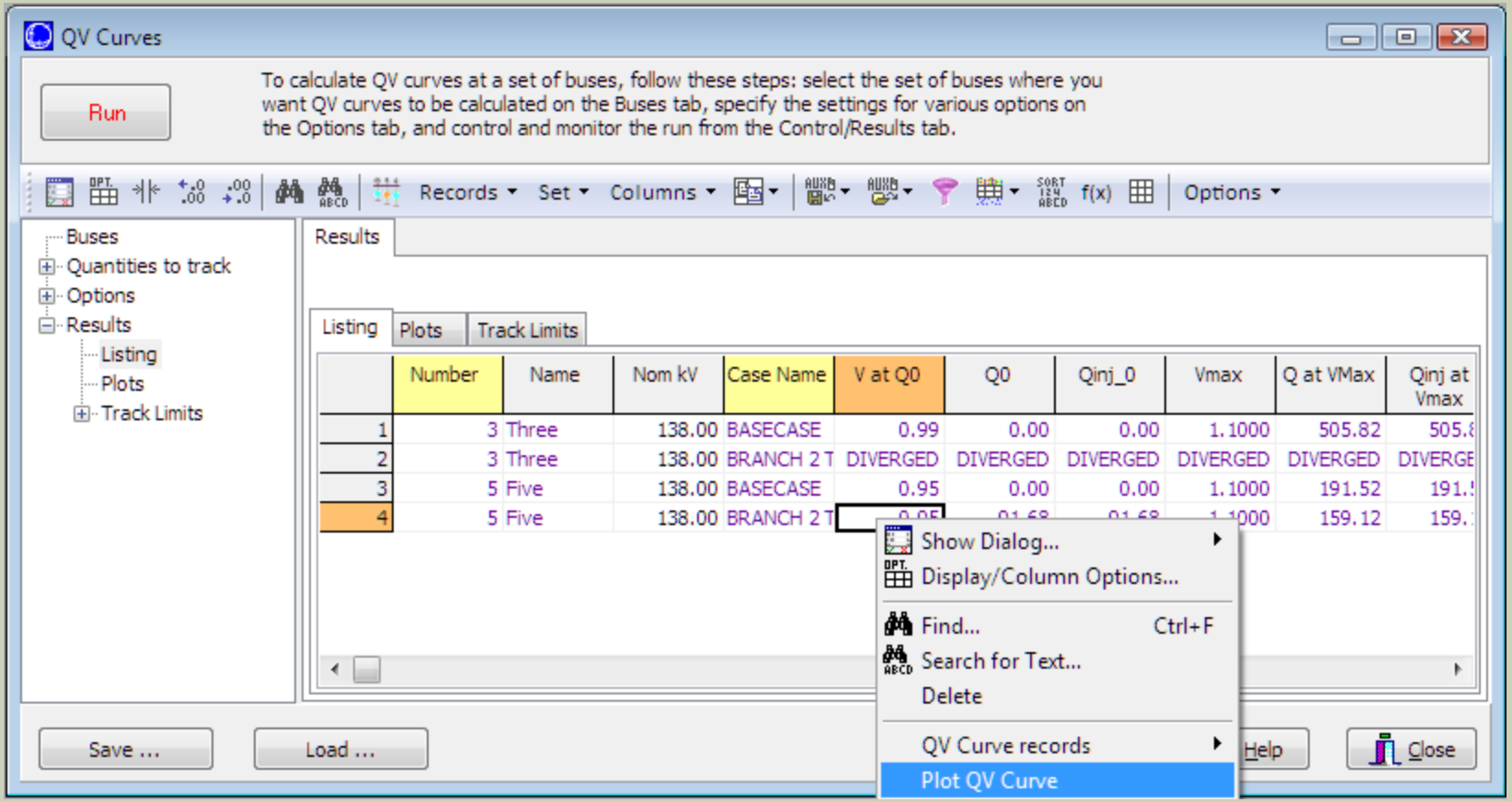


- Sync Condenser:
  - Aids in soln failures
  - QV plotted from Fictious Sync Gen

OPTIONS - OUTPUTS

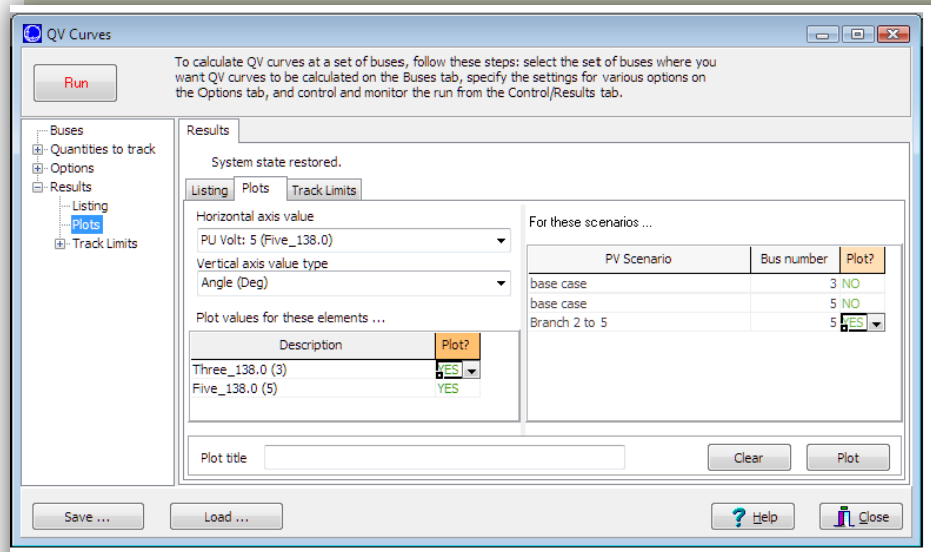


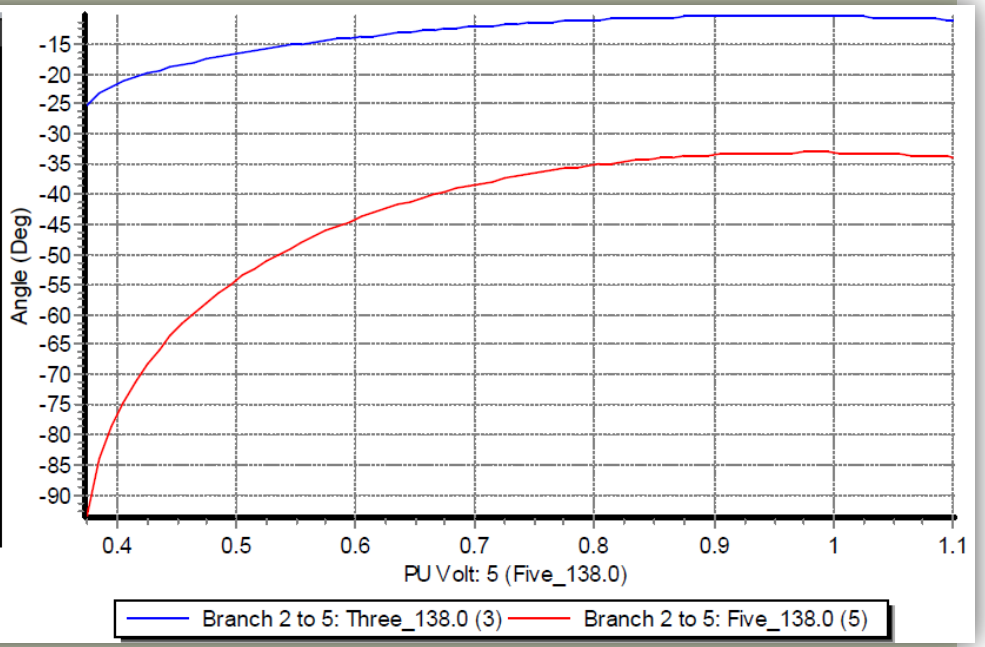
QV - RESULT LISTS



- *Power World QV Slide [22]*

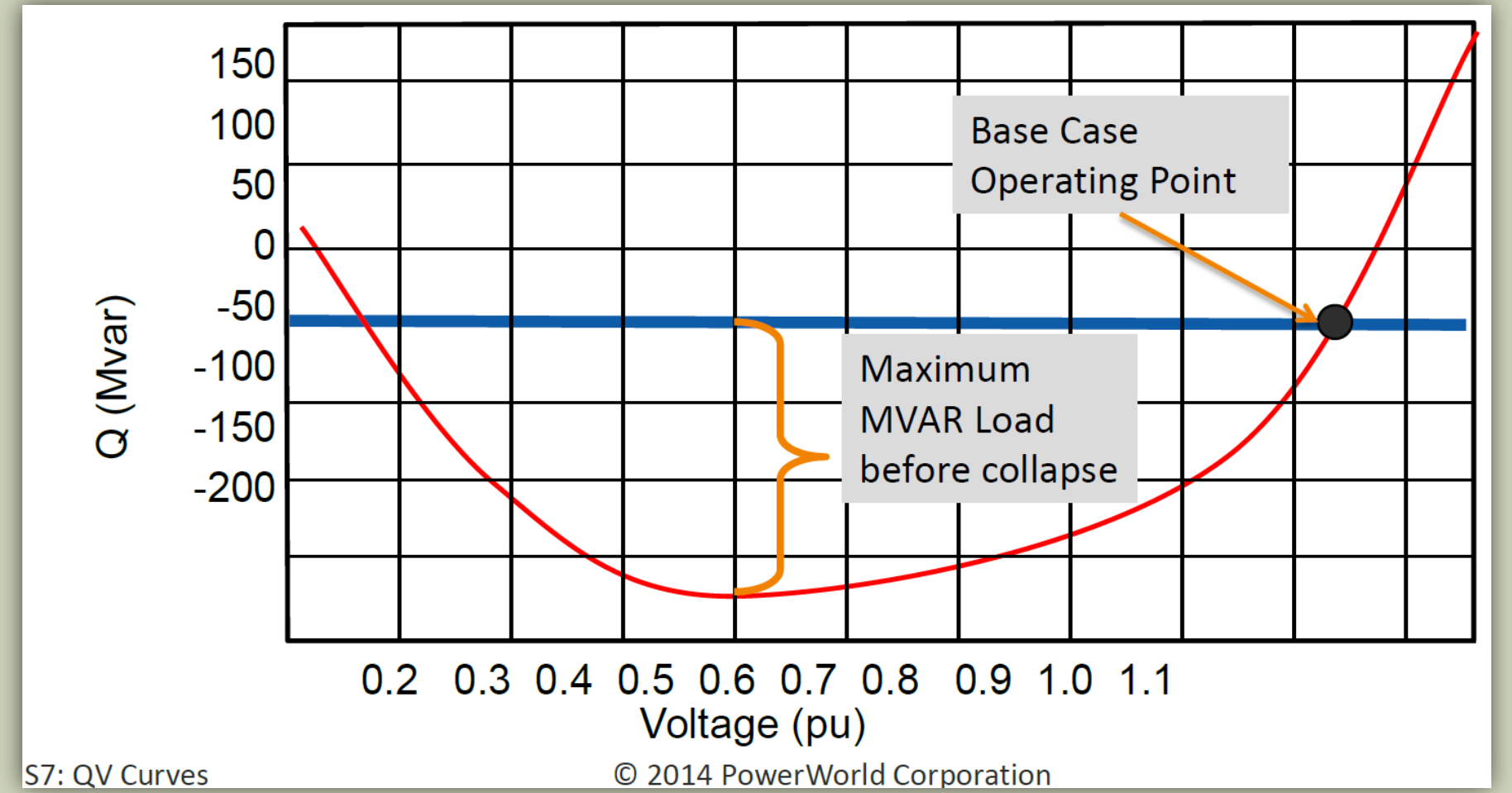
QV – RESULT PLOTTING





- *Power World QV slide [23]*

QV RESULT: (+) REACTIVE MARGIN



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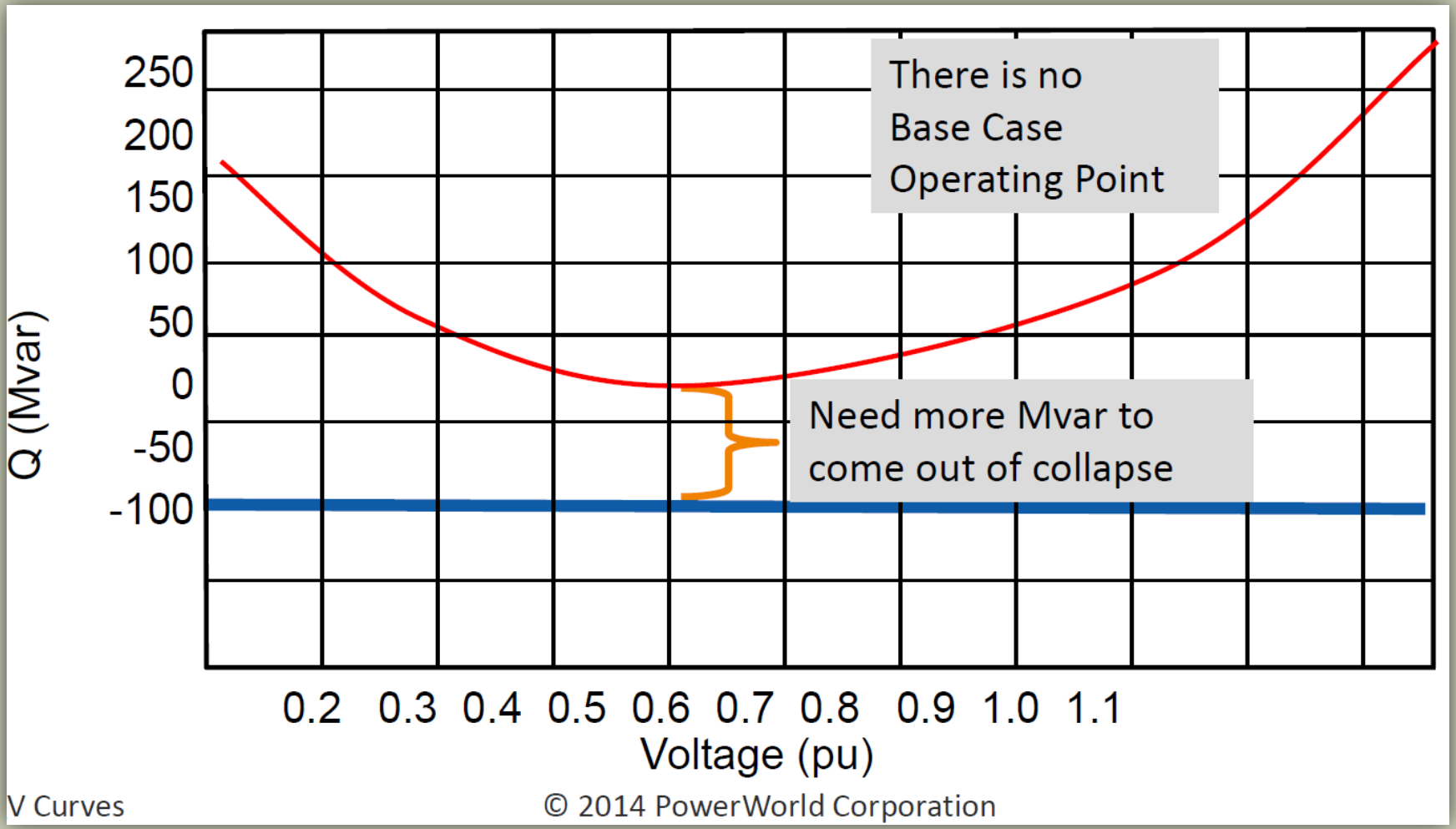
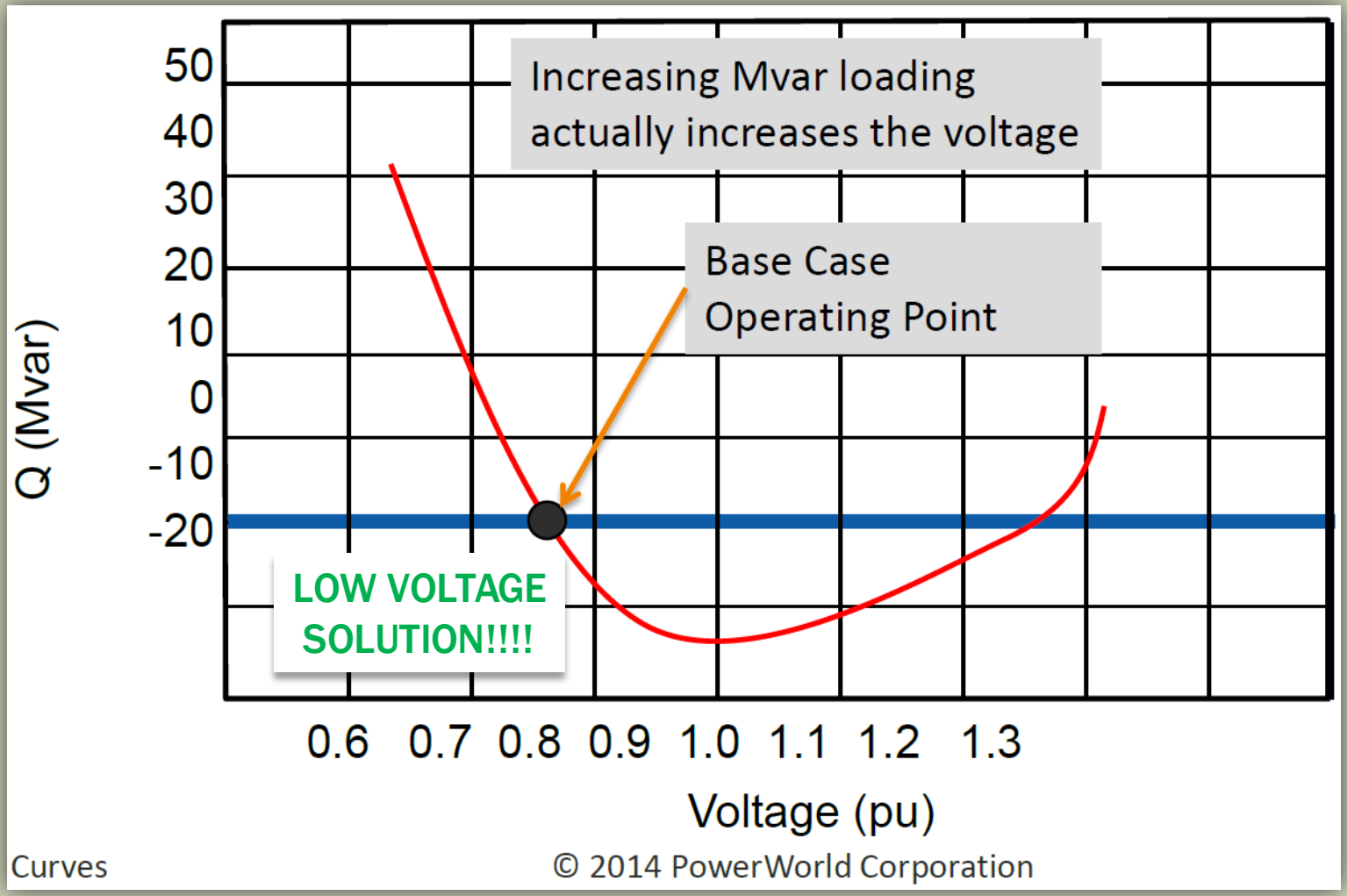
QV RESULT: (-) REACTIVE MARGIN

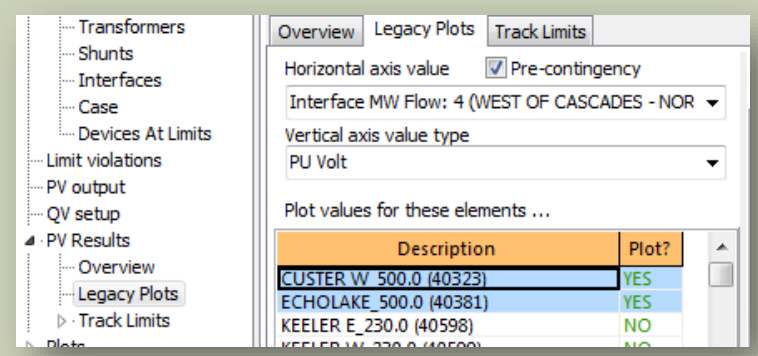


QV RESULT: LOW VOLTAGE SOLN STATE



QV .vs. PV

- PV – Find transfer limit
  - Ramp source and sink until transfers exceed supplied system reactive power - Voltage Collapse
  - Find Vstab IROLs – NOSE point
  - Find SOLs – apply margin to NOSE
  - Save case states during ramp
  - Indicates voltage collapse, but doesn't pinpoint exact collapse point
- QV – Determine reactive margins
  - Uses fictious reactive power injection at a single bus to determine how much reactive power is available to support bus voltage schedule
  - Determine where to place new reactive equipment
  - Determine what bus a voltage collapse occurs

? FURTHER DEVELOPMENT ?

- Calculate pre- to post- contingency voltage deviation at monitored buses
- Ability to define multiple SOURCE and SINK combinations
  - Specify constraints for specific SOURCE/SINK pair
- Revamp the Plot Designer Tool for scripting PV plots.
- Add “nominal KV” column to PV Results\plot\Element Description