Introduction to PowerWorld Simulator: Interface and Common Tools

I7: Power System Analysis and Voltage Control

PowerWorld Corporation

2001 South First Street
Champaign, Illinois 61820
+1 (217) 384.6330

support@powerworld.com
http://www.powerworld.com

Power Flow Analysis and Voltage Control using Simulator

- Formulation of the power flow problem
- Newton's method for solving the power flow
- Description of the **PowerWorld Simulator Options** dialog accessed from the **Options** ribbon tab, **Simulator Options** button.
- Explanation of voltage-related controls
  - generator AVR
  - transformer taps
  - switched shunts

Overall Simulator Solution Methodology

- Simulator actually uses THREE nested loops to solve the power flow
- MW Control Loop
  - Voltage Controller Loop
    - Inner Power Flow loop

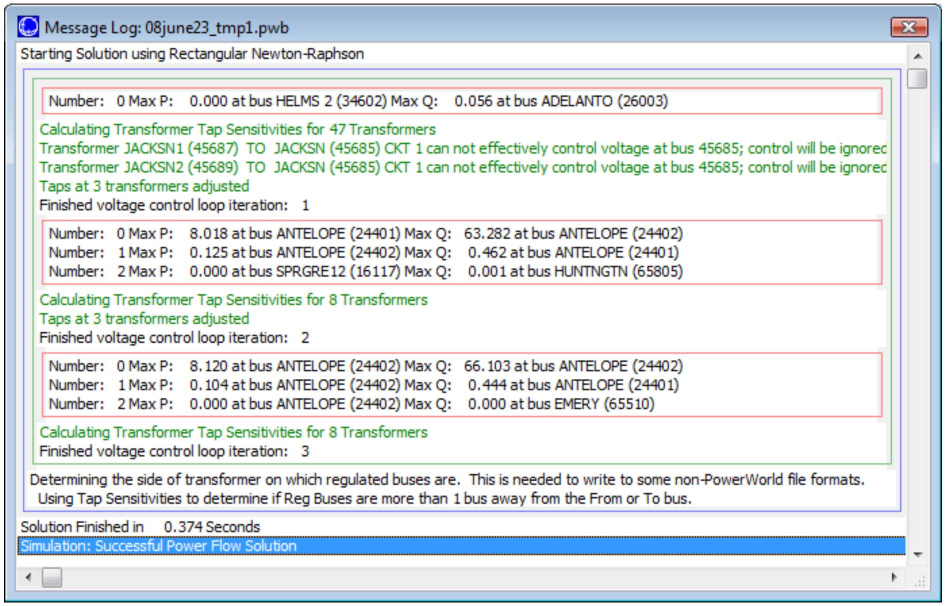
Traditionally called the *Power Flow Solution*

Voltage Control Loop also covered in this section

MW Control Loop also covered later

Overall Simulator Solution Methodology

- Colored outlines in log correspond to the loop that generates the message
- This can be helpful for tracking down the reasons for divergence
- Highlighting colors are also used to identify messages originating from other tools and add-ons (i.e., contingency analysis, OPF, ATC, etc.)



Formulation of Power Flow: “Inner Power Flow Loop”

- Goal is to solve the nonlinear power balance equations for all system buses
- For an n bus power system

  I = Ybus V

  where

  I = complex vector of current injection at all buses

  V = complex vector of voltage at all buses

  Ybus = complex n by n bus admittance matrix

Nonlinear Power Flow Equations

- Complex nonlinear power balance equations

  $S^* = V^* I$

  $S^* = V^* \, Ybus \, V$

- Convert to 2(n-1) real equations

  $S = g(x)$ or $f(x) = 0$

  where

  S = 2(n-1) power injections

  x = 2(n-1) voltage magnitudes and angles

Slack and PV Buses

- Exactly one bus in each electrical island is designated as a slack bus
  - provides an angle and voltage reference
  - must be a bus with a generator
  - voltage angle and magnitude fixed
  - real/reactive output of generator free to vary
    - Simulator tries to maintain them within limits, but if that is not possible, this generator will violate limits
- At AVR generator buses (PV buses)
  - voltage magnitude is fixed
  - reactive output of generator is free to vary
- At other buses (PQ buses)
  - Power and Reactive power injections are fixed

Solving the Power Flow Equations

- Nonlinear equations must be solved iteratively
- There are a number of common solution methods
  - Newton’s Method
    - Simulator uses an enhanced Newton’s method algorithm
  - Fast Decoupled
    - an option in Simulator
  - Gauss-Seidel
    - presently not available in Simulator

Newton's Method

Guess initial value of voltages x^0, k = 0

Repeat

While ($|f(x^k)| > \varepsilon$) and ($k < k^{max}$) Do

$x^{k+1} = x^k - [J(x^k)]^{-1} f(x^k)$

$k = k + 1$

End While

Until (no more automatic control changes)

Newton's Method

Where

k	=	Iteration count
k^{max}	=	Maximum number of iterations
x^k	=	Voltages at the k^{th} iteration
$f(x^k)$	=	Mismatch equations
ε	=	Convergence tolerance (in MVA)
$J(x^k)$	=	Jacobian matrix

Seven Bus Example

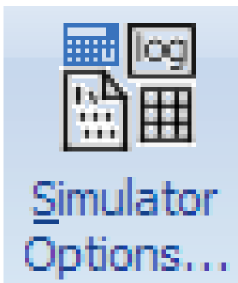
- Open case B7FLAT.PWB, switch into Run Mode and make sure Message Log visible.
- To view initial mismatches, go to the **Case Information** ribbon tab and select **Model Explorer**. In the **Network** category select **Mismatches**. All mismatches are initially less than 0.1 MVA.
- Open line from bus 2 to bus 5; refresh the mismatches. There are now large values at buses 2 and 5. Solve the case.

Power Flow Solution

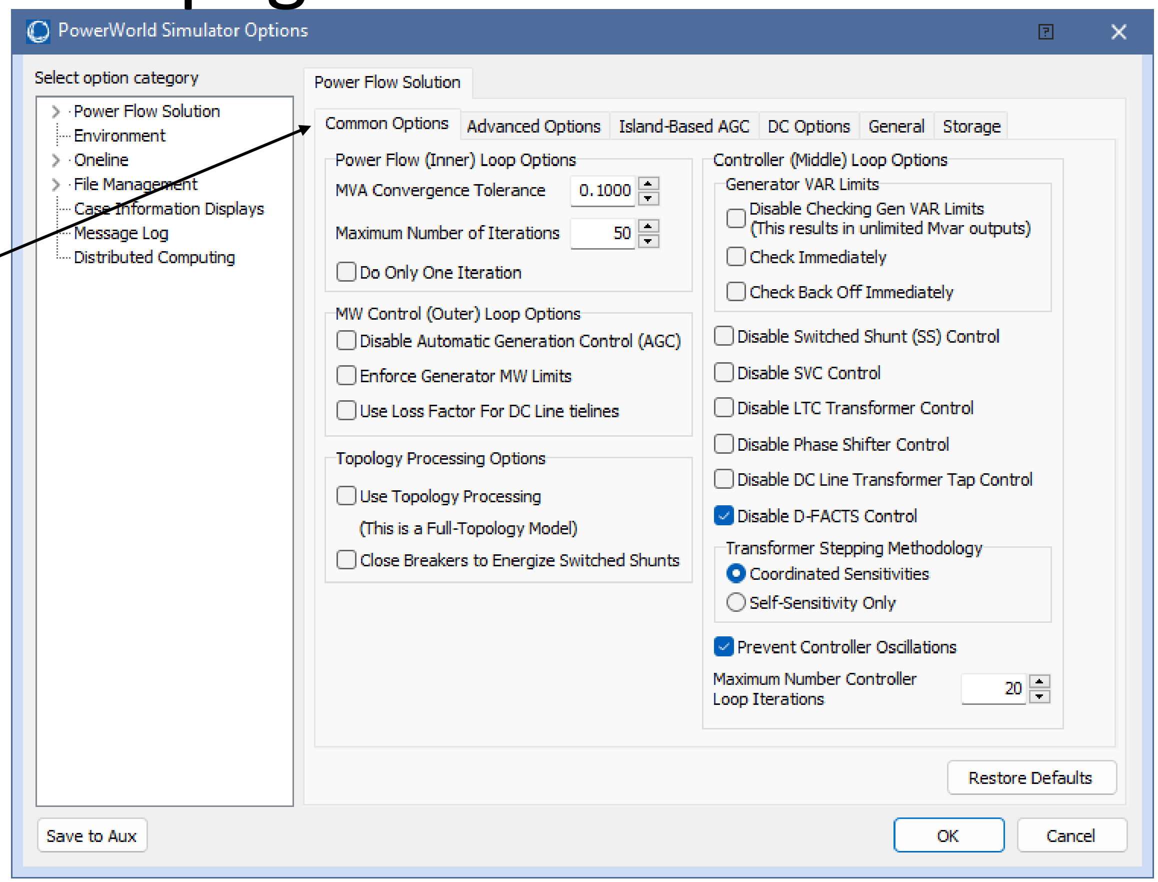
- Go to the **Tools** ribbon tab and select **Solve Power Flow** to resolve the power flow equations
- Refresh the mismatch display; notice that mismatches are again less than 0.1 MVA.
- Notice that voltage magnitude has remained fixed at the generator buses. This is because they are being modeled as PV buses.

Simulator Options: Power Flow Solution Page

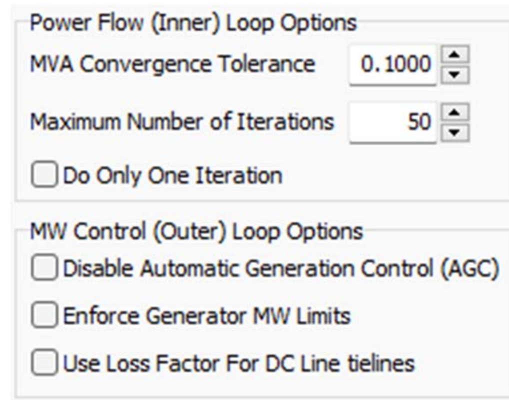
- To customize the power flow solution, go to the **Options** ribbon tab and select **Simulator Options →Power Flow Solution** page



This will open to the Common Options tab by default

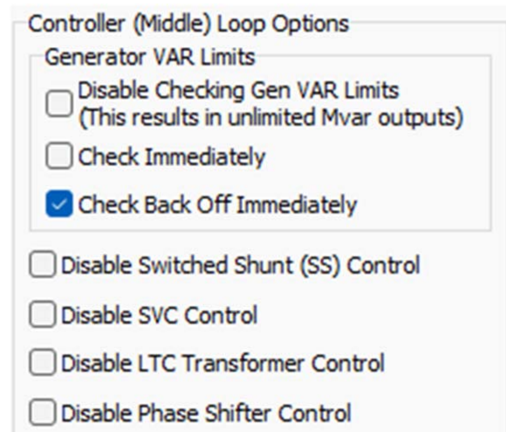


Simulator Options: Power Flow Solution Page



- Common Options Tab
  - MVA Convergence Tolerance
    - Tolerance for the Inner Power Flow Loop
    - Must be larger than zero
  - Maximum Number of Iterations
    - the maximum iterations for the inner power flow loop
  - Do only one iteration
    - Same as setting Maximum Number of Iterations to 1.
  - Disable Automatic Generation Control (AGC) disables enforcement of MW interchange for entire case,
  - Unchecking Enforce Generator MW Limits means generator MW limits are not enforced
  - Use Loss Factor for DC Line tielines uses the aLoss factor for two-terminal DC lines when calculating MW metering flows in area interchange calculations

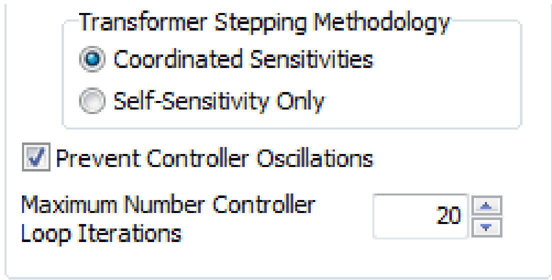
Simulator Options: Power Flow Solution Page



- Common Options Tab
  - Generator VAR Limits
    - Disable Checking means generator MVAR limits are not enforced
    - Check immediately means that MVAR limits are checked in the inner power flow loop
    - Check Back Off Immediately means that generators are allowed to switch from being off control at limits to being on control in the inner power flow loop (switch from PQ to PV)
  - Disable Classes of Power and Impedance Controls (global settings that disable all such devices in case)
    - Switched Shunt (SS)
    - SVC (switched shunt devices on SVC control mode)
    - LTC Transformer
    - Phase Shifter
    - DC Line Transformer Tap Control
    - D-FACTS (distributed FACTS devices that control effective transmission line impedance)

Simulator Options: Power Flow Solution Page

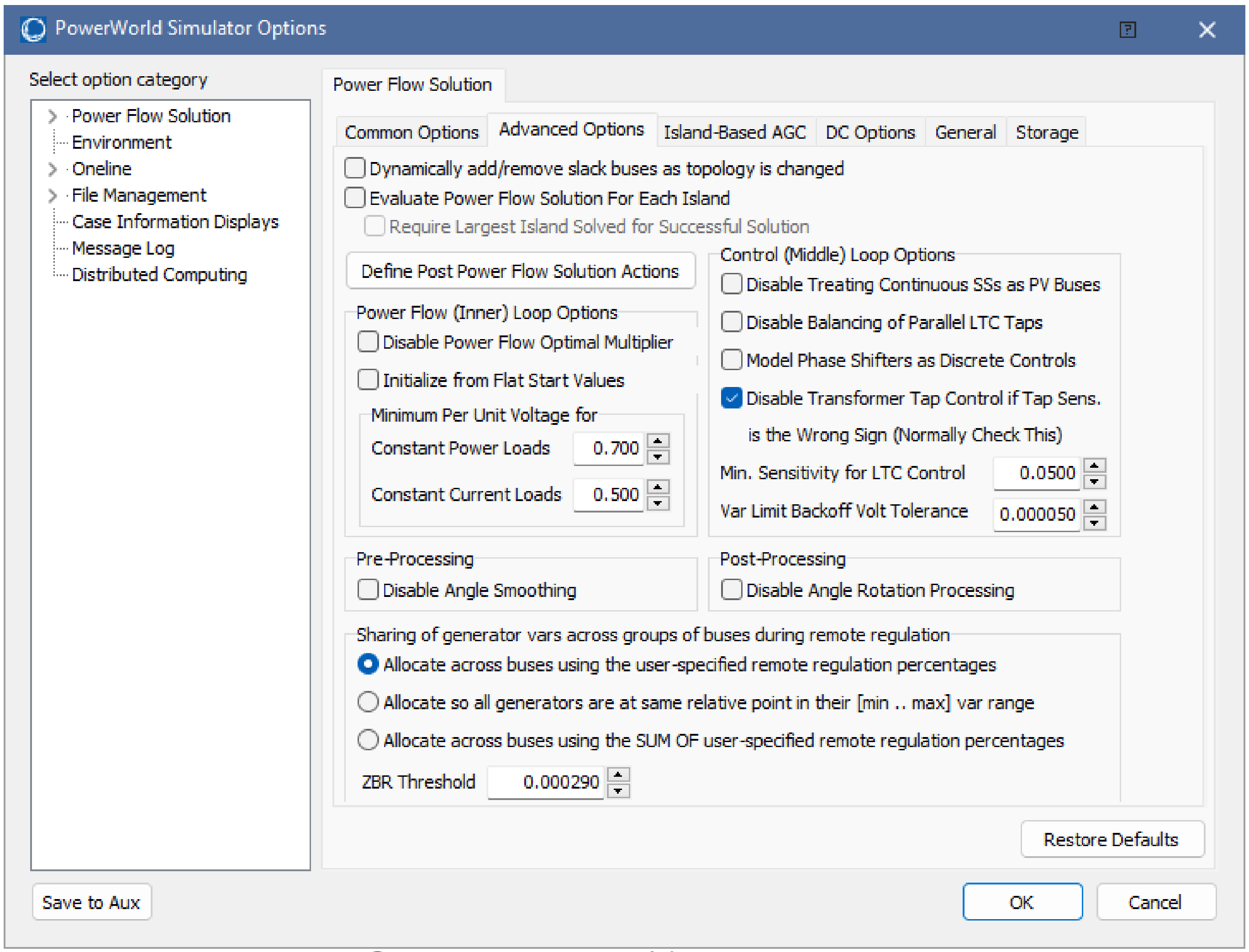
- Common Options Tab
  - Transformer Stepping Methodology
    - *Coordinated Sensitivities* looks at all transformers that are out-of-range and coordinates the movement to bring all back within regulation range
    - *Self-Sensitivity Only* looks at each transformer individually and determines the sensitivity of its regulated value with respect to changing its own tap or phase only
    - Note: If more than 50 transformers are involved, Simulator always uses *Self-Sensitivity Only*
  - Prevent Controller Oscillations
    - keeps controlled devices from continually switching between two control states for the entire case
  - Maximum Number of Controller Loop Iterations
    - The voltage control loop will be limited to this many iterations



Covered in More Detail in other Courses

Simulator Options: Power Flow Solution Page

- Advanced Options Tab



Covered in More Detail in other Courses

Simulator Options: Power Flow Solution Page

- Advanced Options Tab
  - Dynamically add/remove slack buses as topology is changed (Allow Multiple Islands)
    - If a single island is split into two islands (by opening lines), then a new slack bus is chosen (usually generator with the largest MW limit that regulates terminal bus)
  - Evaluate Power Flow Solution for Each Island
    - A partial solution can result if some islands solve and others do not
  - Require Largest Island Solved for Successful Solution
    - Island with the most buses must solve or the entire solution will be reported as unsolved
  - Post Power Flow Solution Actions
    - Allow you to define a list of conditional actions (much like a contingency definition) which occur at the end of *EVERY* power flow solution.
    - An example would be loads that are automatically taken out of service when the voltage drops too low.

Covered in More Detail in other Courses

Simulator Options: Power Flow Solution Page

- Advanced Options Tab
  - Disable Power Flow Optimal Multiplier
    - The optimal multiplier is a mathematically calculated step size for Newton's Method that prevents the mismatch equations from increasing between iterations.
  - Initialize From Flat Start Values always starts power flow solutions with voltages at 1.0 per unit and angles equal to the slack bus angle (not recommended)
  - Minimum Per Unit Voltage for Constant Power Loads and Constant Current Loads
    - At voltages less than the defined values, the constant power and constant current loads will be reduced
    - To disable either of these features, set the values to 0

Covered in More Detail in other Courses

Simulator Options: Power Flow Solution Page

- Advanced Options Tab
  - Disable Treating Continuous SSs as PV Buses
    - Continuous switched shunts are normally treated as buses with fixed power and voltage inside the inner power flow loop.
  - Disable Balancing of Parallel LTC taps
    - Parallel LTC taps normally have their tap values synchronized to prevent circulating Var flow.
  - Model Phase Shifters as Discrete Controls
    - Phase shifters will switch tap positions discretely based on the tap step size
  - Min. Sensitivity for LTC Control
    - Transformers with a sensitivity lower than this will be disabled.

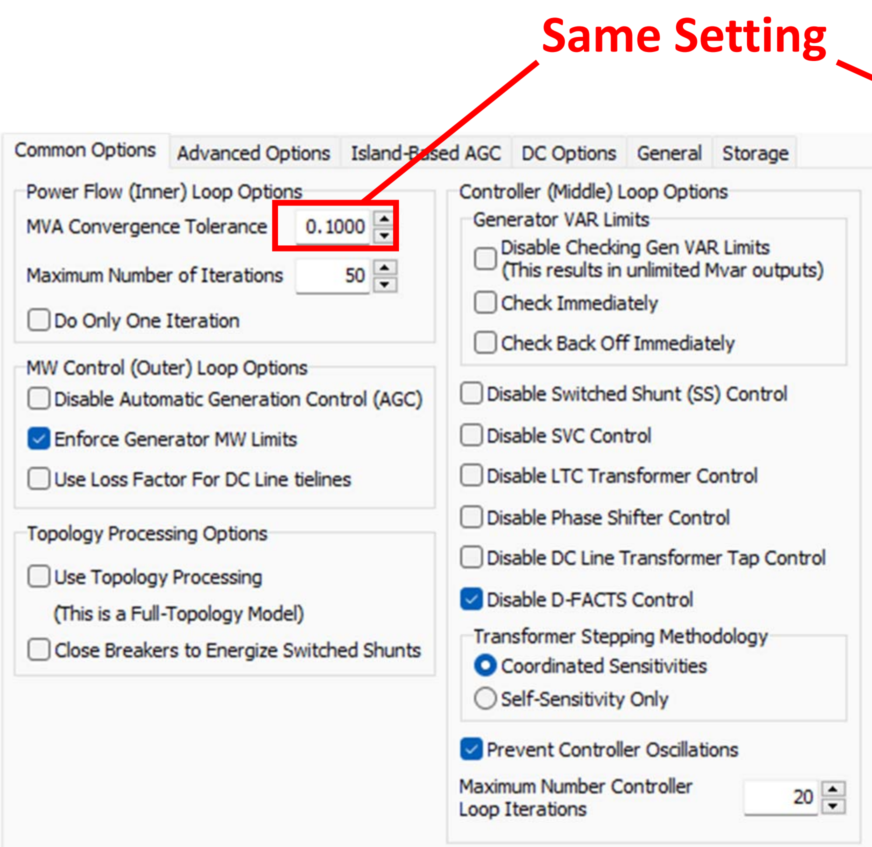
Covered in More Detail in other Courses

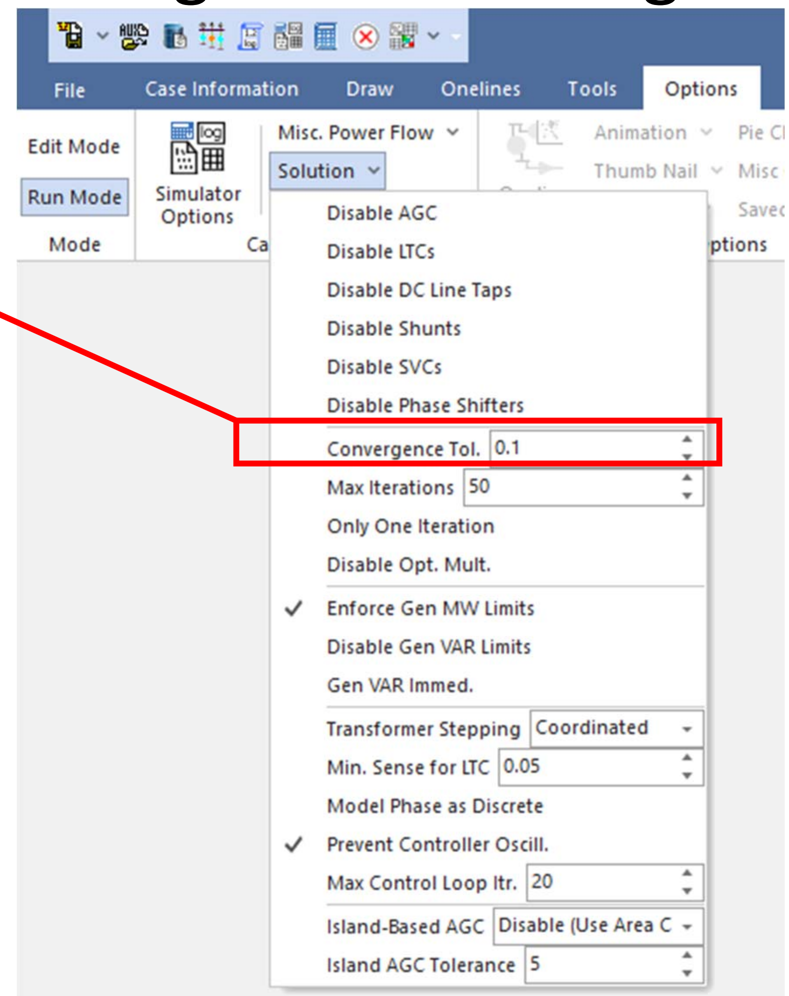
Simulator Options: Power Flow Solution Page

- Advanced Options Tab
  - Disable Angle Rotation Processing
    - Voltage angles are rotated so that the angle range in an island is equally spaced around zero degrees if any angles fall outside +/- 160 degrees
  - Sharing of generator vars across groups of buses
    - Allocate across buses using the user-specified remote regulation percentages
    - Allocate so all generators are at same relative point in their [min..max] var range
    - Allocate across buses using the SUM OF user-specified remote regulation percentages
  - Options for Areas on Economic Dispatch
    - Include Loss Penalty Factors in ED will consider losses in determining the dispatch
    - Enforce Convex Cost Curves in ED will turn units that are operating outside the convex portion of their cost curve off automatic control

Solution Options Toolbar

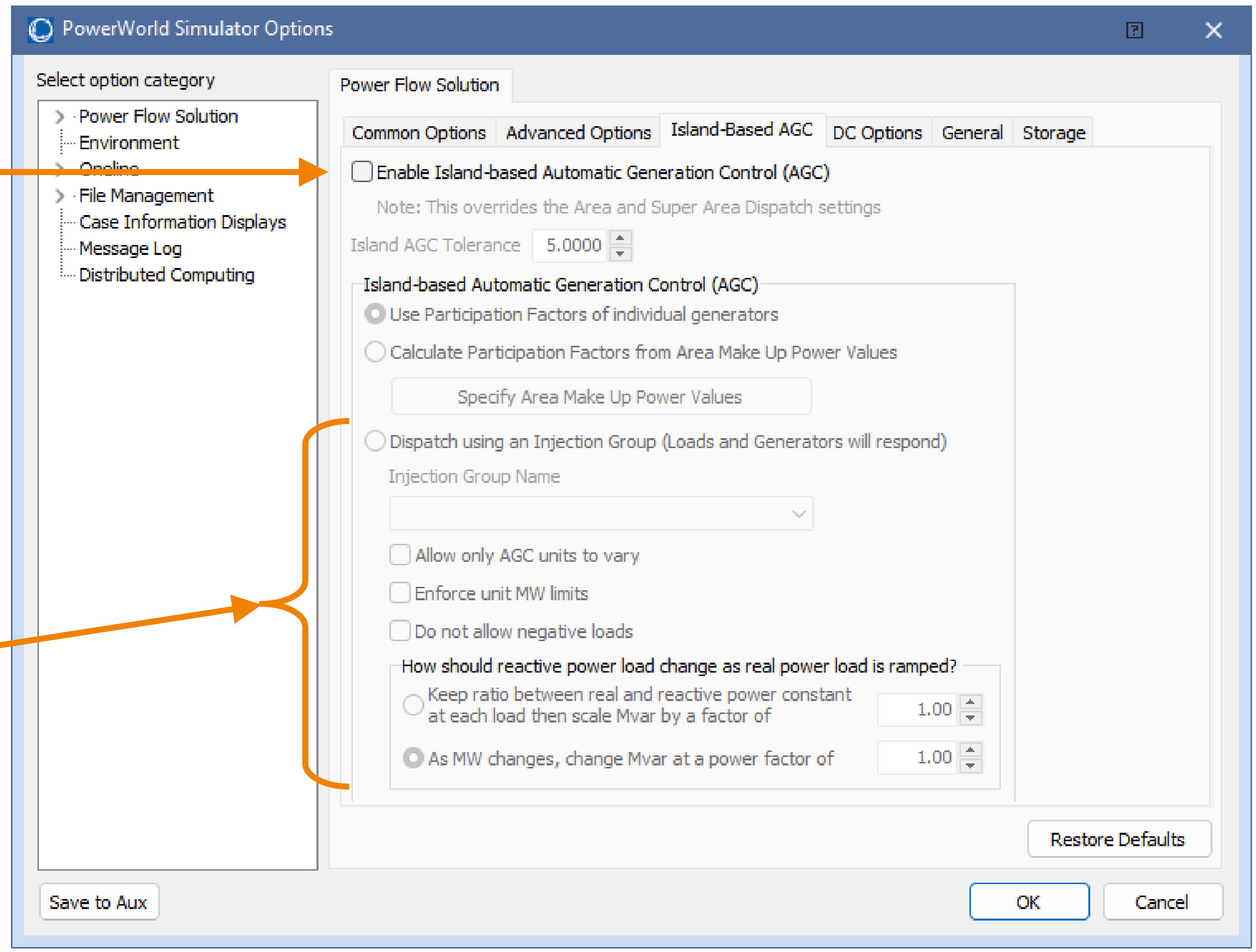
- Select the **Solution** button on the **Case Options** ribbon group. Note that most of the settings on the dialog are available.





Simulator Options: Power Flow Solution Page

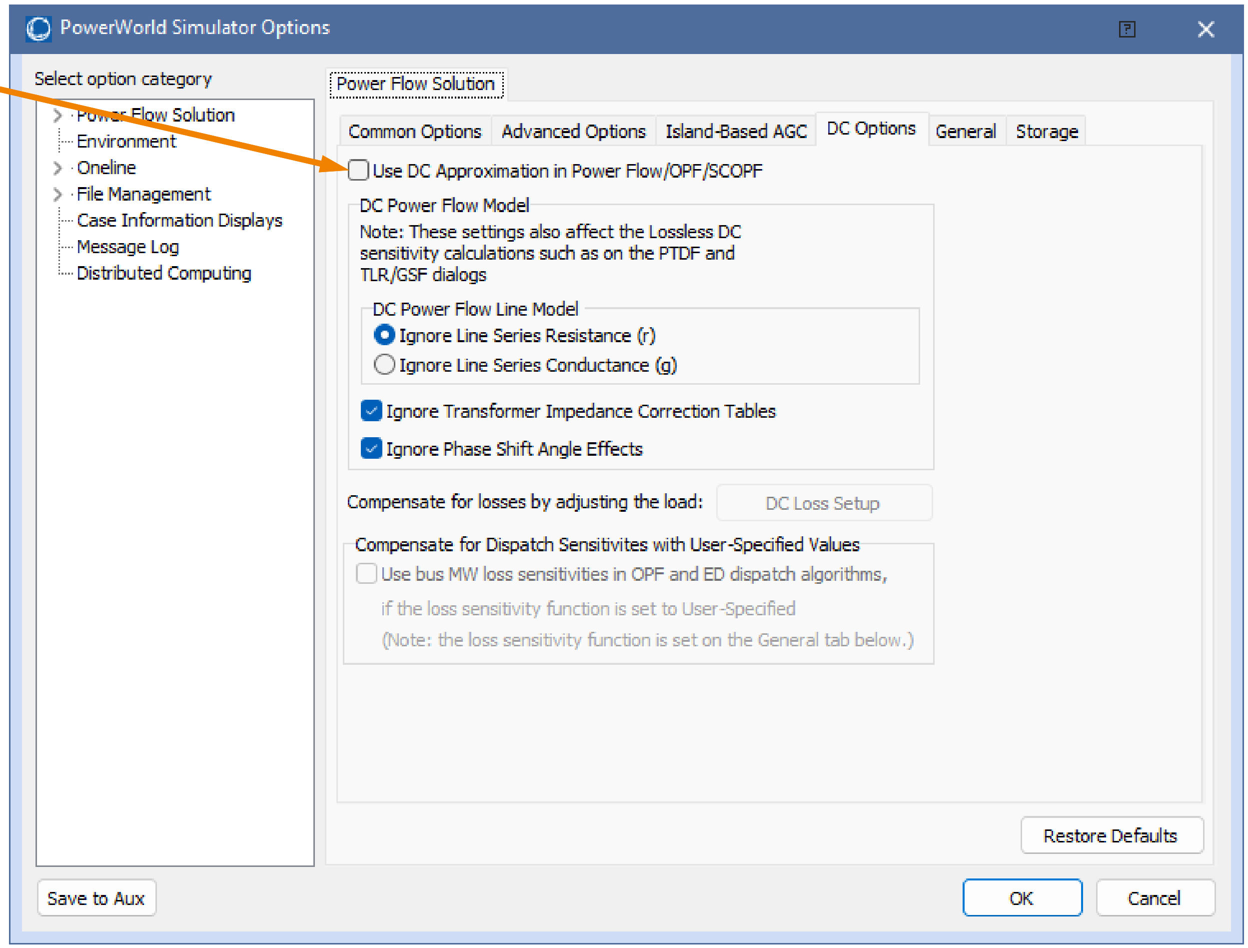
- Island-Based AGC Tab
  - Allow load and generation balancing across an island, instead of Areas or Super Areas



Options used for Injection Group Dispatch

Simulator Options: Power Flow Solution Page

- DC Options Tab
  - Use DC Approx. in Power Flow/OPF/SCOPF
    - Check this box to model the system using a DC power flow.



Note: Once you convert a large system to a DC power flow, it is very difficult to get the AC system to resolve.

Simulator Options: Power Flow Solution Page

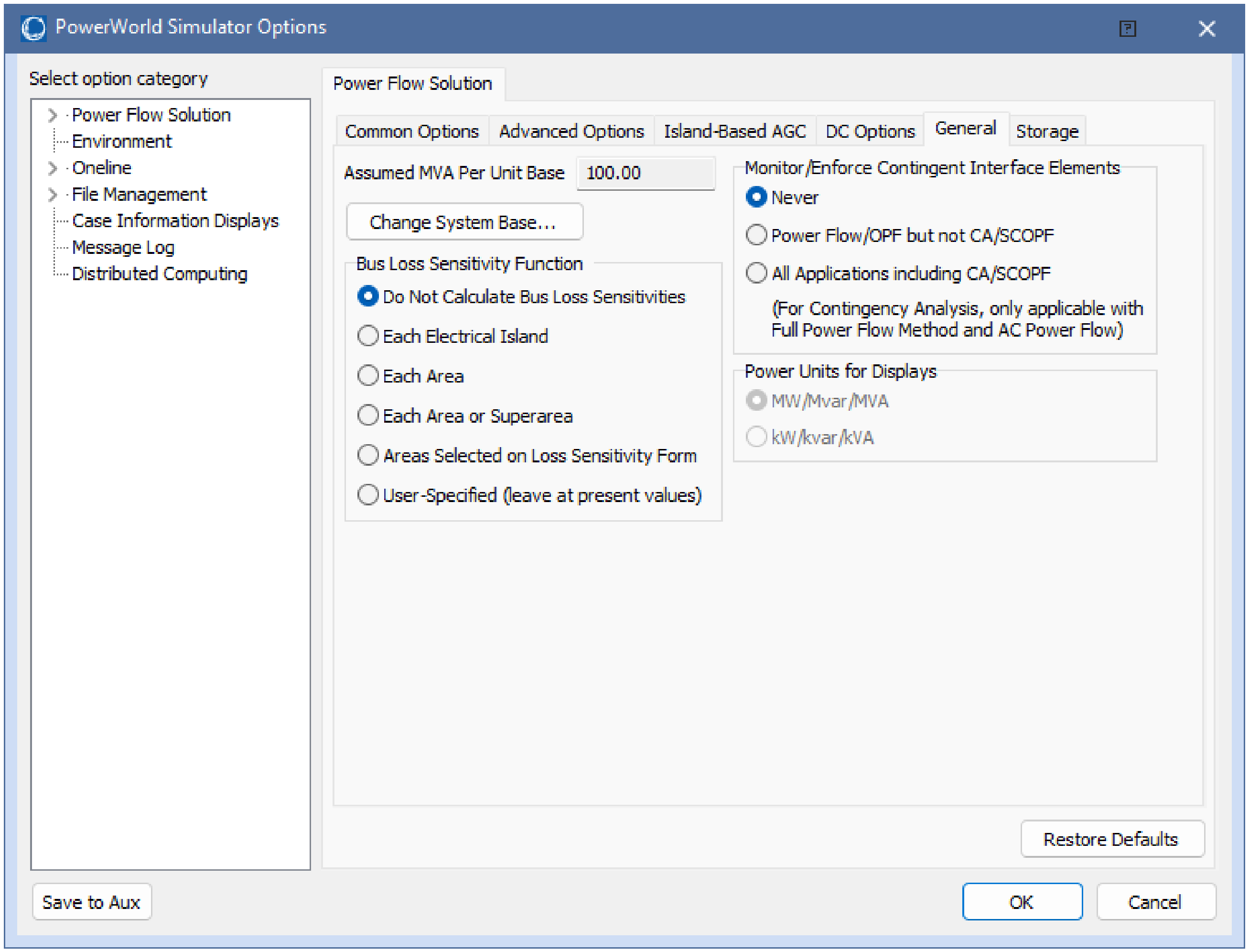
- DC Options Tab
  - Compensate for Losses by Adjusting the Load
    - Specify a load multiplier at each bus. When solving the DC power, Simulator will artificially increase loads by this multiplier
  - Compensate for Dispatch Sensitivities with User-Specified Values
    - Allows you to make use of loss sensitivities even in the DC power flow

Simulator Options: Power Flow Solution Page

- DC Options Tab
  - DC Power Flow Model
    - Ignore Line Series Resistance (r)
      - b = -1/x, g = 0
    - Ignore Line Series Conductance (g)
      - b = -x/(r2+x2), g = 0
    - Ignore Transformer Impedance Correction Tables and Ignore Phase Shift Angle Effects (default is to ignore)
      - Impedance correction tends to increase impedance and phase shift effects tend to decrease impedance
      - By not ignoring, DC equations become a function of the system state and removes some of the advantages of the DC approximation

Simulator Options: Power Flow Solution Page

- General Tab

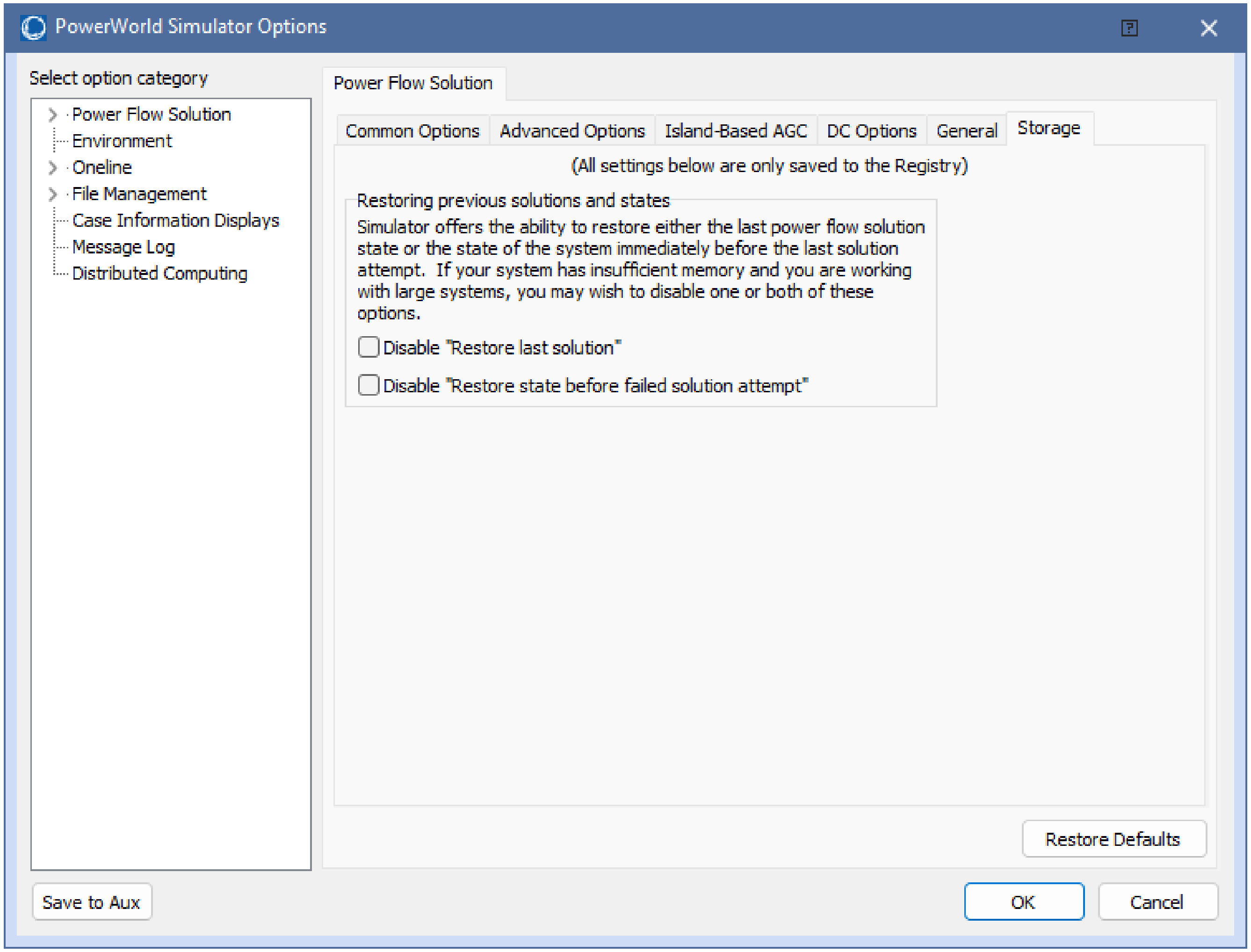


Simulator Options: Power Flow Solution Page

- General Tab
  - Assumed MVA Per Unit Base
    - MVA base used for the entire case
    - Default is 100 MVA
  - Monitor/Enforce Contingent Interface Elements
    - Determine when the impact of contingent interface elements should be calculated
  - Bus Loss Sensitivity Function
    - Discussed when we go over sensitivities in the Sensitivity Training section

Simulator Options: Power Flow Solution Page

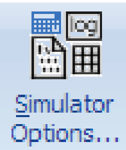
- Storage Tab



Islands - Defined

- Often, a power system consists of a single interconnected system operating in synchronism
- However sometimes multiple systems exist that are either unconnected, or connected only through DC transmission lines.
- Such systems operate asynchronous with one another and are called “Islands”.
- Each island must have a slack bus. Check Allow Multiple Islands.

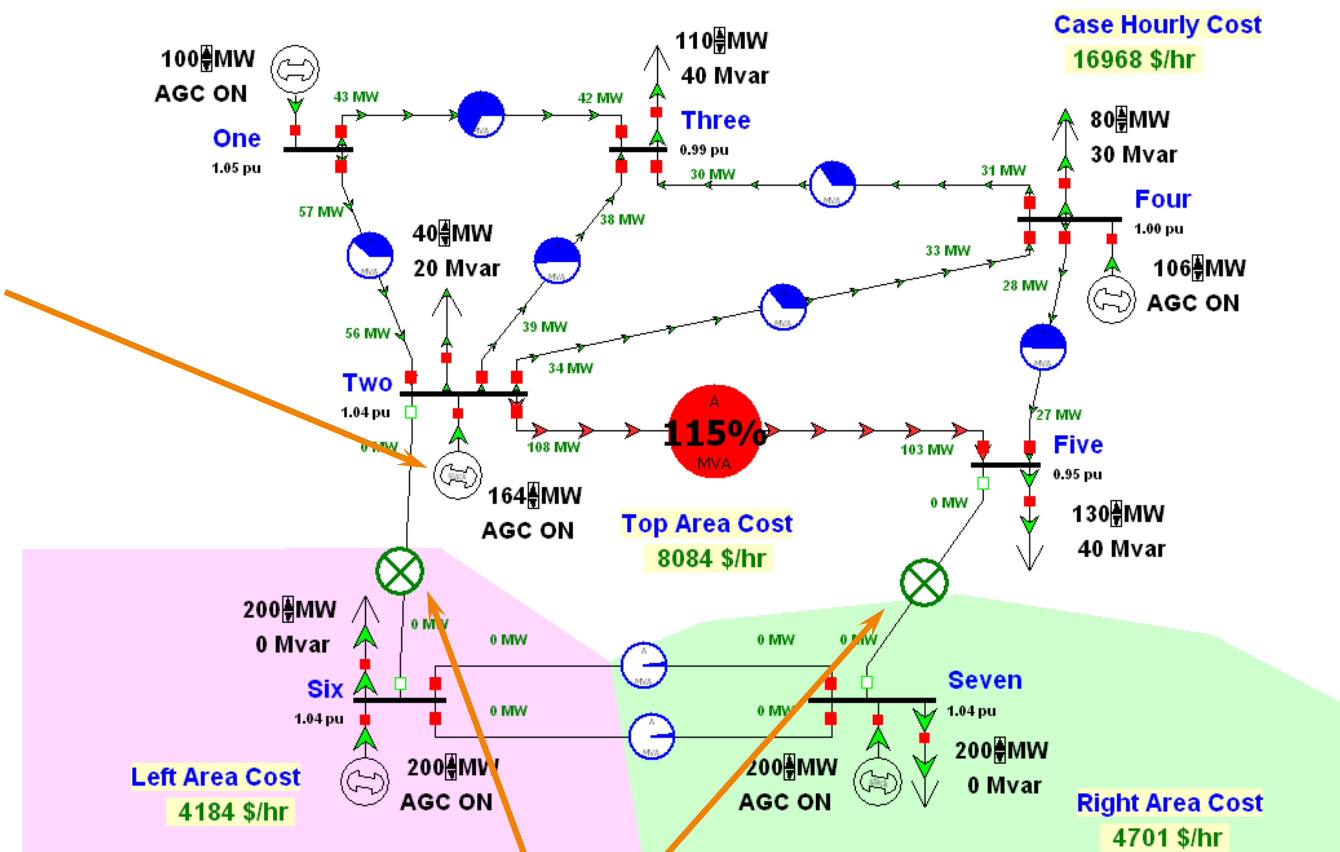
Multiple Islands in Simulator



- Go to the **Options** ribbon tab → **Simulator Options** → **Power Flow Solution** → **Advanced Options** tab
  - Check **Dynamically add/remove slack buses as topology is changed**
- On the B7FLAT case, the slack bus is 7.
- To create two islands, open lines 2-6 and 5-7.
- If new island does not have a slack, Simulator automatically chooses largest generator
- Repeat with **Dynamically add/remove…** unchecked

Case with Multiple Islands

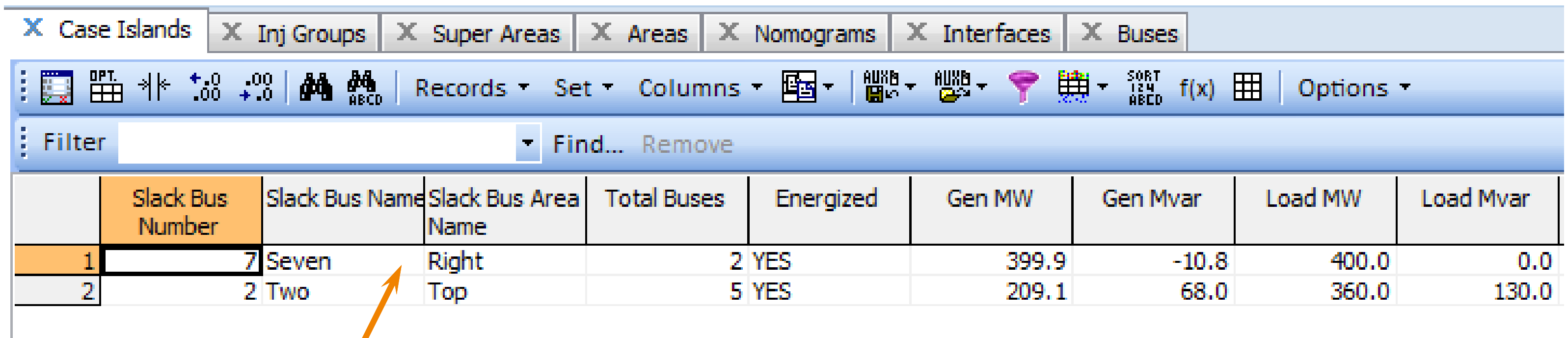
Simulator has auto-matically chosen bus 2 as the slack.



Open tie-lines

Simulator is modeling the two Systems independently

Island Records Display

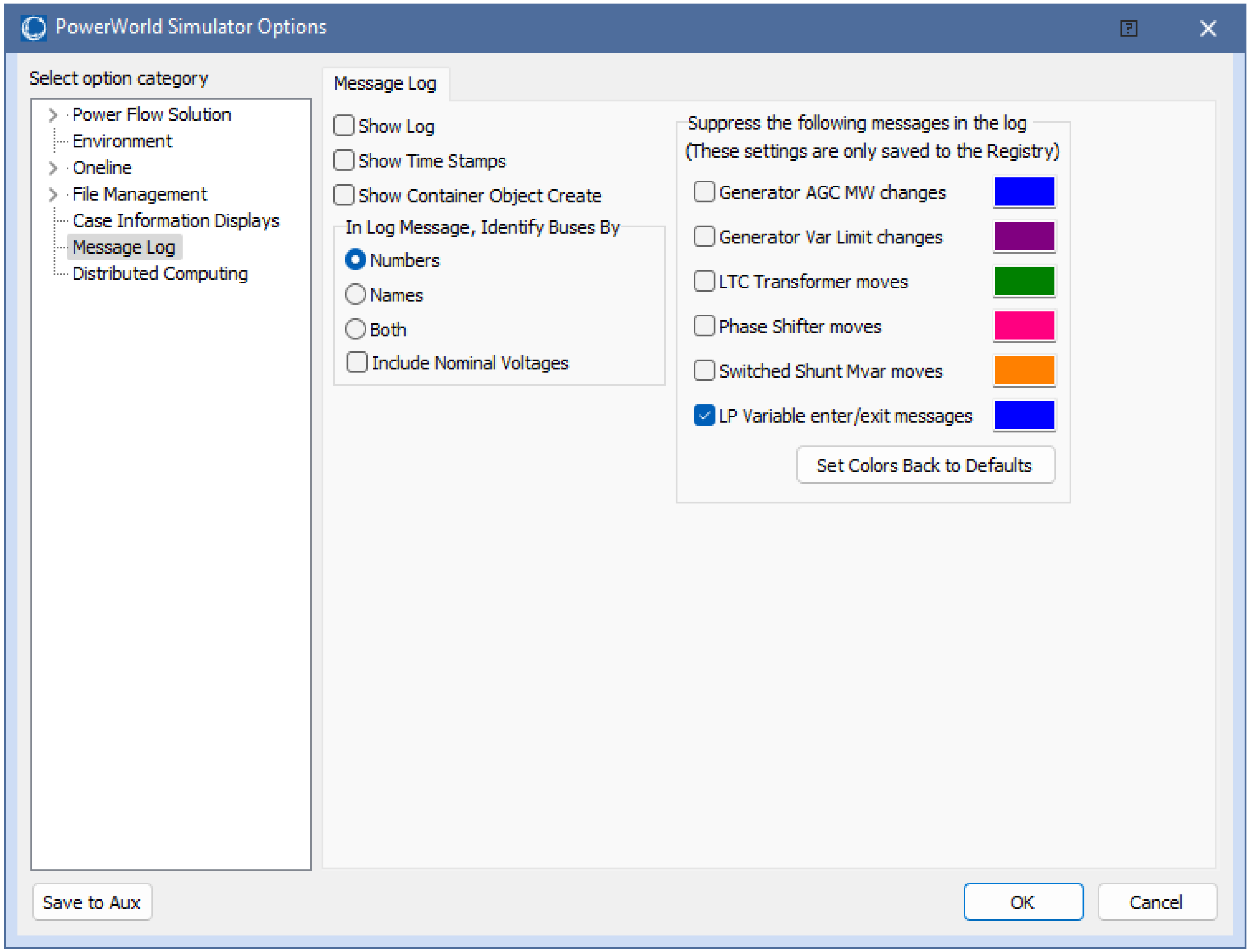


Model Explorer →Aggregations → Island Records shows information about each island in the case, including its slack bus.

It is not uncommon to have multiple islands. Often cases in the the Eastern United States have five islands

Simulator Options: Message Log Page

- Customize message log notation, contents, and appearance



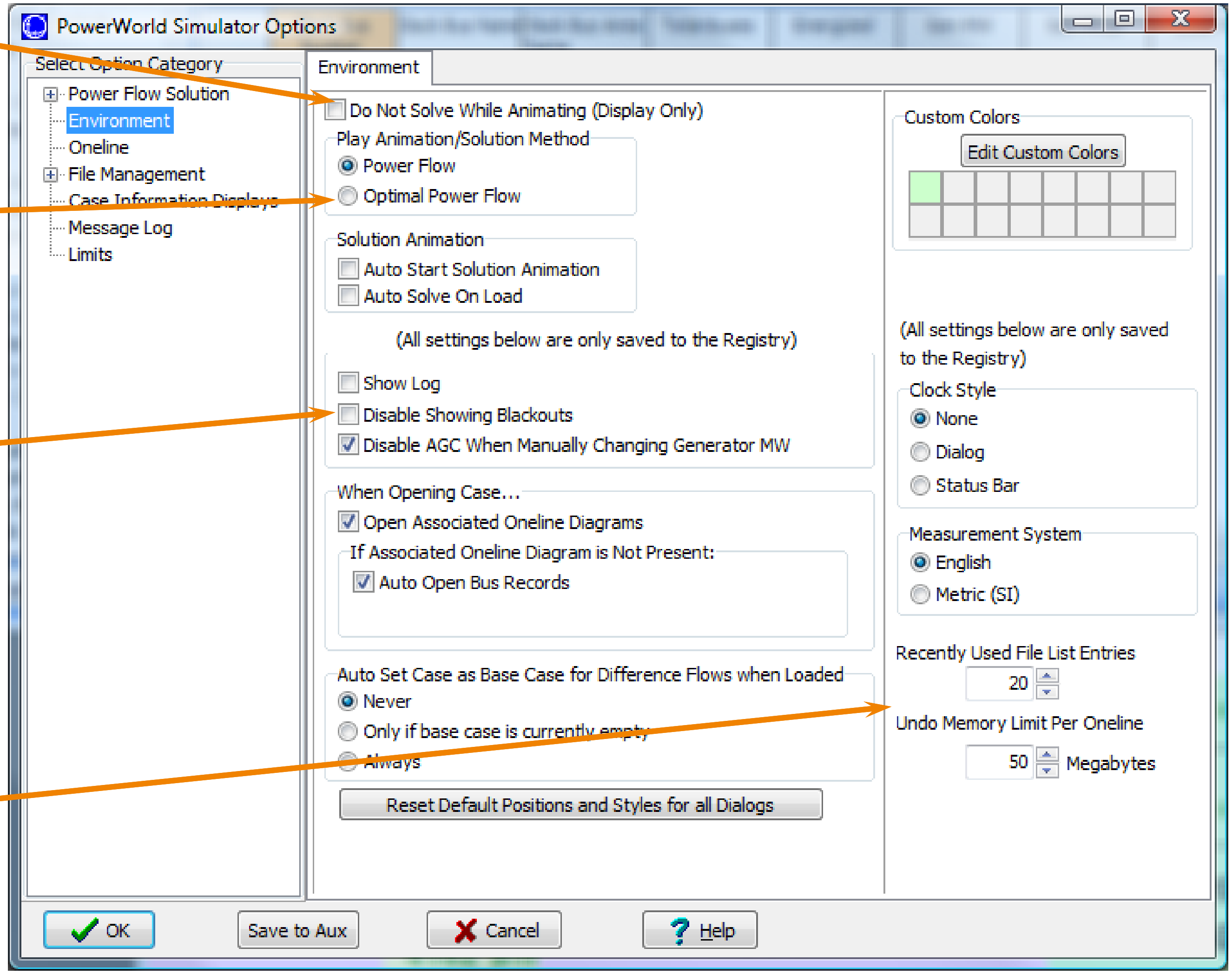
Simulator Options: Environment Page

Display only; no simulation

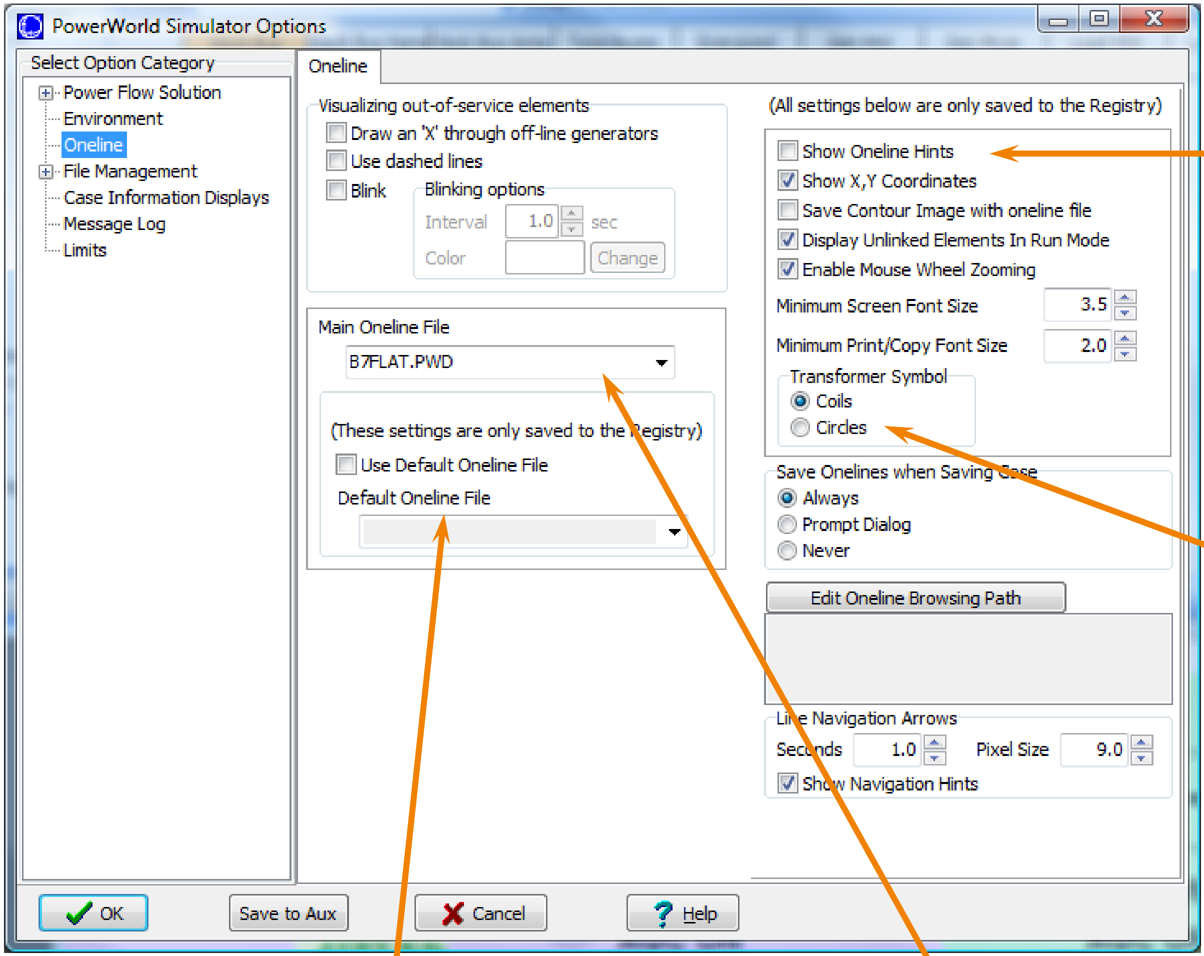
Solution method when animating

Can have "Blackout" appear if case does not converge

Memory limit for Oneline Undo feature



Simulator Options: Oneline Page



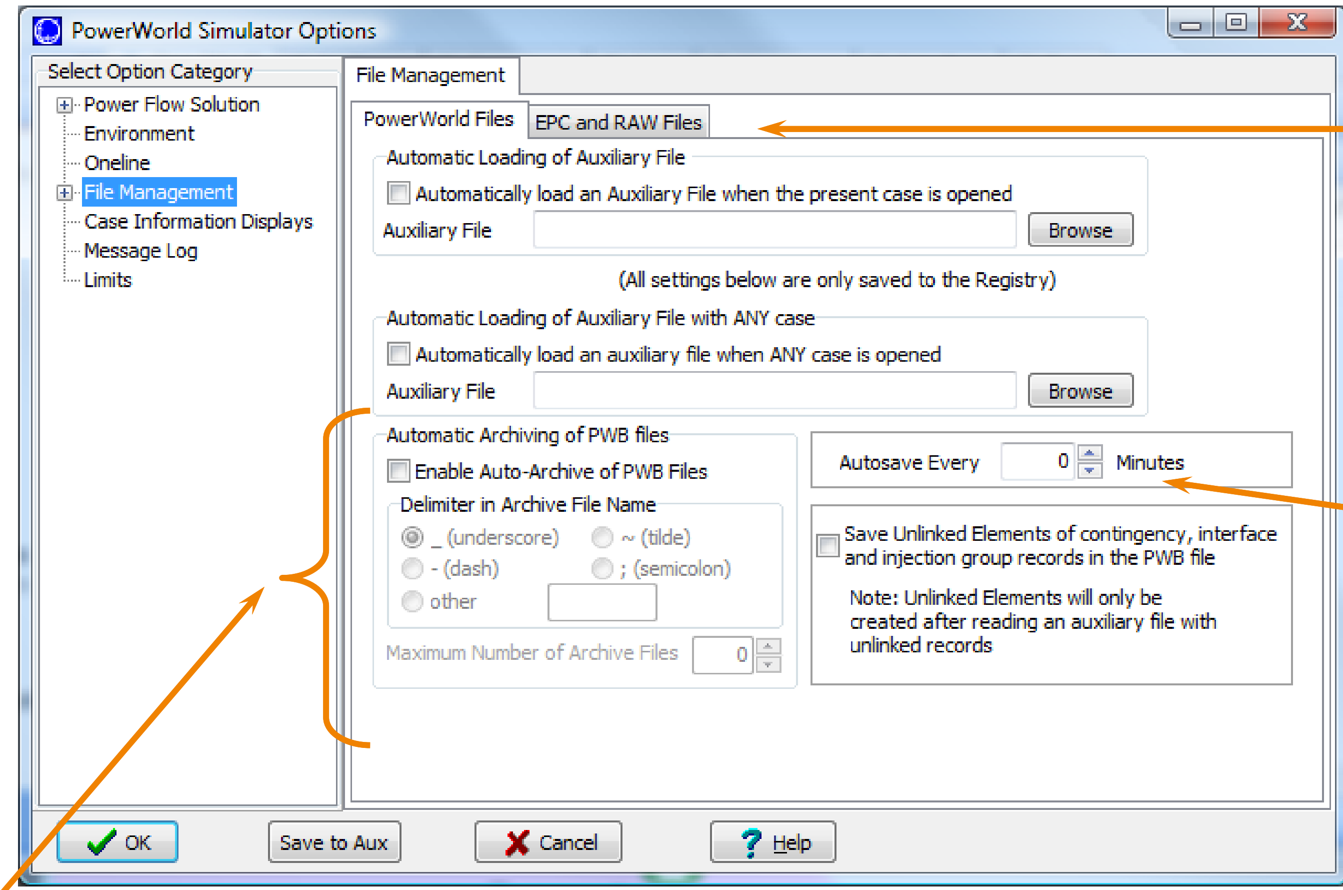
Shows hints when cursor over element

Non-US style XFR symbols

Name of default oneline file to open for ALL cases

Name of main oneline file for CURRENT case

Simulator Options: File Manage Page



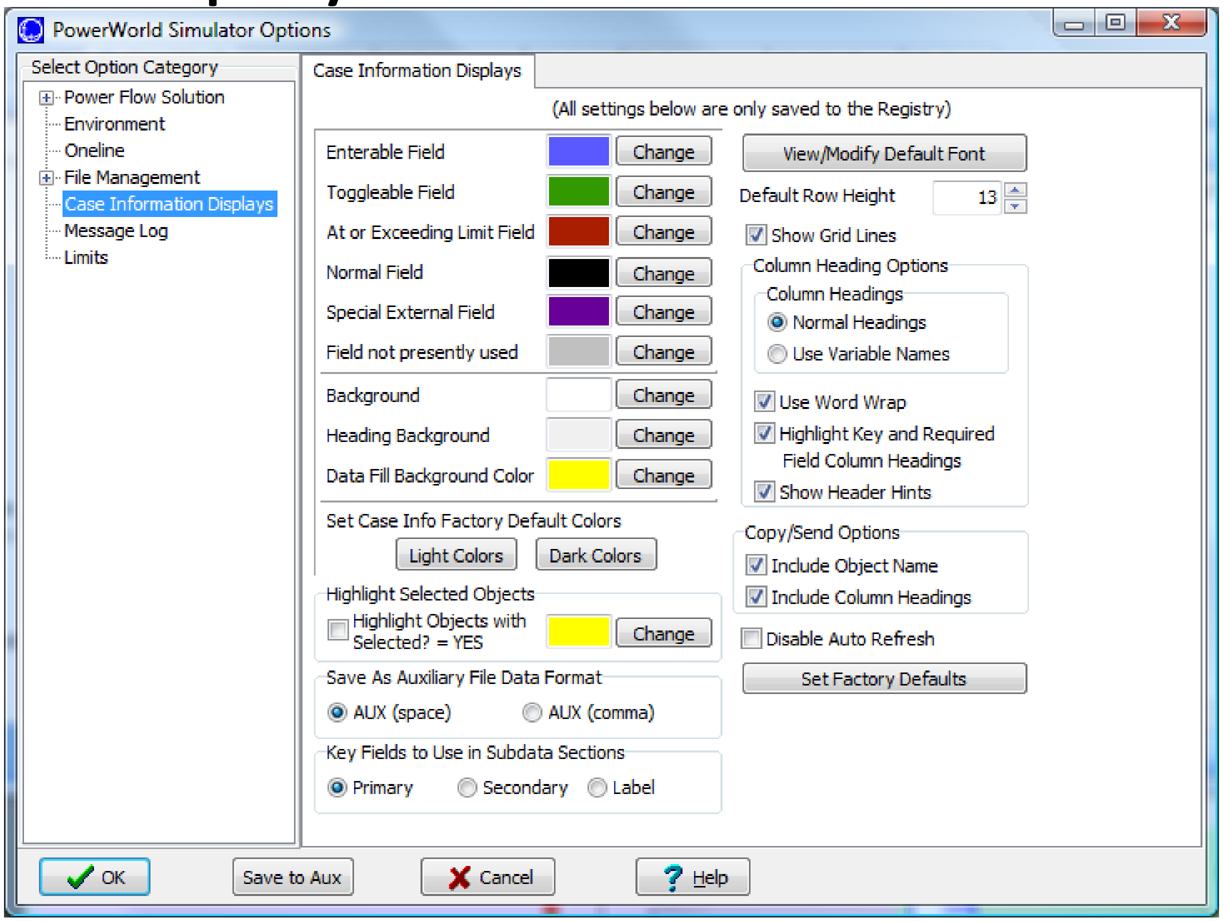
Special options tab for EPC and RAW files

Automatically save over current PWB. “0” means do not Autosave

Enables previously saved PWB files to be automatically archived each time the file is saved with the same name

Simulator Options: Case Information Displays

- This was covered in an earlier section on Case Information Displays



Generator AVR

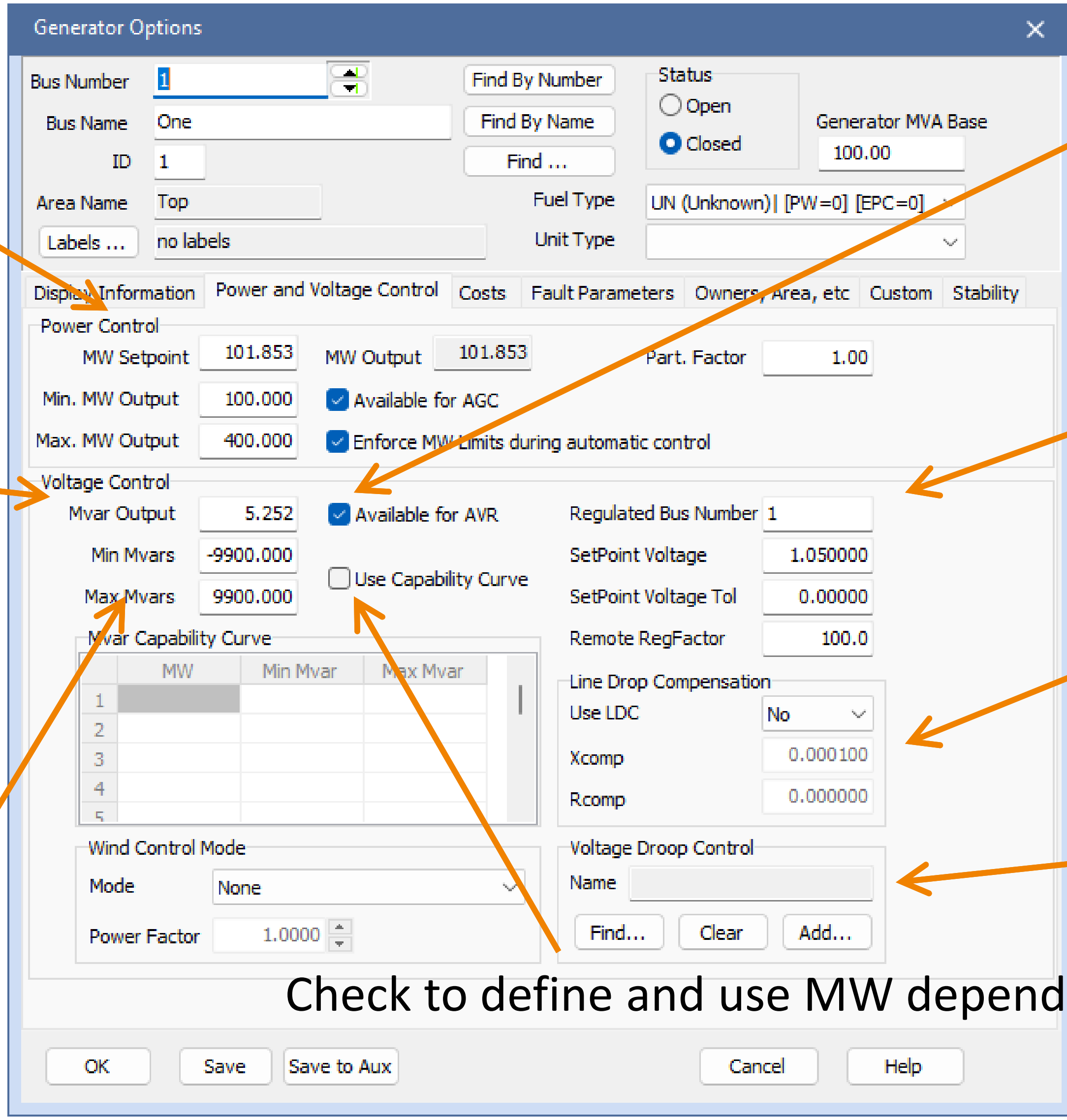
- Generator AVR is integrated directly into the power flow equations. (AVR creates “PV buses”)
- Generators on AVR maintain a fixed voltage magnitude at the regulated bus, provided reactive power output is within limits.
- To change options, right-click on generator symbol and select Information Dialog.

Generator Dialog (Edit Mode)

MW Control will be discussed later

Present reactive power output

Fixed reactive power limits if capability curve is not used



If not checked then Mvar output is fixed

Regulated Bus and voltage regulation parameters

Line Drop Compensation Options

Droop Control Scheme (not used if blank)

Check to define and use MW dependent capability curve

Remote Regulation and Var Sharing

- You may specify a regulated bus number that is not the terminal bus (commonly called “remote” regulation)
- Multiple generators may regulate the same bus
  - Generators at different buses will share the total Var requirement according to the option selected for sharing vars across groups of buses (Advanced Options Tab of Power Flow Solution Page)
  - Generators at the same bus will coordinate Var outputs so they are within the same relative location inside their Var range
  - Generators can share at the same bus and remotely regulate at the same time. In this case the “regulation percentage” refers to all the generators at the bus

Defining Reactive Capability Curve

- To use a reactive capability curve, on the Generator Dialog, check **Use Capability Curve**.
- Then use table to edit the curve. Right-click on a column of table (a point on the curve) to either
  - **insert** a new point (table column)
  - **delete** an existing point (table column)

Reactive Capability Curve

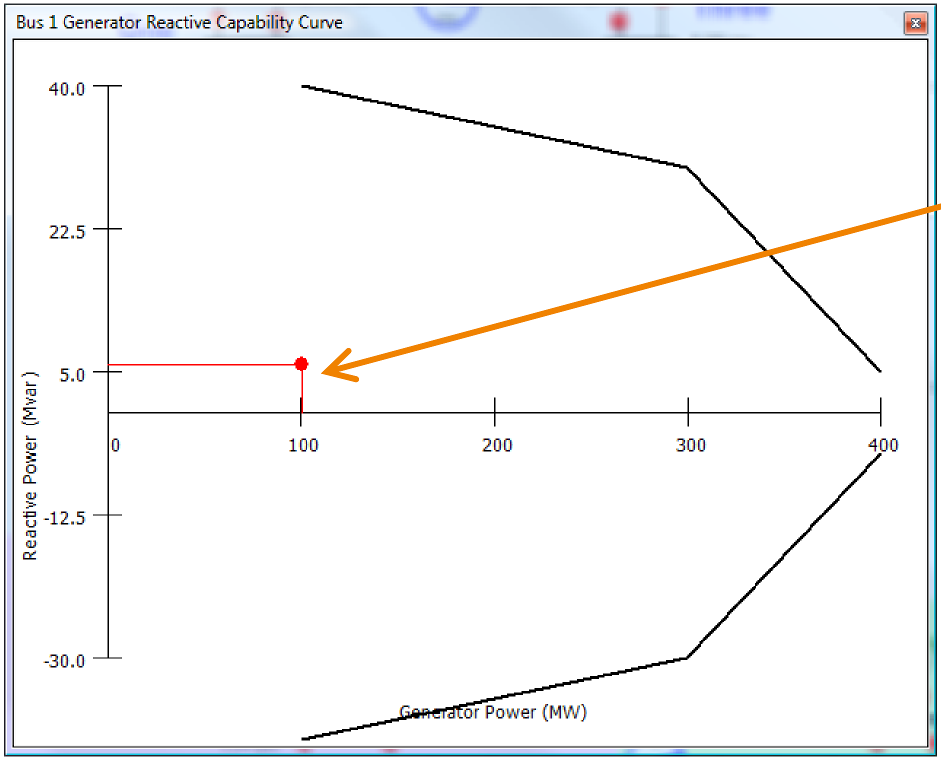
- Enter the following capability curve

MW	100.0	300.0	400.0
Min Mvar	-40.0	-30.0	-5.0
Max Mvar	40.0	30.0	5.0

- You can view a graph of the reactive capability curve by selecting **Reactive Capability Curve** from the generator menu.

Capability Curve Graph

Right-click on generator to view its local-menu



Current MW and Mvar operating point of the generator

Start the simulation, and then use the spin button to the right of the generator to change the MW output of the generator. Notice how the operating point on the graph changes.

Saving Reactive Capability in Text File

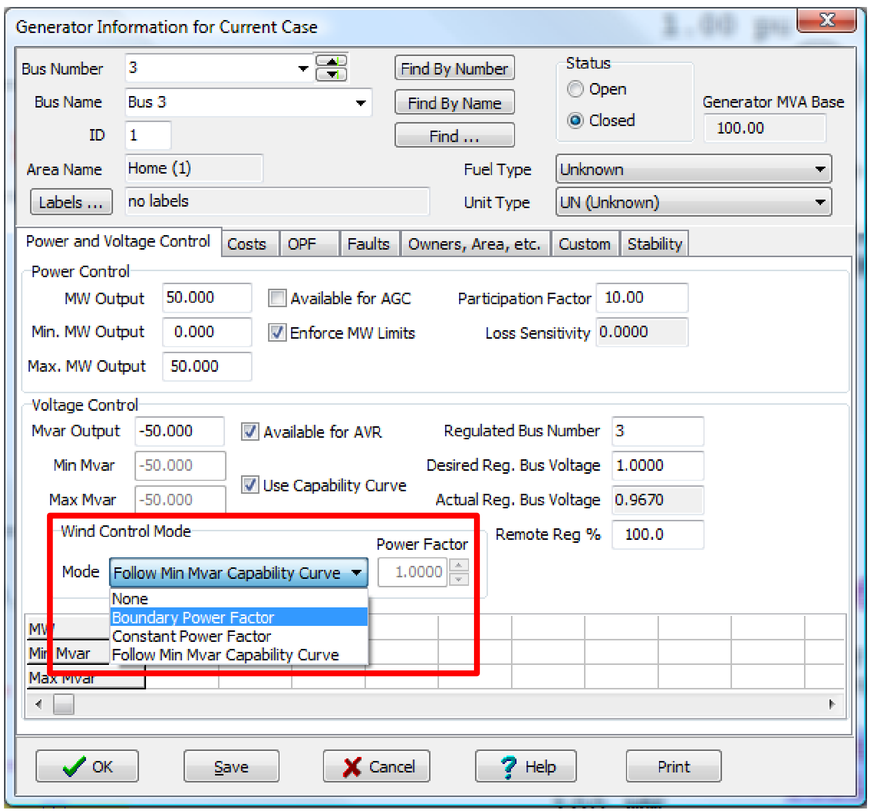
- All power system data, including the generator reactive capability curve, is saved in PowerWorld Binary format (*.pwb) files
- Reactive capability curve data is not saved in most text-based power flow formats, such as PTI RAW or GE EPC files.
- Simulator provides the ability to save this data in text files for easy transfer between cases.

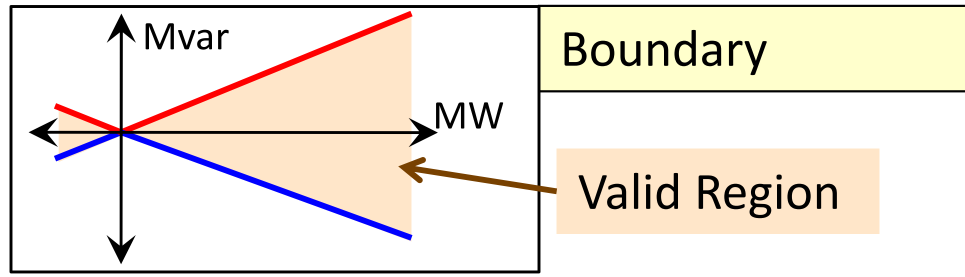
Saving in Text Files

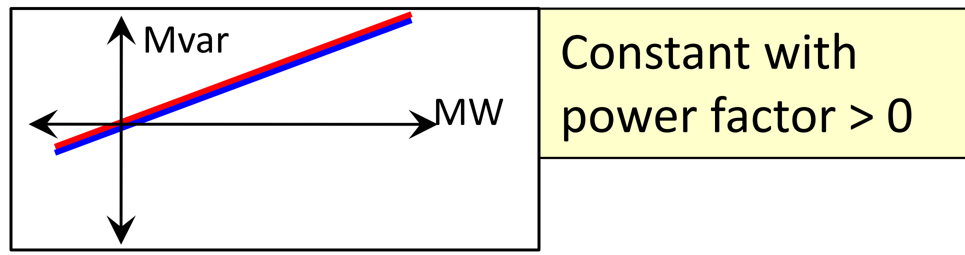
- To save reactive capability data in a text (aux) file
  - Go to the **Model Explorer → Network → Generators**
  - Right-Click and choose **Save As → Auxiliary File**
  - Choose the filename to save under and Click **OK**
  - You will then be prompted regarding saving the Bid Curve and Reactive Capability Curve data to the AUX file. Choose **Yes** to the Reactive Capability Curve
    - Reactive Capability Curves are stored in SUBDATA sections of the AUX file
  - *.aux file can then be manually edited

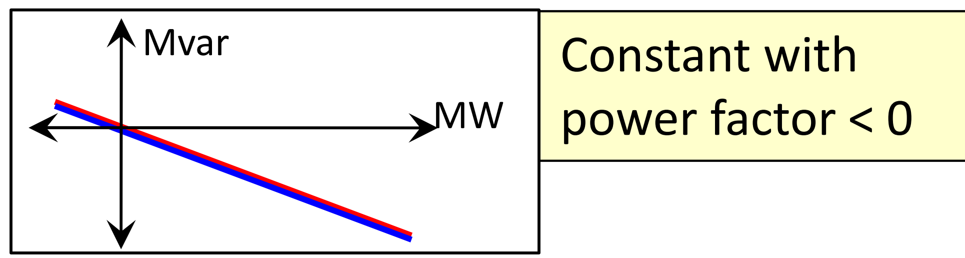
Generator Wind Control Mode

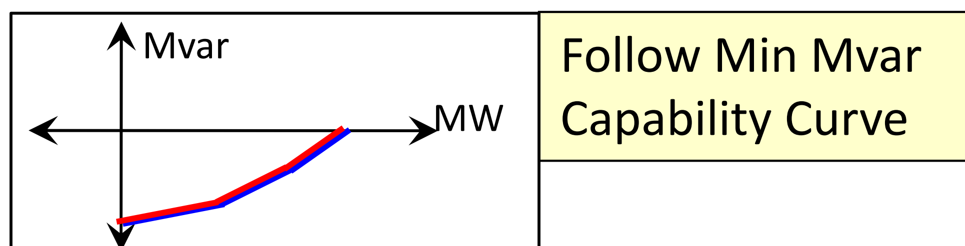
- Wind Farms often have Mvar limits that are related to a specified power factor
- This can be modeled using the Wind Control Mode Option





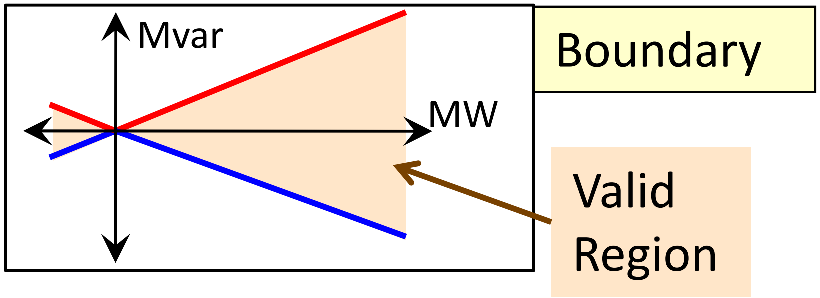






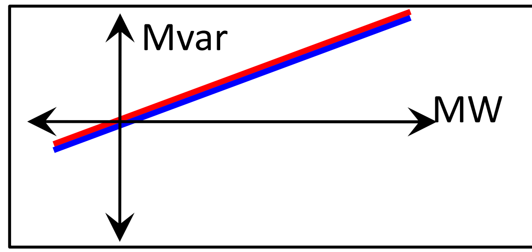
Wind Control Mode Options

- None
  - Use default behavior with specified Max/Min Mvar or capability curve
  - Only generators without a wind control mode may be automatically chosen as a slack bus
- Constant and Boundary Power Factor
  - Mvar limit magnitudes are determined from the actual MW output and the specified power factor
    - Magnitude = MWOutput * tan(arccos(Power Factor))
  - Boundary Power Factor
    - Max Mvar output is positive
    - Min Mvar output is negative
    - Sign of power factor is not used

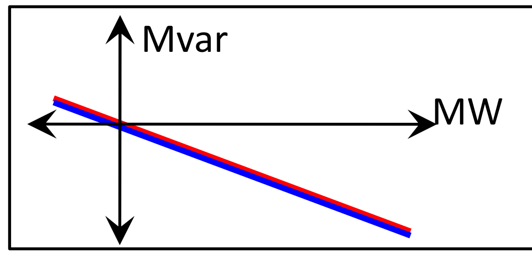


Wind Control Mode Options

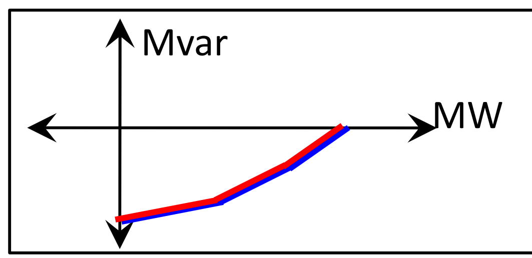
- Constant Power Factor
  - Max Mvar = Min Mvar
  - If power factor is positive, the limits have the same sign as the actual MW output
  - If power factor is negative, the limits have the opposite sign as the actual MW ouput
- Follow Min Mvar Capability Curve
  - Mvar output determined by a lookup of the Min Mvar value on the capability curve
  - Make generator's Mvar output a piece-wise linear function of the MW output



Constant with power factor > 0



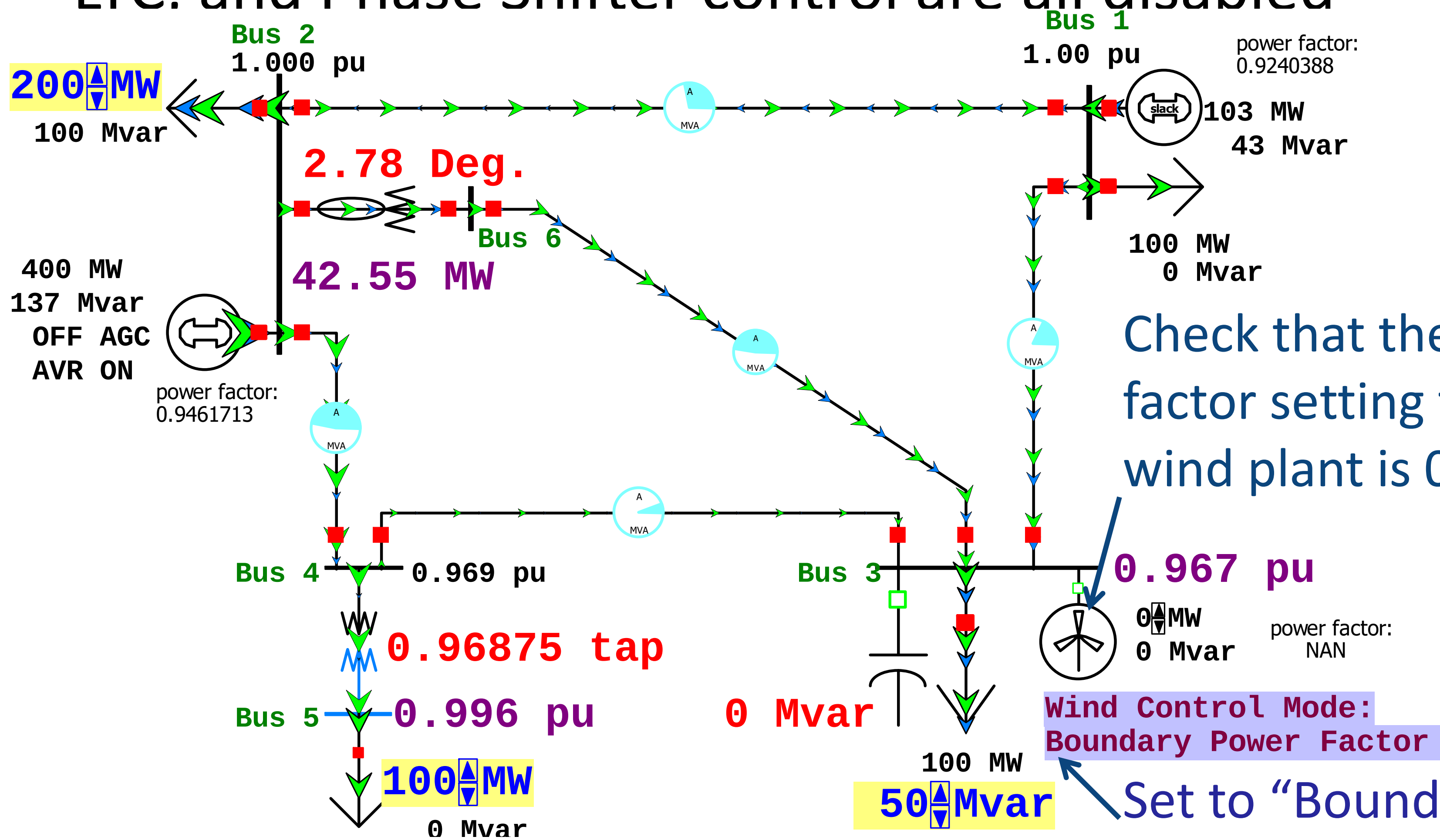
Constant with power factor < 0



Follow Min Mvar Capability Curve

Wind Control Modes

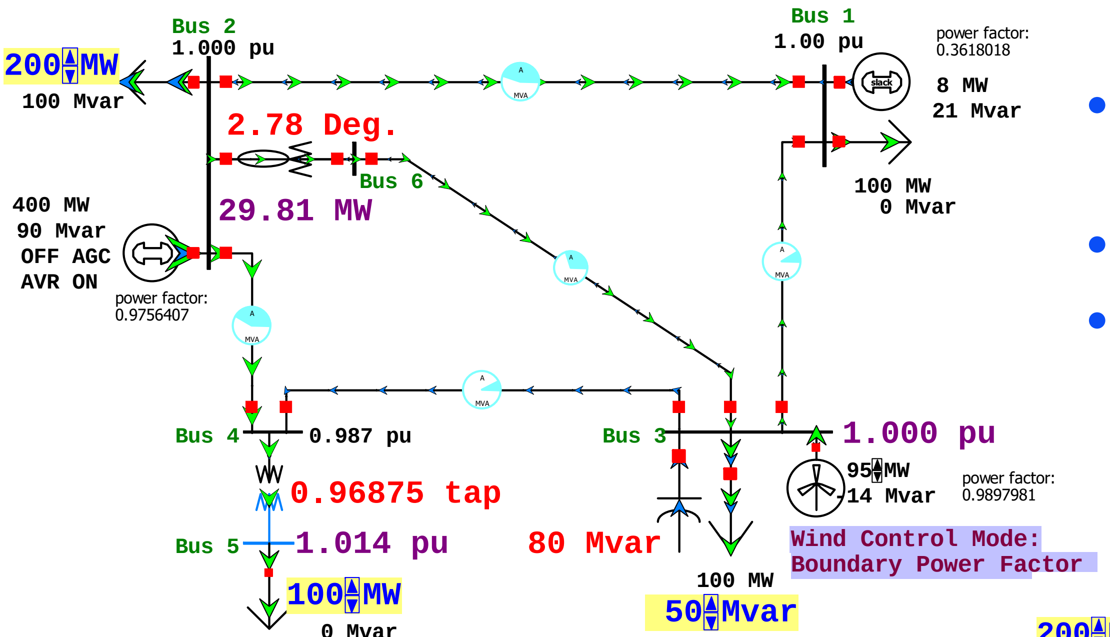
- Open Case B5RWind.pwb – note that Switched Shunt, LTC. and Phase Shifter control are all disabled



Check that the power factor setting for the wind plant is 0.95

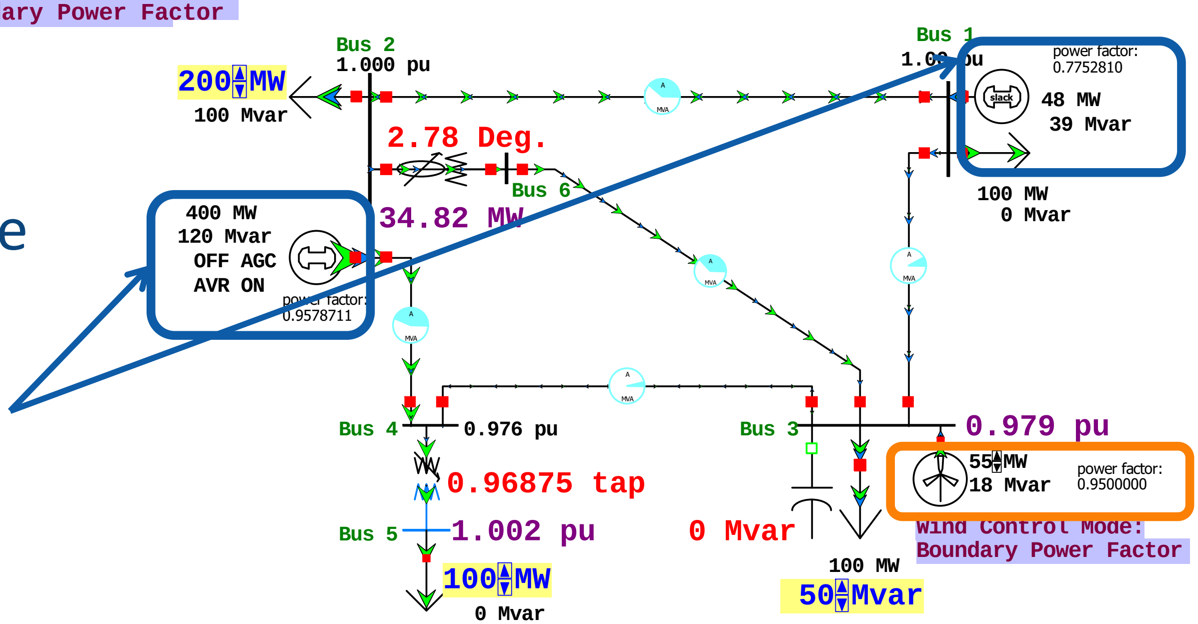
Set to "Boundary Power Factor"

Example
Boundary Power Factor

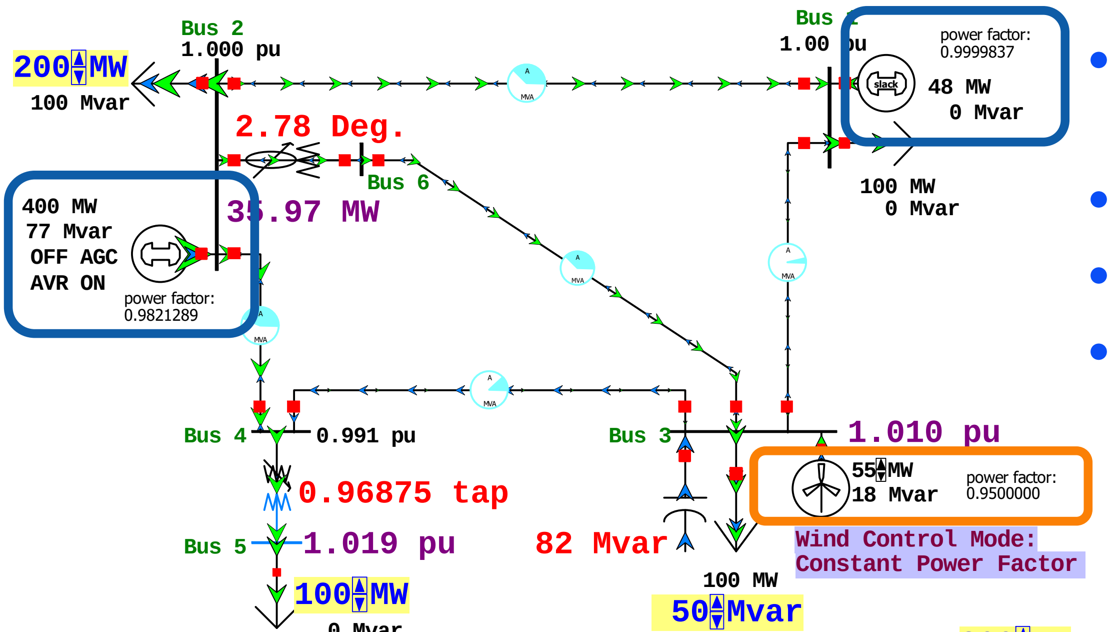


- Run the case, and close the switched shunt
- Close the generator at Bus 3
- Lower the wind MW output to 55 MW and open the switched shunt

Reactive power must be supplied at the other generators; no more is allowed to come from the wind plant.

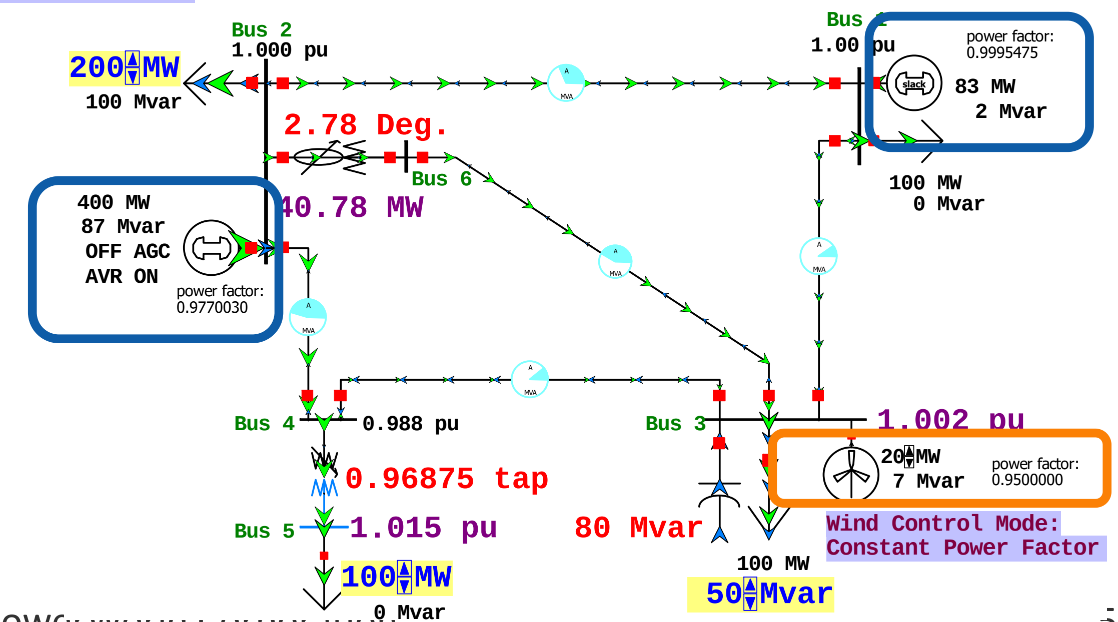


Example
Constant Power Factor



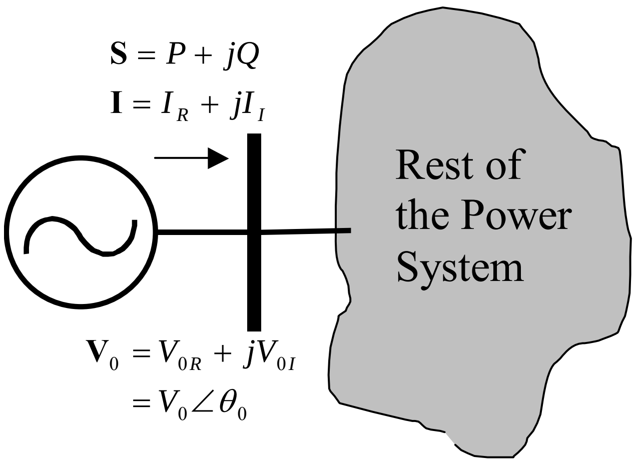
- Change Generator 3 to Constant Power Factor
- Run the case
- Close the switched shunt
- Lower the wind to 20 MW and see the Mvar outputs adjust

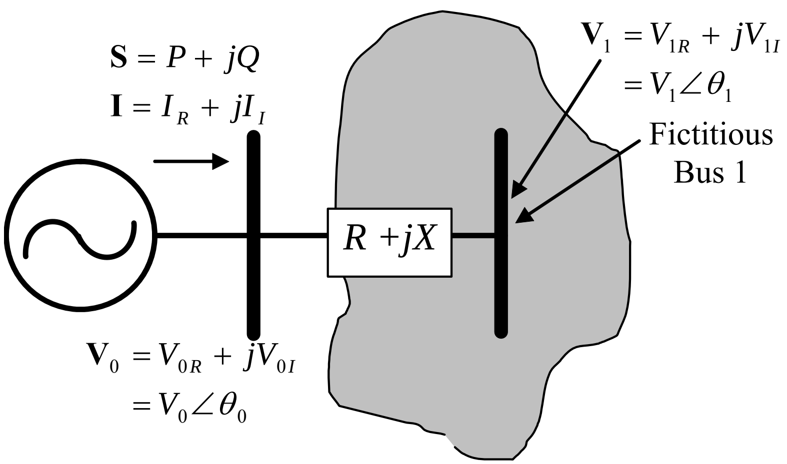
Experiment with the other wind control settings



Line Drop Compensation

- Without LDC
  - Generator is connected to terminal and controls a bus voltage (may be terminal or remote bus)
- Generator using LDC
  - Generator controls the voltage at a "fictitious bus" some impedance away from the generator
  - This models the real-time control done at some generators
  - If Xcomp and Rcomp are both less than the ZBR Threshold (default 0.0002) the generator will regulate its own terminal
- Can be used always (Use LDC=YES) or only during Contingencies (Use LDC= PostCTG)
  - During contingencies, the voltage setpoint for the fictitious bus is set equal to the pre-contingency value at the fictitious bus

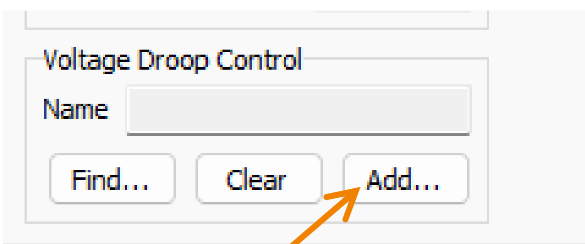




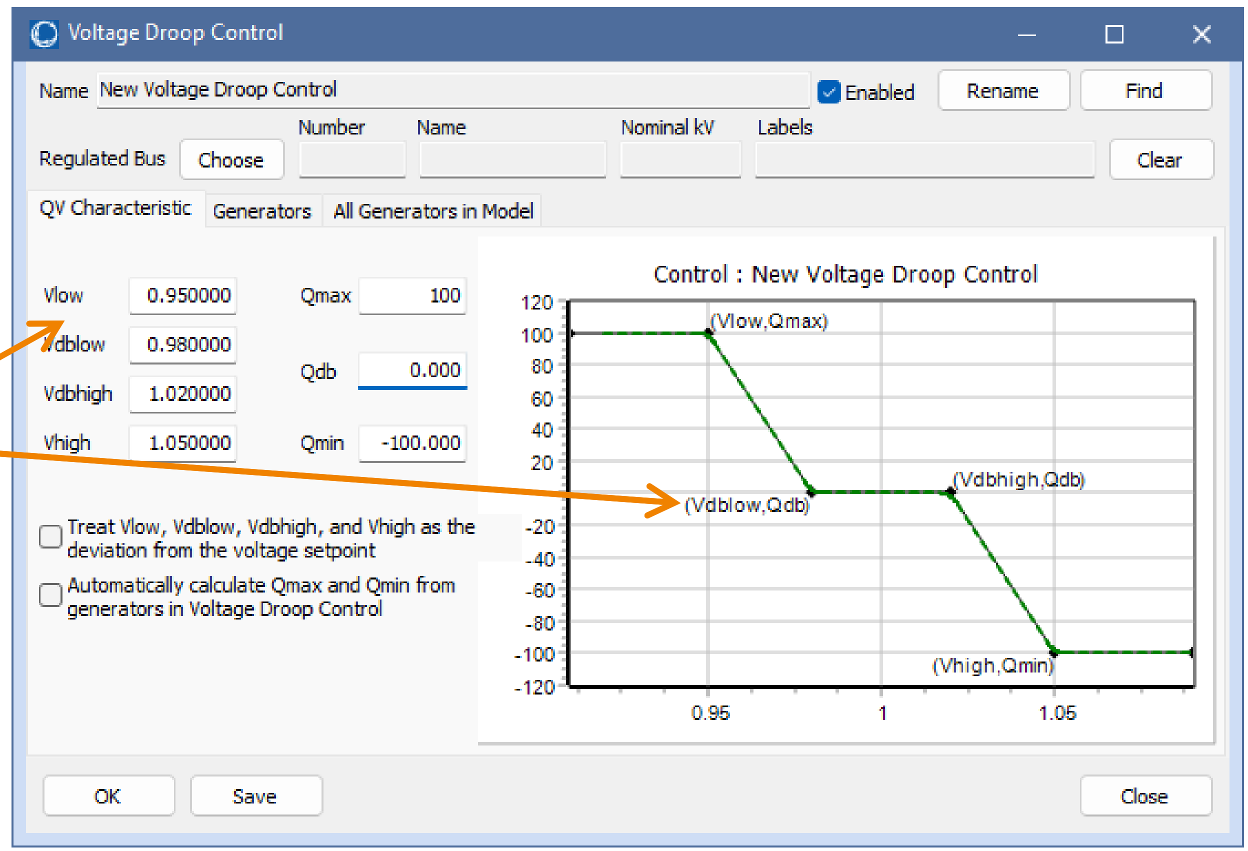
If X < 0 : Called Reactive Current Compensation

Voltage Droop Control

- Scheme to regulate voltage within a range, rather than to a fixed setpoint



Click Add... on Generator Dialog to create scheme and adjust its parameters

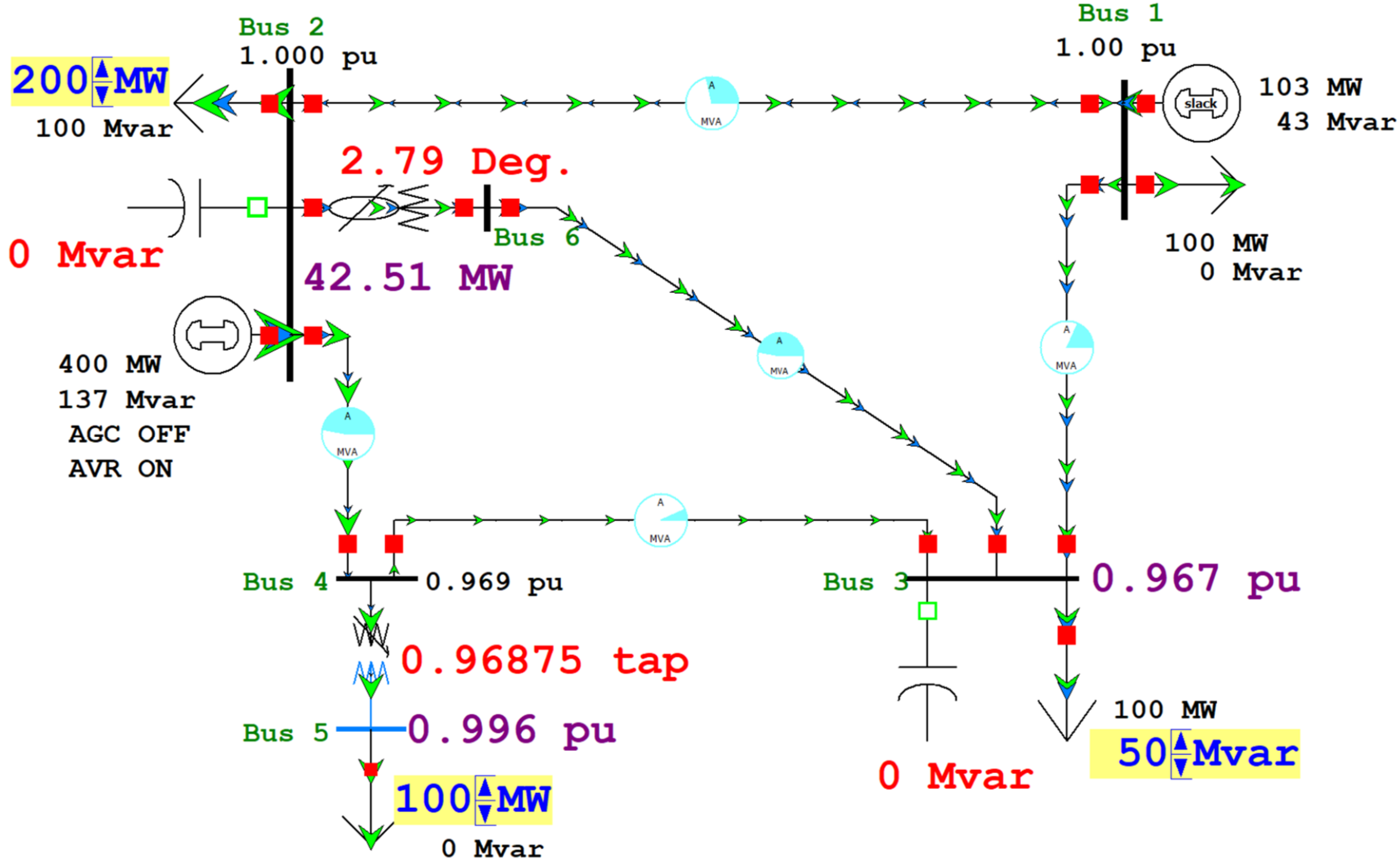


Switched Shunt Control

- Switched shunts can automatically change their shunt susceptance to control voltage at a regulated bus.
- Switched shunts on continuous control are integrated directly into the power flow equations. (They create "PV buses.")
- Automatic switched shunt control can be disabled in three places
  - for entire case on Simulator Options dialog
  - for area on Area Records display
  - individually on Switched Shunt dialog
  - All three of these flags must be set to enable switched shunt control in order for a shunt to move.

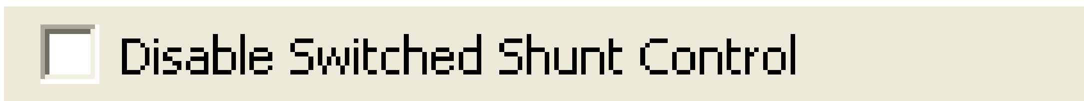
Switch Shunt Control Case

- Open Case B5R.pwb

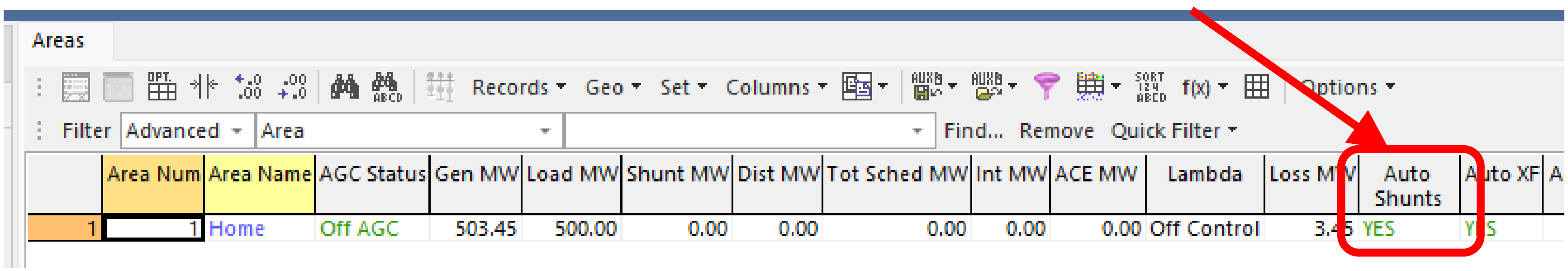


Switched Shunt Control

- Verify the switched shunt control is enabled on Power Flow Solution Options dialog



- Verify control enabled on the Area Records



- Right-click on switched shunt shown at bus 3 to display the Switched Shunt dialog.

Switched Shunt Dialog

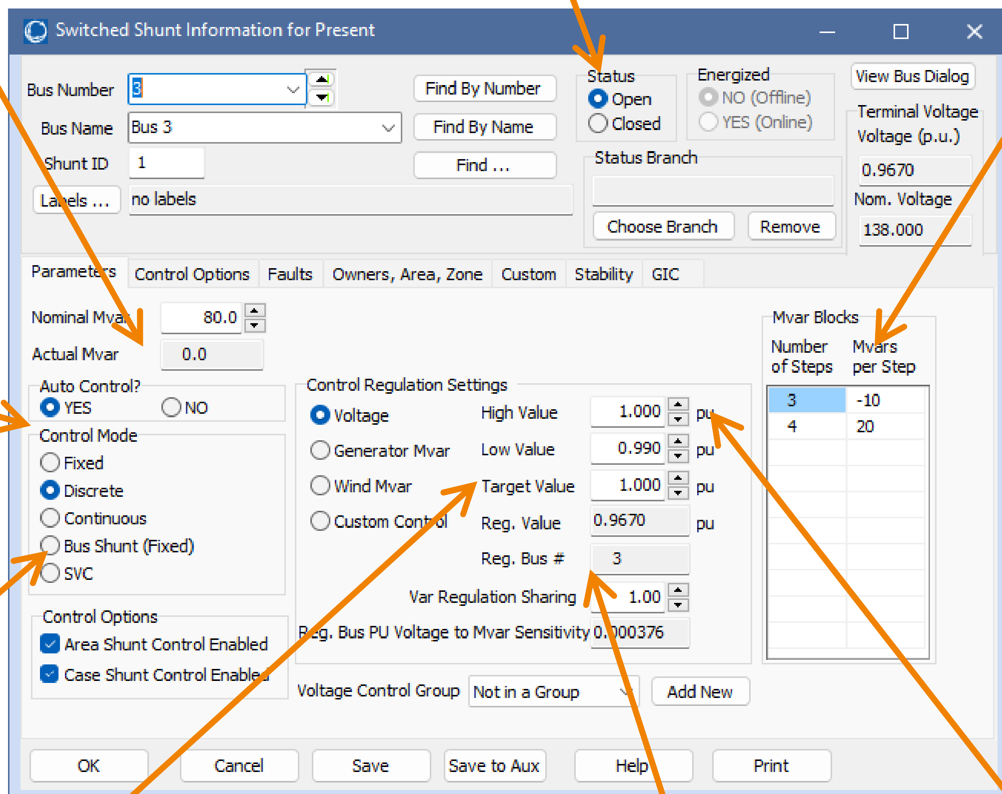
Actual Mvar will differ from Nominal if bus voltage is not 1.0 pu.

Status must be closed to work

Specify the "blocks" of Mvar available for shunt dispatch. This example demonstrated a shunt with the ability to provide -30, -20, -10, 0, 20, 40, 60, or 80 Mvars

Automatic control requires the mode be either discrete, continuous, or SVC

Bus Shunt (Fixed) is the same as Fixed (flag used to support other file format)



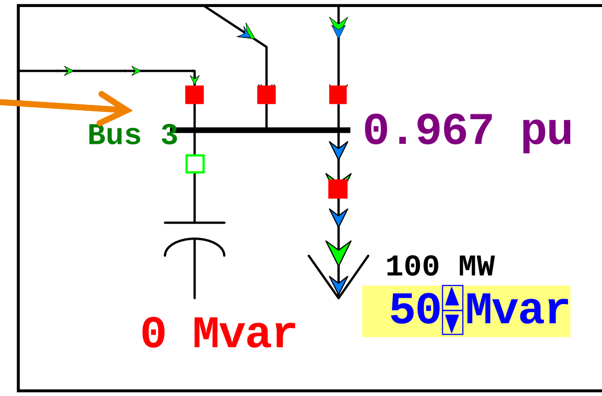
When a value goes out of range, Simulator algorithms attempt to set the value to the target

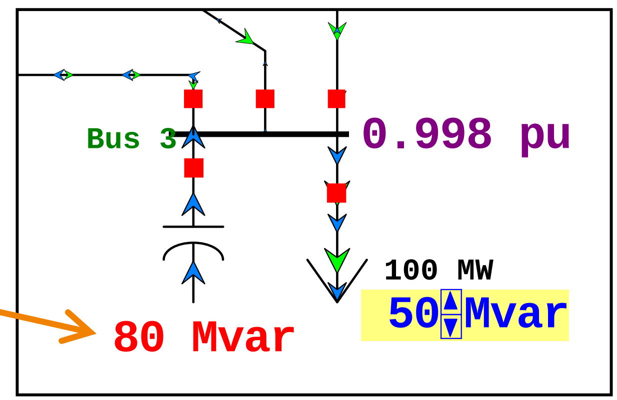
Regulated bus - usually the terminal bus

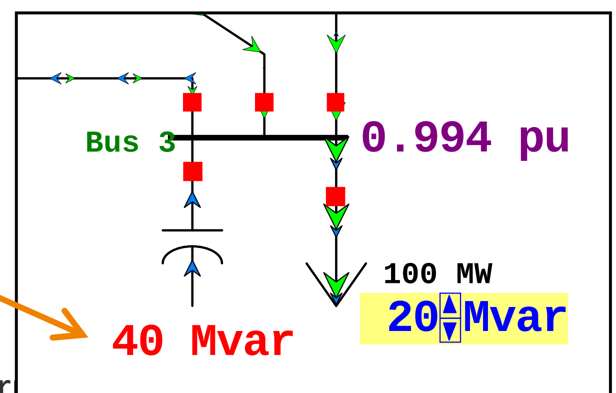
In discrete mode high value must be strictly greater than low value

Example Shunt on B5R Case

- Bus 3 presently has a voltage of 0.967 per unit.
- From earlier slide, we set the control range for the shunt to 0.99 to 1.00 per unit, and switched in the shunt
- This results in the shunt moving to 80 Mvar nominal
- If you decrease the Mvar load at the bus, the voltage increases, and the shunt eventually reduces



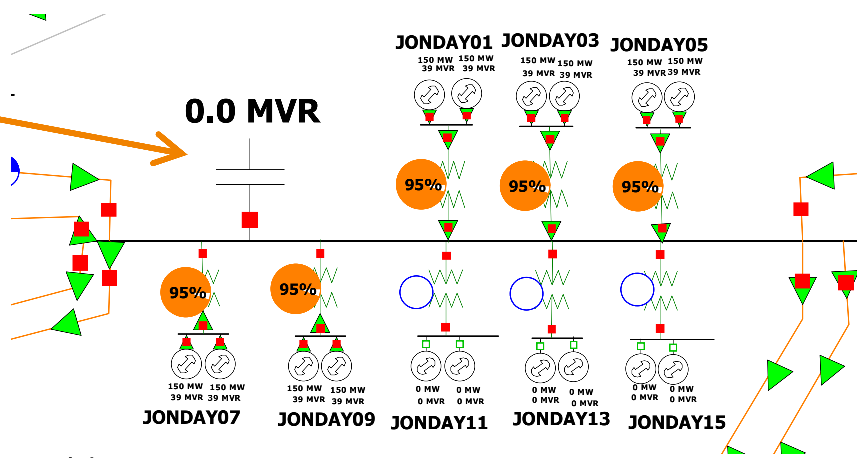




Switched Shunt Control of Generator Mvar Outputs

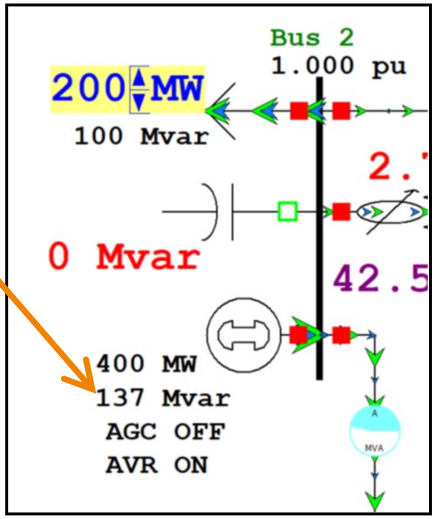
- Switched Shunts may be used to control the Mvar output of generation
- To do this change the **Control Regulation Settings** to *Generator Mvar*
  - Setting **Reg. Bus** now means to control the total generator Mvar output for generators which control the voltage at the bus specified.
- Switched Shunts can also regulate *Wind Mvar* or to a Model Expression (*Custom Control*)

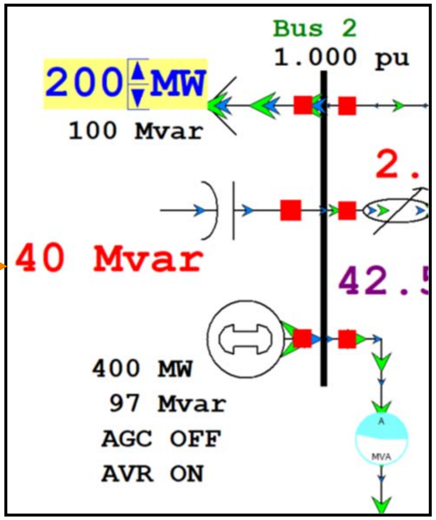
You could set this shunt to control the total generator Mvar output of all 16 generators controlling its terminal bus

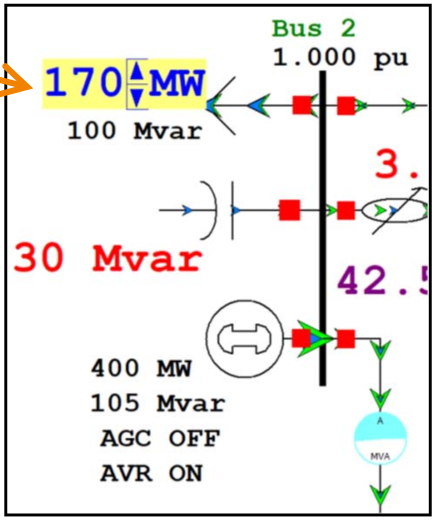


Example Generator Mvar Control

- Bus 2 generator provides 137 Mvar to control to 1.00 pu.
- Close the shunt at Bus 2; it regulates the Gen to 95-105 Mvar, causing the shunt to move to 40 Mvar nominal
- If you vary the load at the bus, the voltage starts to change, prompting the generator Mvar to change; when it goes out of range, the shunts responds





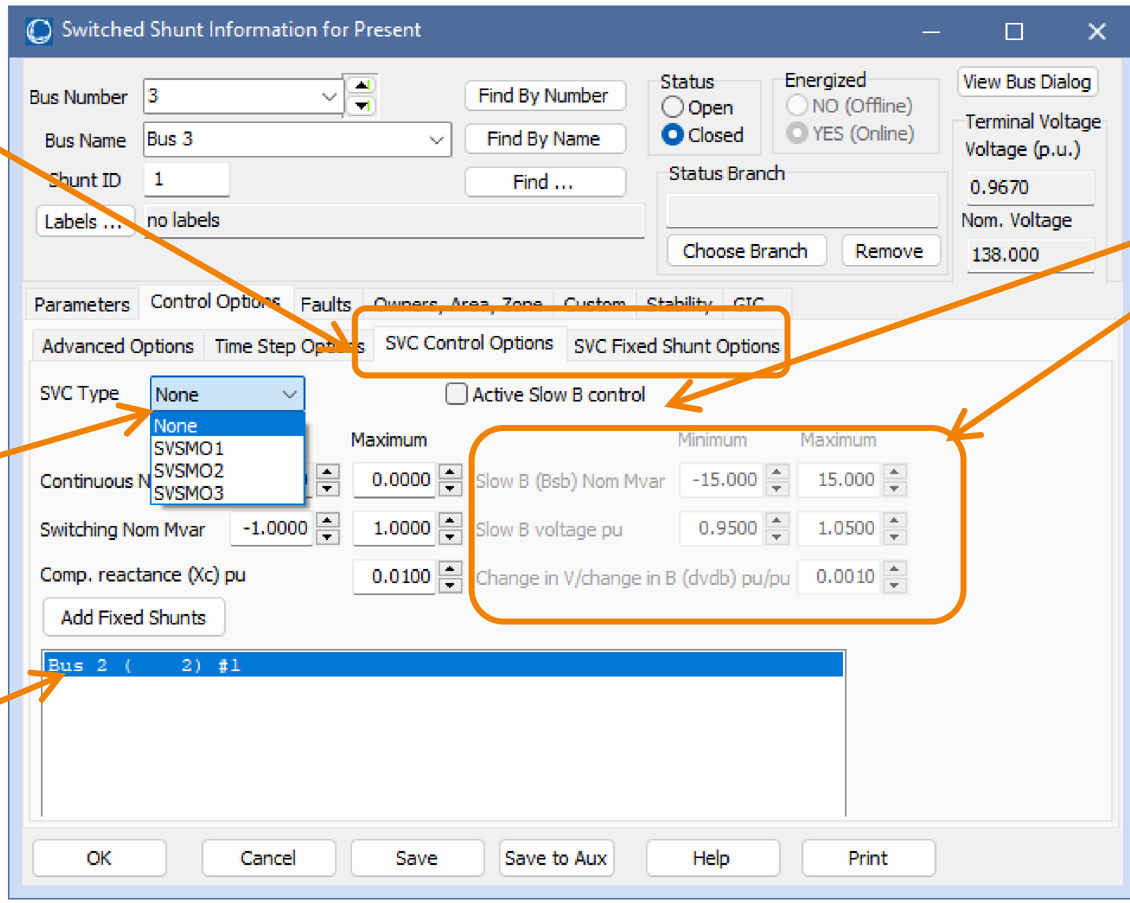


SVC Control Mode

Special options available on subtabs of Control Options

Options for SVC Type

Can control up to 8 fixed shunts



Check to enable Slow B Control Options

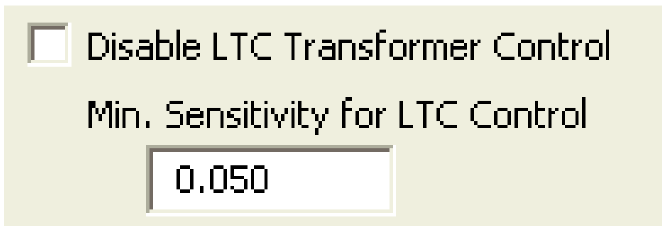
Additional details available in Online Help documentation

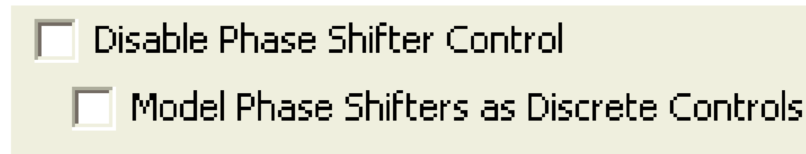
Transformer Tap Control

- Some transformers can automatically change either their tap ratio or their phase angle to control either
  - voltage - Load Tap Changing (LTC) transformer
  - MVAR flow - LTC transformer
  - MW flow - phase shifter
- Again, Automatic control can be disabled in three places
  - for entire case on **Simulator Options** dialog
  - for area on **Area Records** display
  - individually on **Transmission Line/Transformer** dialog
  - All three of these flags must be set to enable switched shunt control in order for a shunt to move.

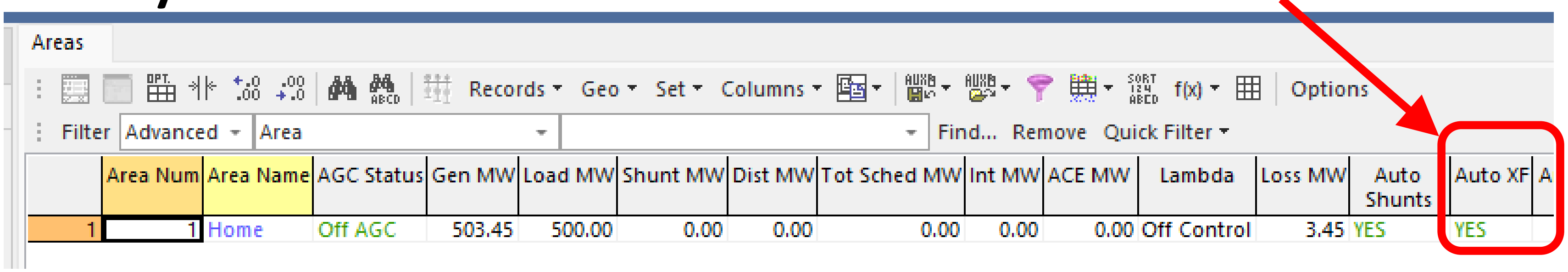
Transformer Control

- Verify the transformer control is enabled on Power Flow Solution Options dialog





- Verify control enabled on the Area Records

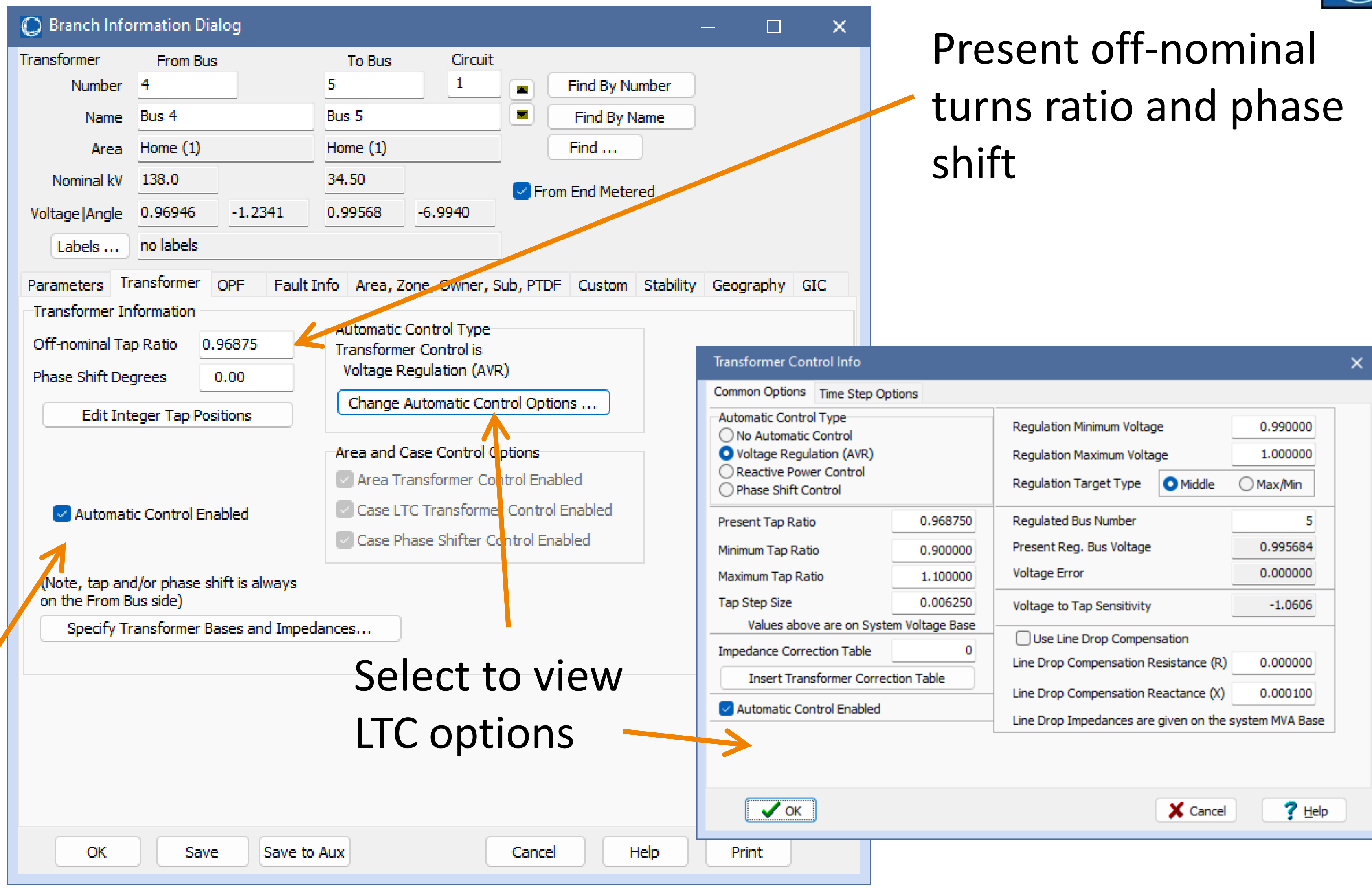


- Right-click on transformer shown between buses 4-5 to display the transformer dialog.

LTC Transformers

Right-click on transformer symbol to view the Branch Options dialog

Present off-nominal turns ratio and phase shift

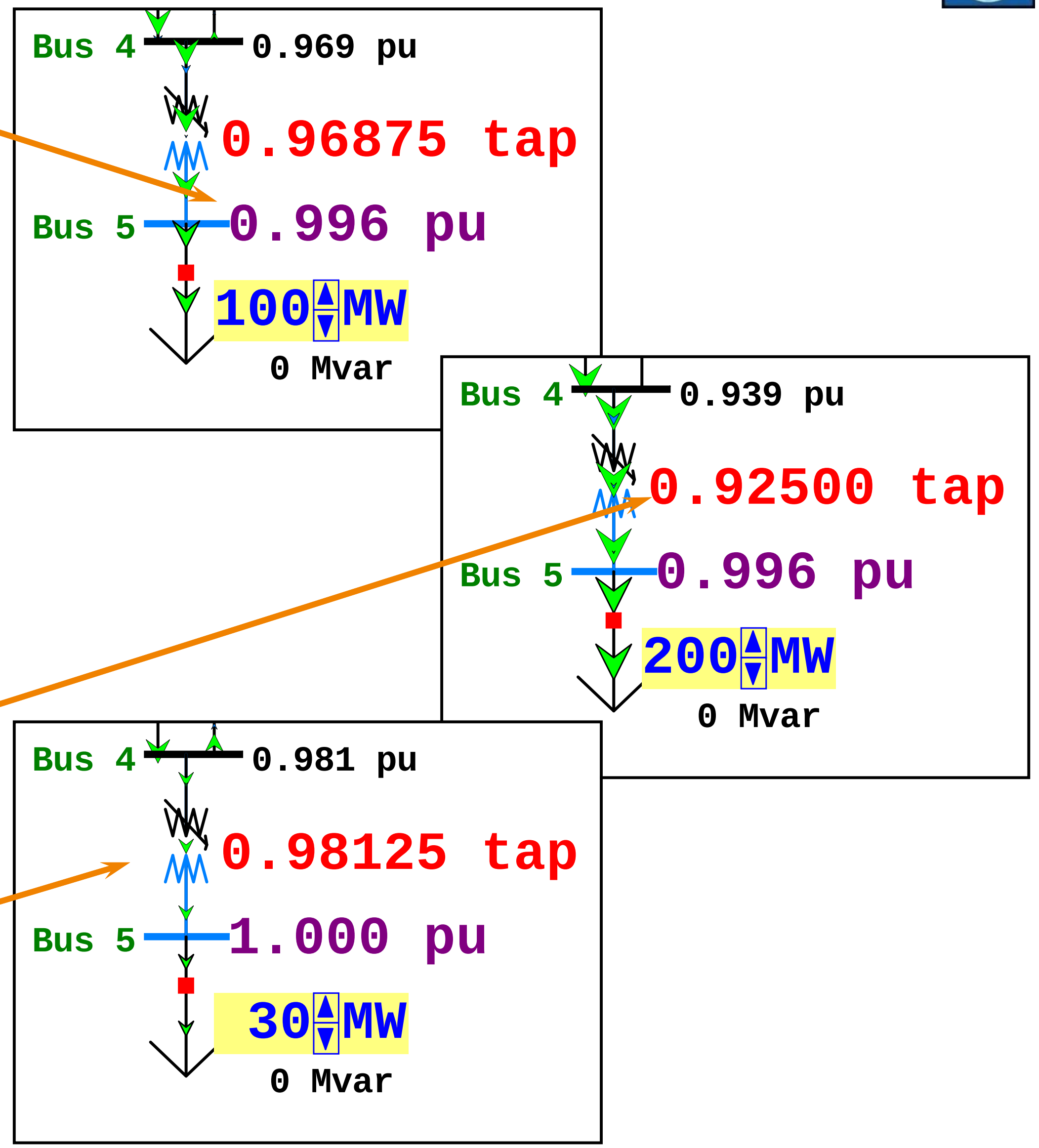


Select to view LTC options

Must be checked to enable control

Example LTC on B5R Case

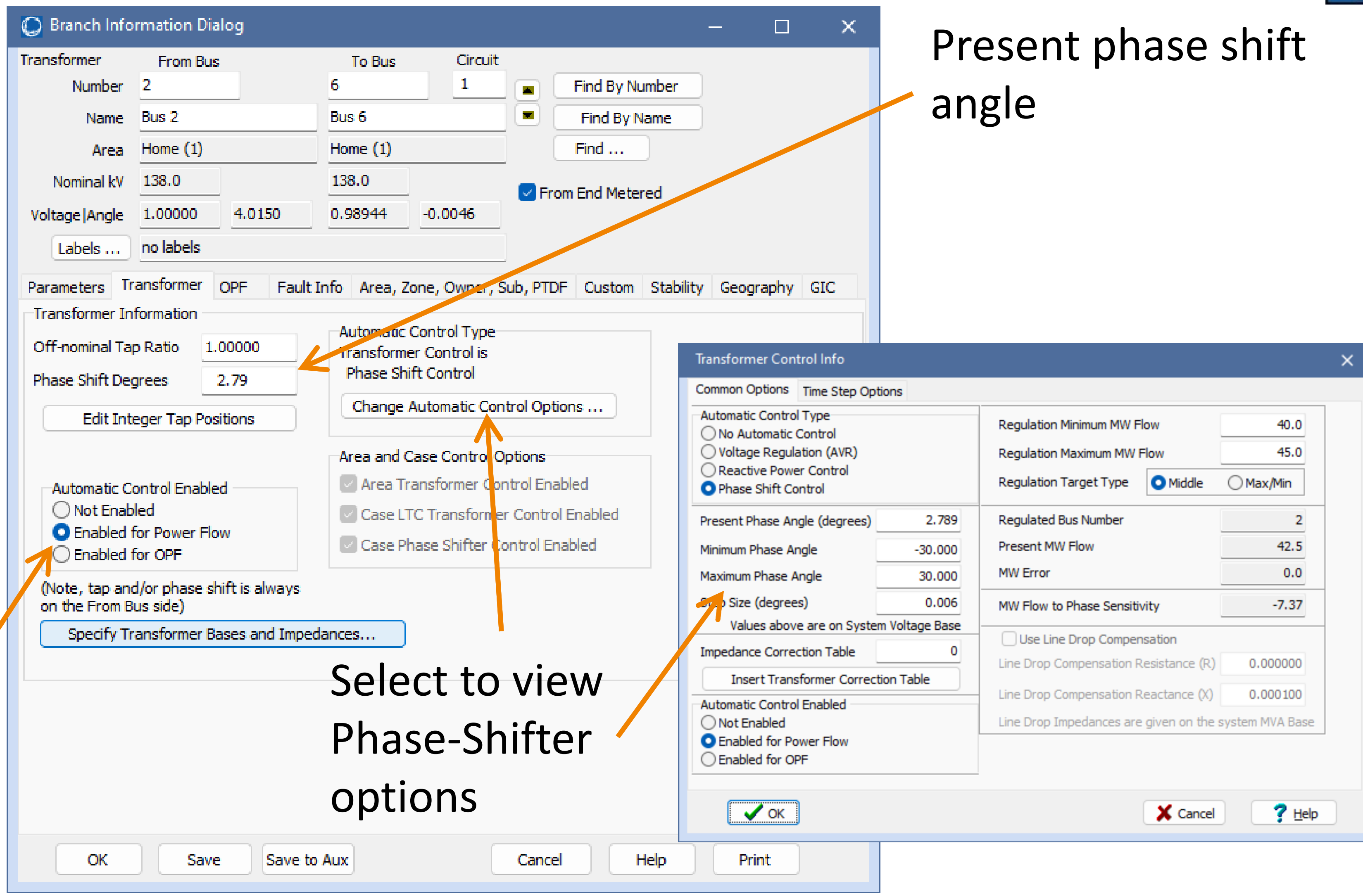
- Bus 5 starts with a voltage of 0.996 per unit
- On previous slide we showed that tap (on the bus 4 side) was set to control voltage at bus 5 between 0.99 and 1.00
- As we increase load tap moves
- As we decrease load tap moves



Phase-Shifting Transformers

Right-click on phase-shifter symbol to view the Branch Information dialog

Present phase shift angle

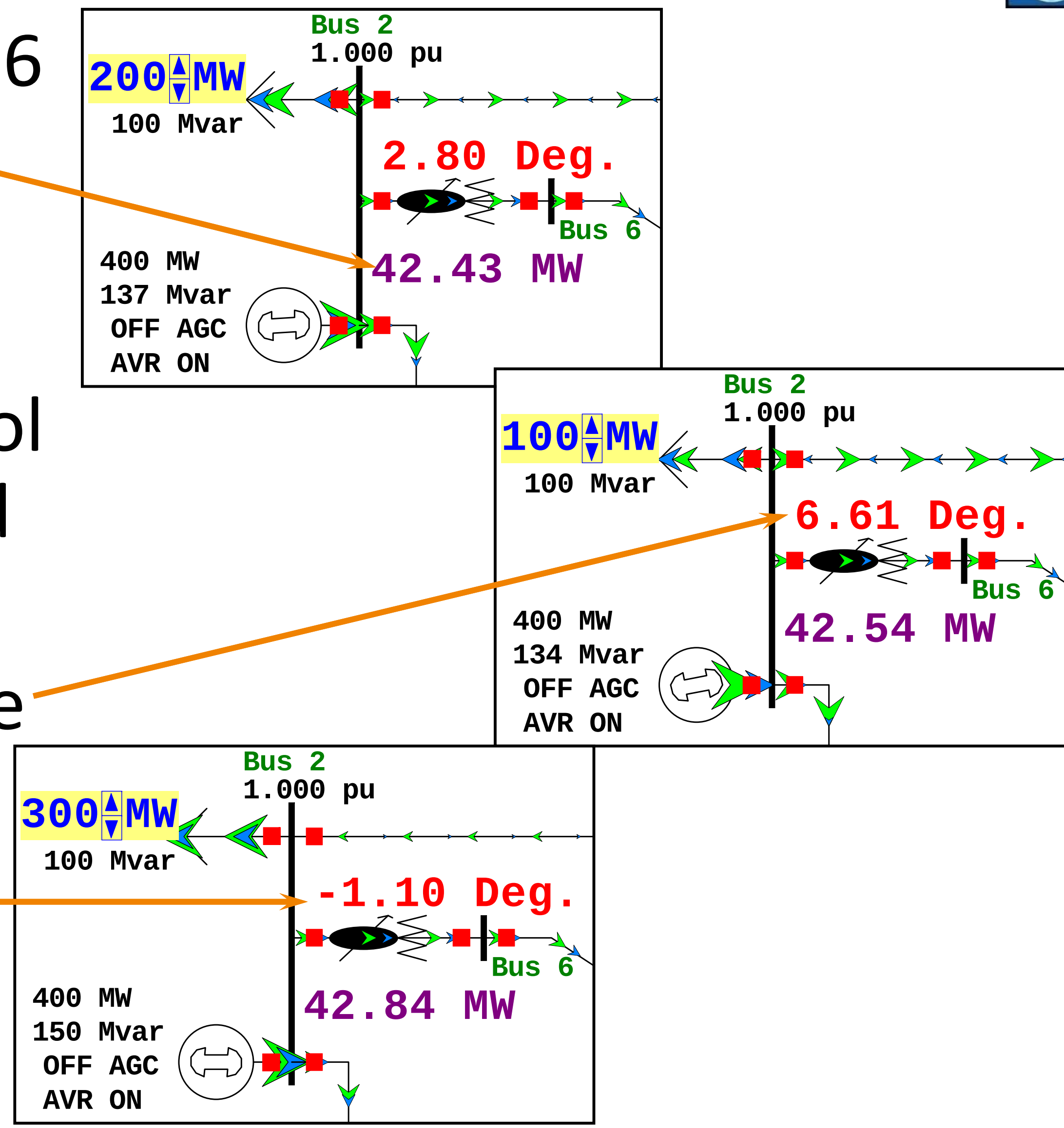


Must be selected to enable control

Select to view Phase-Shifter options

Example Phase-Shifters on B5R Case

- Flow from Bus 2 to Bus 6 starts at 42.43 MW
- On previous slide we showed that phase shifter was set to control flow to between 40 and 45 MW
- As we increase load, the phase shift moves
- As we decrease load, the phase shift moves



Overview of PowerWorld's Solve Power Flow

- What does Solve Power Flow do?
  - Solve Power Flow should not be confused with a single Newton-Raphson (or other technique) power flow
  - Simulator's "Solve Power Flow" encompasses three nested loops that iterate between a power flow routine, logic for control device switching, and generation control until the power flow is solved and no more device switching is detected

Overview of Solve Power Flow Routine

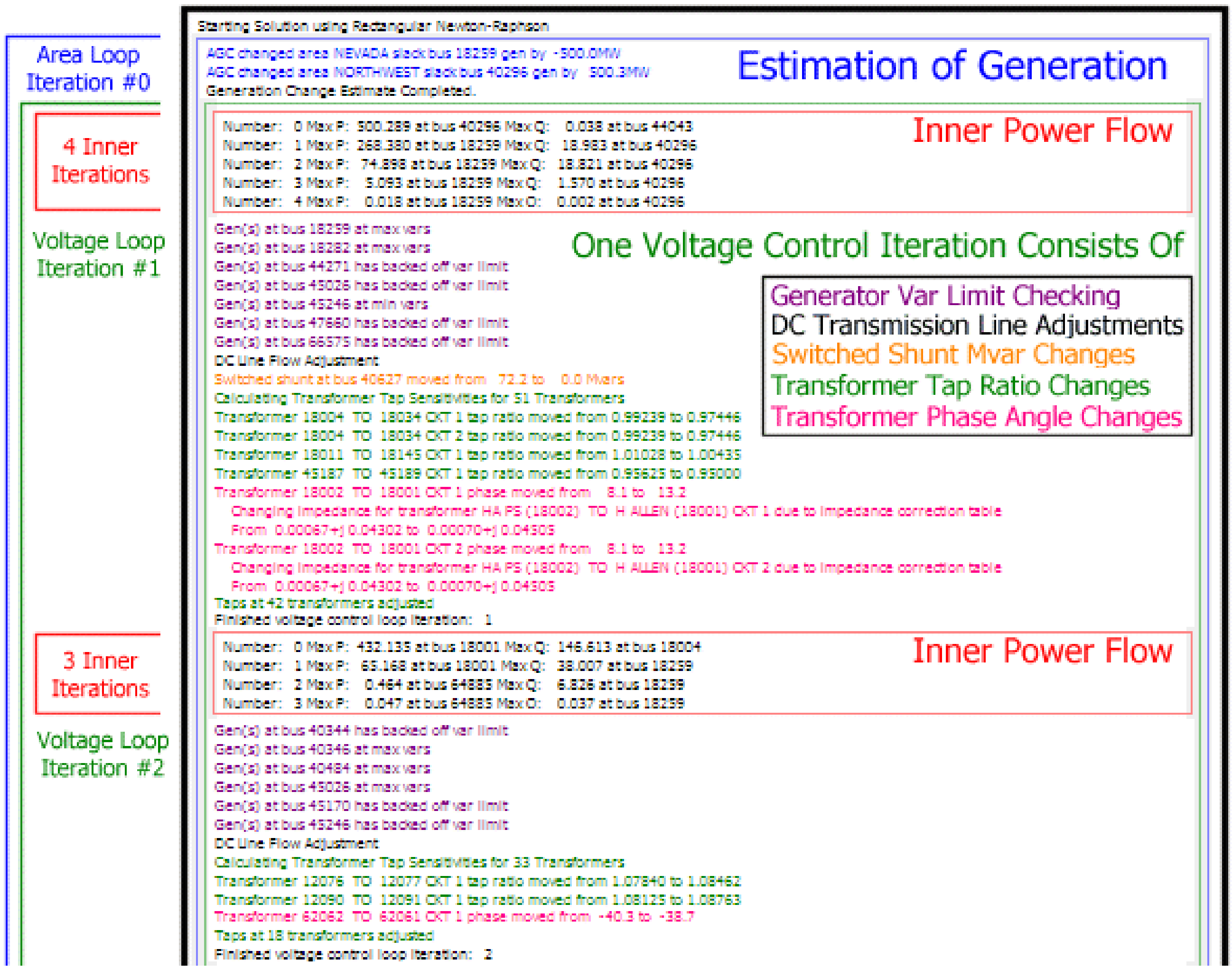
- Pre-processing
  - Angle Smoothing
  - Generator remote regulation viability
  - Estimate MW change needed
- Three Nested Loops Solution Process
  - MW Control Loop
    - Voltage Controller Loop
      - Inner Power Flow loop

Traditionally called the *Power Flow Solution*

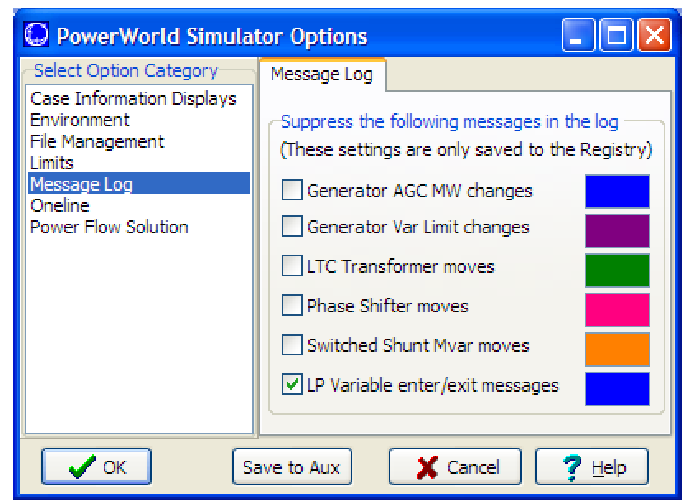
Voltage Control Loop also covered in this section

MW Control Loop also covered later

Example Message Log 1/2



Colors of Messages determined by the Simulators, Message Log colors



Example Message Log 2/2