Automating PowerWorld with Python

PowerWorld Simulator
Accessing Data

December 9-12, 2019

PowerWorld Corporation

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

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

Main Focus and Motivation

- Model Explorer and Case Information Displays
  - Provide access to all object types and fields that are available through auxiliary files and SimAuto
  - Understanding these are key to accessing and manipulating data through your own programs and auxiliary files
  - Object fields are self-documenting with hints provided in case information displays

Main Focus and Motivation

- Auxiliary Files
  - Data sections contain user settings and input that should be applied to particular tools
    - Steady-state and transient stability contingency definitions
    - Options for running contingency and transient stability analysis
  - Script sections allow automated control of the software through script commands
    - Run steady-state contingency analysis
    - Run transient stability analysis
    - These same script commands will be used with SimAuto

Main Focus and Motivation

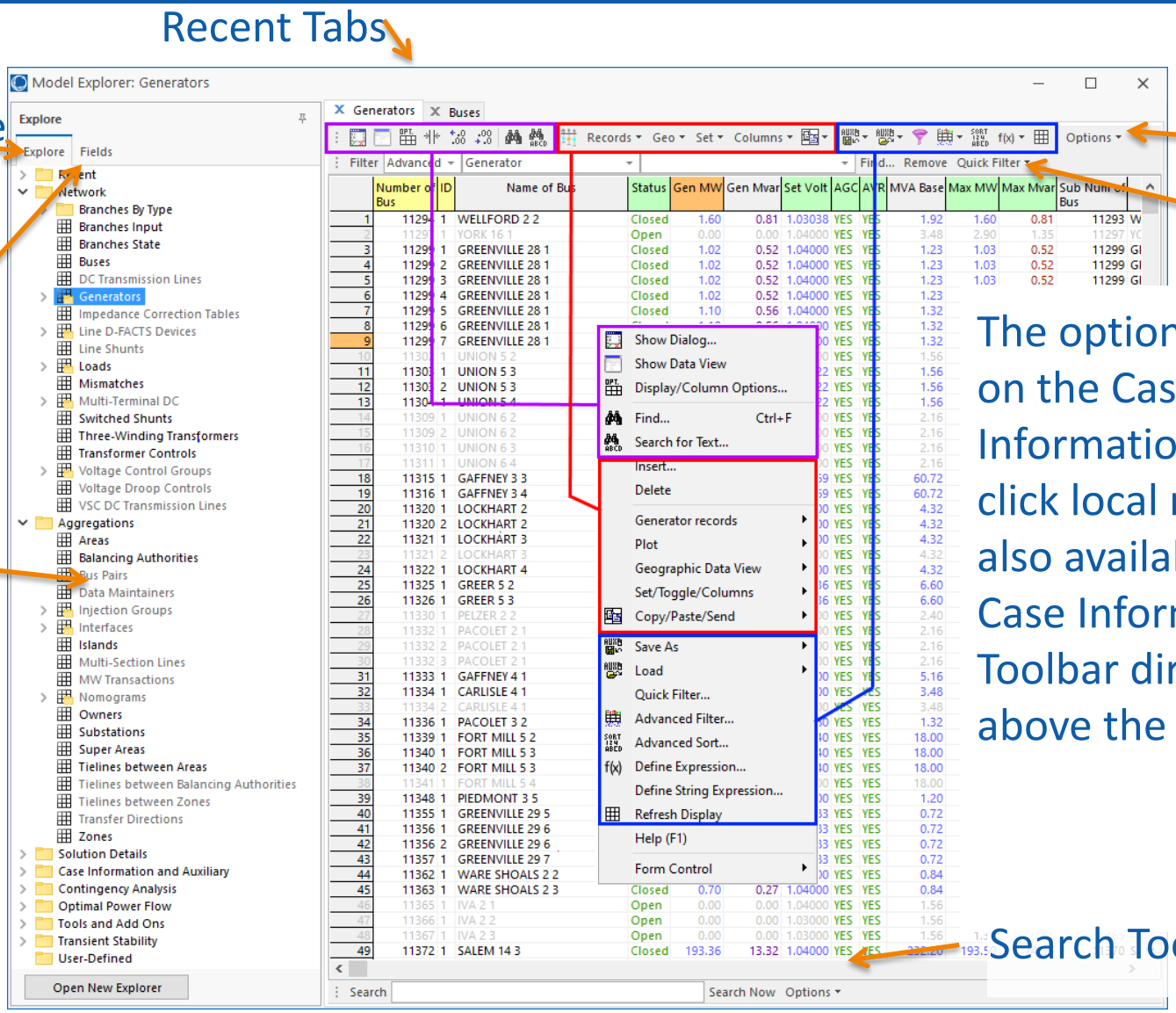
- Most important questions
  - Do I need to automate?
  - Does Simulator already do what I need to do without writing scripts?
  - Does Simulator already do what I need to do without using SimAuto?
  - Will PowerWorld add the feature I need without me having to write my own code?

MODEL EXPLORER AND CASE INFORMATION DISPLAYS

Model Explorer

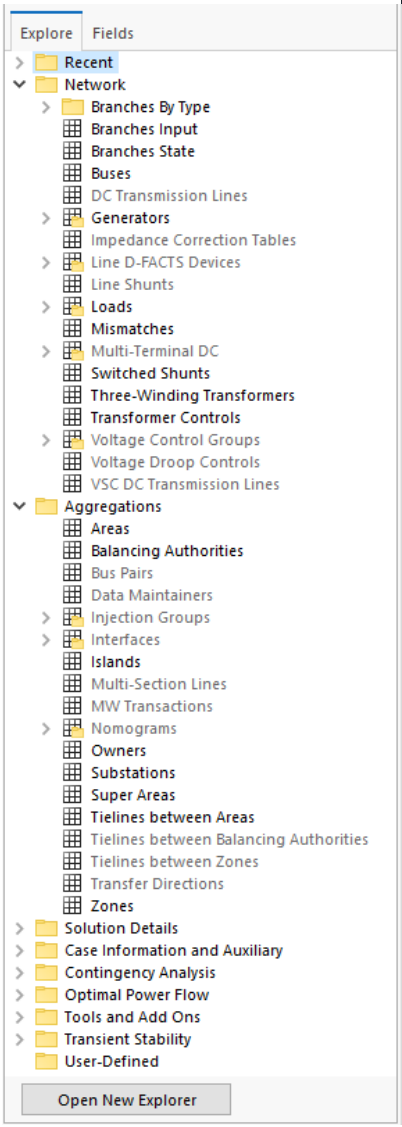
- Encapsulates most Case Information Displays
- Provides means of navigating through almost all of the data in the model
- Available from a few places
  - Case Information Ribbon Tab
  - Tools Ribbon Tab
  - Quick Access Toolbar

Model Explorer



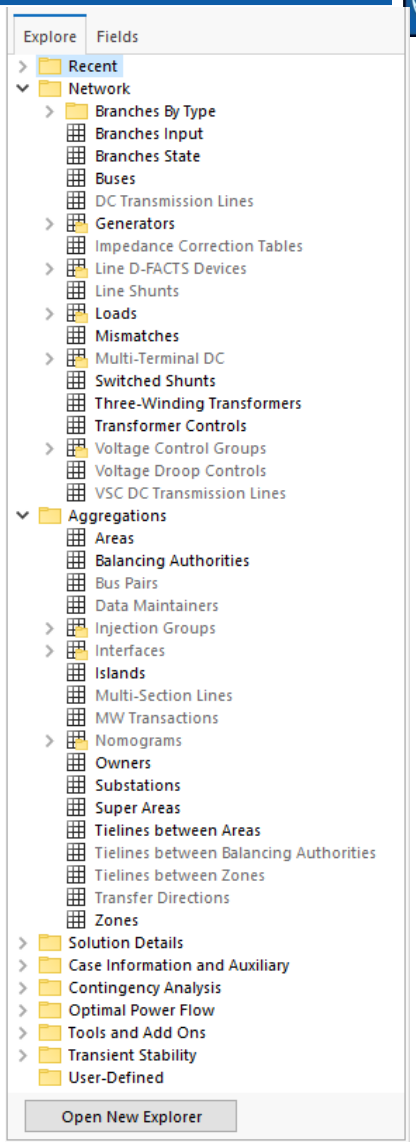
Model Explorer: Explore Pane

- Explore Pane contains a hierarchical list of most of the objects contained in the model
  - Ten Primary Folders, with only Network and Aggregations folder expanded by Default
    - Network Folder
      - physical devices
    - Aggregations Folder
      - groupings of physical objects



Model Explorer: Explore Pane Tips

- Grayed out entries indicate that objects of that type are not presently defined in model
- To open a new separate Model Explorer window
  - Hold down the CTRL key and then left click on an entry in the Explore Pane
  - Or just click the button **Open New Explorer**

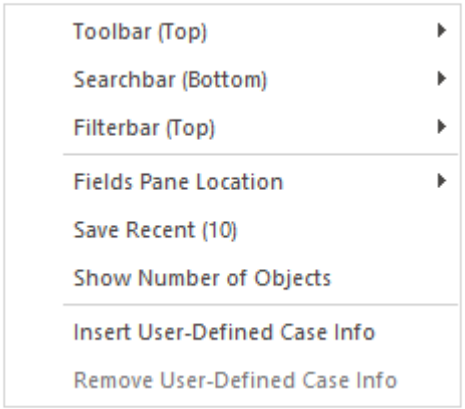


Model Explorer

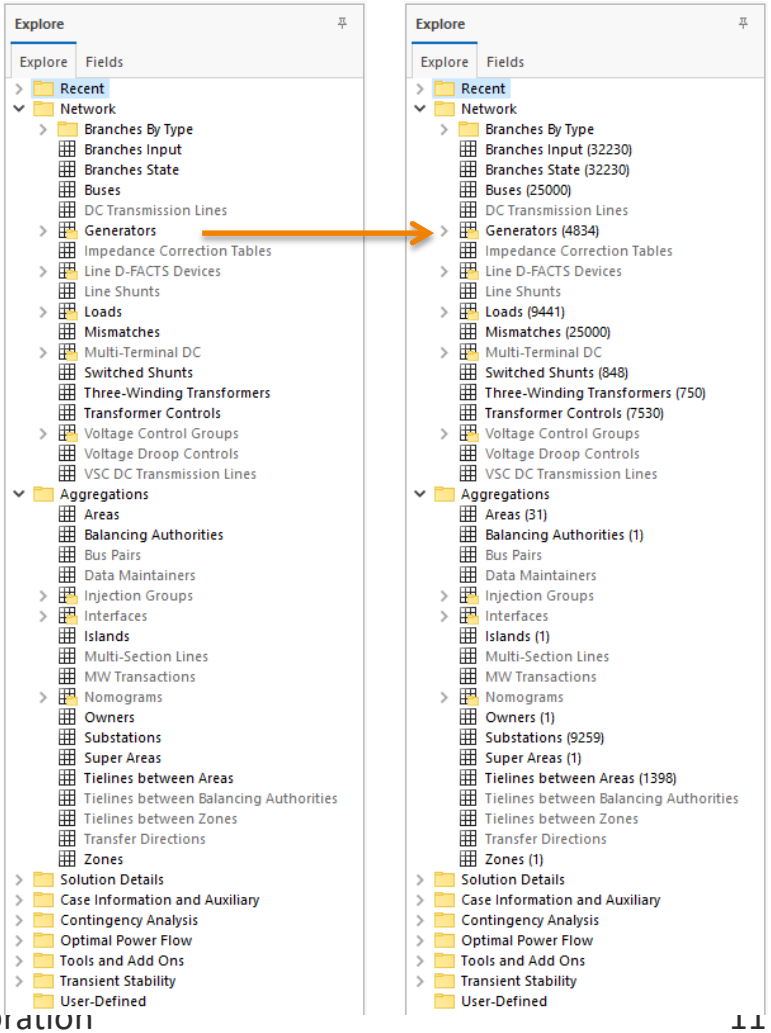
- Fields Pane
  - Provides access to all of the fields available to show on the active case information display
  - Similar to the Display/Column Options
- Recent Tabs
  - List of the most recently viewed case information displays
  - Easier to manage than multiple windows
  - Kind of like “tabbed browsing”

Model Explorer Options

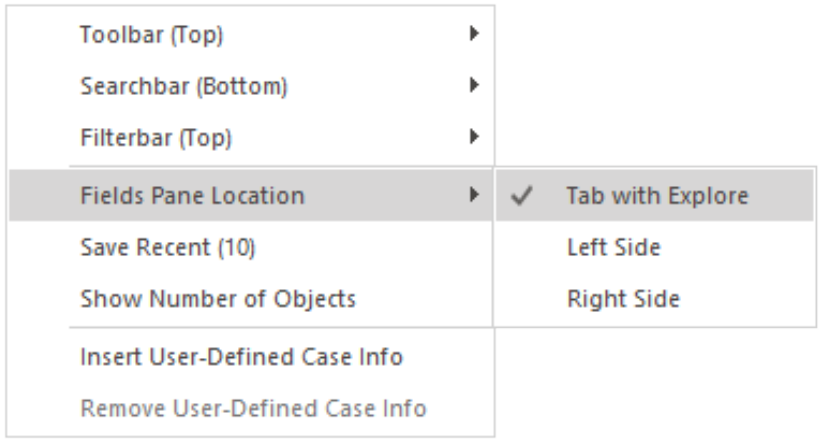
- To access options, right-click on any of
  - Explore Pane
  - Fields Pane
  - Recent Tabs
  - Toolbar
  - Searchbar
  - Filterbar
- Options available
  - Specify location of Toolbar, Searchbar, and Filterbar
  - Specify location of the Fields Pane
  - Specify the number of Recent Tabs to maintain
  - Show Number of Objects
  - Insert and Remove User-Defined Case Information displays

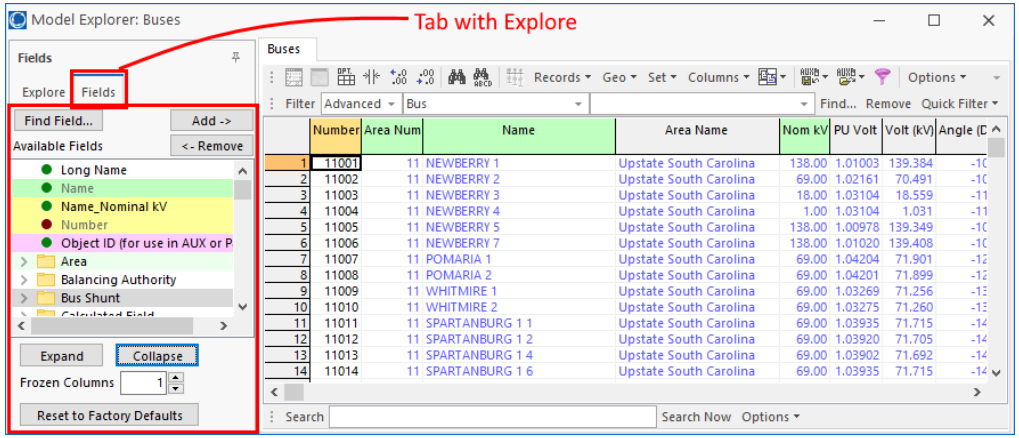


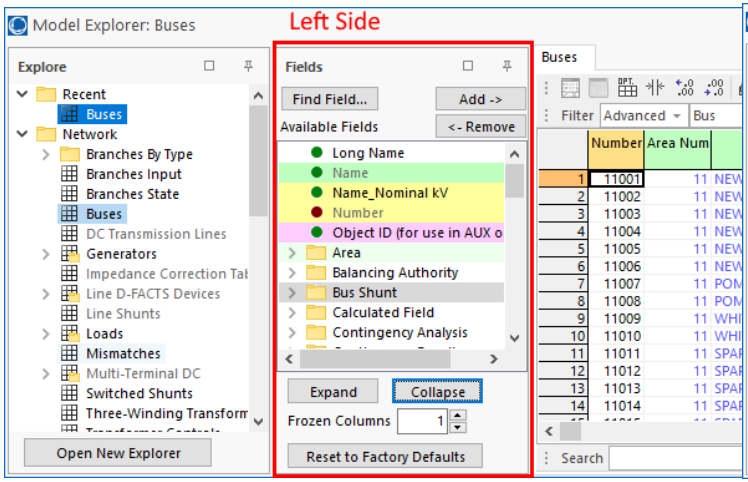
Show Number of Objects

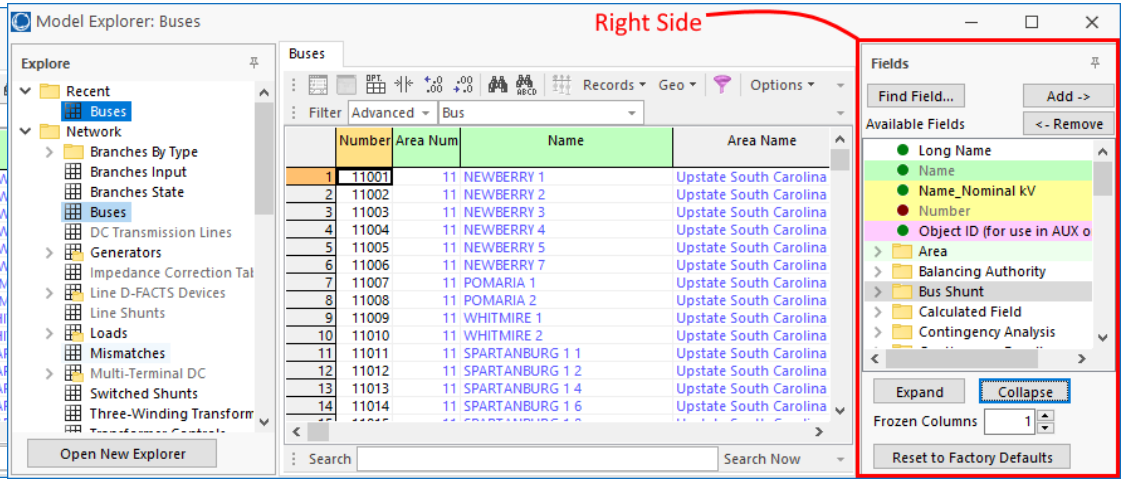


Fields Pane Location



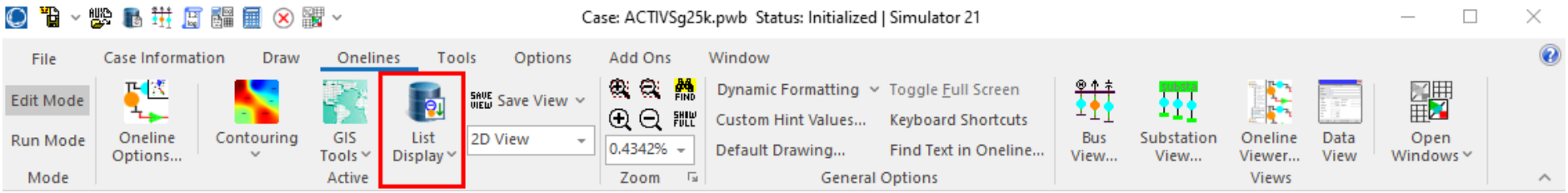






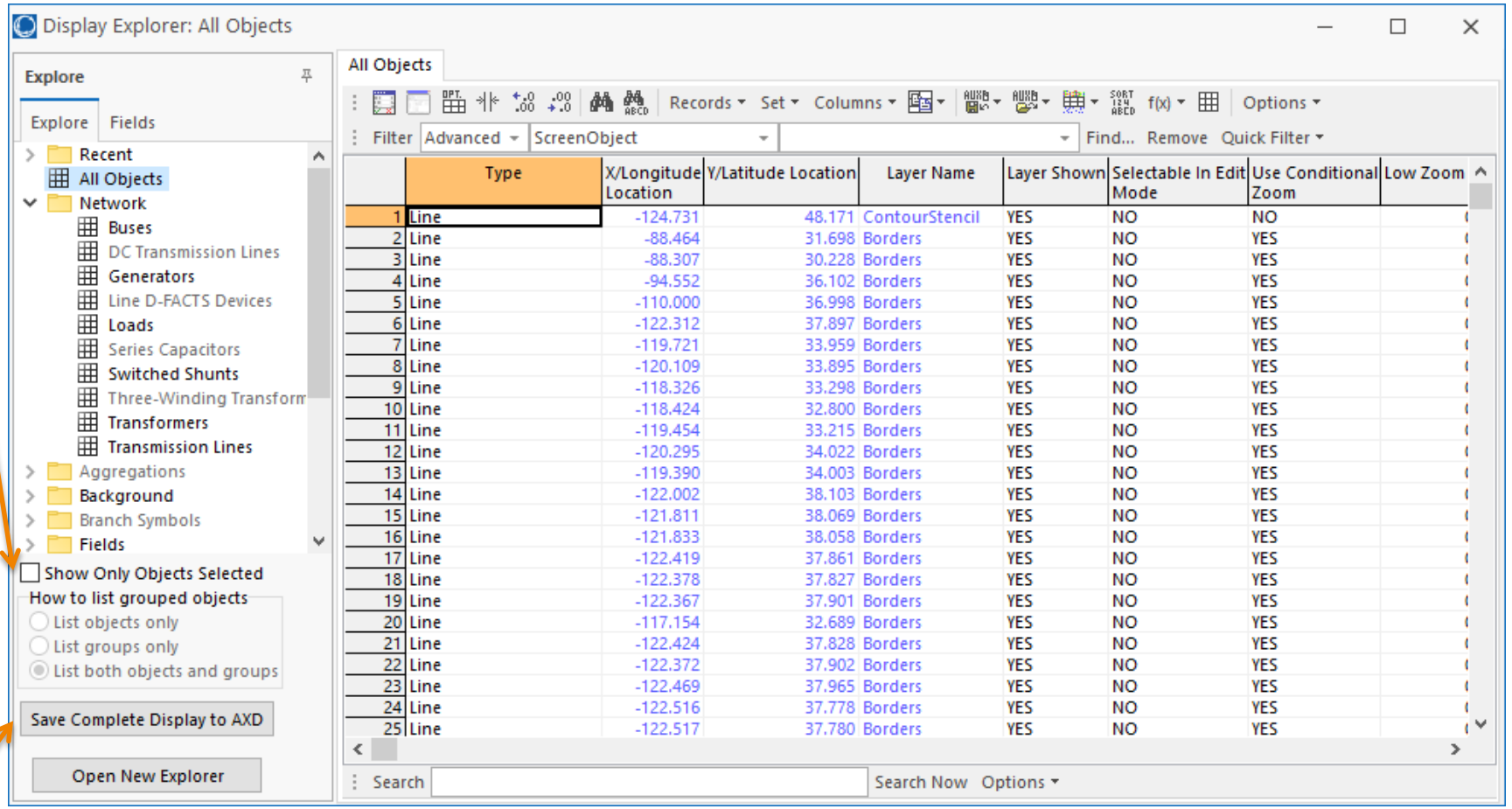
Display Explorer

- Very similar to the Model Explorer
- Contains case information displays for one-line display objects
- Provides means of navigating through data contained on a one-line in tabular form
- Available from the **Onelines** ribbon tab → **Active** ribbon group → **List Display** menu → **All Display Objects** option



Display Explorer

List only selected oneline objects Same structure as Model Explorer



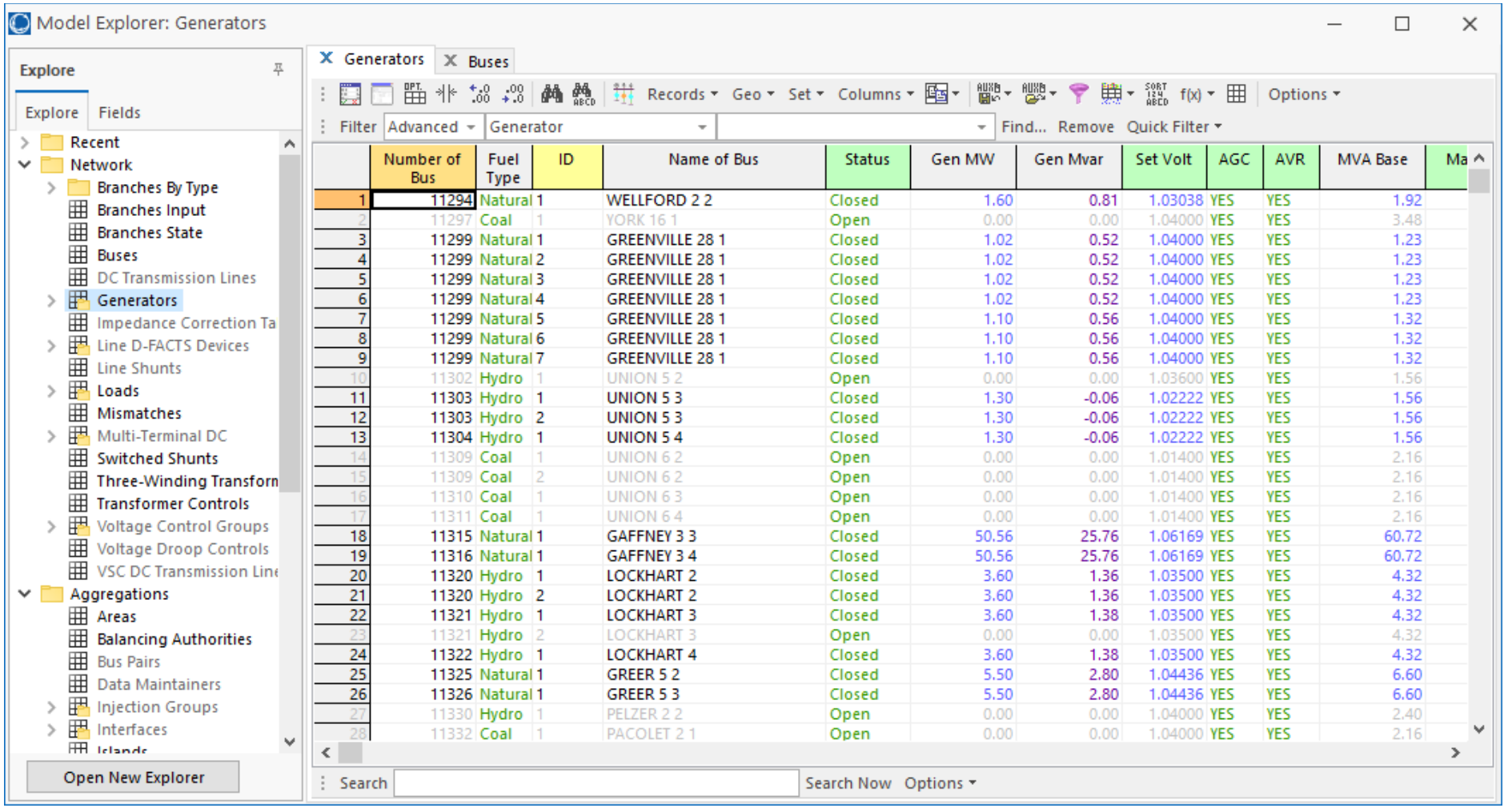
	Type	X/Longitude Location	Y/Latitude Location	Layer Name	Layer Shown	Selectable In Edit Mode	Use Conditional Zoom	Low Zoom
1	Line	-124.731	48.171	ContourStencil	YES	NO	NO	
2	Line	-88.464	31.698	Borders	YES	NO	YES	
3	Line	-88.307	30.228	Borders	YES	NO	YES	
4	Line	-94.552	36.102	Borders	YES	NO	YES	
5	Line	-110.000	36.998	Borders	YES	NO	YES	
6	Line	-122.312	37.897	Borders	YES	NO	YES	
7	Line	-119.721	33.959	Borders	YES	NO	YES	
8	Line	-120.109	33.895	Borders	YES	NO	YES	
9	Line	-118.326	33.298	Borders	YES	NO	YES	
10	Line	-118.424	32.800	Borders	YES	NO	YES	
11	Line	-119.454	33.215	Borders	YES	NO	YES	
12	Line	-120.295	34.022	Borders	YES	NO	YES	
13	Line	-119.390	34.003	Borders	YES	NO	YES	
14	Line	-122.002	38.103	Borders	YES	NO	YES	
15	Line	-121.811	38.069	Borders	YES	NO	YES	
16	Line	-121.833	38.058	Borders	YES	NO	YES	
17	Line	-122.419	37.861	Borders	YES	NO	YES	
18	Line	-122.378	37.827	Borders	YES	NO	YES	
19	Line	-122.367	37.901	Borders	YES	NO	YES	
20	Line	-117.154	32.689	Borders	YES	NO	YES	
21	Line	-122.424	37.828	Borders	YES	NO	YES	
22	Line	-122.372	37.902	Borders	YES	NO	YES	
23	Line	-122.469	37.965	Borders	YES	NO	YES	
24	Line	-122.516	37.778	Borders	YES	NO	YES	
25	Line	-122.517	37.780	Borders	YES	NO	YES	

Save oneline to display auxiliary file

Case Information Displays

- Case Information Displays show the power system model data and results in tabular format
- Case information displays show information about
  - buses
  - generators
  - lines/transformers
  - loads
  - areas, zones
  - and everything else

Model Explorer:
Generator Case Information Display



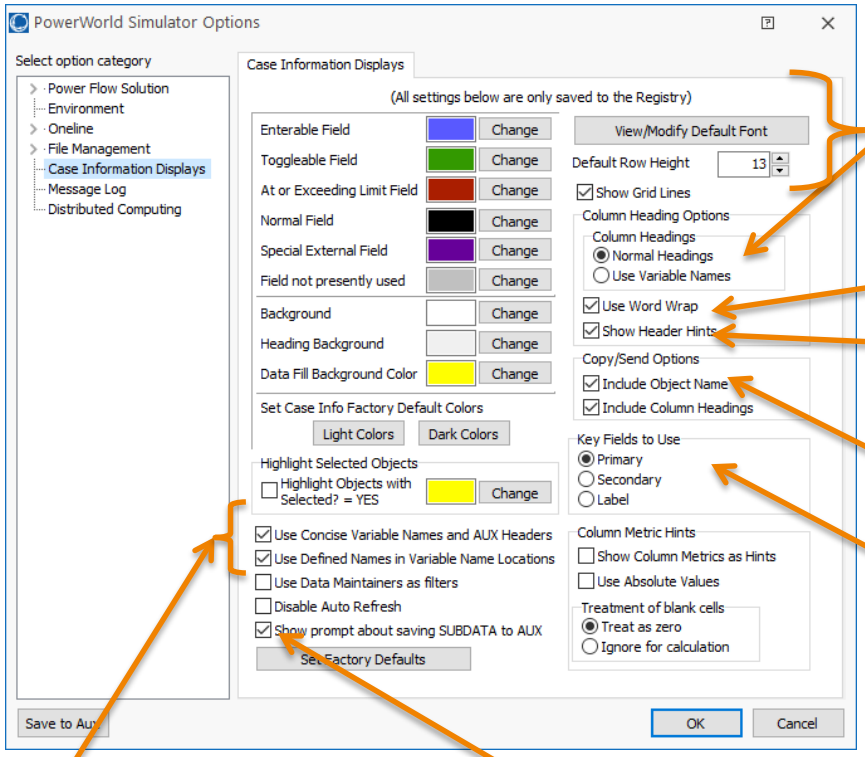
	Number of Bus	Fuel Type	ID	Name of Bus	Status	Gen MW	Gen Mvar	Set Volt	AGC	AVR	MVA Base	Ma
1	11294	Natural	1	WELLFORD 2 2	Closed	1.60	0.81	1.03038	YES	YES	1.92	
2	11297	Coal	1	YORK 16 1	Open	0.00	0.00	1.04000	YES	YES	3.48	
3	11299	Natural	1	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	
4	11299	Natural	2	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	
5	11299	Natural	3	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	
6	11299	Natural	4	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	
7	11299	Natural	5	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	YES	YES	1.32	
8	11299	Natural	6	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	YES	YES	1.32	
9	11299	Natural	7	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	YES	YES	1.32	
10	11302	Hydro	1	UNION 5 2	Open	0.00	0.00	1.03600	YES	YES	1.56	
11	11303	Hydro	1	UNION 5 3	Closed	1.30	-0.06	1.02222	YES	YES	1.56	
12	11303	Hydro	2	UNION 5 3	Closed	1.30	-0.06	1.02222	YES	YES	1.56	
13	11304	Hydro	1	UNION 5 4	Closed	1.30	-0.06	1.02222	YES	YES	1.56	
14	11309	Coal	1	UNION 6 2	Open	0.00	0.00	1.01400	YES	YES	2.16	
15	11309	Coal	2	UNION 6 2	Open	0.00	0.00	1.01400	YES	YES	2.16	
16	11310	Coal	1	UNION 6 3	Open	0.00	0.00	1.01400	YES	YES	2.16	
17	11311	Coal	1	UNION 6 4	Open	0.00	0.00	1.01400	YES	YES	2.16	
18	11315	Natural	1	GAFFNEY 3 3	Closed	50.56	25.76	1.06169	YES	YES	60.72	
19	11316	Natural	1	GAFFNEY 3 4	Closed	50.56	25.76	1.06169	YES	YES	60.72	
20	11320	Hydro	1	LOCKHART 2	Closed	3.60	1.36	1.03500	YES	YES	4.32	
21	11320	Hydro	2	LOCKHART 2	Closed	3.60	1.36	1.03500	YES	YES	4.32	
22	11321	Hydro	1	LOCKHART 3	Closed	3.60	1.38	1.03500	YES	YES	4.32	
23	11321	Hydro	2	LOCKHART 3	Open	0.00	0.00	1.03500	YES	YES	4.32	
24	11322	Hydro	1	LOCKHART 4	Closed	3.60	1.38	1.03500	YES	YES	4.32	
25	11325	Natural	1	GREER 5 2	Closed	5.50	2.80	1.04436	YES	YES	6.60	
26	11326	Natural	1	GREER 5 3	Closed	5.50	2.80	1.04436	YES	YES	6.60	
27	11330	Hydro	1	PELZER 2 2	Open	0.00	0.00	1.04000	YES	YES	2.40	
28	11332	Coal	1	PACOLET 2 1	Open	0.00	0.00	1.04000	YES	YES	2.16	

Case Information Displays

- Most case information displays can be opened from the Model Explorer
  - Case info displays also are integrated into many Simulator dialogs
- Case Information Features
  - Find, Search For Text
  - Sorting
  - Filtering
  - Copy/Paste to/from a spreadsheet
  - Column Contouring
  - Column Metrics
  - Etc.
- User-Defined Case Info Displays
  - Useful for finding fields for objects that do not have a default case information display, i.e., Contingency Options

Case Information Displays Options

- From the **Options** ribbon tab select **Simulator Options**…
- Go to **Case Information Displays** page



Use *Normal Headings* or *Variable Names*

Variable Names are important when working with auxiliary files and SimAuto

Default Font and Row Height for all case info displays

Word Wrap long column headings

Hints explain field when mouse floats over column heading. This is a means of built-in documentation for fields.

Options when using the Copy and Send local menu options

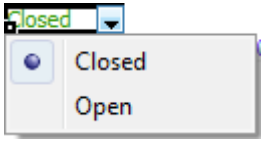
Key field to use when auxiliary file SUBDATA and also identifying objects in some fields

Determine how variables are specified when saving auxiliary files

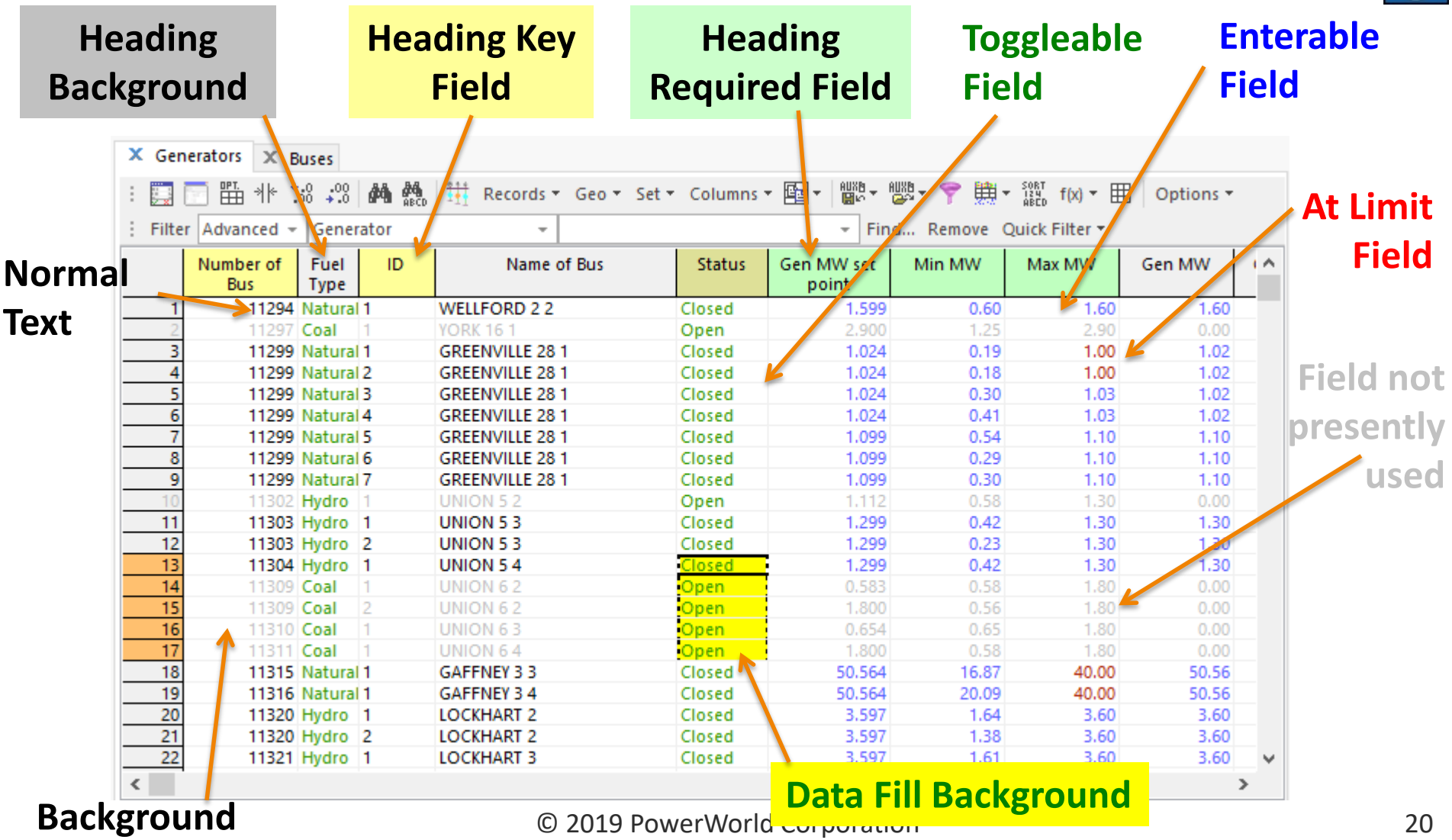
Relevant when saving generator and load data to auxiliary files

Color Schemes

- Field Colors
  - Enterable Field
    - Fields that you can edit directly on the case info display
  - Toggleable Field
    - Double-click to change the value, or click the button to view and select from the available toggle choices
  - Special External Field
    - Fields that cannot be entered inside Simulator, but can via Paste from Excel or AUX file read
  - Field not presently used
    - Data is not applicable, e.g., when a generator is open and all the fields appear gray
  - Normal
    - Field cannot be changed directly by user
  - At or Exceeding Limit
    - Limit Monitoring settings impact relevant objects
- Background Colors
  - Background and Heading Background are self-explanatory
  - Data Fill Background
    - Background used when filling in data via mouse drag to be the same as other data

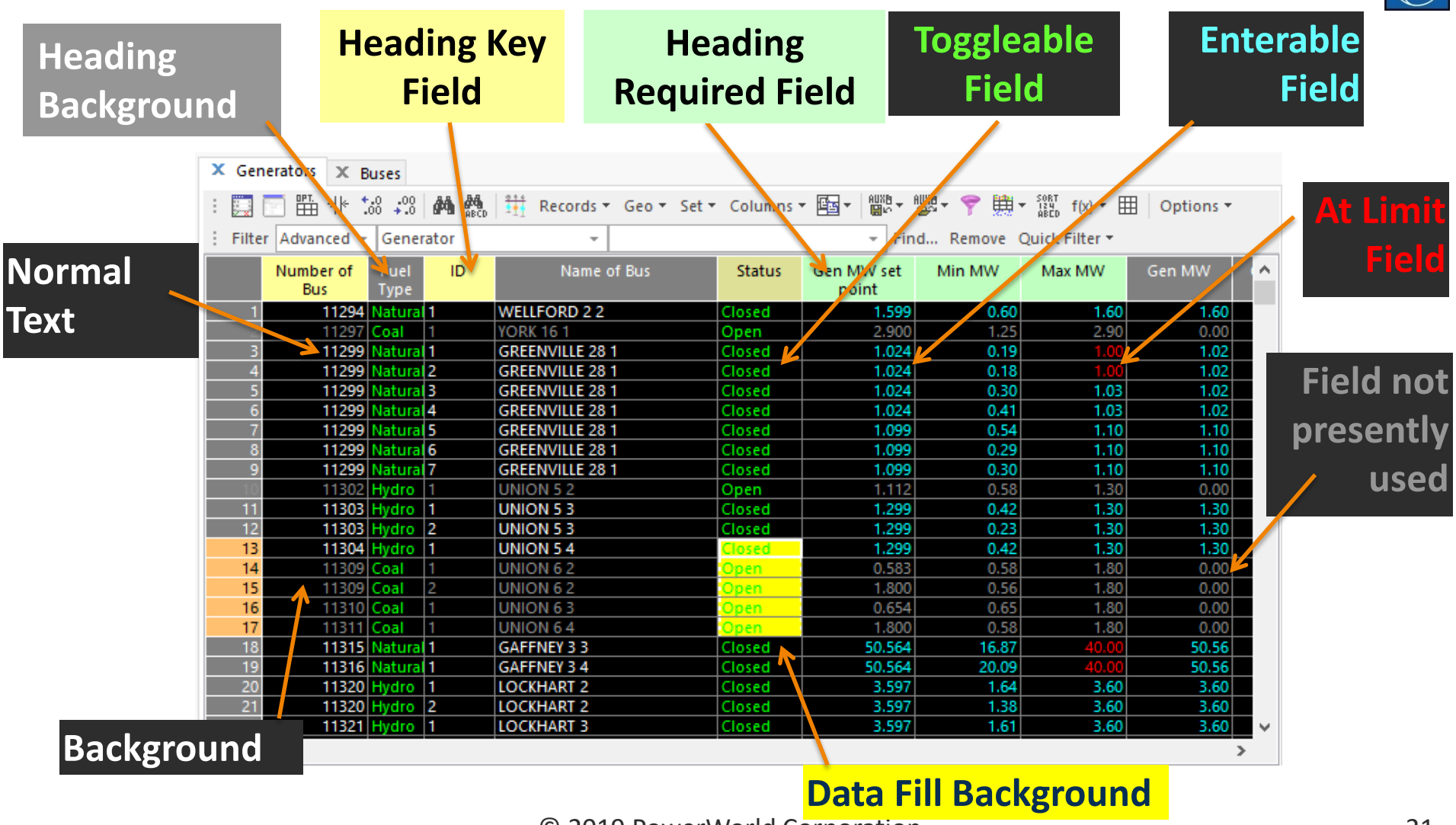


Default Case Information Light Color Scheme



	Number of Bus	Fuel Type	ID	Name of Bus	Status	Gen MW set point	Min MW	Max MW	Gen MW
1	11294	Natural	1	WELLFORD 2 2	Closed	1.599	0.60	1.60	1.60
2	11297	Coal	1	YORK 16 1	Open	2.900	1.25	2.90	0.00
3	11299	Natural	1	GREENVILLE 28 1	Closed	1.024	0.19	1.00	1.02
4	11299	Natural	2	GREENVILLE 28 1	Closed	1.024	0.18	1.00	1.02
5	11299	Natural	3	GREENVILLE 28 1	Closed	1.024	0.30	1.03	1.02
6	11299	Natural	4	GREENVILLE 28 1	Closed	1.024	0.41	1.03	1.02
7	11299	Natural	5	GREENVILLE 28 1	Closed	1.099	0.54	1.10	1.10
8	11299	Natural	6	GREENVILLE 28 1	Closed	1.099	0.29	1.10	1.10
9	11299	Natural	7	GREENVILLE 28 1	Closed	1.099	0.30	1.10	1.10
10	11302	Hydro	1	UNION 5 2	Open	1.112	0.58	1.30	0.00
11	11303	Hydro	1	UNION 5 3	Closed	1.299	0.42	1.30	1.30
12	11303	Hydro	2	UNION 5 3	Closed	1.299	0.23	1.30	1.30
13	11304	Hydro	1	UNION 5 4	Closed	1.299	0.42	1.30	1.30
14	11309	Coal	1	UNION 6 2	Open	0.583	0.58	1.80	0.00
15	11309	Coal	2	UNION 6 2	Open	1.800	0.56	1.80	0.00
16	11310	Coal	1	UNION 6 3	Open	0.654	0.65	1.80	0.00
17	11311	Coal	1	UNION 6 4	Open	1.800	0.58	1.80	0.00
18	11315	Natural	1	GAFFNEY 3 3	Closed	50.564	16.87	40.00	50.56
19	11316	Natural	1	GAFFNEY 3 4	Closed	50.564	20.09	40.00	50.56
20	11320	Hydro	1	LOCKHART 2	Closed	3.597	1.64	3.60	3.60
21	11320	Hydro	2	LOCKHART 2	Closed	3.597	1.38	3.60	3.60
22	11321	Hydro	1	LOCKHART 3	Closed	3.597	1.61	3.60	3.60

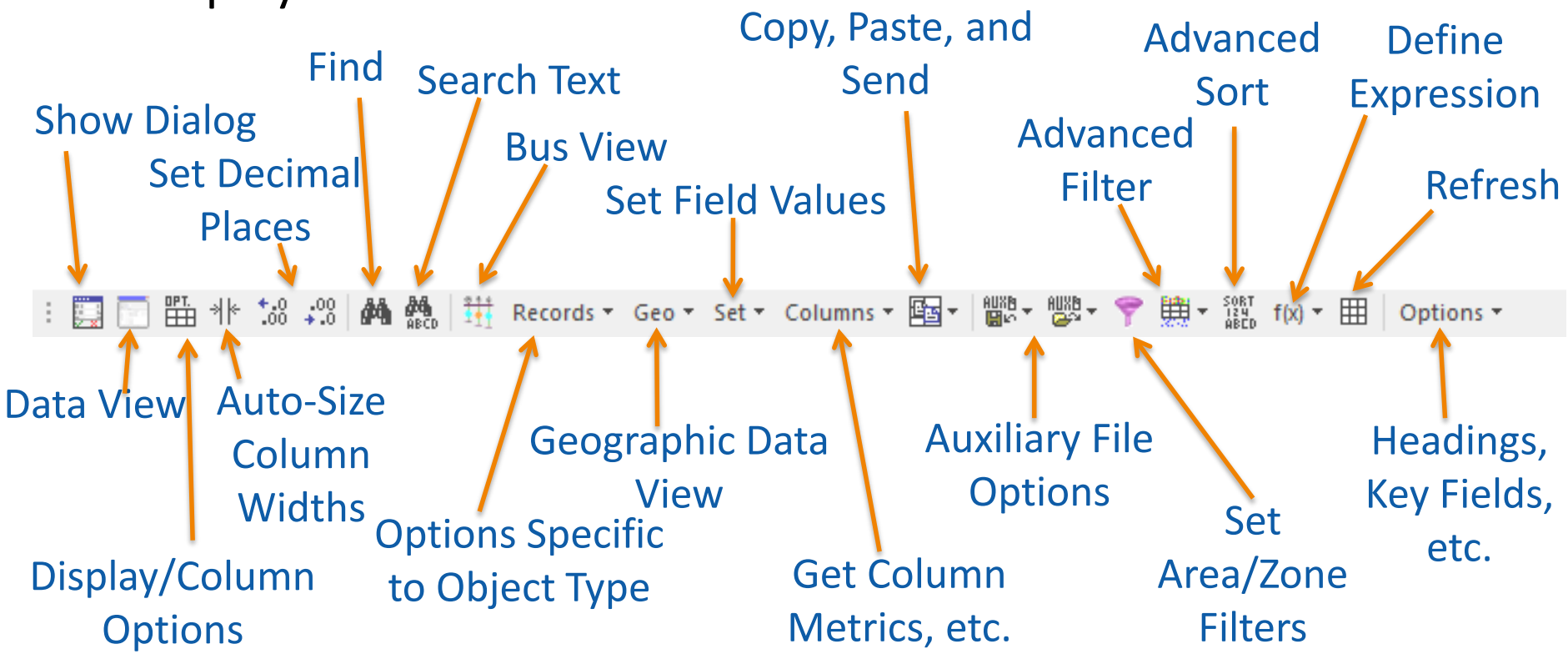
Default Case Information Dark Color Scheme



	Number of Bus	Fuel Type	ID	Name of Bus	Status	Gen MW set point	Min MW	Max MW	Gen MW
1	11294	Natural	1	WELLFORD 2 2	Closed	1.599	0.60	1.60	1.60
2	11297	Coal	1	YORK 16 1	Open	2.900	1.25	2.90	0.00
3	11299	Natural	1	GREENVILLE 28 1	Closed	1.024	0.19	1.00	1.02
4	11299	Natural	2	GREENVILLE 28 1	Closed	1.024	0.18	1.00	1.02
5	11299	Natural	3	GREENVILLE 28 1	Closed	1.024	0.30	1.03	1.02
6	11299	Natural	4	GREENVILLE 28 1	Closed	1.024	0.41	1.03	1.02
7	11299	Natural	5	GREENVILLE 28 1	Closed	1.099	0.54	1.10	1.10
8	11299	Natural	6	GREENVILLE 28 1	Closed	1.099	0.29	1.10	1.10
9	11299	Natural	7	GREENVILLE 28 1	Closed	1.099	0.30	1.10	1.10
10	11302	Hydro	1	UNION 5 2	Open	1.112	0.58	1.30	0.00
11	11303	Hydro	1	UNION 5 3	Closed	1.299	0.42	1.30	1.30
12	11303	Hydro	2	UNION 5 3	Closed	1.299	0.23	1.30	1.30
13	11304	Hydro	1	UNION 5 4	Closed	1.299	0.42	1.30	1.30
14	11309	Coal	1	UNION 6 2	Open	0.583	0.58	1.80	0.00
15	11309	Coal	2	UNION 6 2	Open	1.800	0.56	1.80	0.00
16	11310	Coal	1	UNION 6 3	Open	0.654	0.65	1.80	0.00
17	11311	Coal	1	UNION 6 4	Open	1.800	0.58	1.80	0.00
18	11315	Natural	1	GAFFNEY 3 3	Closed	50.564	16.87	40.00	50.56
19	11316	Natural	1	GAFFNEY 3 4	Closed	50.564	20.09	40.00	50.56
20	11320	Hydro	1	LOCKHART 2	Closed	3.597	1.64	3.60	3.60
21	11320	Hydro	2	LOCKHART 2	Closed	3.597	1.38	3.60	3.60
22	11321	Hydro	1	LOCKHART 3	Closed	3.597	1.61	3.60	3.60

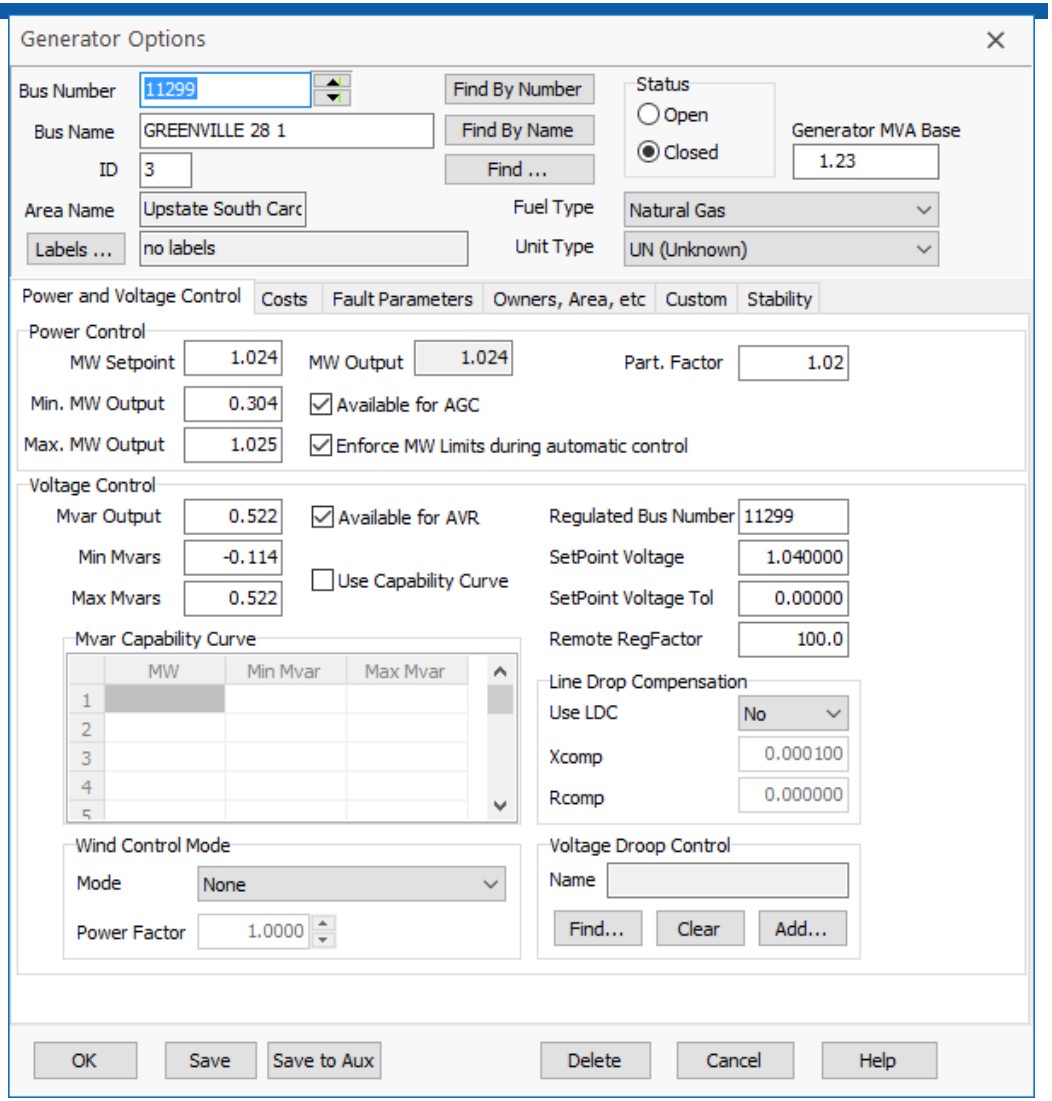
Case Information Toolbar

- Many common Case Information Display actions are available from the Case Information Toolbar
- By default, this toolbar is visible with all case information displays



Show Dialog

- Bring up any object's dialog by choosing **Show Dialog**
- Example:
  - Generator



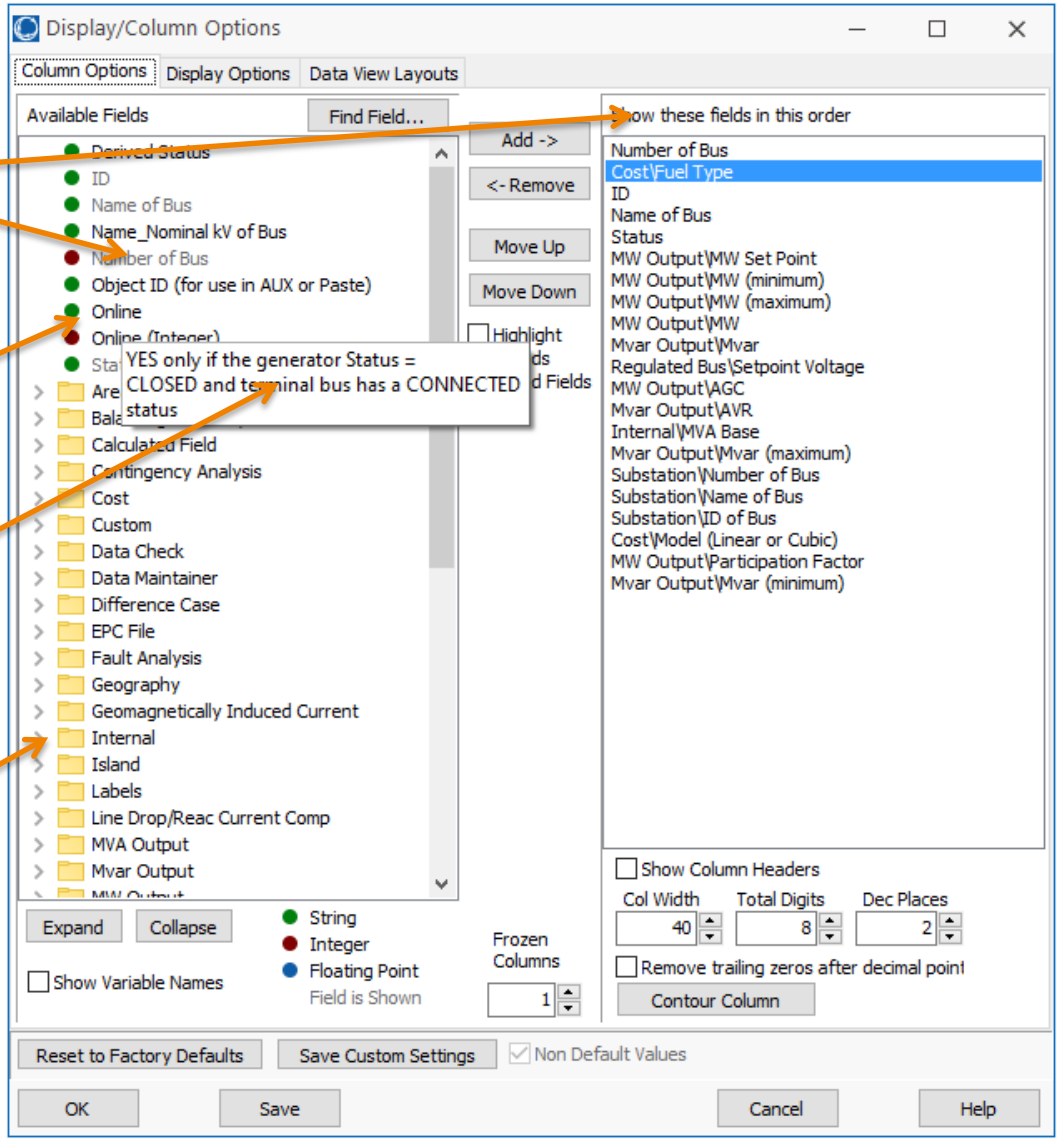
Display/Column Options
Column Options

Gray text means the field is already shown

Colored Dots represent the field type

Hints automatically appear giving a description of the field

Fields organized by folder



Display/Column Options
Column Options

- Choose fields from the **Available Fields** list and then left-click and drag into the **Show these fields in this order** list

Also can click the **Add →** or **←Remove** Buttons to modify the fields shown

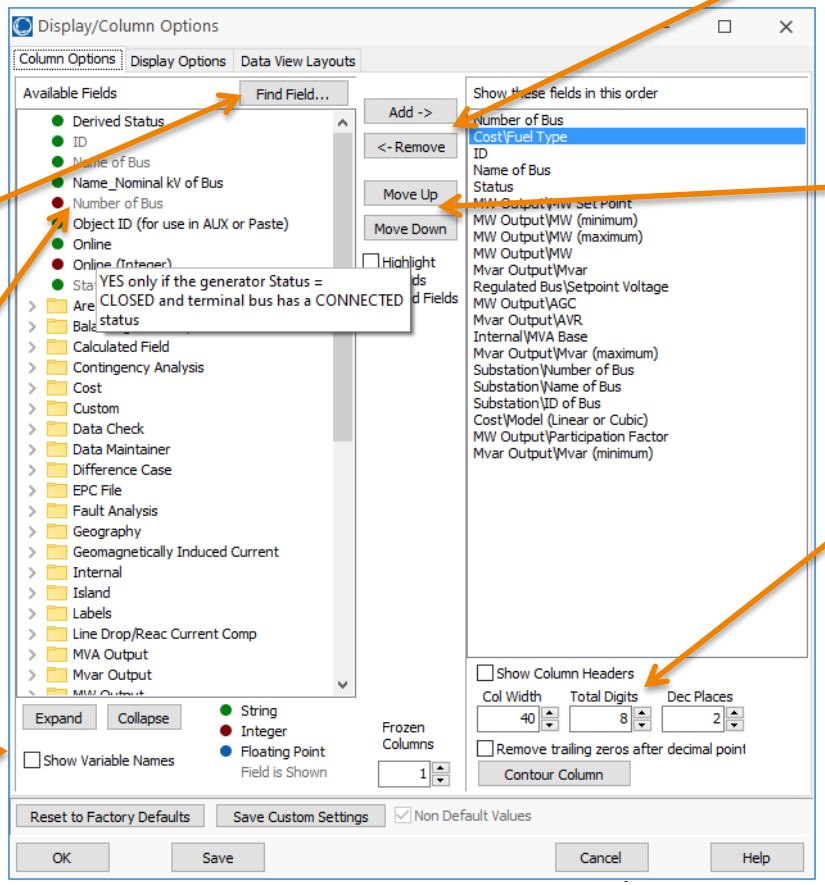
Use a wildcard find for a particular field

Click **Move Up** and **Move Down** to change the order of the columns

Fields grayed out if already in display

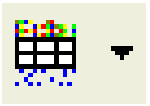
Change attributes of the display columns. Also, use toolbar buttons

Show Variable Names

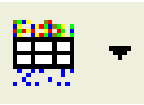


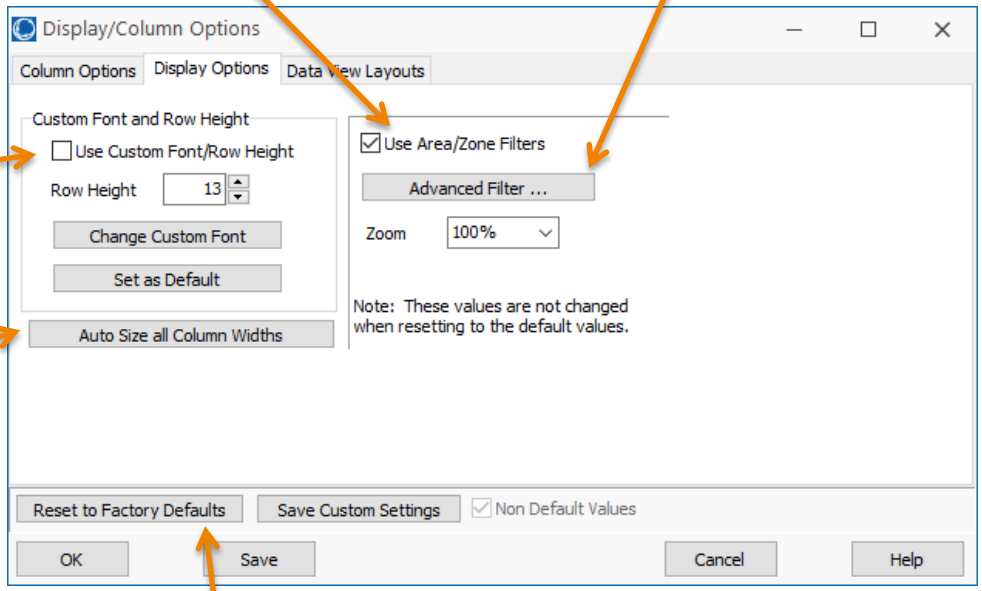
Display/Column Options
Display Options

Will disable the area/zone filtering for a single case info display. Also available via a toolbar button.



Define a custom filter
Also available via a toolbar button





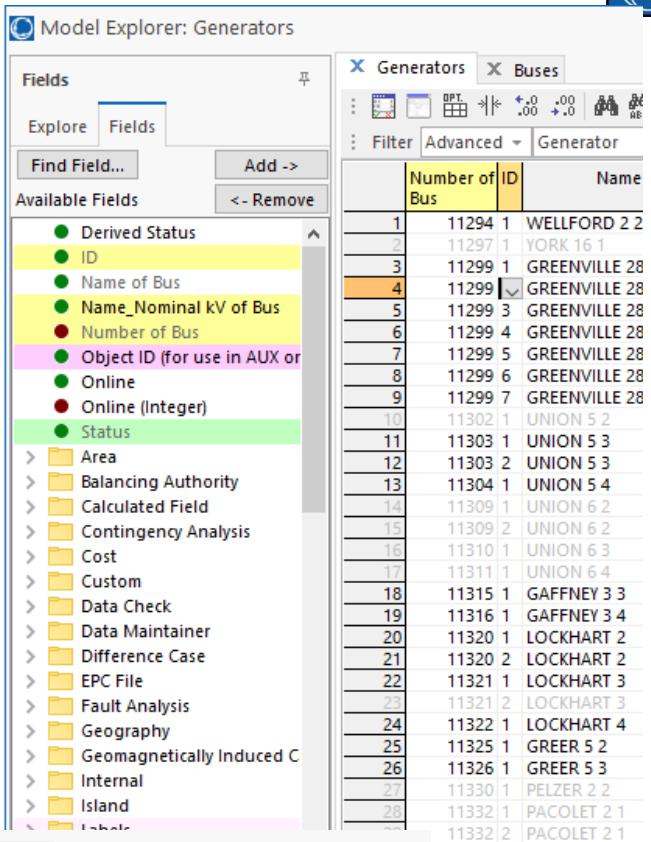
Change custom fonts and row heights

Auto resize all column widths. Also available via a toolbar button.

Reset all values to default

Alternative Display/Column Options
Model Explorer: Fields Pane

- Fields Pane: Directly modify the columns shown by left clicking and dragging from the Fields Pane onto the case information display
  - Location of new field is highlighted by a **red** line
- Left click and drag at the top of columns to reorder them on any case information display
  - Column being moved is highlighted by **red** box
  - Location being moved to is highlighted by a **red** line



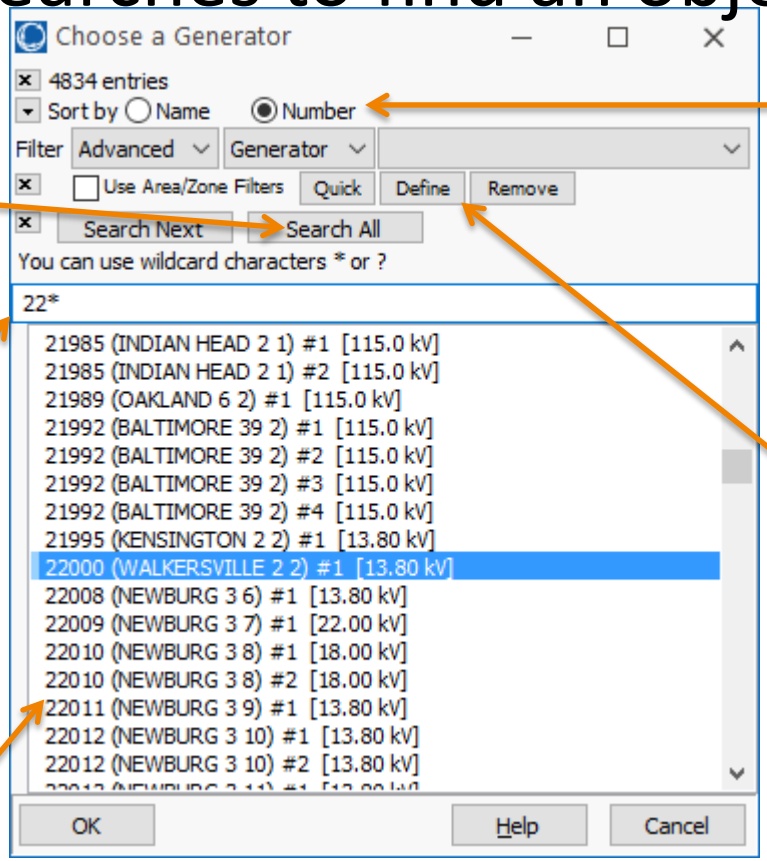
Find…

- Use wildcard searches to find an object

Brings up a dialog list of all objects that meet the wildcard string

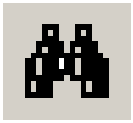
Wildcard string. Use:
* - several unknown characters
? - a single unknown character

A list of all the objects



Sort List by name or number

Filter the List



Example Wildcard Searches

- On both the Find and Search for Text Dialogs, you can use wildcard searching
  - * several unknown characters
  - ? a single unknown character
- * Examples
  - *pw* would find “abcpw123”, “pw123”, and “abcpw”
  - pw* would only find “pw123”
  - *pw would only find “abcpw”
- ? Examples
  - ?pw* would find “apw123” and “apw”
  - ?pw* would NOT find “abcpw123”

Search for Text…

- Search through the text shown on the case information display for a particular string
- Feature can also be accessed directly on the Search Toolbar at the bottom of the Model Explorer

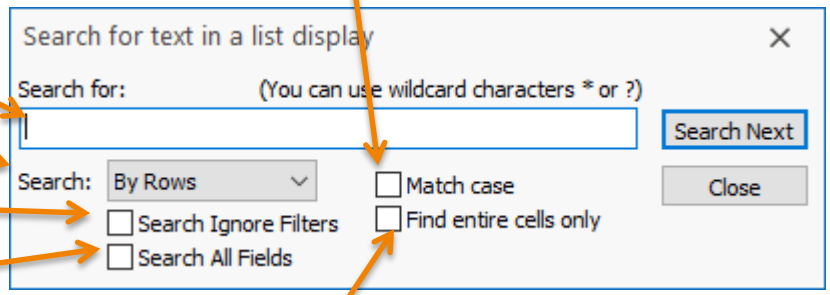
Enter Search String

Search by columns or rows

Search records filtered out

Search fields not displayed

Match upper/lower case letters



Only search if entire cell matches

Search for Text Options

- Search Ignore Filters
  - Choose this option to search through all records of the object type shown on the case information display regardless of the present filtering applied
  - If the text is found outside of the presently shown objects, then you will be prompted to remove filtering
- Search All Fields
  - Choose this option to search through all fields of the object type shown on the case information display regardless of the presently shown fields
  - If the text is found in a field not presently shown, then you will be prompted to show the column

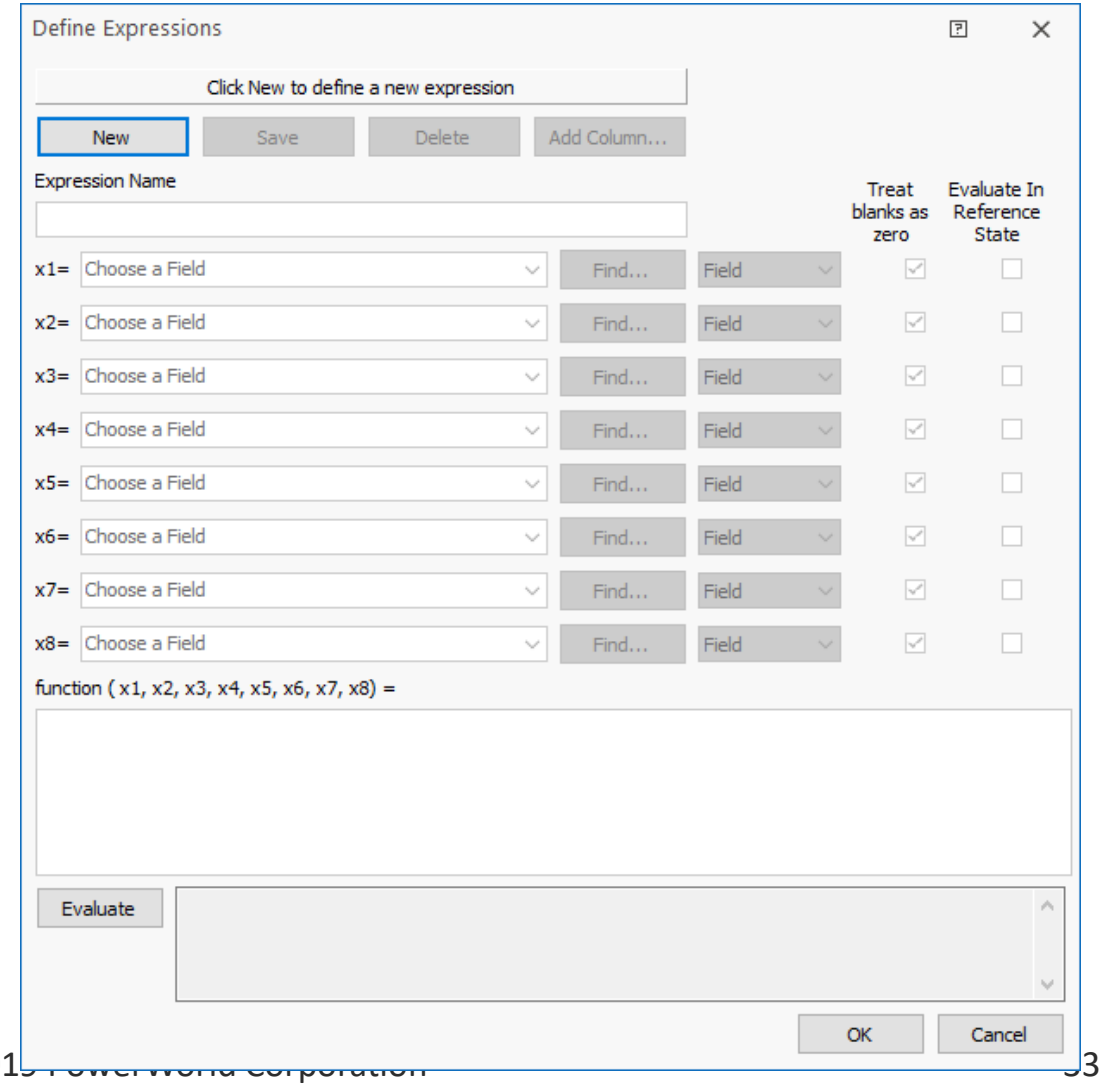
Records Menu

- Contains a list of actions related to the specific kinds of records displayed in the case information display
- Common choices available here
  - **Insert** and **Delete**: to insert and delete objects
  - **Bus View** and **Substation View**
  - **Area/Zone/Owner Filters**
  - **Pan to Object on Oneline** – choose to pan to a display object that represents the active row
- Typical other choices
  - Special choices for each particular record type
  - Automatically creating objects from the selection

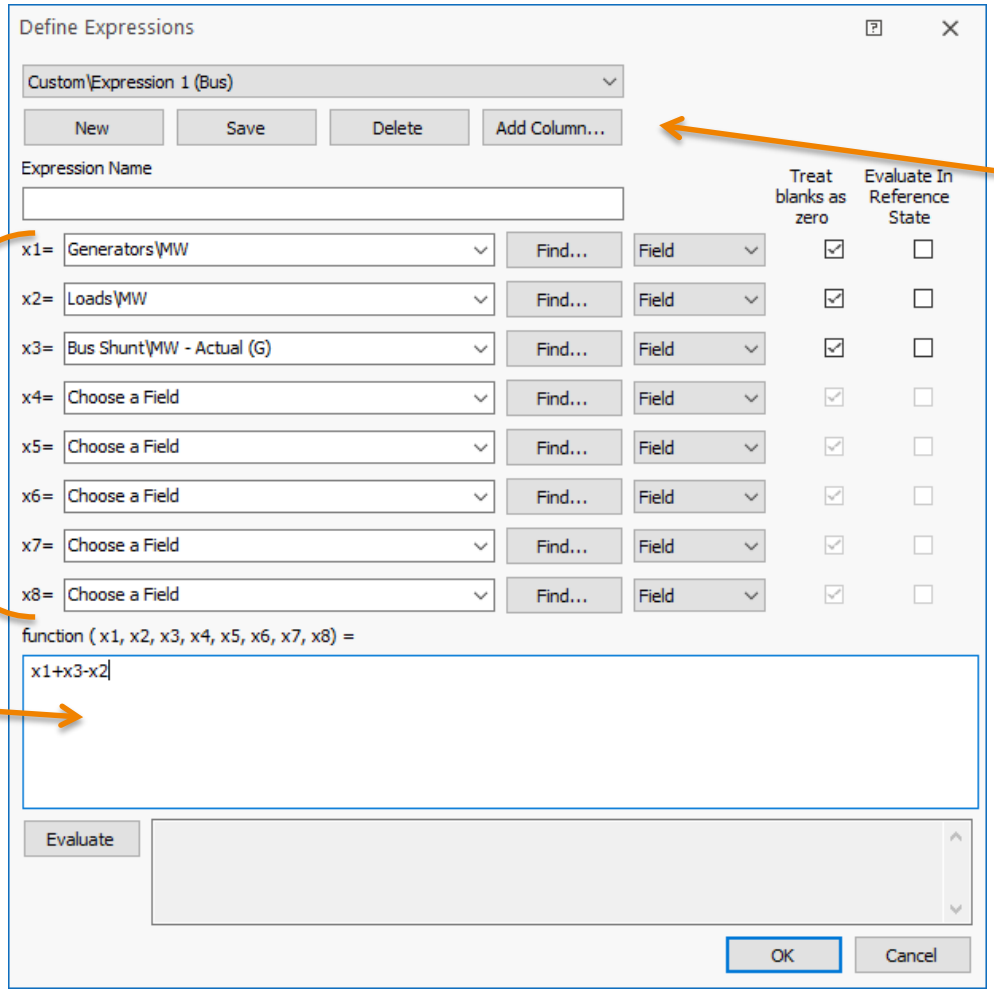
f(x)

Define Expression

- To open the Custom Expression Dialog, select the **f(x)** toolbar menu and choose **Define Expression**…
- Then click **New** to make a new expression



f(x) Creating a Custom Expression



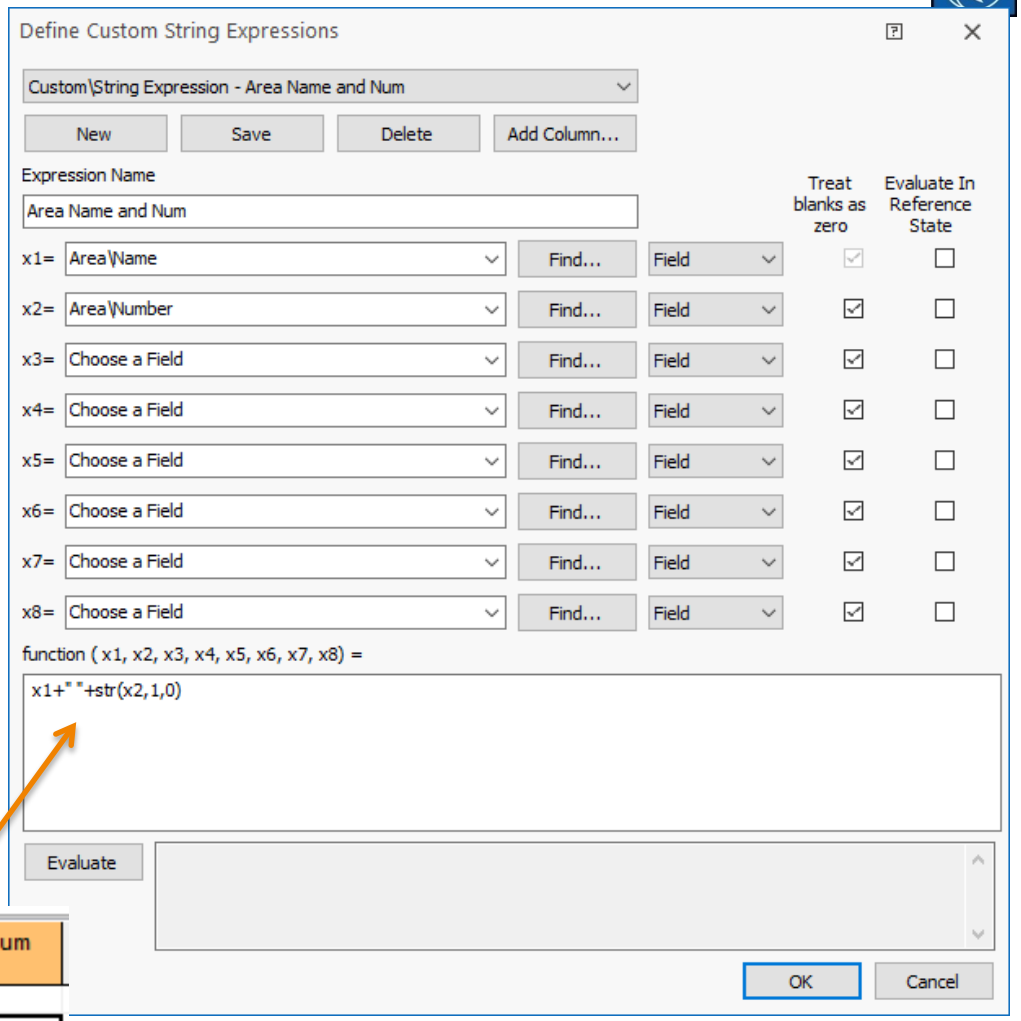
Specify the fields used in the expression

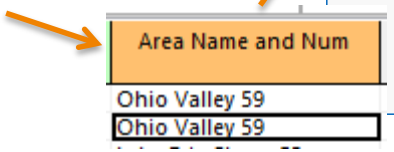
Write the expression as a function of x1, x2, …

Choose Add Column… as a quick way to add the column to the Case Info Display

Define String Expression

- Select the **f(x)** toolbar menu, choose **Define String Expression**…, and click **New**
- Can concatenate strings with the **+** operator
- Convert numeric fields to strings with **Str** function
- Example: Area Name and Number





Geo Menu

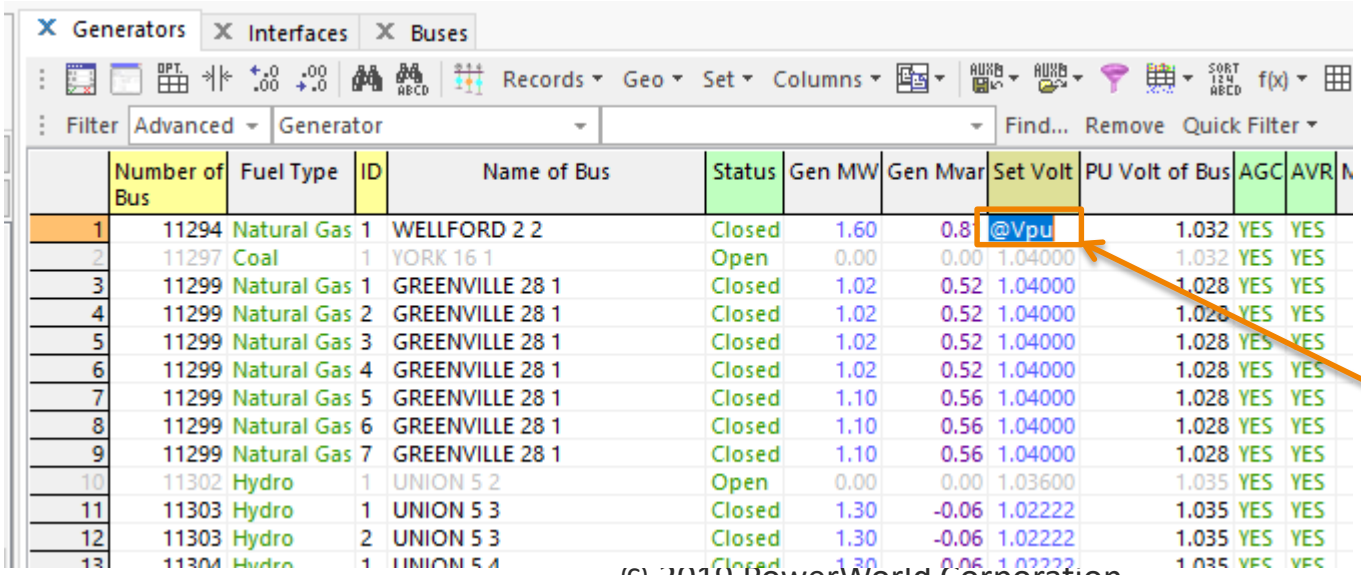
- Geo Menu provides access to options related to the automatic creation of Geographic Data Views
  - There must be latitude/longitude information populated in either the bus records or the substation records for this to work

Set Menu

- Set Menu contains options for changing values in the presently selected column
  - **Toggle All YES**, **NO**, **Closed**, **Open**, etc.
  - **Set All Values To**…
    - Choose this option to set all values in the active column to a particular value. A dialog will appear allowing you to specify the value to which to set the values.
  - **Set All Values to Field**…
    - Choose this option to set all values in the active column to the values in another column.
      - For example, you may change the voltage set-point of a generator to be equal to the terminal voltage of the generator. A dialog will appear asking you to choose the field.
- Actions only apply to objects presently being shown on the display – *Filtering is important*

Set Values to Field… Another Way
Enter Data from Another Field

- When typing, append the @ symbol to copy data from another field
- Fields must be identified with Variable Names
  - Auxiliary files use variable names exclusively
- Example: Type **@Vpu** into the generator setpoint voltage and it will change the setpoint to the terminal voltage
- This also works in auxiliary files or when pasting from Excel
  - When entering in Excel, you may need to add a single quote (') before the @ symbol



	Number of Bus	Fuel Type	ID	Name of Bus	Status	Gen MW	Gen Mvar	Set Volt	PU Volt of Bus	AGC	AVR
1	11294	Natural Gas	1	WELLFORD 2 2	Closed	1.60	0.8	@Vpu	1.032	YES	YES
2	11297	Coal	1	YORK 16 1	Open	0.00	0.00	1.04000	1.032	YES	YES
3	11299	Natural Gas	1	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.028	YES	YES
4	11299	Natural Gas	2	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.028	YES	YES
5	11299	Natural Gas	3	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.028	YES	YES
6	11299	Natural Gas	4	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.028	YES	YES
7	11299	Natural Gas	5	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	1.028	YES	YES
8	11299	Natural Gas	6	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	1.028	YES	YES
9	11299	Natural Gas	7	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	1.028	YES	YES
10	11302	Hydro	1	UNION 5 2	Open	0.00	0.00	1.03600	1.035	YES	YES
11	11303	Hydro	1	UNION 5 3	Closed	1.30	-0.06	1.02222	1.035	YES	YES
12	11303	Hydro	2	UNION 5 3	Closed	1.30	-0.06	1.02222	1.035	YES	YES

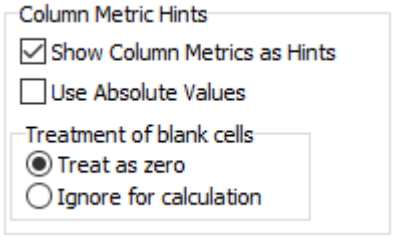
Value will be set to 1.032 on enter

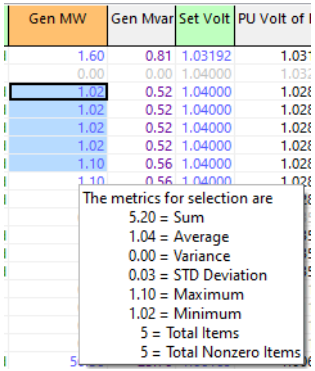
Columns Menu

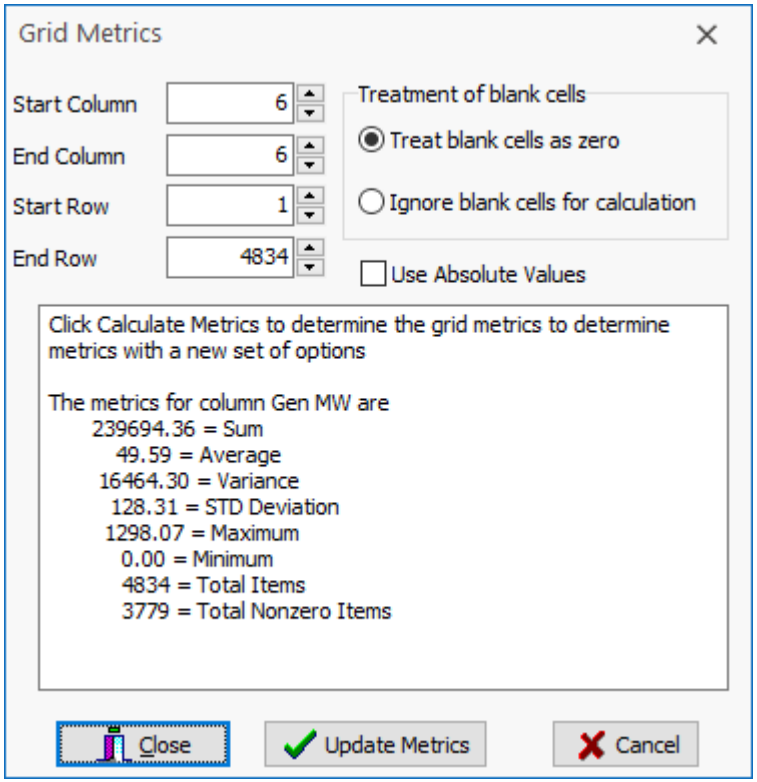
- Several options generally available
  - **Select Columns** and **Select Rows**
  - **Get Column Metrics**
    - Get statistical information about the data shown
  - **Contour Columns**
    - Color the background of the cells in the column
  - **Plot Columns**
    - Show a plot of the data in the columns

Get Column Metrics

- Available under the **Columns** toolbar menu
- Choose to get the statistical information about the column you click
  - Only for those values that are presently displayed
- Column metrics can also be displayed as hover hints when specifying with option with Case Information Displays Options







Columns

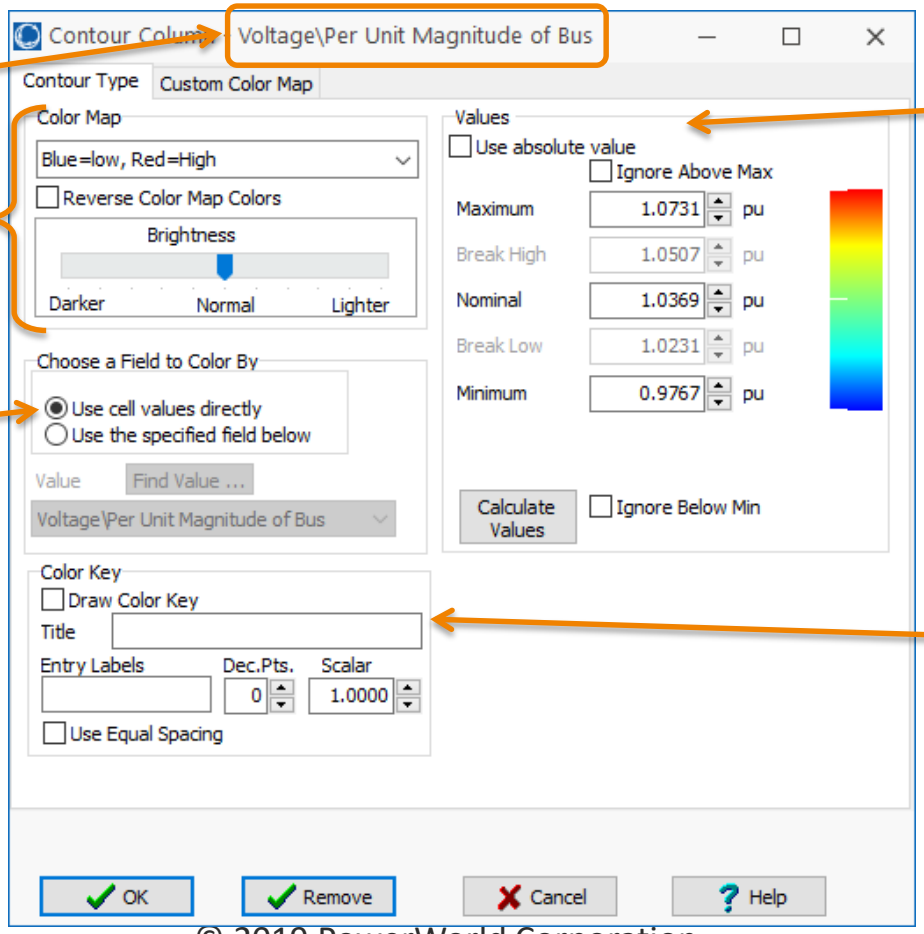
Contour Column

- To open the Contour Column Dialog, select the **Columns** toolbar menu and choose **Contour Column…**

Column being contoured

Choose your color map

Choose the fields to use for the contouring (normally the same as the column being contoured)

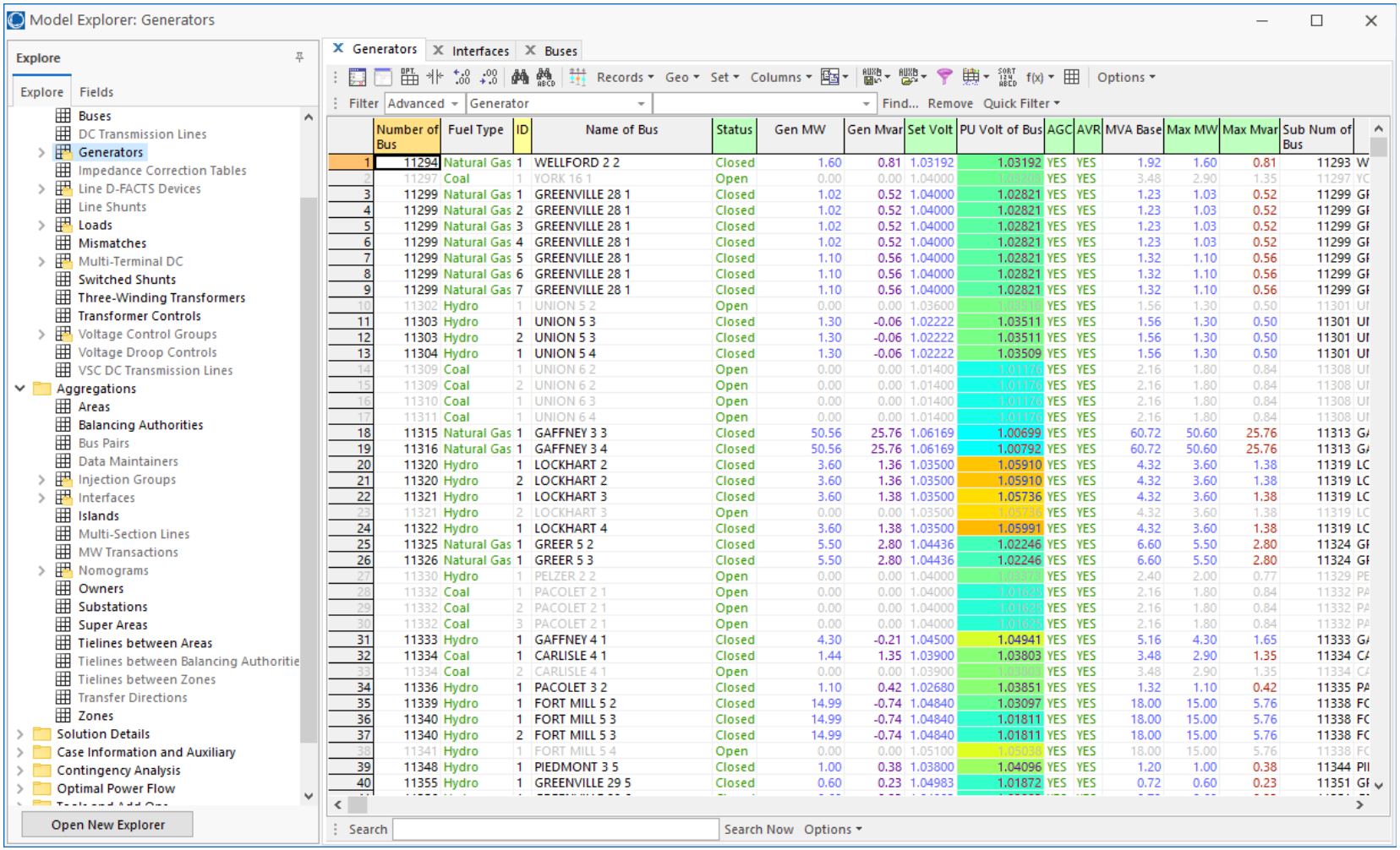


Choose how the values map to colors

Options regarding the Color Key

Columns

Example Display with Contoured Columns



	Number of Bus	Fuel Type	ID	Name of Bus	Status	Gen MW	Gen Mvar	Set Volt	PU Volt of Bus	AGC	AVR	MVA Base	Max MW	Max Mvar	Sub Num of Bus	
1	11294	Natural Gas	1	WELLFORD 2 2	Closed	1.60	0.81	1.03192	1.03192	YES	YES	1.92	1.60	0.81	11293	W
2	11297	Coal	1	YORK 16 1	Open	0.00	0.00	1.04000	1.03200	YES	YES	3.48	2.90	1.35	11297	YC
3	11299	Natural Gas	1	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.02821	YES	YES	1.23	1.03	0.52	11299	GF
4	11299	Natural Gas	2	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.02821	YES	YES	1.23	1.03	0.52	11299	GF
5	11299	Natural Gas	3	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.02821	YES	YES	1.23	1.03	0.52	11299	GF
6	11299	Natural Gas	4	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	1.02821	YES	YES	1.23	1.03	0.52	11299	GF
7	11299	Natural Gas	5	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	1.02821	YES	YES	1.32	1.10	0.56	11299	GF
8	11299	Natural Gas	6	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	1.02821	YES	YES	1.32	1.10	0.56	11299	GF
9	11299	Natural Gas	7	GREENVILLE 28 1	Closed	1.10	0.56	1.04000	1.02821	YES	YES	1.32	1.10	0.56	11299	GF
10	11302	Hydro	1	UNION 5 2	Open	0.00	0.00	1.03600	1.03510	YES	YES	1.56	1.30	0.50	11301	UI
11	11303	Hydro	1	UNION 5 3	Closed	1.30	-0.06	1.02222	1.03511	YES	YES	1.56	1.30	0.50	11301	UI
12	11303	Hydro	2	UNION 5 3	Closed	1.30	-0.06	1.02222	1.03511	YES	YES	1.56	1.30	0.50	11301	UI
13	11304	Hydro	1	UNION 5 4	Closed	1.30	-0.06	1.02222	1.03509	YES	YES	1.56	1.30	0.50	11301	UI
14	11309	Coal	1	UNION 6 2	Open	0.00	0.00	1.01400	1.01176	YES	YES	2.16	1.80	0.84	11308	UI
15	11309	Coal	2	UNION 6 2	Open	0.00	0.00	1.01400	1.01176	YES	YES	2.16	1.80	0.84	11308	UI
16	11310	Coal	1	UNION 6 3	Open	0.00	0.00	1.01400	1.01176	YES	YES	2.16	1.80	0.84	11308	UI
17	11311	Coal	1	UNION 6 4	Open	0.00	0.00	1.01400	1.01176	YES	YES	2.16	1.80	0.84	11308	UI
18	11315	Natural Gas	1	GAFFNEY 3 3	Closed	50.56	25.76	1.06169	1.00699	YES	YES	60.72	50.60	25.76	11313	GA
19	11316	Natural Gas	1	GAFFNEY 3 4	Closed	50.56	25.76	1.06169	1.00792	YES	YES	60.72	50.60	25.76	11313	GA
20	11320	Hydro	1	LOCKHART 2	Closed	3.60	1.36	1.03500	1.05910	YES	YES	4.32	3.60	1.38	11319	LC
21	11320	Hydro	2	LOCKHART 2	Closed	3.60	1.36	1.03500	1.05910	YES	YES	4.32	3.60	1.38	11319	LC
22	11321	Hydro	1	LOCKHART 3	Closed	3.60	1.38	1.03500	1.05736	YES	YES	4.32	3.60	1.38	11319	LC
23	11321	Hydro	2	LOCKHART 3	Open	0.00	0.00	1.03500	1.05736	YES	YES	4.32	3.60	1.38	11319	LC
24	11322	Hydro	1	LOCKHART 4	Closed	3.60	1.38	1.03500	1.05991	YES	YES	4.32	3.60	1.38	11319	LC
25	11325	Natural Gas	1	GREER 5 2	Closed	5.50	2.80	1.04436	1.02246	YES	YES	6.60	5.50	2.80	11324	GF
26	11326	Natural Gas	1	GREER 5 3	Closed	5.50	2.80	1.04436	1.02246	YES	YES	6.60	5.50	2.80	11324	GF
27	11330	Hydro	1	PELZER 2 2	Open	0.00	0.00	1.04000	1.03817	YES	YES	2.40	2.00	0.77	11329	PE
28	11332	Coal	1	PACOLET 2 1	Open	0.00	0.00	1.04000	1.01625	YES	YES	2.16	1.80	0.84	11332	PA
29	11332	Coal	2	PACOLET 2 1	Open	0.00	0.00	1.04000	1.01625	YES	YES	2.16	1.80	0.84	11332	PA
30	11332	Coal	3	PACOLET 2 1	Open	0.00	0.00	1.04000	1.01625	YES	YES	2.16	1.80	0.84	11332	PA
31	11333	Hydro	1	GAFFNEY 4 1	Closed	4.30	-0.21	1.04500	1.04941	YES	YES	5.16	4.30	1.65	11333	GA
32	11334	Coal	1	CARLISLE 4 1	Closed	1.44	1.35	1.03900	1.03803	YES	YES	3.48	2.90	1.35	11334	CA
33	11334	Coal	2	CARLISLE 4 1	Open	0.00	0.00	1.03900	1.03803	YES	YES	3.48	2.90	1.35	11334	CA
34	11336	Hydro	1	PACOLET 3 2	Closed	1.10	0.42	1.02680	1.03851	YES	YES	1.32	1.10	0.42	11335	PA
35	11339	Hydro	1	FORT MILL 5 2	Closed	14.99	-0.74	1.04840	1.03097	YES	YES	18.00	15.00	5.76	11338	FC
36	11340	Hydro	1	FORT MILL 5 3	Closed	14.99	-0.74	1.04840	1.01811	YES	YES	18.00	15.00	5.76	11338	FC
37	11340	Hydro	2	FORT MILL 5 3	Closed	14.99	-0.74	1.04840	1.01811	YES	YES	18.00	15.00	5.76	11338	FC
38	11341	Hydro	1	FORT MILL 5 4	Open	0.00	0.00	1.05100	1.05036	YES	YES	18.00	15.00	5.76	11338	FC
39	11348	Hydro	1	PIEDMONT 3 5	Closed	1.00	0.38	1.03800	1.04096	YES	YES	1.20	1.00	0.38	11344	PI
40	11355	Hydro	1	GREENVILLE 29 5	Closed	0.60	0.23	1.04983	1.01872	YES	YES	0.72	0.60	0.23	11351	GF

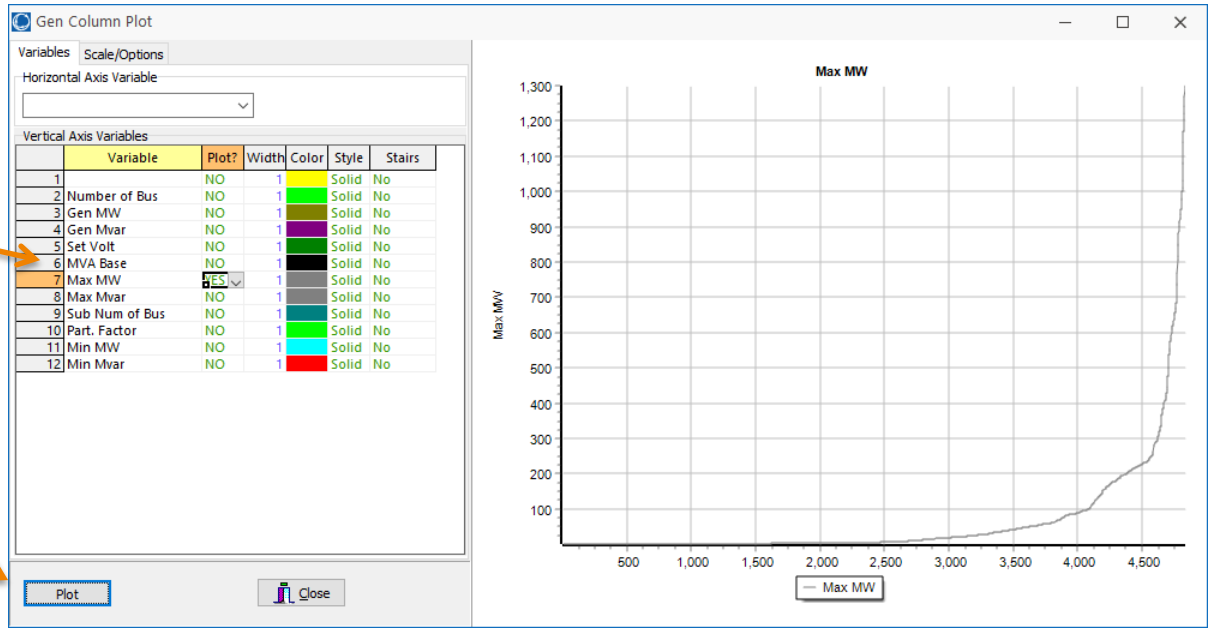
Columns

Plot Columns

- Choose the Plot Columns option to allow yourself to plot any column that is presently shown on the case information display
- An example using generator Maximum MW outputs is shown below

Set options

Click **Plot** to update plots



Area/Zone/Owner/DataMaintainer Filtering

- Slightly shorten the name by calling *Area/Zone/Owner* filtering
  - Data maintainers are a fairly new addition to this global filter and not as widely used
- Area/Zone/Owner filtering is a GLOBAL setting
  - They apply to **all** case information displays with a few exceptions
  - Areas, zones, owners, and data maintainers are **not** filtered using these settings
  - Case information displays have an option to not use Area/Zone/Owner filtering but default is to use this filtering

Area/Zone/Owner/DataMaintainer Filtering

- Use Area/Zone/Owner filtering to limit what is shown in case information displays to only those elements whose:
  - Area is set to be shown

    AND
  - Zone is set to be shown

    AND
  - Owner is set to be shown

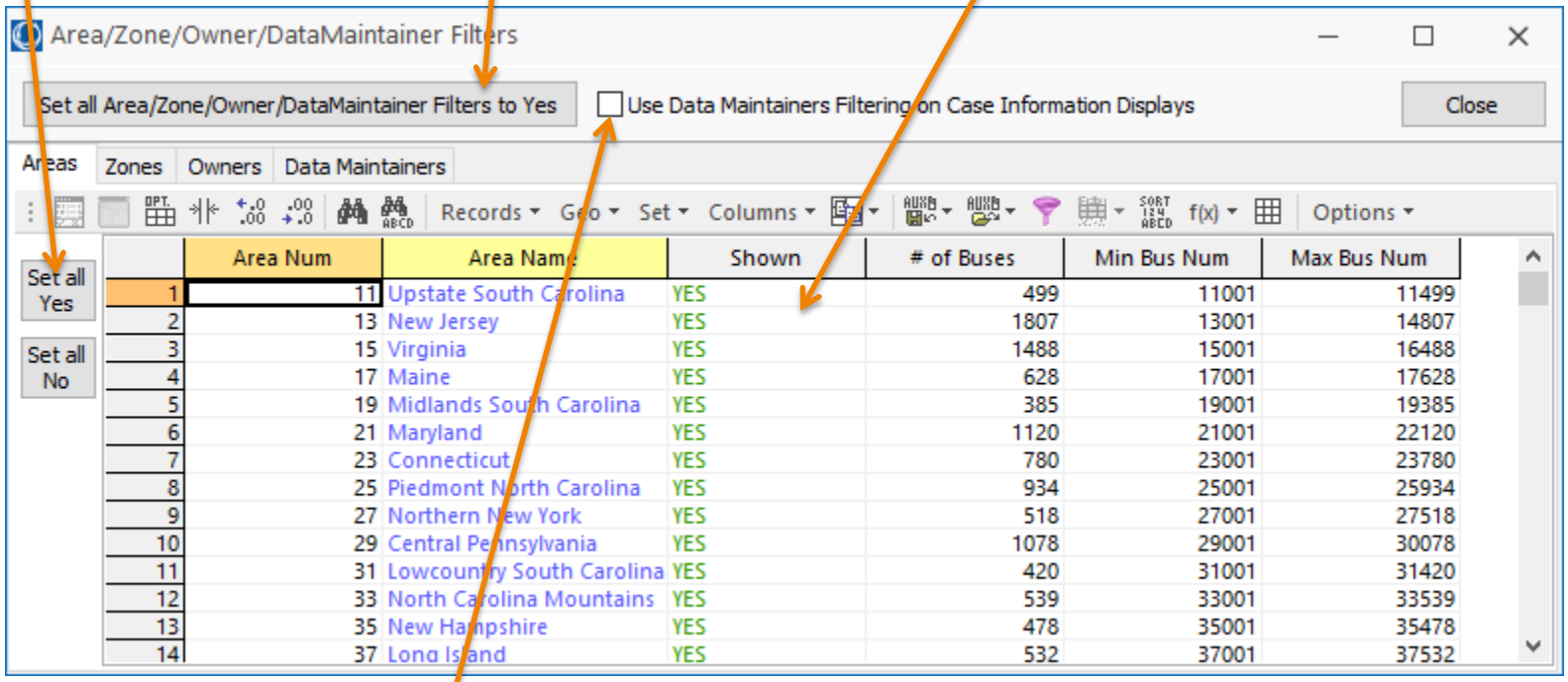
    AND
  - DataMaintainer is set to be shown

Area/Zone/Owner/DataMaintainer Filtering

Easily toggle the Shown field for the current tab

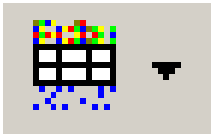
Easily reset to show everything

Toggle the Shown field for each of the Areas, Zones, Owners, and DataMaintainers to filter on



	Area Num	Area Name	Shown	# of Buses	Min Bus Num	Max Bus Num
1	11	Upstate South Carolina	YES	499	11001	11499
2	13	New Jersey	YES	1807	13001	14807
3	15	Virginia	YES	1488	15001	16488
4	17	Maine	YES	628	17001	17628
5	19	Midlands South Carolina	YES	385	19001	19385
6	21	Maryland	YES	1120	21001	22120
7	23	Connecticut	YES	780	23001	23780
8	25	Piedmont North Carolina	YES	934	25001	25934
9	27	Northern New York	YES	518	27001	27518
10	29	Central Pennsylvania	YES	1078	29001	30078
11	31	Lowcountry South Carolina	YES	420	31001	31420
12	33	North Carolina Mountains	YES	539	33001	33539
13	35	New Hampshire	YES	478	35001	35478
14	37	Long Island	YES	532	37001	37532

Data Maintainers are not as commonly used. Check box to include them and then set Shown field for individual Data Maintainers



Advanced Filtering

- Click on the **Advanced Filter** toolbar button and choose **Advanced Filter…**
- Default is to see filters that have been defined for the type of object that is being filtered (e.g. Bus, Generator, Interface, etc.)
- When choosing the field to filter against, use the **Find…** button
  - Many locations in Simulator have a drop-down list of fields to choose from
  - Lists can have 100s of entries and are difficult to navigate
  - Use the **Find…** button to make it easier

Advanced Filter Dialog

Indicates if an *Advanced* or *Device* filter

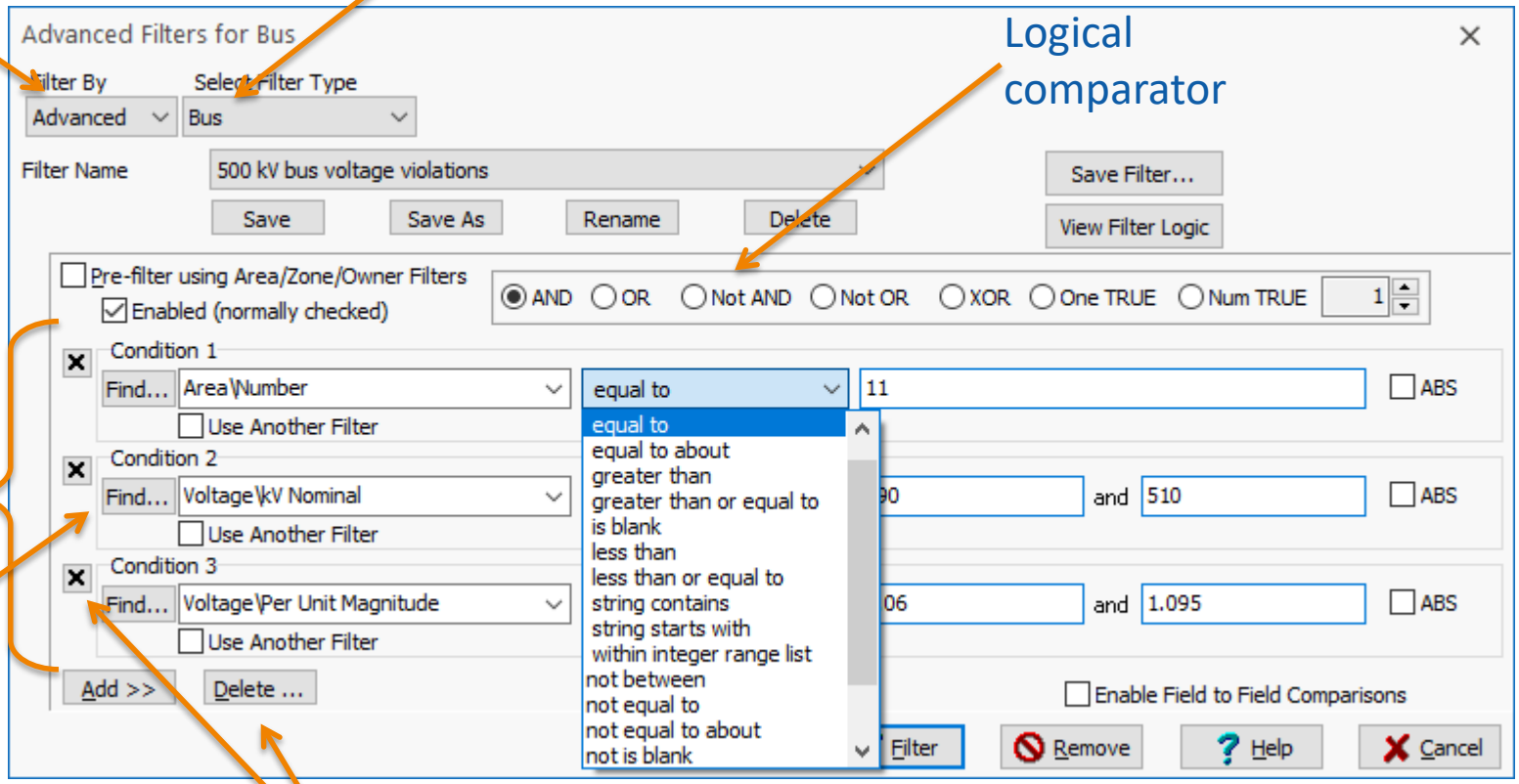
Type of object being filtered

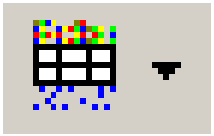
Logical comparator

Conditions

Use the **Find…** buttons

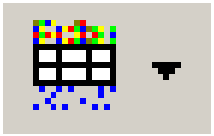
Click to delete a condition





Advanced Filter

- No Maximum Amount of Conditions
  - Choose the field, the comparator, and the values for comparison
  - Fields are the same as those available for case information displays
- Optionally “pre-filter” using the Area/Zone/Owner Filters can be done
  - Be careful with this option because as soon as changes are made to the Area/Zone/Owner filtering this will be reflected in the advanced filter



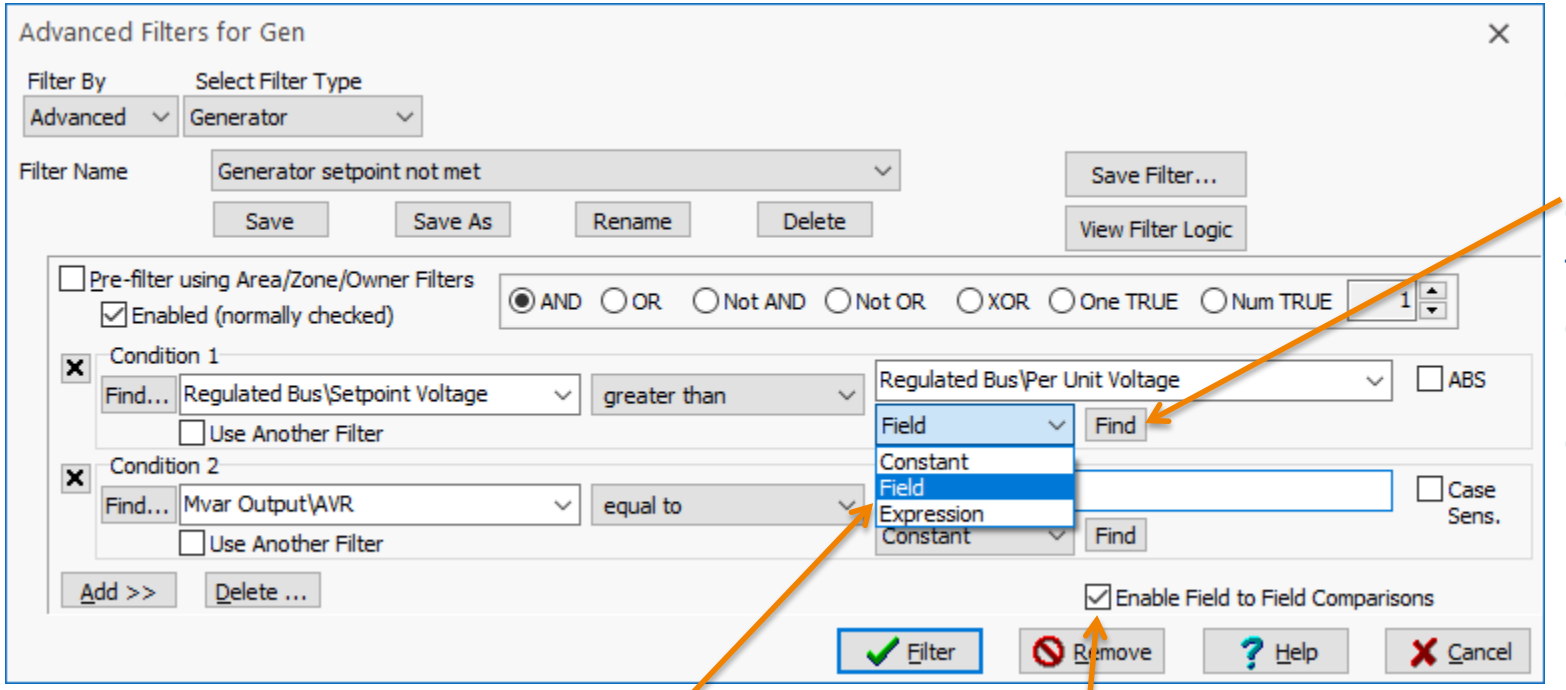
Advanced Filter

- Logical Comparison specifies the filter logic
  - Comparison applies across ALL conditions
    - AND – filter is met if ALL conditions are met
    - OR – filter is met if ANY condition is met
    - NOT AND – filter is NOT met if and only if ALL conditions are met
    - NOT OR – filter is NOT met if and only if ANY condition is met
    - XOR – filter is met if an odd number of conditions are met
    - One TRUE – filter is met if exactly one of the conditions is met
    - Num TRUE – filter is met if exactly the specified number of conditions is met

Advanced Filter

- Other advanced options
  - **ABS**
    - Absolute value comparison for numeric conditions
  - **Case Sens.**
    - Case sensitive compare for string conditions
  - **Enable Field to Field Comparisons**
    - Compare the condition field to another field of the same object
    - Compare the condition field to a Model Expression result
  - **Use Another Filter**
    - Using another filter as a filter condition
- An Advanced Filter Toolbar is also available for quickly selecting and applying filters

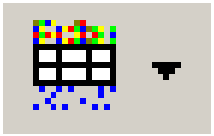
Field-To-Field Comparisons



Click the **Find** button to choose another field to compare to instead of a constant value

Set the dropdown to *Field*

Check the box for **Enable Field to Field Comparisons**



Using a Filter as a Condition
X *AND* (Y *OR* Z)

- Filters are very flexible; however, more than one logical comparator cannot be used in the same filter
  - X *and* (Y *or* Z)
- To do this two filters must be created
  - First create a filter that represents "Y or Z"
  - Second create a filter that uses first filter as a condition
    - Check the box **Use Another Filter** under the list of fields for the condition
    - This changes the dialog to have choices of *meets filter* or *not meets filter*

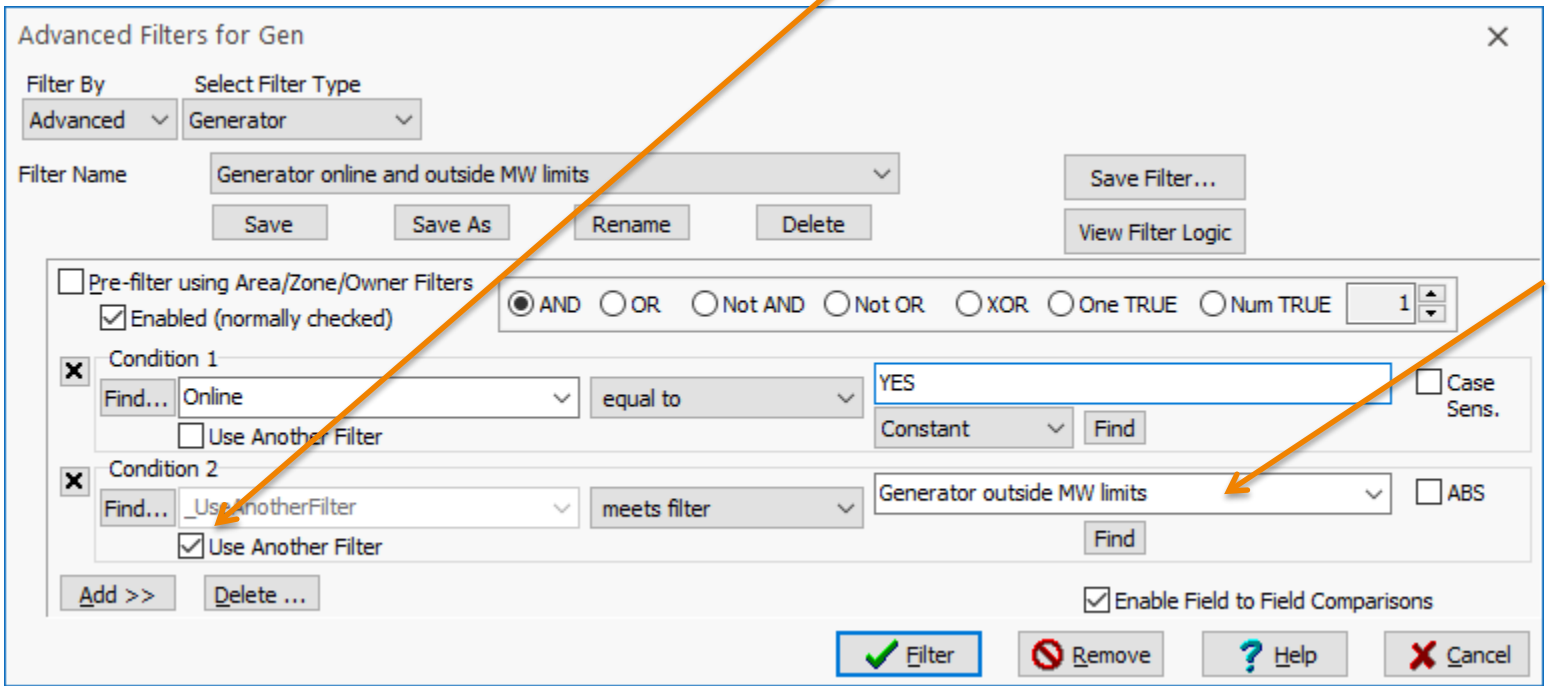
Result = X *and* (Y *or* Z)

B = (Y *or* Z)

Result = X *and* B

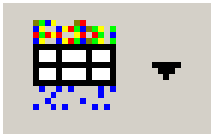
Using a Filter as a Condition
X AND (Y OR Z)

Check Box
Use Another Filter



Specify name of the other filter

Be careful to avoid circular references

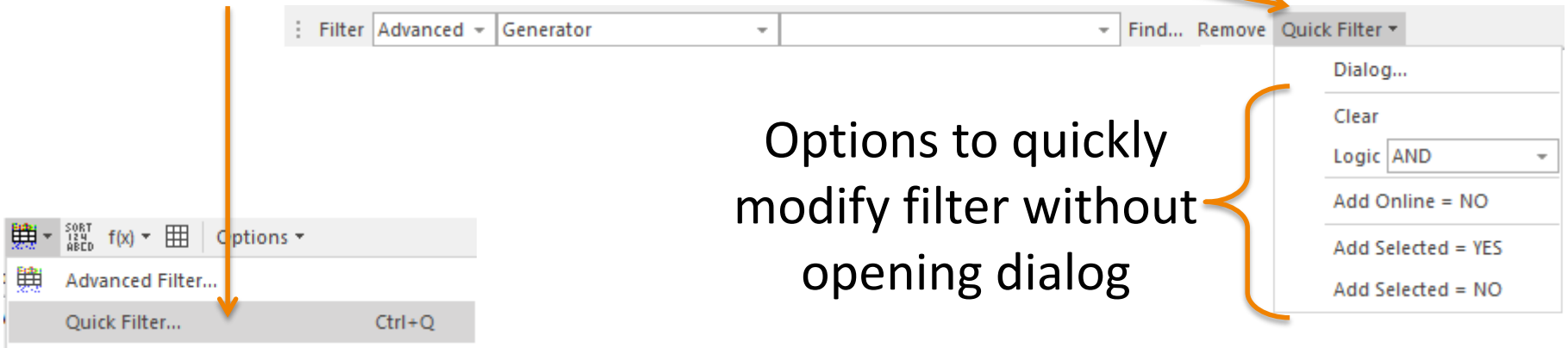


Advanced Filtering: Across Object Types

- Some objects allow the use of filters defined for related objects
  - Often referred to as *Secondary Filtering*
  - Change **Select Filter Type** to select/define filters for related objects
    - Example: Use bus filter for nominal voltages greater than 138 kV to filter generator, load, or switched shunt objects
  - If the object being filtered contains more than one of the filter object type, then OR is assumed
    - If a bus object uses an area filter, the bus meets the filter if the area of the bus meets the filter
    - If an area object uses a bus filter, the area meets the filter if ANY single bus in the area meets the filter

Quick Filter

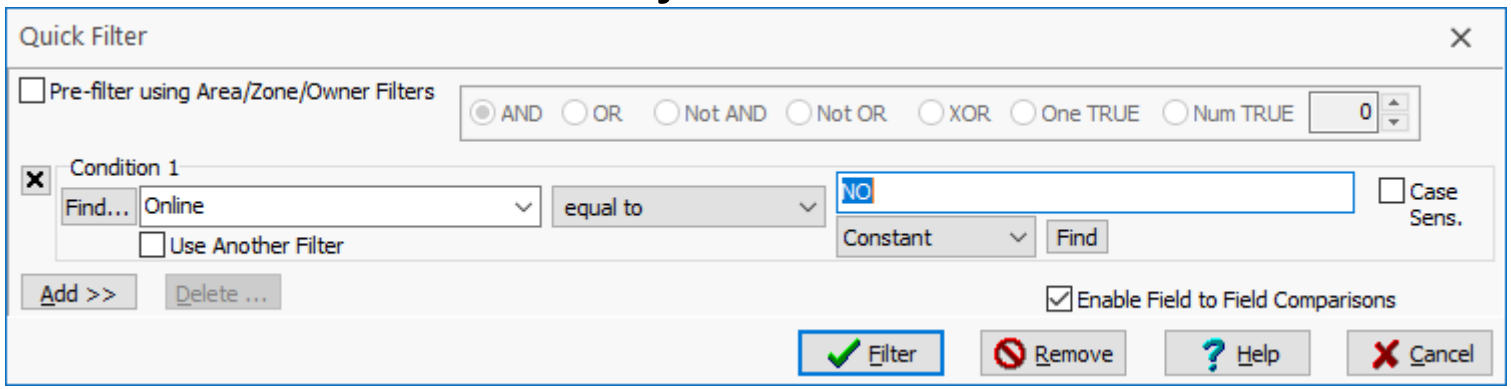
- Filters may also be quickly created and applied without saving the filter name
- Choose **Quick Filter…** from the **Advanced Filter dropdown** or **Filterbar**



Options to quickly modify filter without opening dialog

Quick Filter

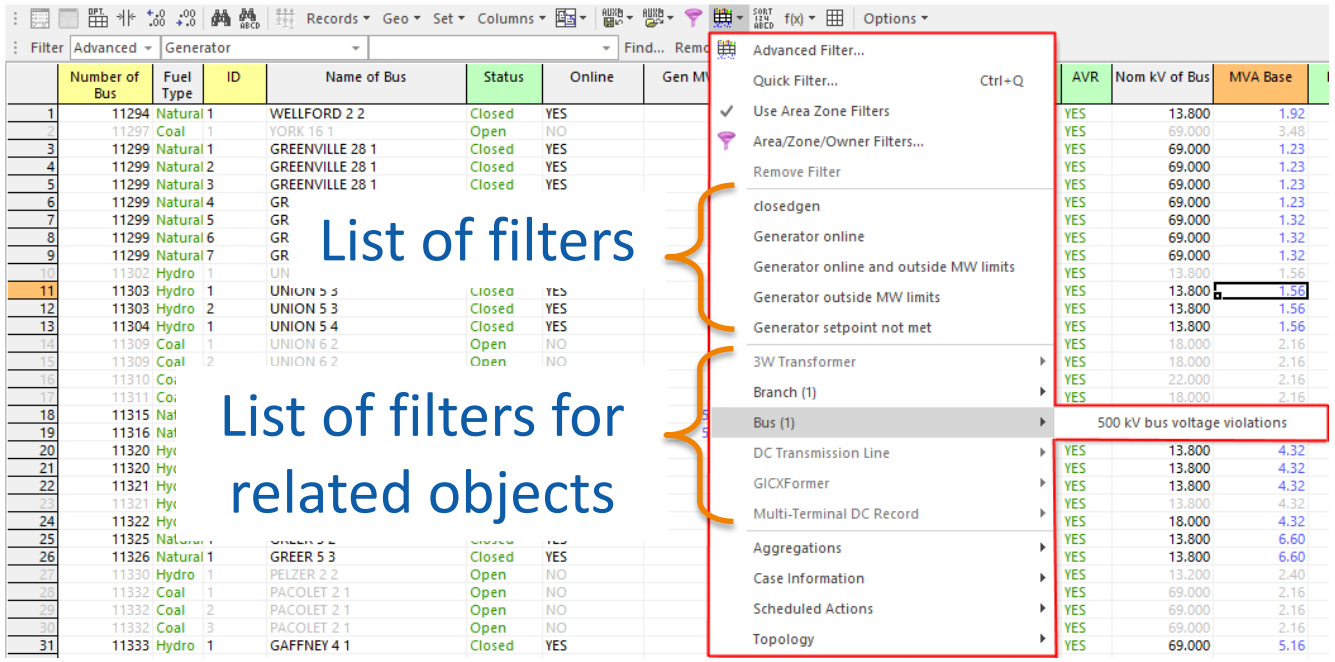
- Quick Filters are created just like Advanced Filters



- **Condition 1** will default to the field and value of the presently selected cell in the case information display
  - Subsequent selection of **Quick Filter** with different cell selections can be used to add conditions
- If not saved, Quick Filters are lost when another Advanced or Quick Filter is created or applied
  - To save a Quick Filter, open the **Advanced Filter Dialog** while the Quick Filter is applied, then click **Save** or **Save As**

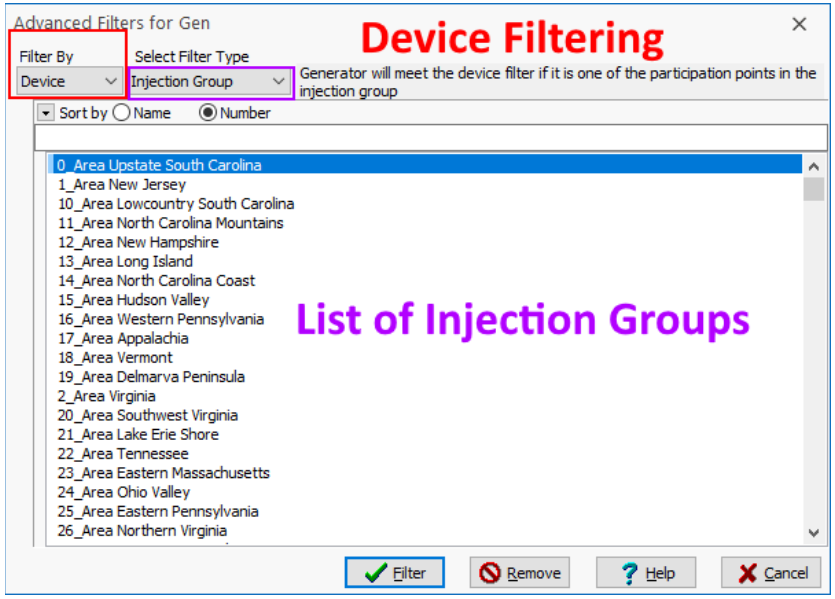
Case Information Toolbar: Filters Menu

- Provides access to the old **Advanced Filter…** button and **Area/Zone/Owner Filters**
- Also provides submenu access to advanced filters defined for related object types

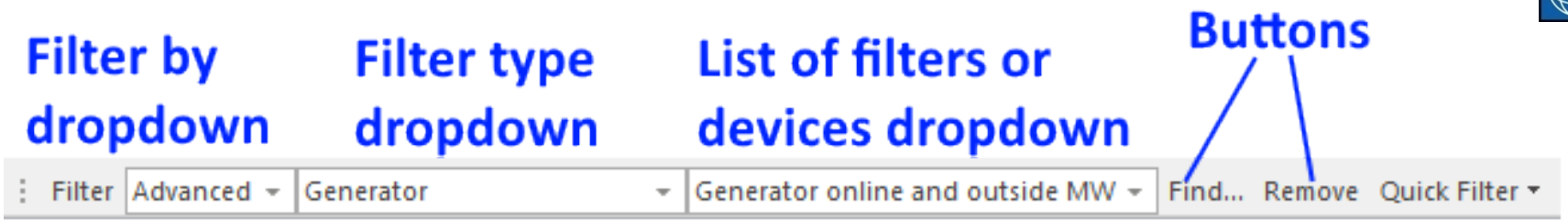


Advanced Filtering: Device Filtering

- **Filter By** = *Device*
- Directly use one of the model objects as a filter
- Relationship between the object types will determine filter action
  - Use an injection group as a device filter on a list of generators
  - Only generators in the injection group will be



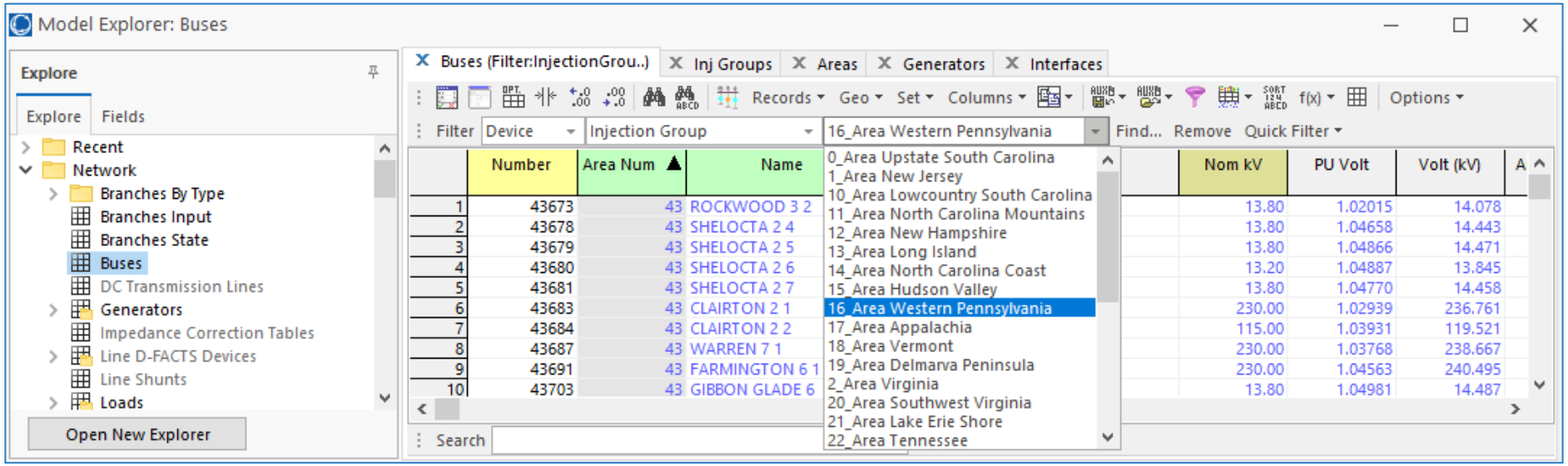
Case Information Filterbar



- Shown directly above the case information display on the Model Explorer
  - Not shown by default in other locations
  - To show, right-click on case info toolbar and choose Filterbar>Top
- **Filter By** and **Filter Type** → same as dropdown on filter dialog
- **List of Filters** or **List of Devices**
  - For Advanced Filters, this will be a list of presently defined filters
  - For Device Filters, this will a list of the devices of the type
  - If too many entries in dropdown, dropdown will behave like clicking the **Find...** button instead
- **Find…** button → will open the Advanced Filter dialog
- **Remove** button → will remove filtering from the case info

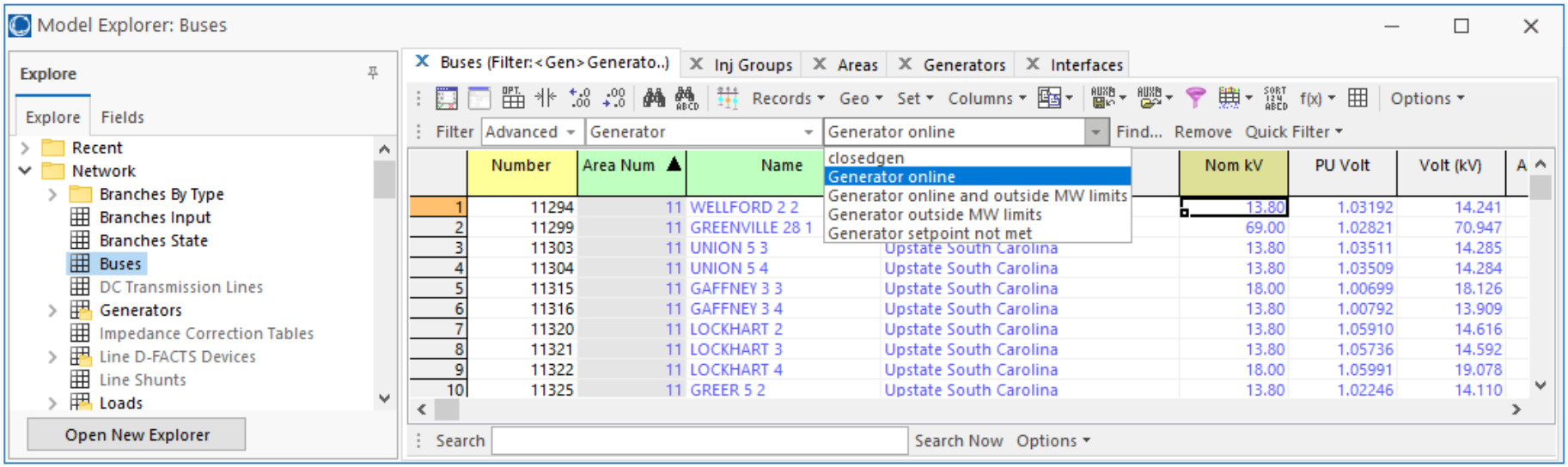
Filterbar Example: Device Filtering

- Use Injection Group as a Device Filter on a list of buses
  - Get a list of the terminal buses for all generator, loads, and shunts in the injection group



Filterbar Example: Advanced Filtering

- Use the advanced filter for a generator on a list of buses
  - Get a list of terminal buses of the generators that meet the advanced filter



Simple Sorting

- To sort a column, left click on the column heading. Click again to sort in the opposite direction.
- SHIFT + Left-Click will sort by absolute value

Sorted descending by Gen MW

Arrow showing sort direction

Absolute value sort

Click here to remove sorting

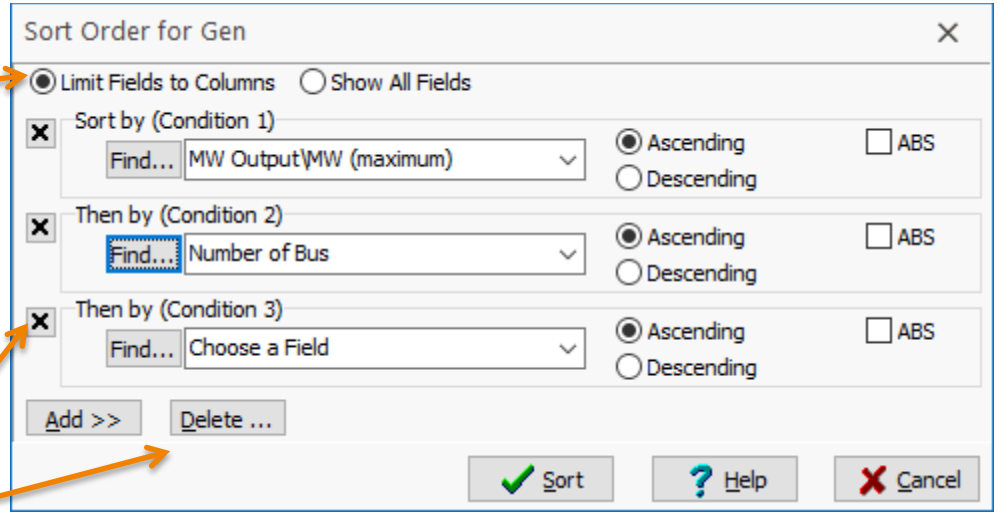
	Number of Bus	Fuel Type	ID	Name of Bus	Status	Online	Gen MW	Gen Mvar	Set Volt
1	42018	Nuclear	1	BUCHANAN 2 4	Closed	YES	1298.07	-11.61	1.04400
2	62255	Nuclear	1	BERWICK 3 4	Closed	YES	1297.07	455.22	1.04000
3	62256	Nuclear	1	BERWICK 3 5	Closed	YES	1297.07	455.22	1.04000
4	14645	Nuclear	1	HANCOCKS BRIDGE 2 4	Closed	YES	1289.78	184.19	1.03800
5	55528	Nuclear	1	TELLICO PLAINS 2 4	Closed	YES	1268.99	135.47	1.03500
6	35457	Nuclear	1	SEABROOK 2 4	Closed	YES	1241.11	180.12	1.04600
7	55588	Nuclear	1	SIGNAL MOUNTAIN 2 4	Closed	YES	1219.63	197.41	1.04300
8	55587	Nuclear	1	SIGNAL MOUNTAIN 2 3	Closed	YES	1219.63	197.41	1.04300
9	25691	Nuclear	1	HUNTE					
10	25692	Nuclear	1	HUNTE					

	Number of Bus	Fuel Type	ID	Name of Bus	Status	Online	Gen MW	Gen Mvar
1	62256	Nuclear	1	BERWICK 3 5	Closed	YES	1297.07	455.22
2	62255	Nuclear	1	BERWICK 3 4	Closed	YES	1297.07	455.22
3	29815	Coal	1	NEW FLORENCE 2 5	Closed	YES	191.75	436.18
4	29814	Coal	1	NEW FLORENCE 2 4	Closed	YES	935.33	436.18
5	43741	Coal	1	SHELOCTA 3 8	Closed	YES	935.33	436.18
6	14471	Nuclear	1	HANCOCKS BRIDGE 1 4	Closed	YES	1169.16	430.56
7	14472	Nuclear	1	HANCOCKS BRIDGE 1 5	Closed	YES	1169.16	430.56
8	43825	Coal	1	SHIPPINGPORT 2 8	Closed	YES	913.05	425.78
9	43826	Coal	1	SHIPPINGPORT 2 9	Closed	YES	217.61	425.78
10	43827	Coal	1	SHIPPINGPORT 2 10	Closed	YES	610.93	425.78

Advanced Sorting

- Click on the **Advanced Sort** toolbar button to open the Advanced Sorting dialog

Check to limit the fields available to sort by to those which are shown on the list display



Click to delete condition

Advanced Sorting

- Choose the desired sort order
  - Either ascending or descending
- No maximum amount of sort conditions
- Other advanced options
  - Absolute value (ABS) compare for numeric conditions
  - Case sensitive compare for string conditions

Save As

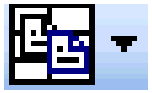
- Save As
  - Auxiliary File…
    - This will save ***ALL*** information shown in the present case information display as a DATA section in an auxiliary file
    - ***ALL*** fields being displayed will be saved
  - Auxiliary File (only selected records)…
    - Same as previous, but
    - ***Only Selected*** records will be saved
    - Again ***ALL*** fields being displayed will be saved
  - Auxiliary File (only selected records/columns)
    - Same as previous, but
    - ***Only Selected*** records will be saved
    - ***Only Selected*** fields will be saved

Save As

- Save As
  - CSV (Comma delimited)...
    - This will save ***ALL*** information shown in the present case information display in a comma-separate value (CSV) text file
    - The first line of text will be the object type
    - The second line of text will be the list of the displayed fields
    - The rest will be values of all displayed fields for all objects shown, separated by commas
  - CSV (only selected records/columns)…
    - Same as previous but ***Only Selected*** Records and columns will be saved
  - HTML
    - This will save the case info as an HTML file
  - Bitmap, Jpeg
    - Saves image of the case information display as it is currently displayed
  - Other formats (depending on the display)
    - Some case information displays have other formats available that are often formats supported by other software

Load

- Load
  - Auxiliary File (any data)…
    - Will load all DATA sections from an auxiliary file
  - Auxiliary File (only *specific* data)…
    - Will load only the DATA sections for the *specific* object type that is presented in the current case information display
  - Other formats (depending on the display)
    - Some case information displays have other formats available that are often formats supported by other software

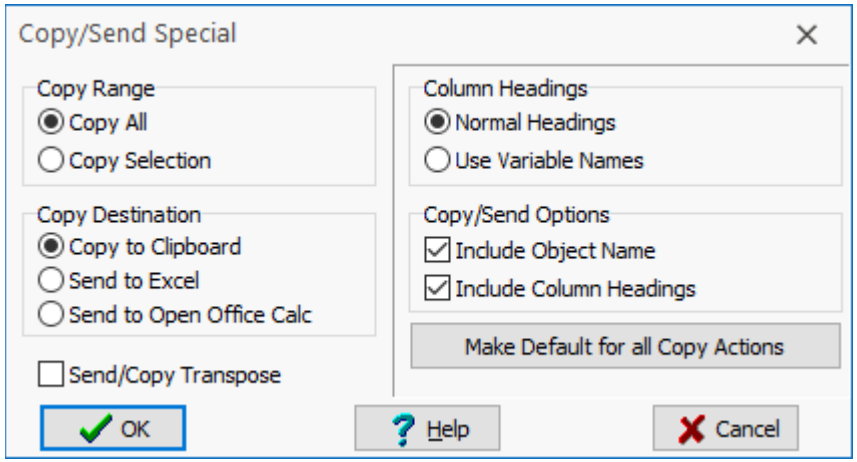


Copying from and Pasting to Case Information Displays

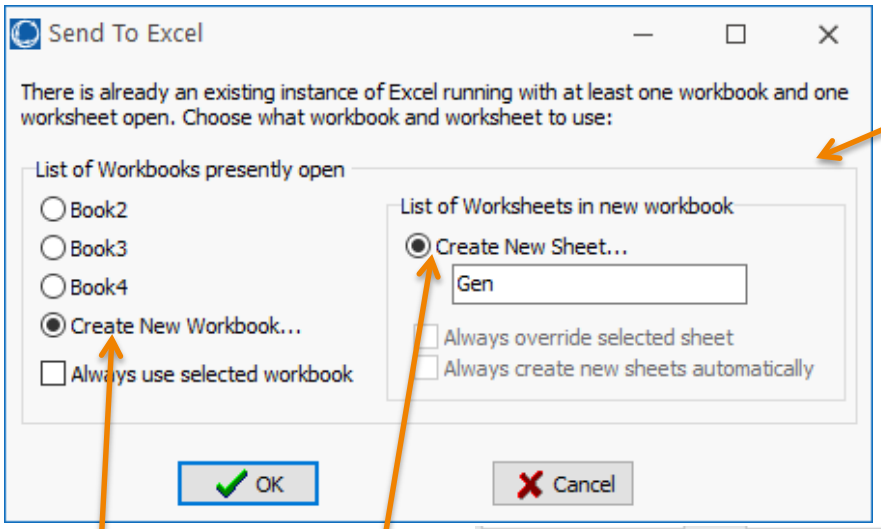
- There are five Copy/Send options
  - Copy All
    - Copy all contents of display
  - Copy Selection
    - Copy selection which includes the specific objects and fields selected
  - Send All to Excel
    - Send all contents directly to Excel
    - This will open a session of Excel and populate a worksheet
  - Send Selection to Excel
    - Send only selected objects and fields to Excel
  - Copy/Send Special
    - Opens a dialog with options about how data should be sent to Excel

Copy/Send Special

- Provides the same options as the other four Copy/Send options
- Allows specification of using column headings from the case info display or variable names from the DATA section of the auxiliary file format
- Allows specification of copying the two informational rows that contain the object name and column headings
- **Send/Copy Transpose** will send/copy the column information to rows and the row information to columns



Copy/Send to Excel



Dialog occurs only if session of Excel is already running

Select existing or new workbook and worksheet for sending data

Cell A1 describes the kind of data

	A	B	C	D	E
1	Load				
2	Number of Bus	Name of Bus	ID	Status	MW
3	11005	NEWBERRY 5	1	Closed	53.22
4	11008	POMARIA 2	1	Closed	5.89
5	11009	WHITMIRE 1	1	Closed	8.78
6	11009	WHITMIRE 1	2	Closed	3.51
7	11012	SPARTANBURG 1 2	1	Closed	41.52
8	11018	SPARTANBURG 2 3	1	Closed	40.37
9	11018	SPARTANBURG 2 3	2	Closed	0.25

Row 2 describes which fields are being pasted

For Loads, *Number* and *ID* are the **key fields**

Description of Data: (Cell A1)

- The first entry in Cell A1 (highlighted) is a description of the data
  - VERY important
  - Keep this description and DO NOT modify
  - When pasting back into the case information display, Simulator reads this line to find what kind of data is being pasted
  - This is the same as the object type that is used in an auxiliary file

Description of Fields: (Second Row in Table)

- The second row (highlighted) provides a list of the fields in the data
  - VERY important
  - When pasting back into Simulator, the second row is used to determine what kind of fields are being pasted
  - If Simulator does not recognize a field heading, it ignores this field in the paste
  - Column headers or variable names from the DATA section of the auxiliary format can be used to identify fields

Data Record Key Fields

- Each kind of data record has a few columns that serve as *key fields* for Simulator
  - Buses: *Number*
  - Lines: *From Number*, *To Number*, and *Circuit*
  - Loads: *Number of Bus* and *ID*
- To paste data into Simulator these columns MUST be included

Secondary Key Fields

- There are also secondary key fields
  - Often represent a combination of Name/Nominal kV for bus-related objects
- When pasting into Simulator there is a priority by which key fields are examined
  - First look to see if the key fields are available
  - Then look for the secondary key fields and use them instead

Labels

- Unique identifier for an object of a particular type
- Refer to equipment in the model in a way unique to your organization
- Likely to change less frequently that bus numbers
- Can be used for pasting and updating
  - *Label (for use in input from AUX or Paste)*
- Used with full topology models that include breakers and nodes

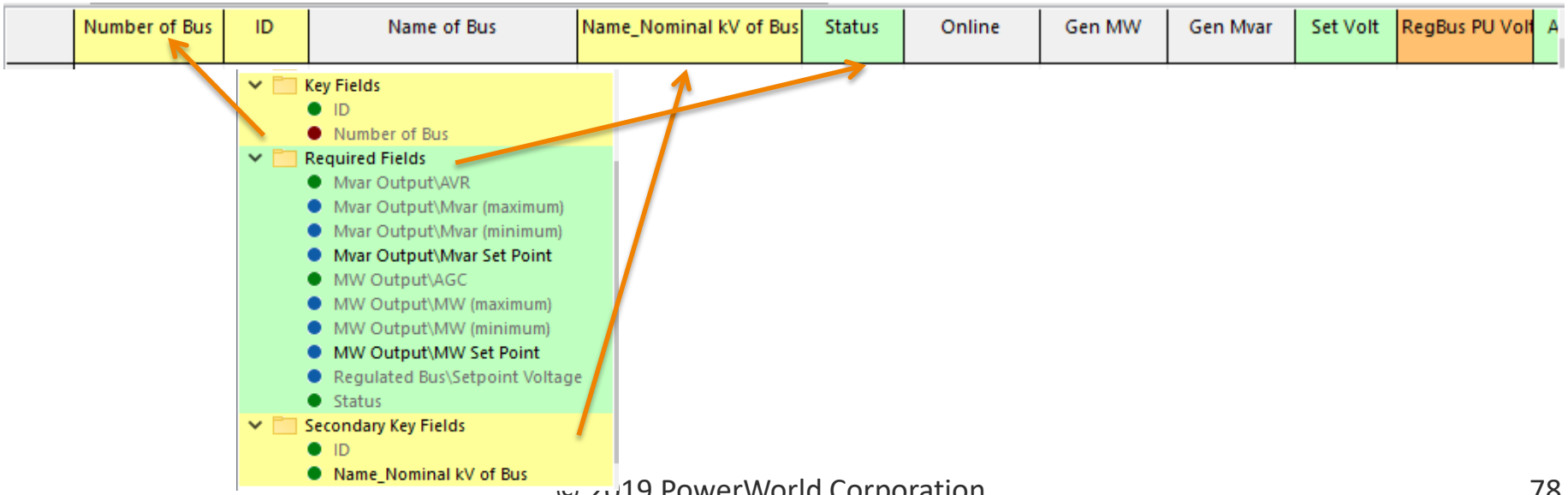
Data Record Key Fields

- You can get a list of the key fields by choosing **Export Case Object Fields → Send to Excel** from the Window ribbon tab
  - The key fields will be denoted in this output with asterisks (*1*, *2*, and *3*)
  - The secondary key fields will be denoted in this output with asterisks (*A*, *B*, and *C*)

	A	B	C	D	E	F	G
1	Object Type	SUBDATA Al	Key/Required Fields	Variable Name	Concise Variable Name	Type of Variable	Description
1575	Branch						
1576				ABCPhaseAngle	FaultCurAngleAFrom	Real	Phase angle A at From bus during fault
1577				ABCPhaseAngle:	FaultCurAngleBFrom	Real	Phase angle B at From bus during fault
1578				ABCPhaseAngle:	FaultCurAngleCFrom	Real	Phase angle C at From bus during fault
1579				ABCPhaseAngle:	FaultCurAngleATo	Real	Phase angle A at To bus during fault
1580				ABCPhaseAngle:	FaultCurAngleBTo	Real	Phase angle B at To bus during fault
1581				ABCPhaseAngle:	FaultCurAngleCTo	Real	Phase angle C at To bus during fault
1632				BusMCMW:1	BusMargCostMWTo	Real	OPF: Marginal MW Cost. May be interpreted as the cost of supplying 1.0 MV
1633			<	BusName	BusNameFrom	String	Name at From bus
1634			<	BusName:1	BusNameTo	String	Name at To bus
1635			*A*<	BusName_NomV	BusNameNomkVFrom	String	Name_Nominal kV at From bus
1636			*B*<	BusName_NomV	BusNameNomkVTo	String	Name_Nominal kV at To bus
1637				BusName_NomV	MSBusNameNomkVFrom	String	Multi-Section Line Record's Name_Nominal kV at From bus
1638				BusName_NomV	MSBusNameNomkVTo	String	Multi-Section Line Record's Name_Nominal kV at To bus
1639				BusNeighborList	IslandedBusList	String	When using the Branches that Create Islands tool, this field is populated w
1640			<	BusNomVolt	NomkVFrom	Real	The nominal kv voltage specified as part of the input file. at From bus
1641			<	BusNomVolt:1	NomkVTo	Real	The nominal kv voltage specified as part of the input file. at To bus
1642			*1*<	BusNum	BusNumFrom	Integer	Number at From bus
1643			*2*<	BusNum:1	BusNumTo	Integer	Number at To bus
1644				BusNum:2	MSBusNumFrom	Integer	Multi-Section Line Record's Number at From bus
1645				BusNum:3	MSBusNumTo	Integer	Multi-Section Line Record's Number at To bus

Data Record Key Fields

- For every type of object the list of available fields contains folders for *Key Fields*, *Required Fields*, and *Secondary Key Fields*
- Case information display column headers are highlighted yellow to indicate a key field and green to indicate a required field

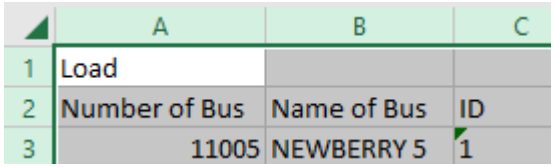


Use the Spreadsheet

- You can now make full use of Excel to modify the data
  - Columns and rows can be deleted and modified in any manner with two exceptions
- Two requirements that MUST be met EXACTLY for the final format of the data
  - Two header rows must be specified EXACTLY as they were pasted
  - Must include the columns for the key fields
- For example, you can change the reactive power component of all the loads and then read them back in to see how the voltages are affected

Select the Spreadsheet

- When changes to the spreadsheet are completed and ready for pasting back into Simulator, do the following
  - Select the entire spreadsheet (the easiest way to do this is to click on the top left square between the Row A and Column 1 headers)
  - Select **Copy** (or CTRL+C)



	A	B	C
1	Load		
2	Number of Bus	Name of Bus	ID
3	11005	NEWBERRY 5	1

- You can alternatively select only part of the spreadsheet as long as you capture all of the required format

Pasting into Simulator

- Go back to Simulator, click on the **Copy, Paste, and Send** toolbar menu and choose **Paste**
  - If the clipboard format is not correct, Simulator will disable the Paste option
  - Data can only be pasted into case information displays that contain the same object type being pasted, i.e., bus data cannot be pasted into a generator case information display
- Values can only be pasted into case information displays if the values are enterable
  - Enterable Fields are displayed as blue by default
  - Special External Fields displayed as purple by default can also be pasted but cannot be directly modified in a case information display

Pasting NEW objects

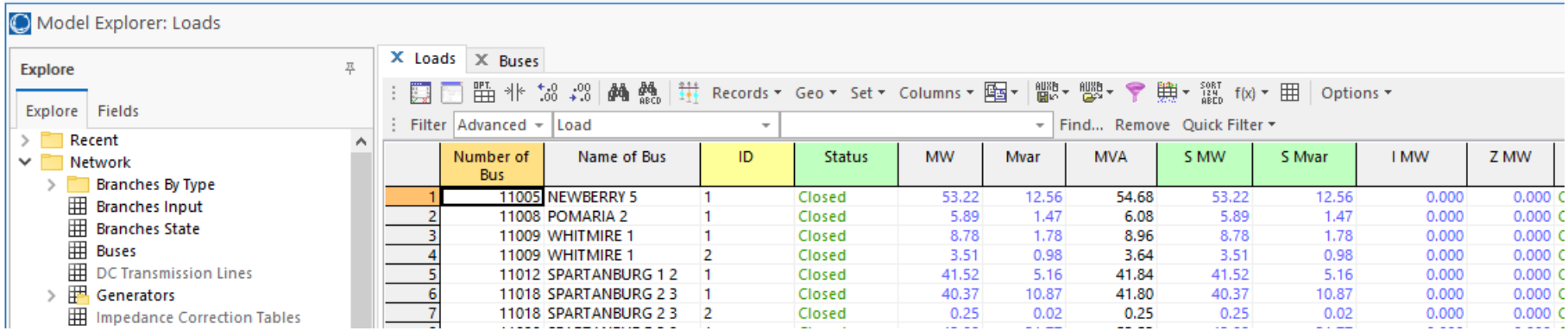
- New objects can be created by pasting from a spreadsheet
- Must provide all required data for the object
- Required Fields will be highlighted in green in the case information displays and in the list of available fields for an object shown in the Fields pane
- Many object types require being in Edit Mode in order to create new objects

Redundant Data

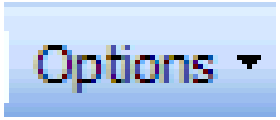
- Be careful about pasting redundant data
  - For example, in the Bus Records both voltage in *per unit* and voltage in *kV* are enterable, but they specify the same information
- Copy only ONE of these columns into Simulator
  - Simulator will paste the information in twice, and whatever value was 2nd will show up
  - Usually fields will be pasted in the order in which they are specified
    - Key fields will always be read first
    - Simulator enforces a priority order for some fields that must be processed before other fields

Example Redundant Data

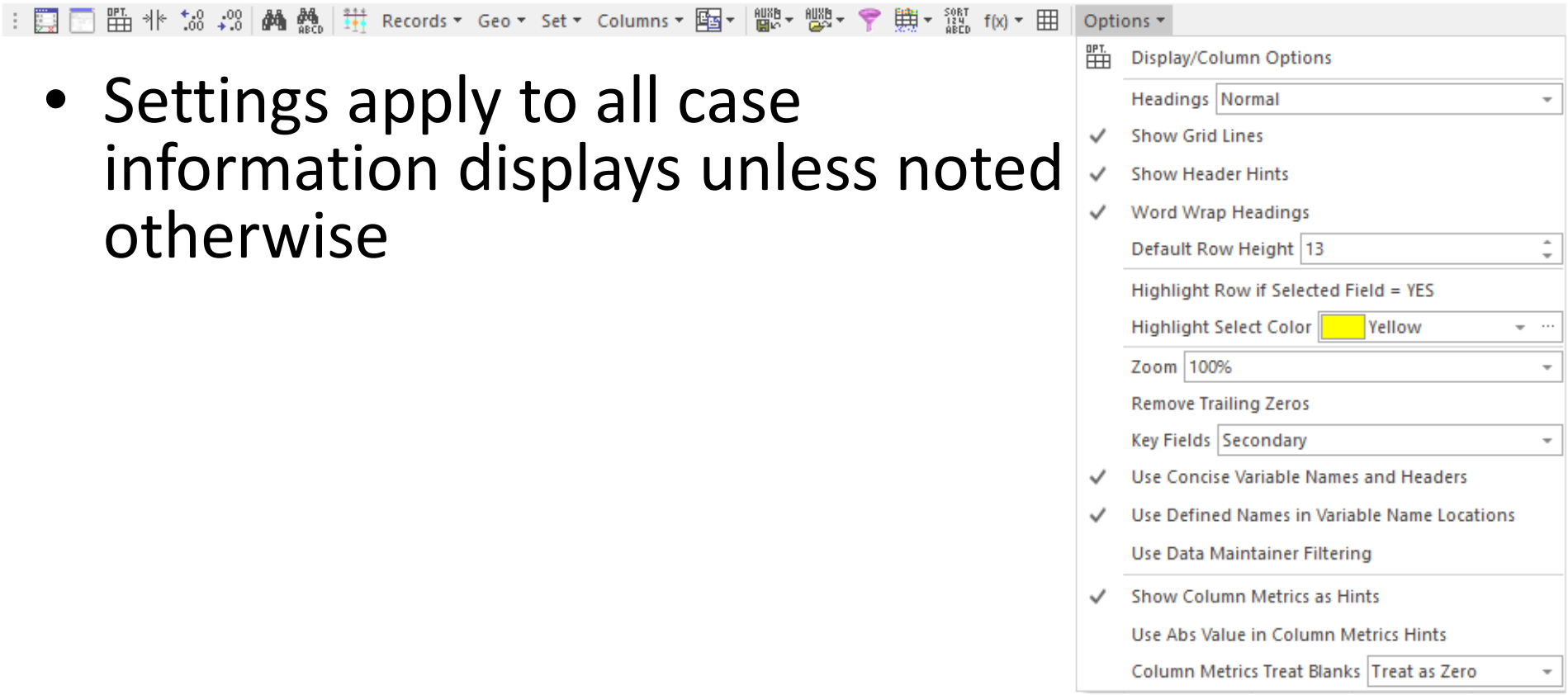
- Load Records represent an example of redundant data
  - MW value is a function of the S MW, I MW, and Z MW values
  - $MW = S\ MW + I\ MW * V_{pu} + Z\ MW * V_{pu}^2$
- If you do the following nothing changes because the S MW, I MW, and Z MW columns get pasted in separately
  - **Send All to Excel** on the load case information display
  - Modify the **MW** columns
  - **Copy All** and then **Paste** back into Simulator



	Number of Bus	Name of Bus	ID	Status	MW	Mvar	MVA	S MW	S Mvar	I MW	Z MW
1	11005	NEWBERRY 5	1	Closed	53.22	12.56	54.68	53.22	12.56	0.000	0.000
2	11008	POMARIA 2	1	Closed	5.89	1.47	6.08	5.89	1.47	0.000	0.000
3	11009	WHITMIRE 1	1	Closed	8.78	1.78	8.96	8.78	1.78	0.000	0.000
4	11009	WHITMIRE 1	2	Closed	3.51	0.98	3.64	3.51	0.98	0.000	0.000
5	11012	SPARTANBURG 1 2	1	Closed	41.52	5.16	41.84	41.52	5.16	0.000	0.000
6	11018	SPARTANBURG 2 3	1	Closed	40.37	10.87	41.80	40.37	10.87	0.000	0.000
7	11018	SPARTANBURG 2 3	2	Closed	0.25	0.02	0.25	0.25	0.02	0.000	0.000

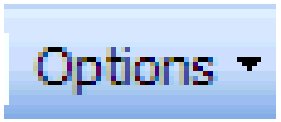


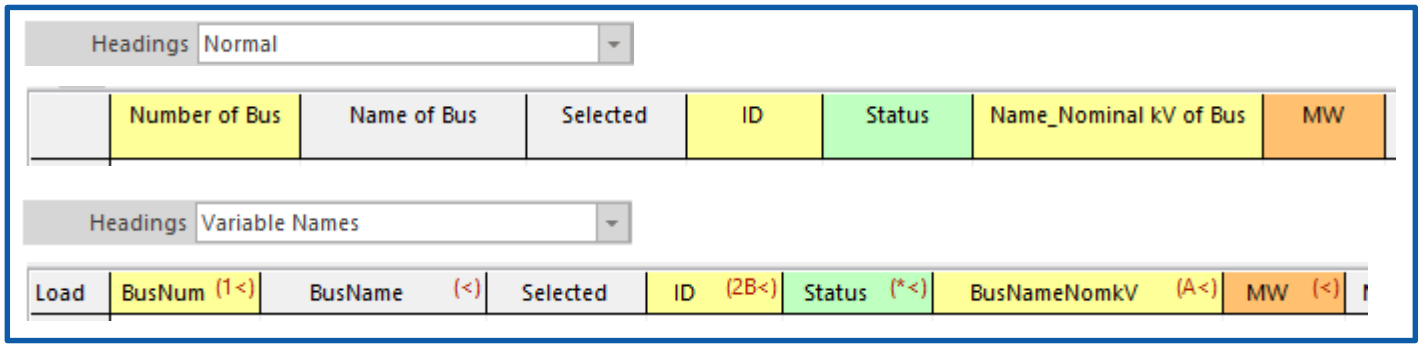
Case Information Displays: Options Menu

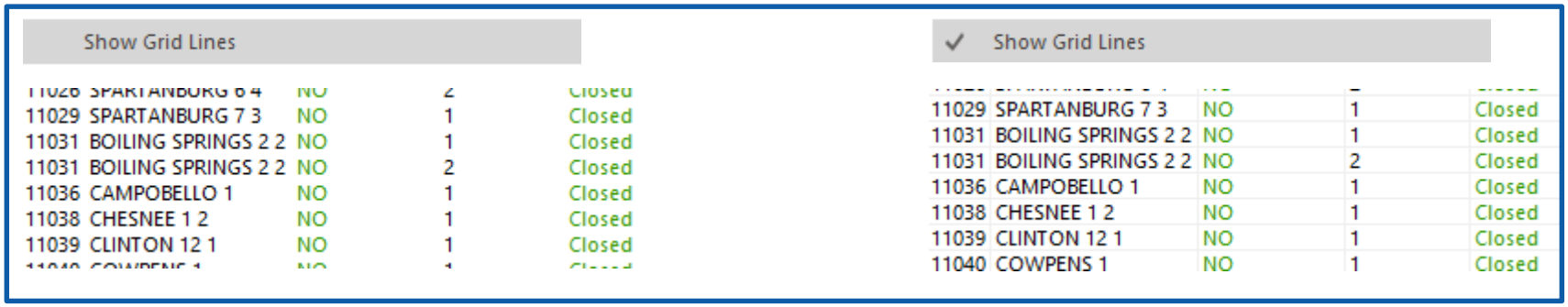


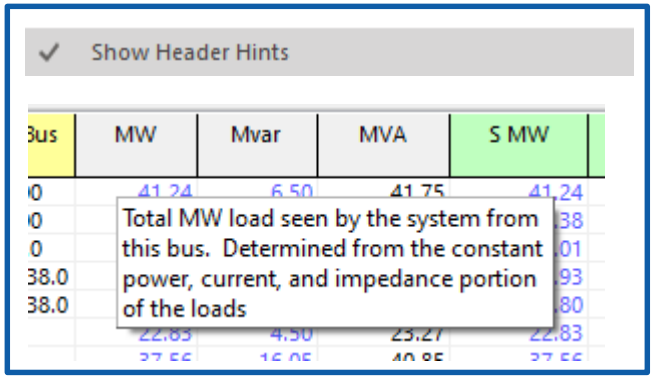
- Settings apply to all case information displays unless noted otherwise

Case Information Displays: Options Menu

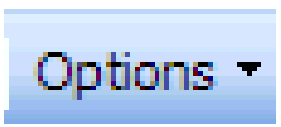


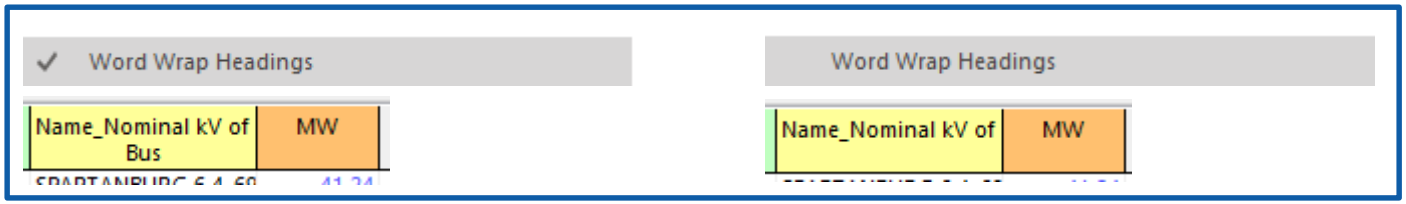


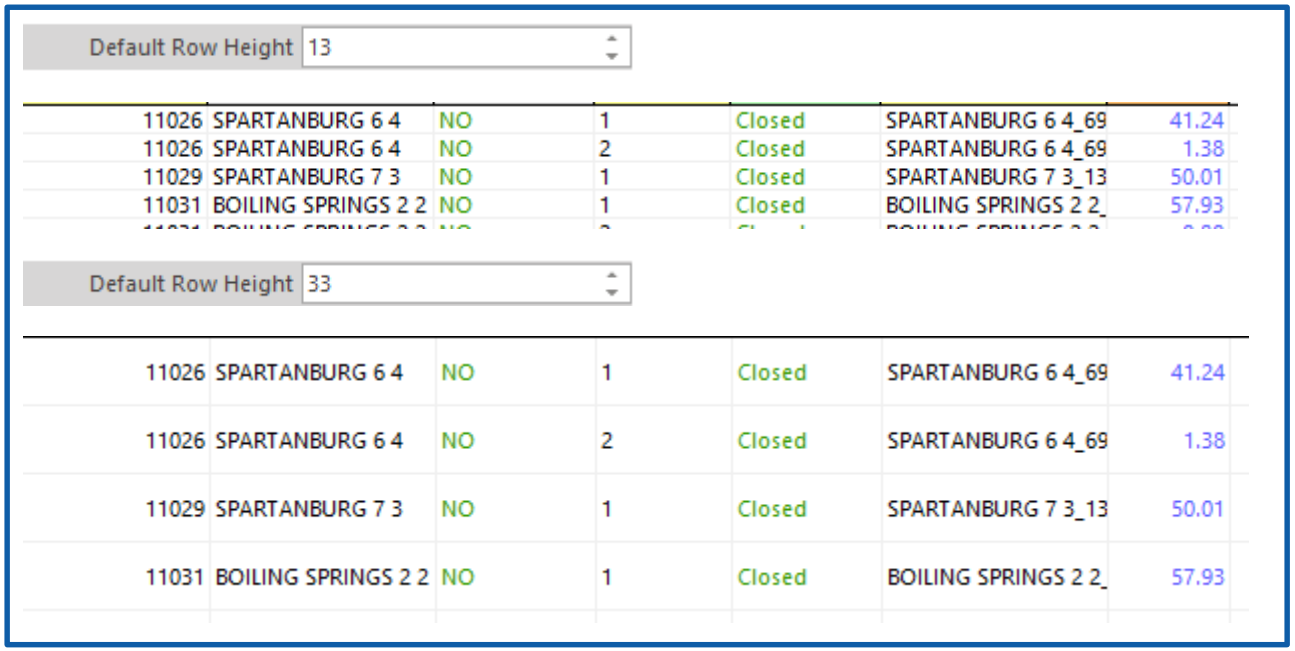


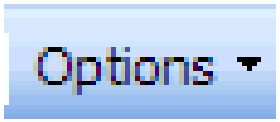


Case Information Displays: Options Menu

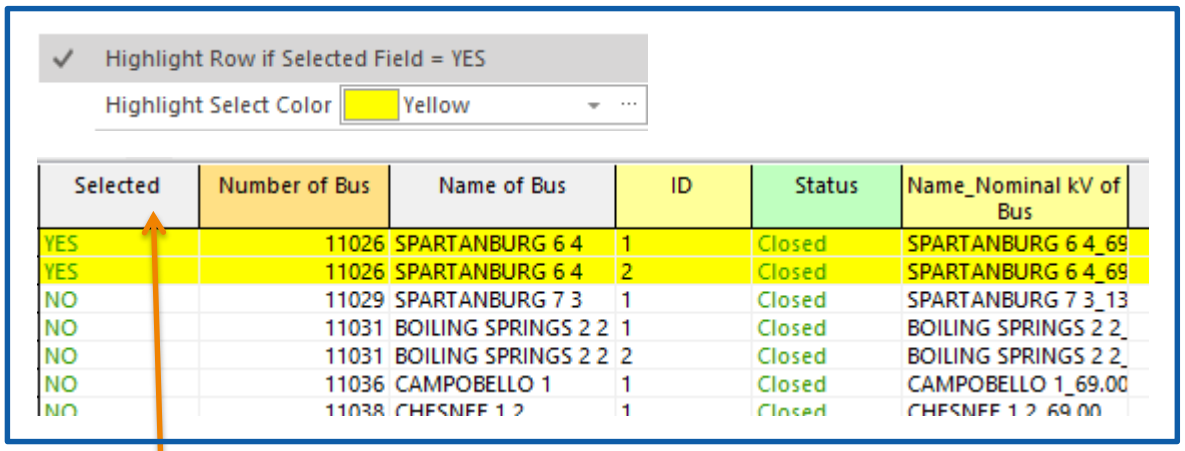






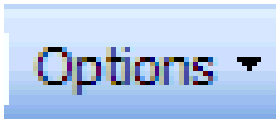


Case Information Displays: Options Menu



Selected	Number of Bus	Name of Bus	ID	Status	Name_Nominal kV of Bus
YES	11026	SPARTANBURG 6 4	1	Closed	SPARTANBURG 6 4_69
YES	11026	SPARTANBURG 6 4	2	Closed	SPARTANBURG 6 4_69
NO	11029	SPARTANBURG 7 3	1	Closed	SPARTANBURG 7 3_13
NO	11031	BOILING SPRINGS 2 2	1	Closed	BOILING SPRINGS 2 2_
NO	11031	BOILING SPRINGS 2 2	2	Closed	BOILING SPRINGS 2 2_
NO	11036	CAMPOBELLO 1	1	Closed	CAMPOBELLO 1_69.00
NO	11038	CHESNEE 1 2	1	Closed	CHESNEE 1 2_69.00

Selected field is a specific field that is available with most objects



Case Information Displays: Options Menu

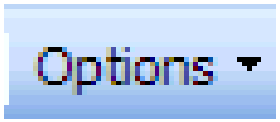
Zoom 100%

11029	SPARTANBURG 7 3	NO	1	Closed
11031	BOILING SPRINGS 2 2	NO	1	Closed
11031	BOILING SPRINGS 2 2	NO	2	Closed
11036	CAMPOBELLO 1	NO	1	Closed
11038	CHESNEE 1 2	NO	1	Closed
11039	CLINTON 12 1	NO	1	Closed
11040	COWPENS 1	NO	1	Closed

Zoom level applies only to the current case information display

Zoom 200%

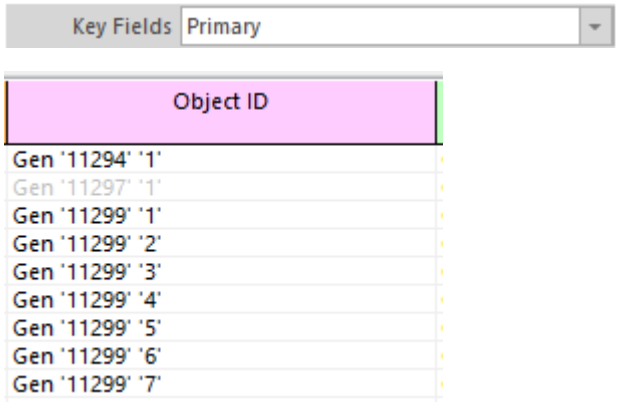
11029	SPARTANBURG 7 3	NO	1	Closed
11031	BOILING SPRINGS 2 2	NO	1	Closed
11031	BOILING SPRINGS 2 2	NO	2	Closed
11036	CAMPOBELLO 1	NO	1	Closed
11038	CHESNEE 1 2	NO	1	Closed
11039	CLINTON 12 1	NO	1	Closed
11040	COWPENS 1	NO	1	Closed

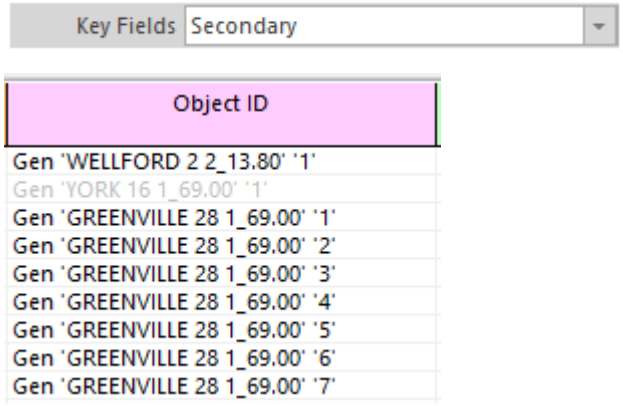


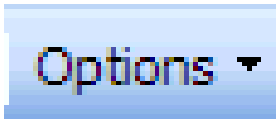
Case Information Displays: Options Menu

Remove Trailing Zeros applies only to the current case information display

Some fields identify objects by the selected key field type

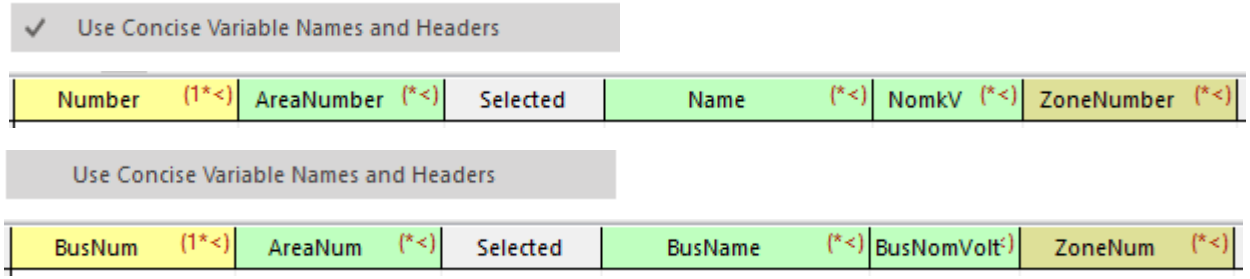




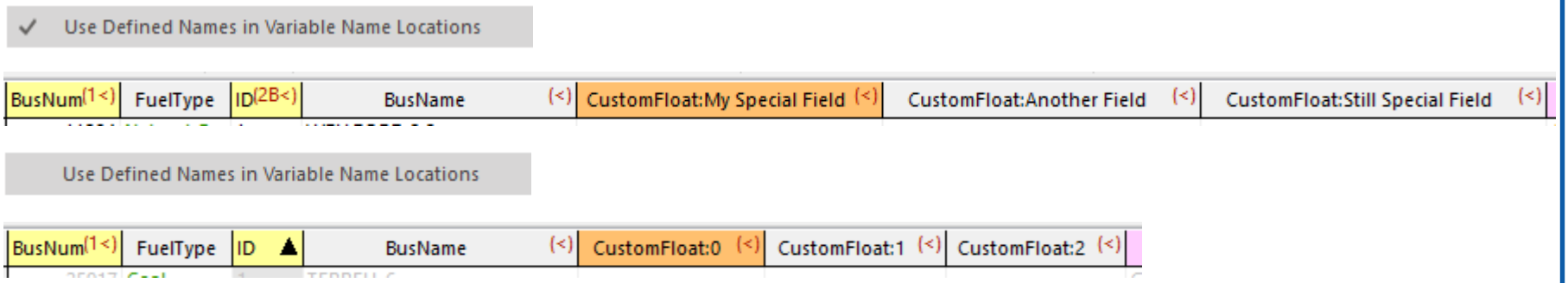


Case Information Displays: Options Menu

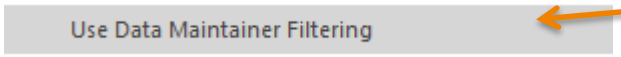
Concise variable names are used by default starting with Simulator version 20



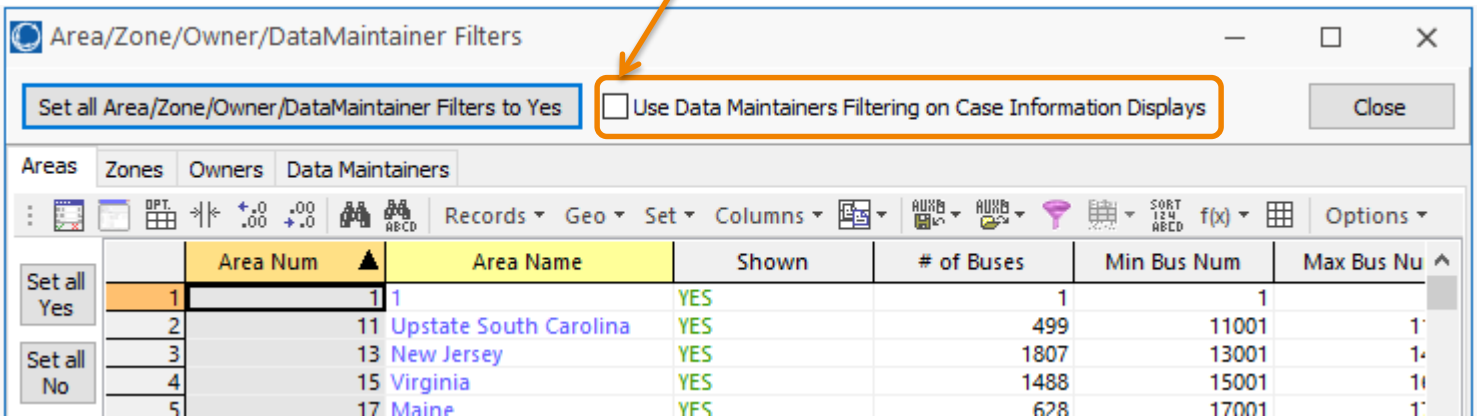
Defined names make it easier to ensure the correct field is being used

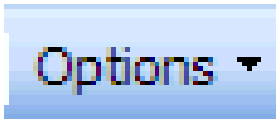


Case Information Displays: Options Menu

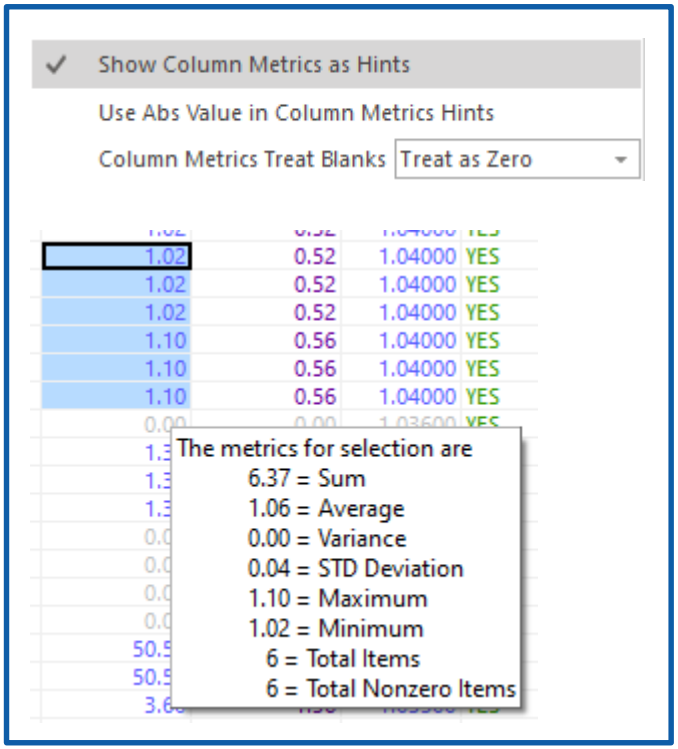


Set whether or not Data Maintainers should be included with Area/Zone/Owner Filters





Case Information Displays: Options Menu

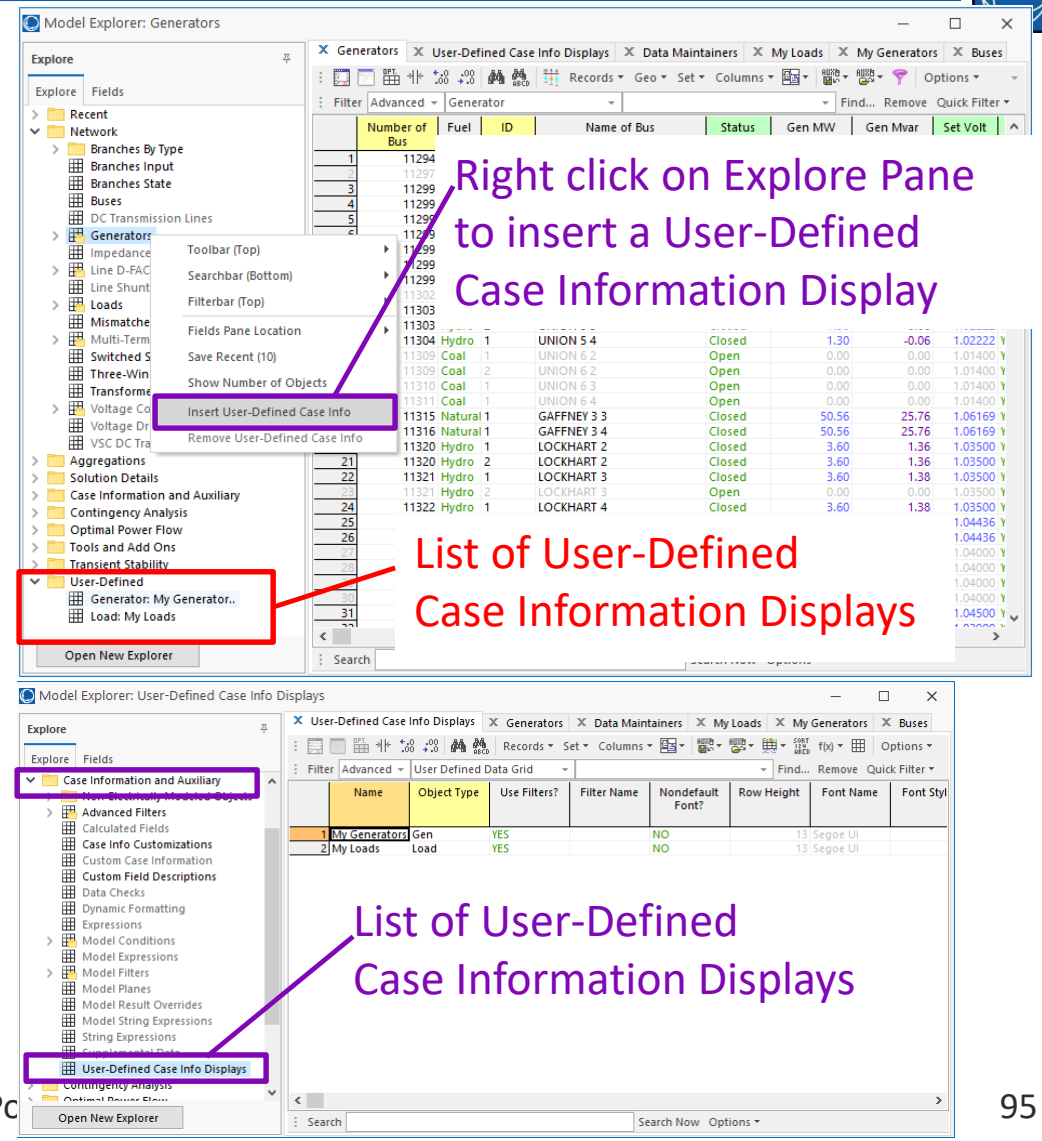


User-Defined Case Information Displays

- Motivation
  - It may be convenient to define one set of generator fields for studying voltage regulation problems and another set for MW-related studies
  - Some objects like tool options do not appear elsewhere in the Model Explorer
- User-Defined Case Information Displays meet these needs
  - Allow customization of columns, filters, sorting, etc. without requiring repeated changes to the same case information display
  - Having access to all object types that are supported in auxiliary files is very useful for auxiliary file development
- Limitation
  - User-defined case information displays are more generic than case information displays that appear specifically in the Model Explorer and will not include object-specific actions that appear in Records menu

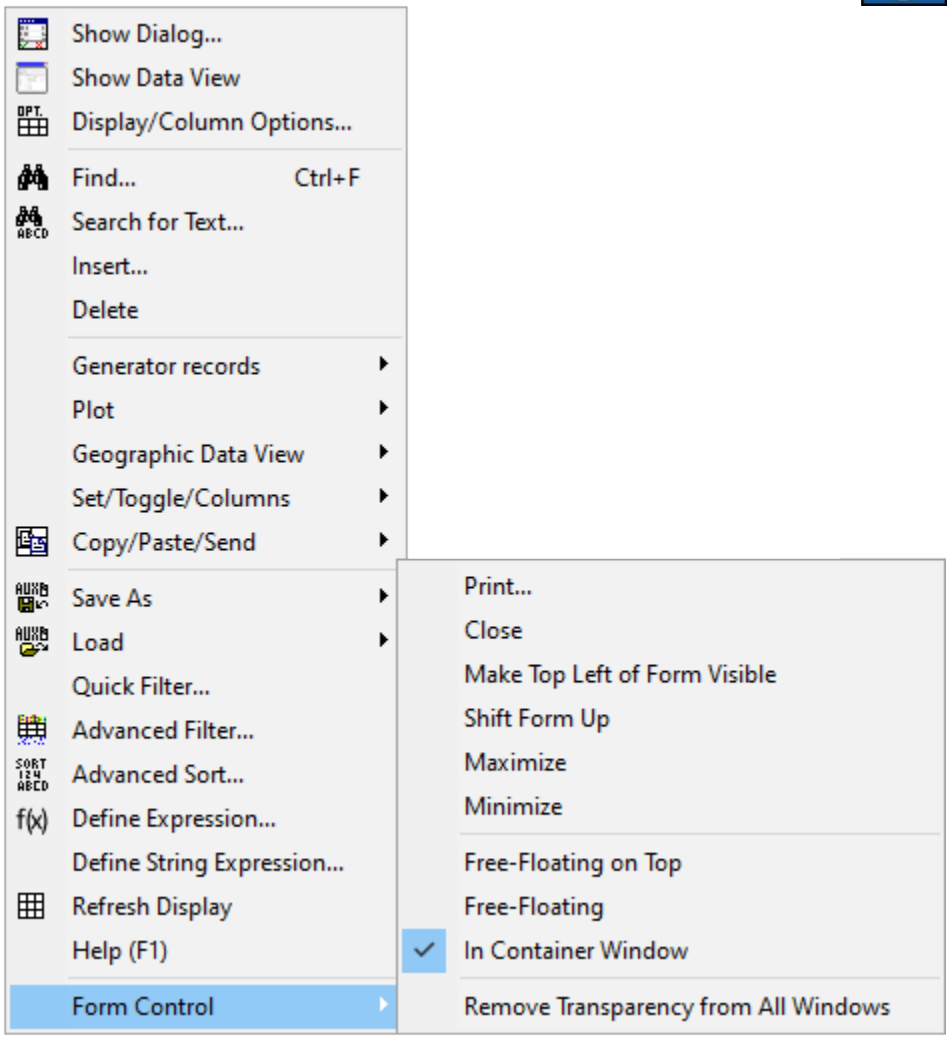
User-Defined Case Information Display Management

- Right click on Explore Pane to create User-Defined Case Information Displays
  - They show up under the **User-Defined** folder of the Explore Pane
  - Customization is the same as other case information displays
  - Navigate to **Case Information and Auxiliary\User-Defined Case Info Displays** to save customization settings to auxiliary file
- User-Defined Case Information Displays can be made to display any object type, including various settings and options

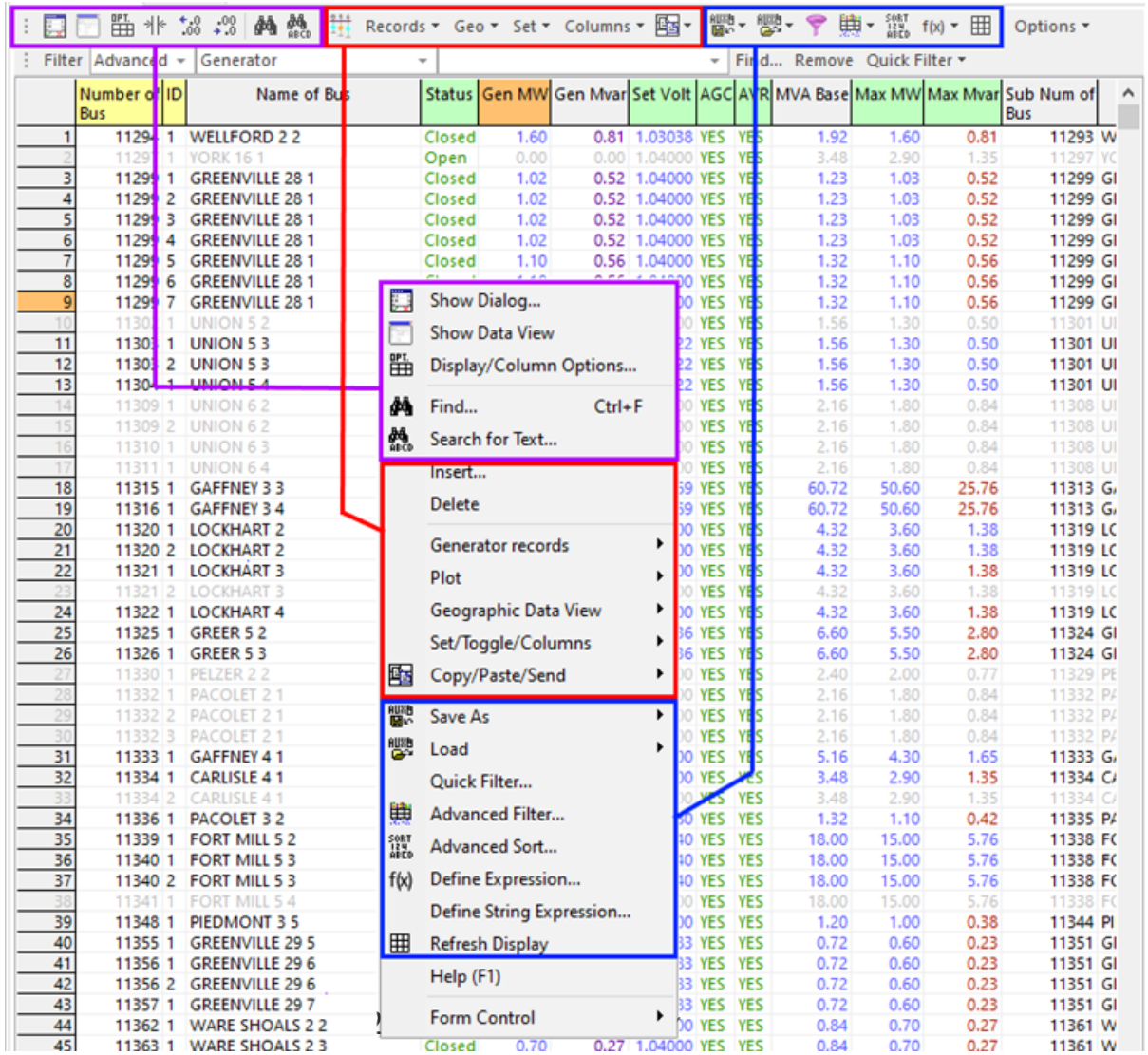


Case Information Display Local Menu

- Local menu can be opened by right clicking on a case information display
- Most of the options and actions available are identical to the options available on the Case Information Toolbar
- Options on Local Menu not available on the Case Information Toolbar
  - Help
  - Form Control
    - Provides options for printing and showing the case information display



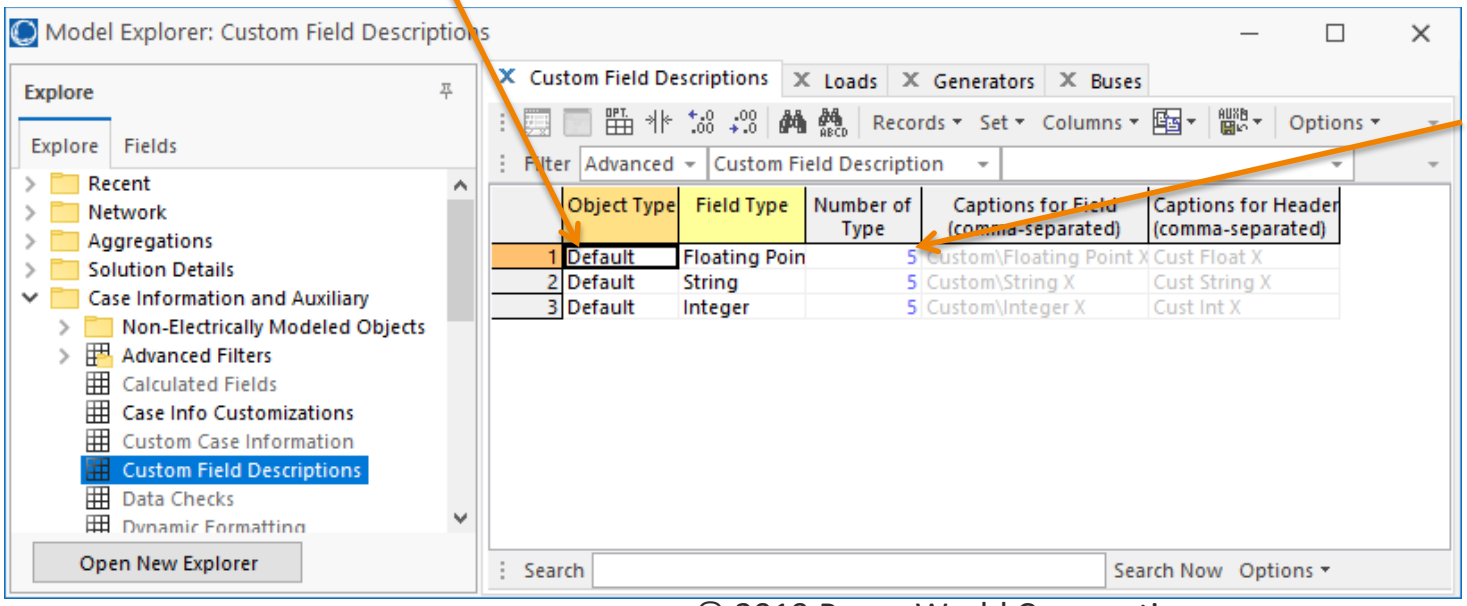
Case Information Display Local Menu



Custom Field Descriptions: Custom Floats, Integers, and String

- Access these definitions on the Model Explorer Explore Pane under **Case Information and Auxiliary → Custom Field Descriptions**

Defaults for all object types are always listed

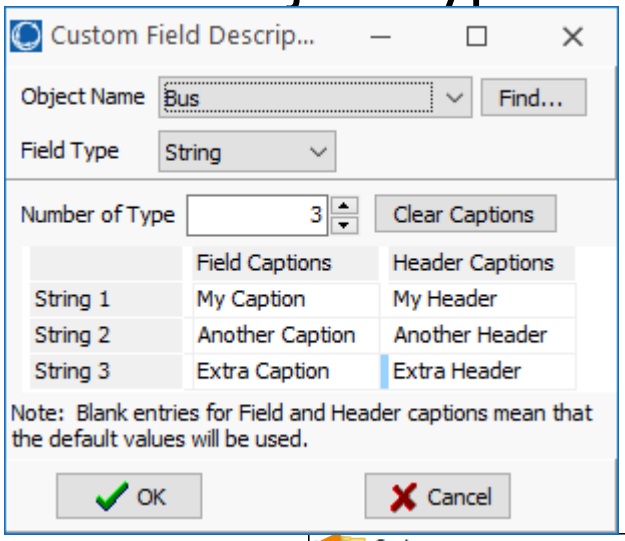


The default number of each type can be changed directly here

There is no limit to how many can be specified

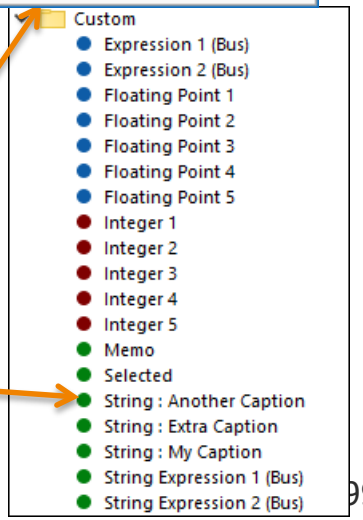
Custom Field Descriptions: Custom Floats, Integers, and String

- Custom settings can be specified for different object types by right clicking and choosing **Insert**
  - Choose the **Object Name**
  - Choose the **Field Type**
  - Choose the **Number of Type**
  - Define **Field Captions**
  - Define **Header Captions**



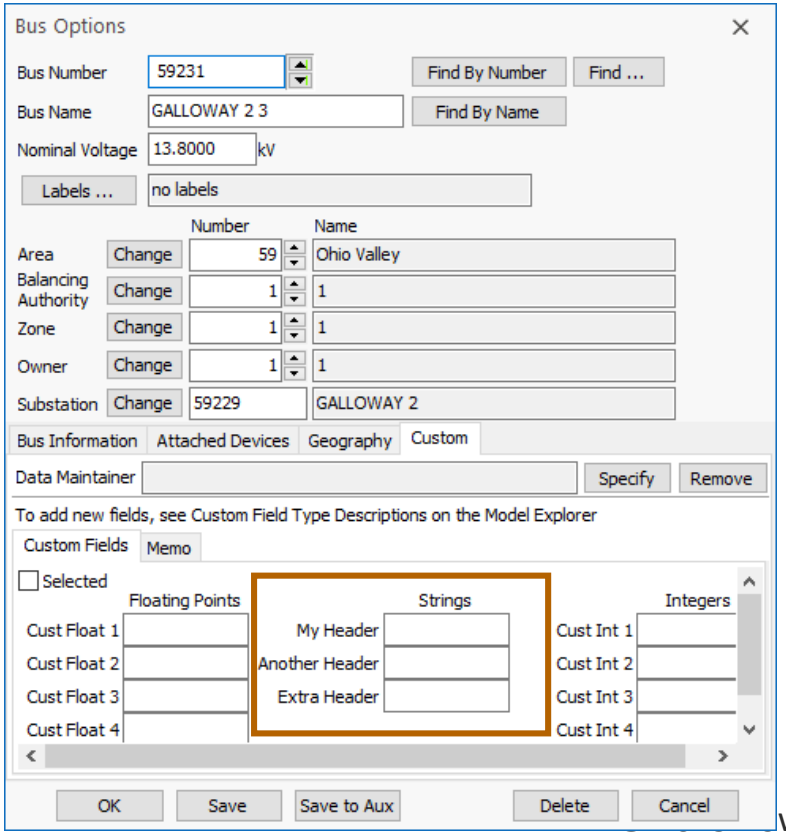
	Object Type	Field Type	Number of Type	Captions for Field (comma-separated)	Captions for Header (comma-separated)
1	Default	Floating Poin	5	Custom\Floating Point X	Cust Float X
2	Default	String	5	Custom\String X	Cust String X
3	Default	Integer	5	Custom\Integer X	Cust Int X
4	Bus	String	3	My Caption,Another Caption,Extra Caption	My Header,Another Header,Extra Header

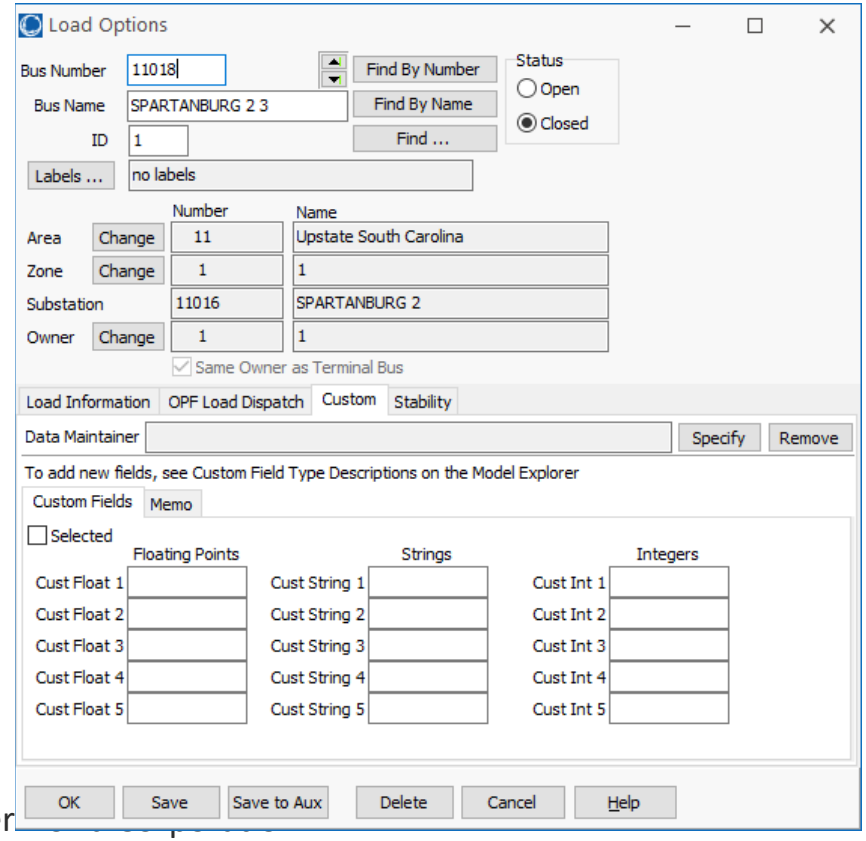
Folder view of available bus fields becomes



Integration of Custom Fields into User Interface Dialogs

- Custom tab is available on information dialogs
  - Access to Custom Fields, Memo, and Selected field





AUXILIARY FILES

Auxiliary Files

- PowerWorld Simulator data can be stored and edited in a text file format
- A scripting language is available for modifying data and automatically running PowerWorld Simulator commands
- The auxiliary (*.aux) file format accomplishes both functions
- The auxiliary file format also extends to oneline diagrams (*.axd)

What Can You DO with Auxiliary Files?

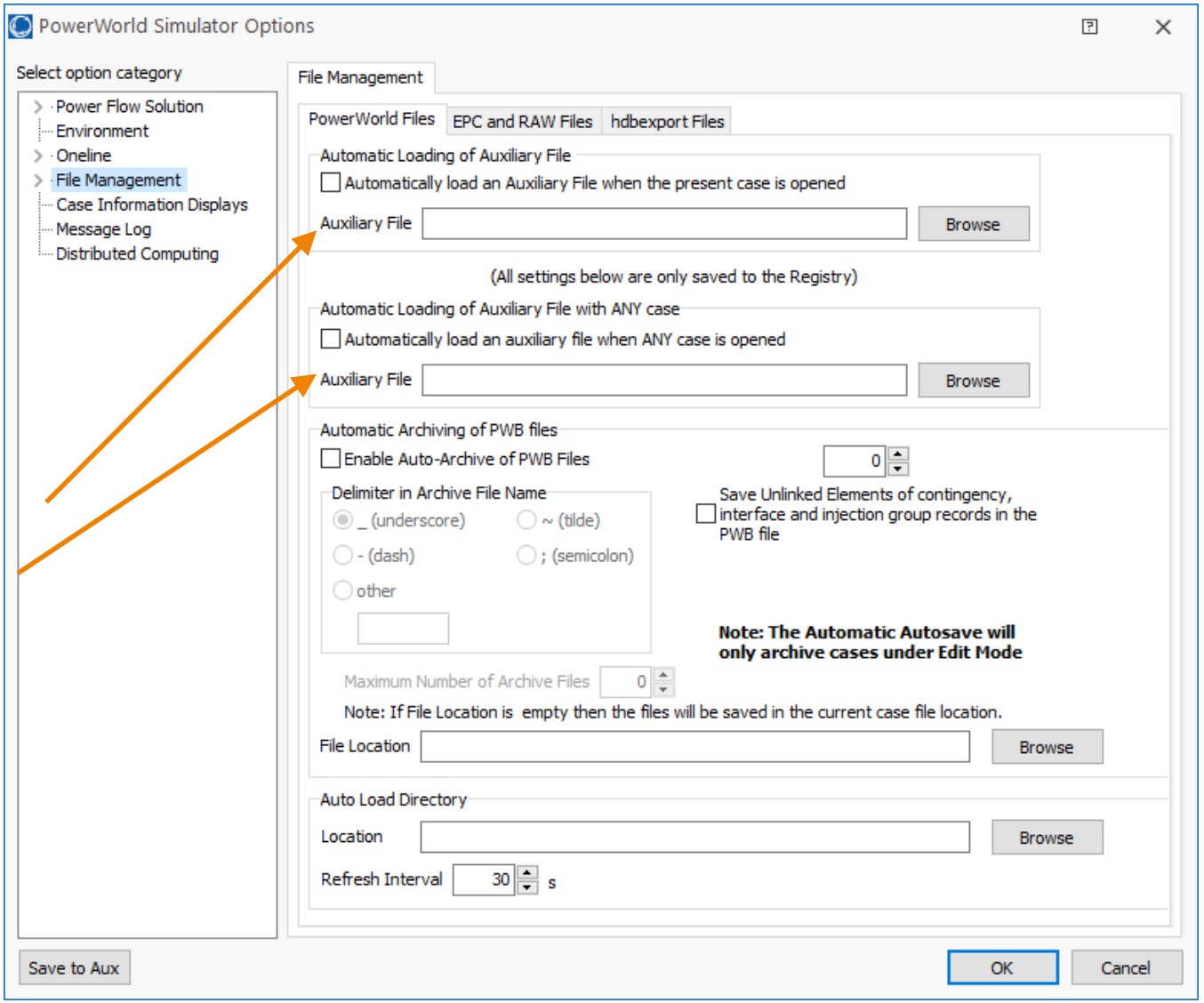
- Quality Assurance: Standardize settings and controls for multiple cases and studies
- Customize Simulator environment
- Document
  - Describe an analysis procedure for a manager or client
  - Create a detailed project record
  - Enable reproducibility
- Automate detailed calculations and storage of the results
- Automate building and editing of a oneline diagram

Example: Using Aux Files to Customize Simulator Environment

- Automatically load aux file each time a case is loaded
- Allows standardization of options
- Use to customize
  - Area/Zone/Owner Filters
  - Advanced Filters
  - Custom Expressions
  - Custom Data Grids
  - Many more

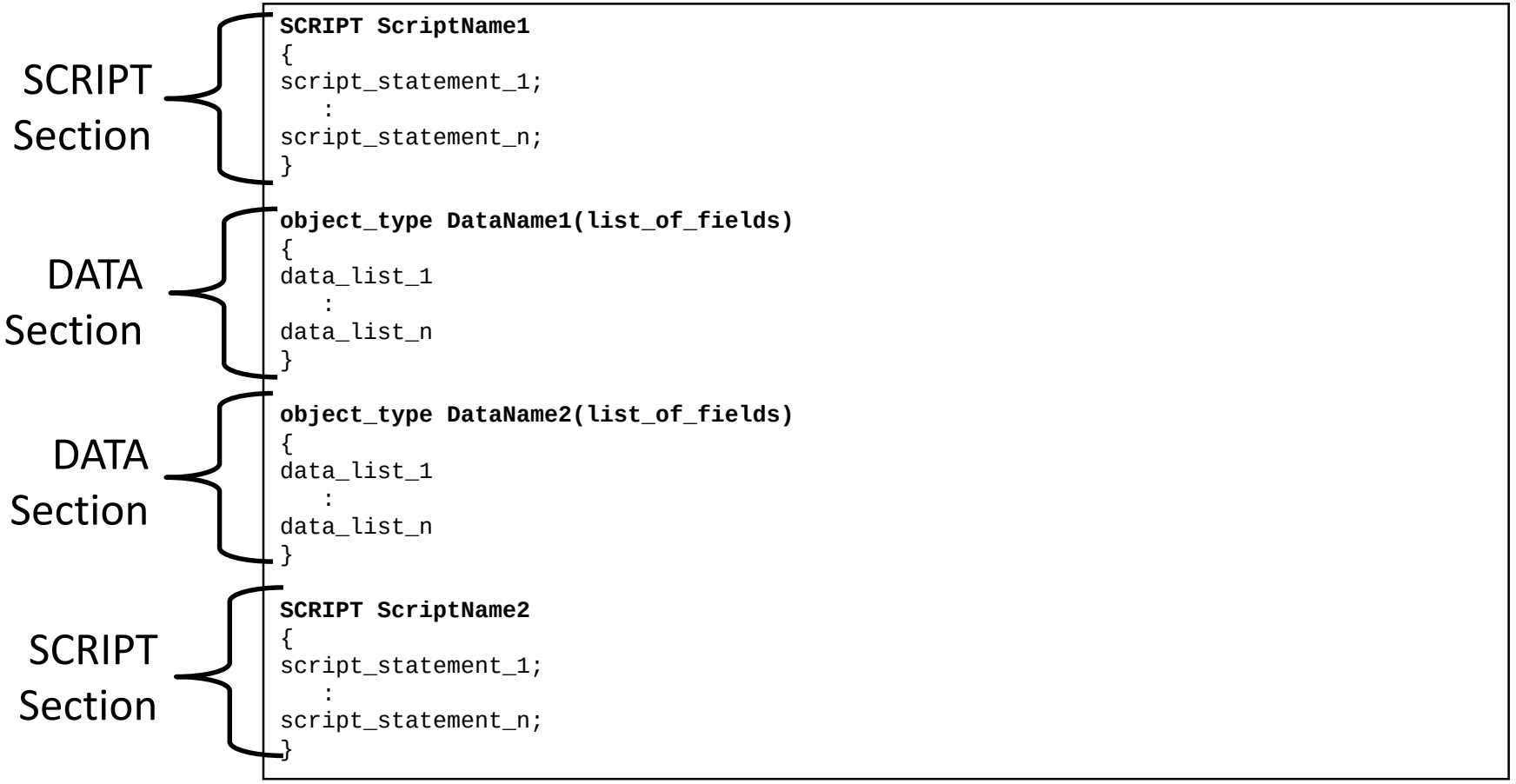
Automatically Load File

Load a file for PRESENT case or ANY case



Auxiliary File Format Overview

- Has two types of sections
  - There is no limit to the number of sections in a file



Auxiliary File SCRIPT Sections

- Start with the word SCRIPT
  - An optional script name may follow
    - For use with the LoadScript action
- A block of script actions follow enclosed in curly braces { }
- Each script statement must end in a semicolon ;

```
SCRIPT ScriptName1
{
script_statement_1;
   :
script_statement_n;
}
```

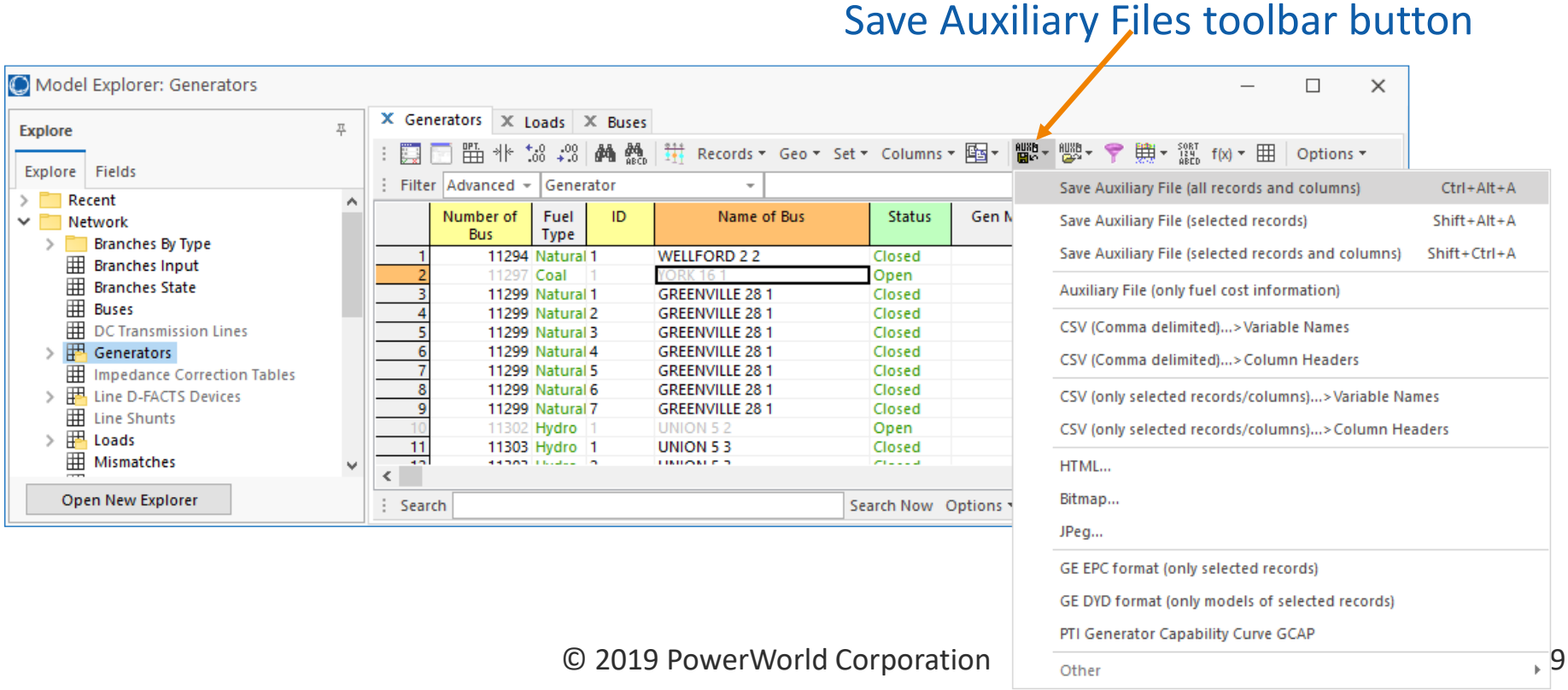
Auxiliary File DATA Sections

- Start with a valid `object_type` string
- An optional data name may follow
  - For use with the LoadData action
- Following this is a list of fields enclosed in parenthesis
  - **`(list_of_fields)`**

```
object_type DataName1(list_of_fields)
{
data_list_1
   :
data_list_n
}
```

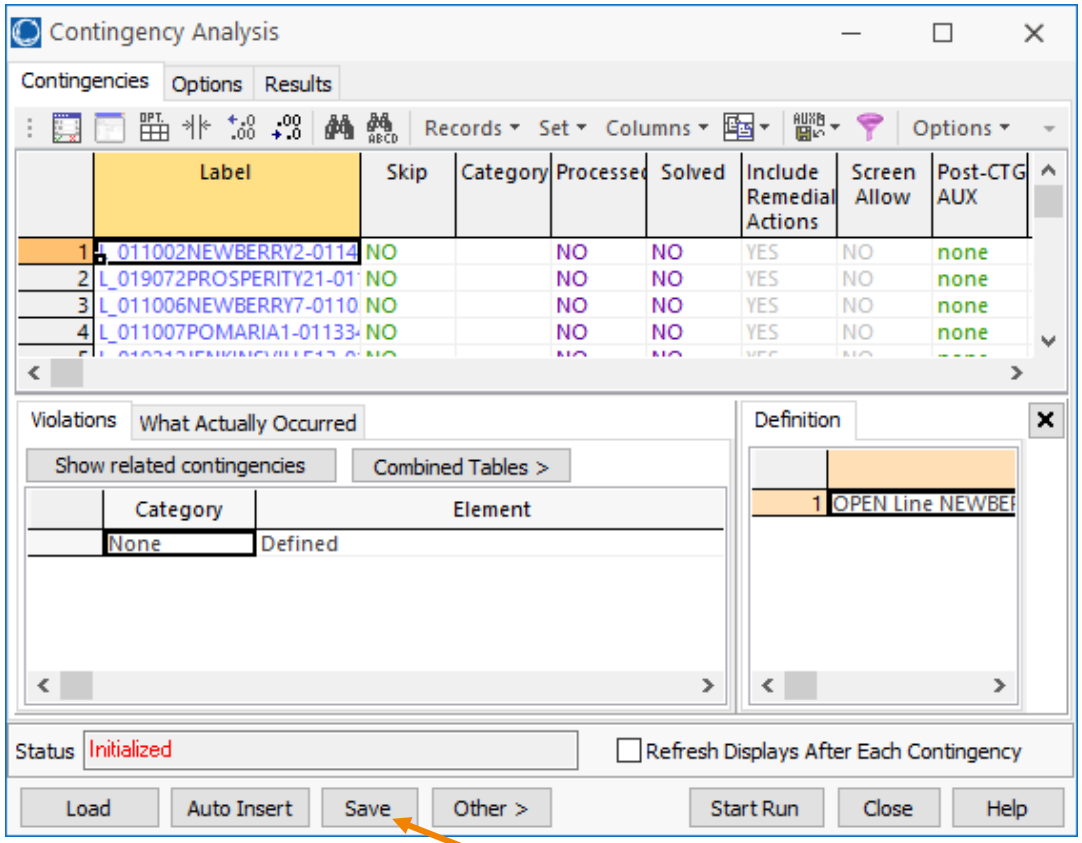
Creating an Auxiliary File

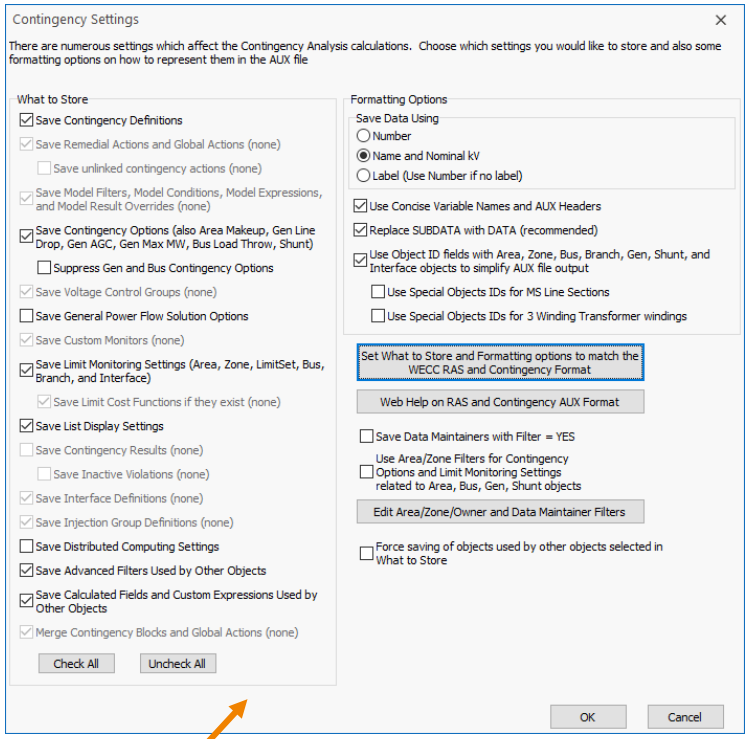
- Most grids in Simulator have an option to save data to an auxiliary file
  - Save Auxiliary Files toolbar button
  - Right click and choose **Save As → Auxiliary File**



Creating an Auxiliary File

- Some dialogs have a Save button that will create an auxiliary file with all relevant information





Click Save, then get a prompt for what details to include

DATA Section
`object_type`

- Identifies the type of object or data element the DATA section describes or models
- Any object that can be stored in an auxiliary file will be available in the Model Explorer
- Valid object types are usually not the same as the longer names that appear in the Model Explorer
  - Generators → Gen
  - Branches Input → Branch
  - Mismatches → Bus

DATA Section
`list_of_fields`

- Lists the types of values the records in the DATA section contain
- Usually the order of the fields dictate the order that fields will be read from the DATA section
  - Key fields will be read first
  - Simulator enforces a priority on some fields that must be read before other fields
- Simulator recognizes thousands of fields
  - Only a small subset will be used with a particular type of object

DATA Section
`list_of_fields` Parameter

- Specifications for a `list_of_fields`
  - Must be encompassed in brackets [ ]
  - May take up several lines of text
  - You may use the Simulator comment string //
    - Simulator will ignore all text to the right of the double slash
  - Blank lines, or lines which begin with the comment string will be ignored
  - Field names must be separated by commas
  - Field names may be optionally augmented with a field location integer (by default, we assume Location is 0)
    - Format is Fieldname:Location
    - CustomInteger:0 means get the first custom integer
    - CustomInteger:1 means get the second custom integer

DATA Section
Key Fields

- Each object type has a few fields that serve as key fields for Simulator
- These fields must be included in the `list_of_fields`
  - Buses: Number
  - Lines: BusNumFrom, BusNumTo, Circuit
  - Loads: BusNum, ID
- A list of available fields for each object type may be obtained on the Windows ribbon tab in the Auxiliary Files ribbon group under **Export Case Object Fields → Text File** or **Send To Excel**
  - The key fields will be denoted in this output with asterisks (*1*, *2*, and *3*)

DATA Section
Secondary Key Fields

- Secondary key fields
  - Often represent a combination of Name/Nominal kV for bus-related objects
  - The secondary key fields will be denoted in this output with asterisks (*A*, *B*, and *C*)
- When pasting into Simulator there is a priority by which key fields are examined
  - First look to see if the key fields are available
  - Then look for the secondary key fields and use them instead

Labels

- Unique identifier for an object of a particular type
- Refer to equipment in the model in a way unique to your organization
- Likely to change less frequently that bus numbers
- Can be used for pasting and updating
  - *Label (for use in input from AUX or Paste)*
- Used with full topology models that include breakers and nodes

DATA Section
Required Fields

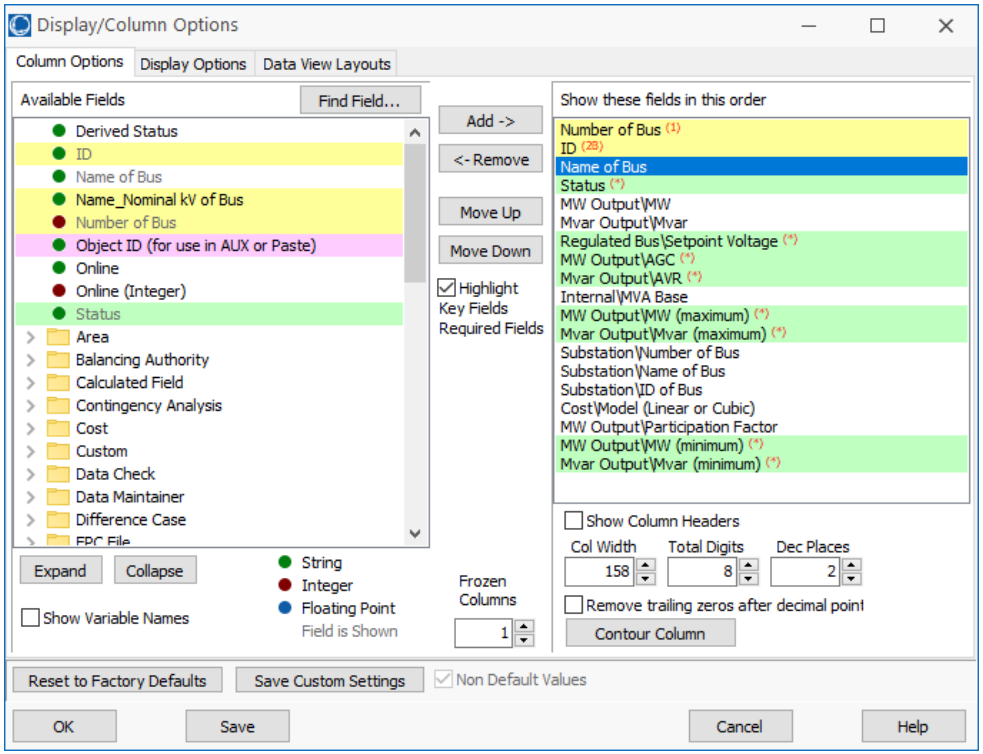
- You can also create new objects by reading in data from the DATA Section of an auxiliary file
- Must provide all **required fields** for the object
- Required Fields will be highlighted in green in the case information displays and in the list of available fields for an object shown in the Fields pane
- Many object types require being in Edit Mode in order to create new objects

Finding Key and Required Fields in the Simulator Interface

- Key Fields are yellow, Required Fields are Green

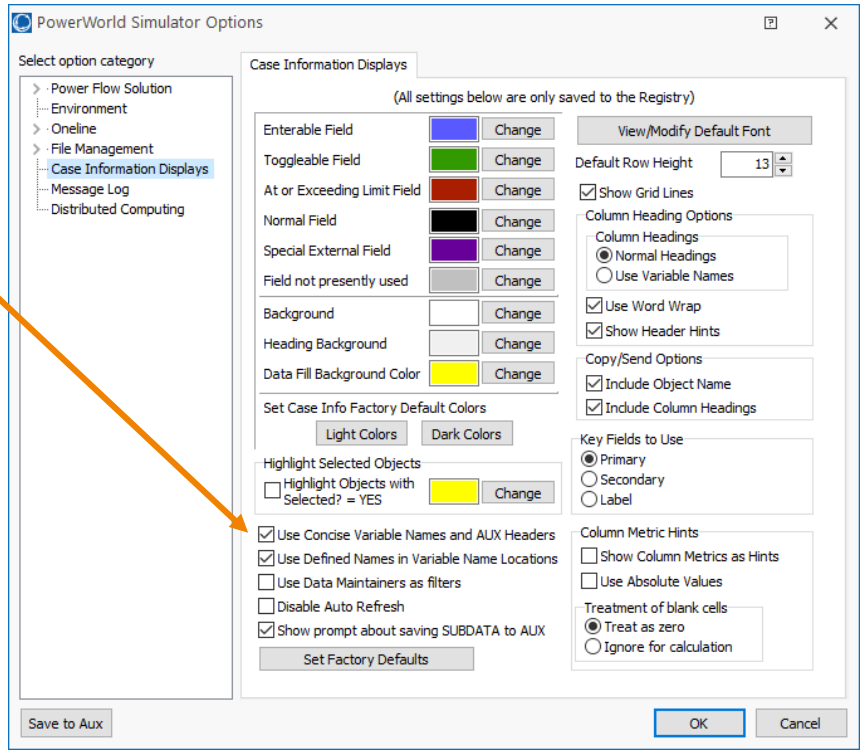
	Number of Bus	ID	Name of Bus	Status	Gen MW	Gen Mvar	Set Volt	AGC	AVR	MVA Base	Max MW	Max M
1	11294	1	WELLFORD 2 2	Closed	1.60	0.81	1.03038	YES	YES	1.92	1.60	
2	11297	1	YORK 16 1	Open	0.00	0.00	1.04000	YES	YES	3.48	2.90	
3	11299	1	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	1.03	
4	11299	2	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	1.03	
5	11299	3	GREENVILLE 28 1	Closed	1.02	0.52	1.04000	YES	YES	1.23	1.03	

- Or in the Display/Column Options dialog



Legacy Auxiliary File Header DATA Sections

- Concise format is used by default starting with Simulator version 20
  - Legacy auxiliary files can still be read to support auxiliary files used in existing processes
  - Legacy auxiliary files can be created for compatibility with older versions of Simulator



ONLY For Legacy Auxiliary File Header DATA Sections

- Start with the word DATA
- An optional data name may follow
  - For use with the LoadData action
- Following this is a list of parameters enclosed in parenthesis
  - **(object_type,[list_of_fields],file_type_specifier, create_if_not_found)**
    - **object_type**
    - **[list_of_fields]**
    - **file_type_specifier**
    - **create_if_not_found**

```
DATA DataName1(object_type, [list_of_fields], file_type_specifier, create_if_not_found)
{
data_list_1
   :
data_list_n
}
```

ONLY For Legacy DATA Section `file_type_specifier` Parameter

- Simulator presently accepts two values
  - none specified
    - Fields that follow are space-delimited
  - CSV
    - Fields that follow are comma-separated

ONLY For Legacy DATA Section `create_if_not_found` Parameter

- Optional field
- Specifies whether or not to create a new object if an existing one is not found
  - YES to create object
  - NO to deny creation
  - If omitted, user is prompted
  - If using the LoadAux script command, `create_if_not_found` will override the CreateIfNotFound script parameter

DATA Section
Data List

- Following the argument list describing the DATA section, the Data List is given
- Starts with a left curly brace {
- Ends with a right curly brace }
  - Curly braces must appear on their own lines
- Between the curly braces, any number of data lists can be entered
  - Each data list represents a single object in Simulator

```
object_type DataName1(list_of_fields)
{
data_list_1
   :
data_list_n
}
```

DATA Section
Data List

- Specifications of a data list
  - May take up several lines of text
    - Simulator will read the number of fields specified in `list_of_fields`
    - Each new data object must start on its own line of text
  - You may use the Simulator comment string //
    - Simulator will ignore all text to the right of the double slash
  - Blank lines, or lines that begin with the comment string will be ignored
  - Remember that the curly braces must appear on their own lines
  - Fields separated by space or comma
    - Space is used with the default concise format
    - `file_type_specifier` is only used with the legacy format
  - Strings can be enclosed in double quotes, but this is not required
    - You should however always enclose strings that contain spaces (or commas) in quotes. Otherwise, strings containing commas would cause errors for comma-delimited files, and spaces would cause errors for space-delimited formatted files.

Example DATA Section

object_type

list_of_fields

```
BRANCH (BusNumFrom,BusNameFrom,BusNumTo,BusNameTo,Circuit,Status,IsXF,R,X,B, // comment
        // comments can appear here
        LimitMVAA,LimitMVAB,LimitMVAC)
{
//--comments can appear here-----------------------------------------------------------------------------------
// Num  Name      ToNum  ToName     CKT   Status  Xfmr?     R         X         B       Alimit    Blimit    Climit
//-------------------------------------------------------------------------------------------------------------
    1 "ROANSPRA"   964 "GIBCRK C" " 1" "Closed" "No"   0.00690   0.03980   0.01080     236.0     236.0     236.0
    1 "ROANSPRA"     4  IOLA      " 1" "Closed" "No"   0.00828   0.04776   0.01296     236.0     236.0     236.0
    5 "IOLA    "     4 "IOLA    " " 1" "Closed" "Yes"  0.00763   0.14166   0.00000      60.0      60.0      60.0
    5 "IOLA    "    13 "KEITH   " " 1" "Closed" "No"   0.13735   0.12184   0.00175      24.0      24.0      24.0
    5 "IOLA    "     9 "BEDIAS  " " 1" "Closed" "No"   0.01980   0.11477   0.00194     118.0     118.0     118.0
    9 "BEDIAS  "    25 "NTHZULCH" " 1" "Closed" "No"   0.03173   0.18395   0.00312      88.0     118.0     118.0
   13 "KEITH   "    17 "CARLOSSW" " 1" "Closed" "No"   0.08233   0.07303   0.00105      24.0      24.0      24.0
   17 "CARLOSSW"    29 "BOONVIL " " 1" "Closed" "No"   0.21753   0.19295   0.00277      24.0      24.0      24.0
   17 "CARLOSSW"    21 "CARLOS  " " 1" "Closed" "No"
      // data can appear on more than one line.  It just read a field for each entry in the list_of fields
                                   0.06540   0.10810   0.00160      35.0      35.0      35.0
   25 "NTHZULCH"    48 "HLTOPLKS" " 1" "Closed" "No"   0.04232   0.24532   0.00416      88.0     118.0     118.0
//-------------------------------------------------------------------------------------------------------------
}
```

"GIBCRK C" needs double quotes because it has a space in the name
IOLA may optionally have quotes

Start and End Data Lists

DATA Section
SubData

- For some object types, the DATA section does not provide an adequate method of defining information
- For these special instances, SUBDATA sections are optionally added to each data list

```
object_type (list_of_fields)
{
value_list_1
    <SUBDATA subobject_type1>
      precise format describing an object_type1
      precise format describing an object_type1
      :
    </SUBDATA>
    <SUBDATA subobject_type2>
      precise format describing an object_type2
      precise format describing an object_type2
      :
    </SUBDATA>
value_list_2
    :
value_list_n
}
```

DATA Section
SubData

- Starts with tag `<SUBDATA subobject_type>`
- Ends with tag `</SUBDATA>`
- Inside the tags, you must follow specified format for the respective `subobject_type`
  - Values must appear in a precisely defined order
  - For detailed description of the precisely defined format for each subdata section, see the online help at https://www.powerworld.com/WebHelp/Content/Other_Documents/Auxiliary-File-Format.pdf

Example DATA Section with SubData

normal Data List

```
CONTINGENCY (Name,Skip,Processed,Solved)
{
"Contingency Name" "NO" "NO" "NO"
  <SUBDATA CTGElement>
    // just some comments
    // action                    Model Criteria  Status Time Delay  Persistent  comment
    "BRANCH 40821 40869 1  OPEN" ""              ALWAYS    0            NO     //Raver - Paul 500 kV
    "GEN 45041 1  OPEN"          ""              ALWAYS    0            NO     //Trip Unit #2
    "BRANCH 42702 42727 1  OPEN" "Line X Limited" CHECK     0            NO     //Open Fern Hill
    "GEN 40221 1  OPEN"          "Interface L1"  CHECK     0            NO     //Drop ~600 MW
    "GEN 40227 1  OPEN"          "Interface L2"  CHECK     0            NO     //Drop ~1200 MW
    "GEN 40221 1  OPEN"          "Interface L3"  CHECK     0            NO     //Drop ~600 MW
    "GEN 40227 1  OPEN"          "Interface L3+" CHECK     0            NO     //Drop ~1200 MW
  </SUBDATA>

"Contingency Name 2" "NO" "NO" "NO"
  <SUBDATA CTGElement>
    // just some comments
    // action                    Model Criteria Status Time Delay  Persistent  comment
    "BRANCH 40821 40869 1  OPEN" ""             ALWAYS    0            NO     //Raver - Paul 500 kV
  </SUBDATA>
}
```

subobject_type

Specific Format for CTGElement

SUBDATA, /SUBDATA tags

DATA Section
SubData

- For the most part SubData sections are not necessary and are represented by other object types directly
  - Object types have been created that provide access to this data in “sub-tables”
    - [in “database speak” = this is table with a foreign key constraint]
- This gives direct access to these objects so that the standard case information display and auxiliary file functionality can be used
  - Copy/Paste To/From a spreadsheet
  - SimAuto command access
  - Script command access (SaveData, SetData)

DATA Section
SubData

The following are equivalent representations of the same data

```
Contingency (Name,Selected,Skip,Category,Processed,Solved,RemedialActionInclude,ScreenAllow,
   PostCTGAuxFile,LoadMWIslanded,GenMWIslanded,OccurredGlobalCount,
   OccurredTransientCount,OccurredRemedialCount,ViolCustom,Violations,
   BranchMaxPerc,MinVolt,MaxVolt,InterfaceMaxPerc,BusPairAngleMax,Memo)
{
"L_011002NEWBERRY2-011454CHAPPELLS4C1" "YES" "NO " "" "NO " "NO" "YES" "NO " "none" "" "" "" "" "" "" "" "" "" "" "" "" "" ""
   <SUBDATA CTGElement>
     "BRANCH 'NEWBERRY 2_69.00' 'CHAPPELLS 4_69.00' 1 OPEN" "" CHECK 0 NO
   </SUBDATA>
"L_019072PROSPERITY21-011002NEWBERRY2C1" "YES" "NO " "" "NO " "NO" "YES" "NO " "none" "" "" "" "" "" "" "" "" "" "" "" "" "" ""
   <SUBDATA CTGElement>
     "BRANCH 'PROSPERITY 2 1_69.00' 'NEWBERRY 2_69.00' 1 OPEN" "" CHECK 0 NO
   </SUBDATA>
}
```

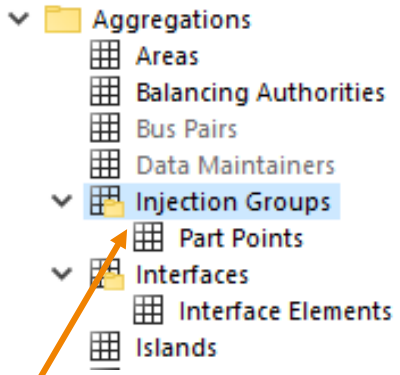
```
Contingency (Name,Selected,Skip,Category,Processed,Solved,RemedialActionInclude,ScreenAllow,
   PostCTGAuxFile,LoadMWIslanded,GenMWIslanded,OccurredGlobalCount,
   OccurredTransientCount,OccurredRemedialCount,ViolCustom,Violations,
   BranchMaxPerc,MinVolt,MaxVolt,InterfaceMaxPerc,BusPairAngleMax,Memo)
{
"L_011002NEWBERRY2-011454CHAPPELLS4C1" "YES" "NO " "" "NO " "NO" "YES" "NO " "none" "" "" "" "" "" "" "" "" "" "" "" "" "" ""
"L_019072PROSPERITY21-011002NEWBERRY2C1" "YES" "NO " "" "NO " "NO" "YES" "NO " "none" "" "" "" "" "" "" "" "" "" "" "" "" "" ""
}

ContingencyElement (Contingency,ObjectAction,Criteria,CriteriaStatus,Persistent,TimeDelay,Comment)
{
"L_011002NEWBERRY2-011454CHAPPELLS4C1" "BRANCH 'NEWBERRY 2_69.00' 'CHAPPELLS 4_69.00' 1 OPEN" "" "CHECK" "NO " 0 ""
"L_019072PROSPERITY21-011002NEWBERRY2C1" "BRANCH 'PROSPERITY 2 1_69.00' 'NEWBERRY 2_69.00' 1 OPEN" "" "CHECK" "NO " 0 "“
}
```

Object Types Instead of SubData

- Model Explorer structure is helpful in showing object types that are sub-objects of another object type
  - If an object is shown in a case information display in the Model Explorer it can be represented in its own DATA section in an auxiliary file
- Objects that are listed in a subfolder of another object are often sub-objects and can be presented as SubData or in a separate DATA section

Object Types Instead of SubData

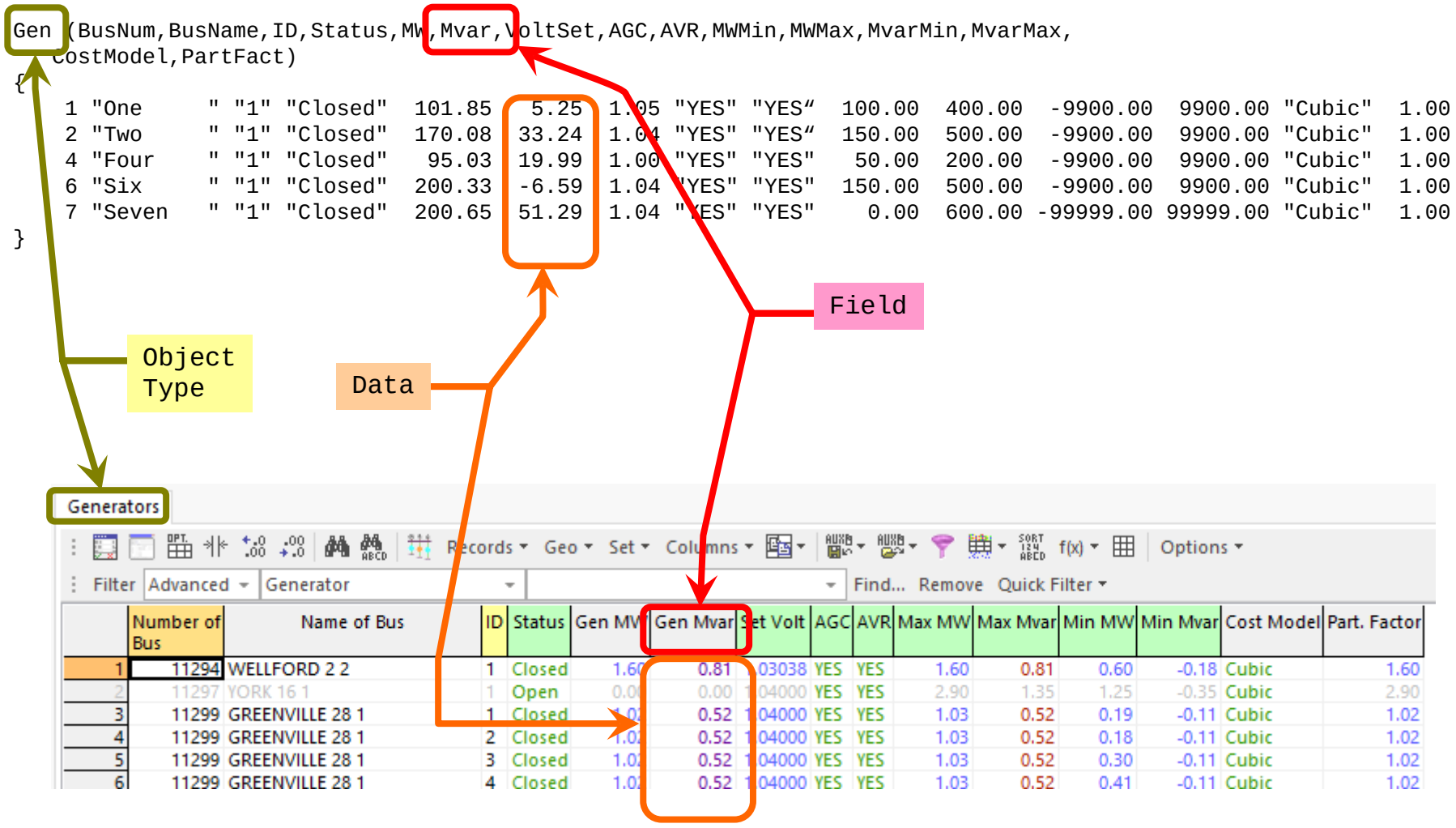
```
InjectionGroup
(Name,CountGen,PartFactMWGen,CountLoad,PartFactMWLoad,PartFactMvar
Load,CountShunt,
   PartFactMvarShunt,MW,Mvar)
{
"INJGRP:0_Area 11"         3   100.00         0     0.00     0.00
0     0.00     3.65     1.86
   <SUBDATA PartPoint>
     "GEN" "11294" "1" 1.6000 "SPECIFIED" "YES"
     "GEN" "11299" "1" 1.0250 "SPECIFIED" "YES"
     "GEN" "11299" "2" 1.0250 "SPECIFIED" "YES"
   </SUBDATA>
}
```



Participation points of an injection group can be represented as SubData within the InjectionGroup DATA section or as a PartPoint object type

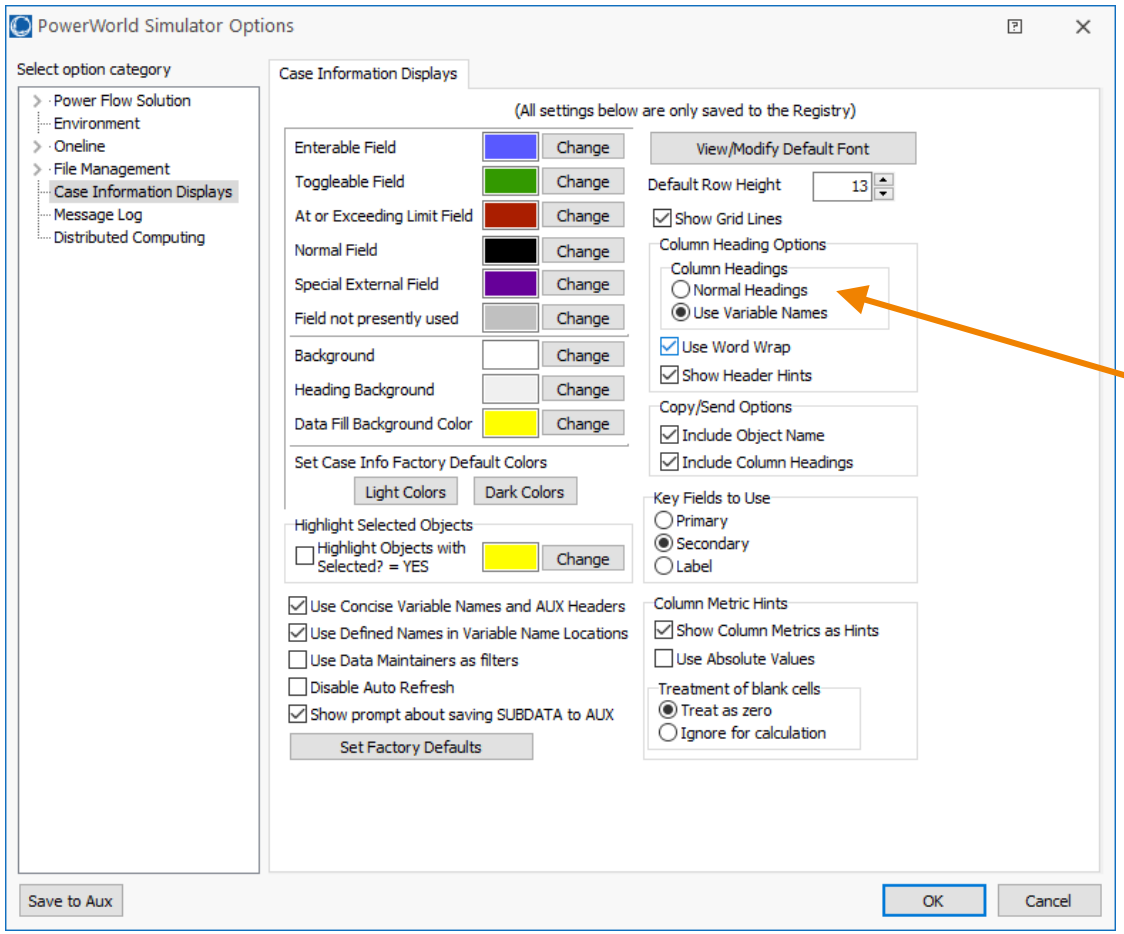
```
PartPoint (Object,GroupName,AutoCalcMethod,PartFact,AutoCalc)
{
"Gen 'WELLFORD 2 2_13.80' '1'" "INJGRP:0_Area 11" "SPECIFIED" 1.60
"YES"
"Gen 'GREENVILLE 28 1_69.00' '1'" "INJGRP:0_Area 11" "SPECIFIED"
1.02 "YES"
"Gen 'GREENVILLE 28 1_69.00' '2'" "INJGRP:0_Area 11" "SPECIFIED"
1.02 "YES"
}
```

Correlation of Case Information Display to an Auxiliary DATA Section



Option for Changing Case Information Display Column Heading to Variables

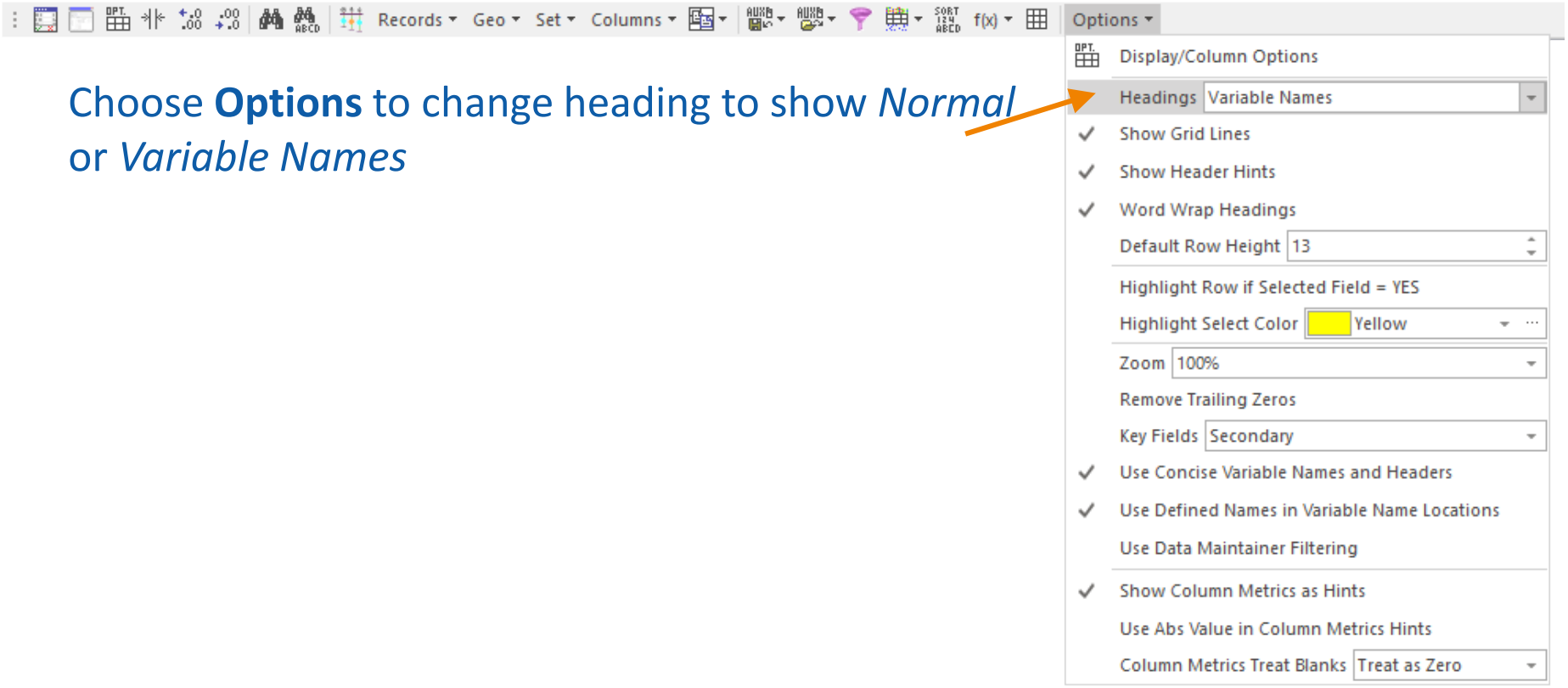
- Choose **Options → Simulator Options**
  - Then go to the Case Information Displays option category
  - Change the **Column Headings** to *Use Variable Names*



Use *Normal Headings* or *Variable Names*

Option for Changing Case Information Display Column Heading to Variables

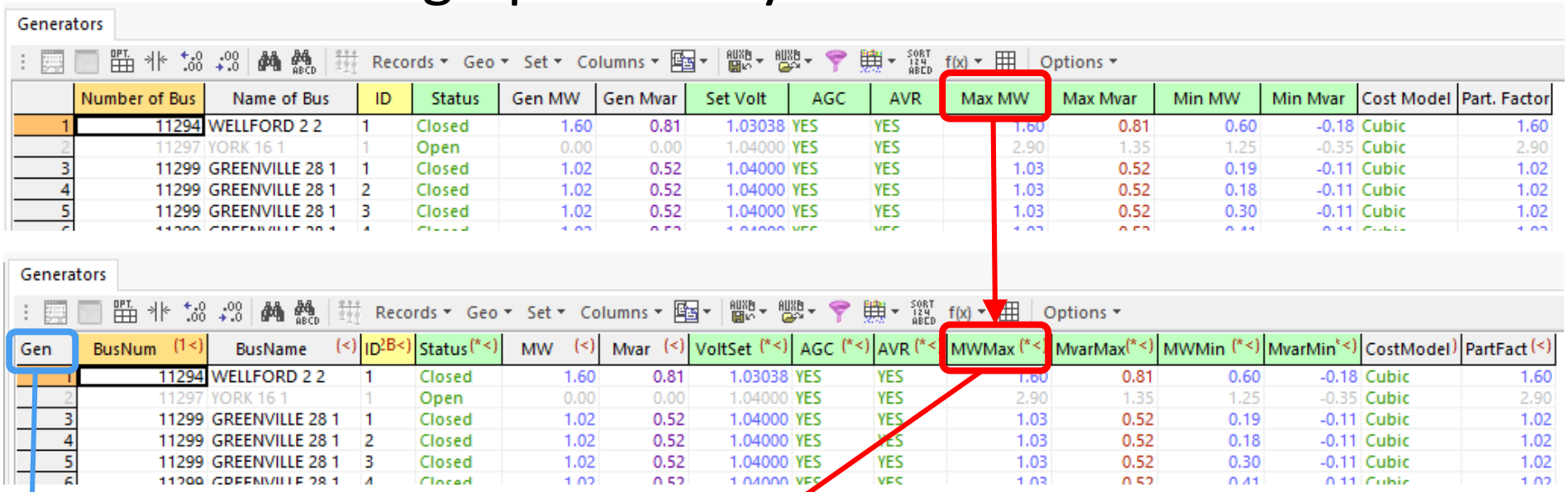
- You can also change the option in the toolbar



Choose **Options** to change heading to show *Normal* or *Variable Names*

Use Variable Names

- Provides a graphical way to see the variable names

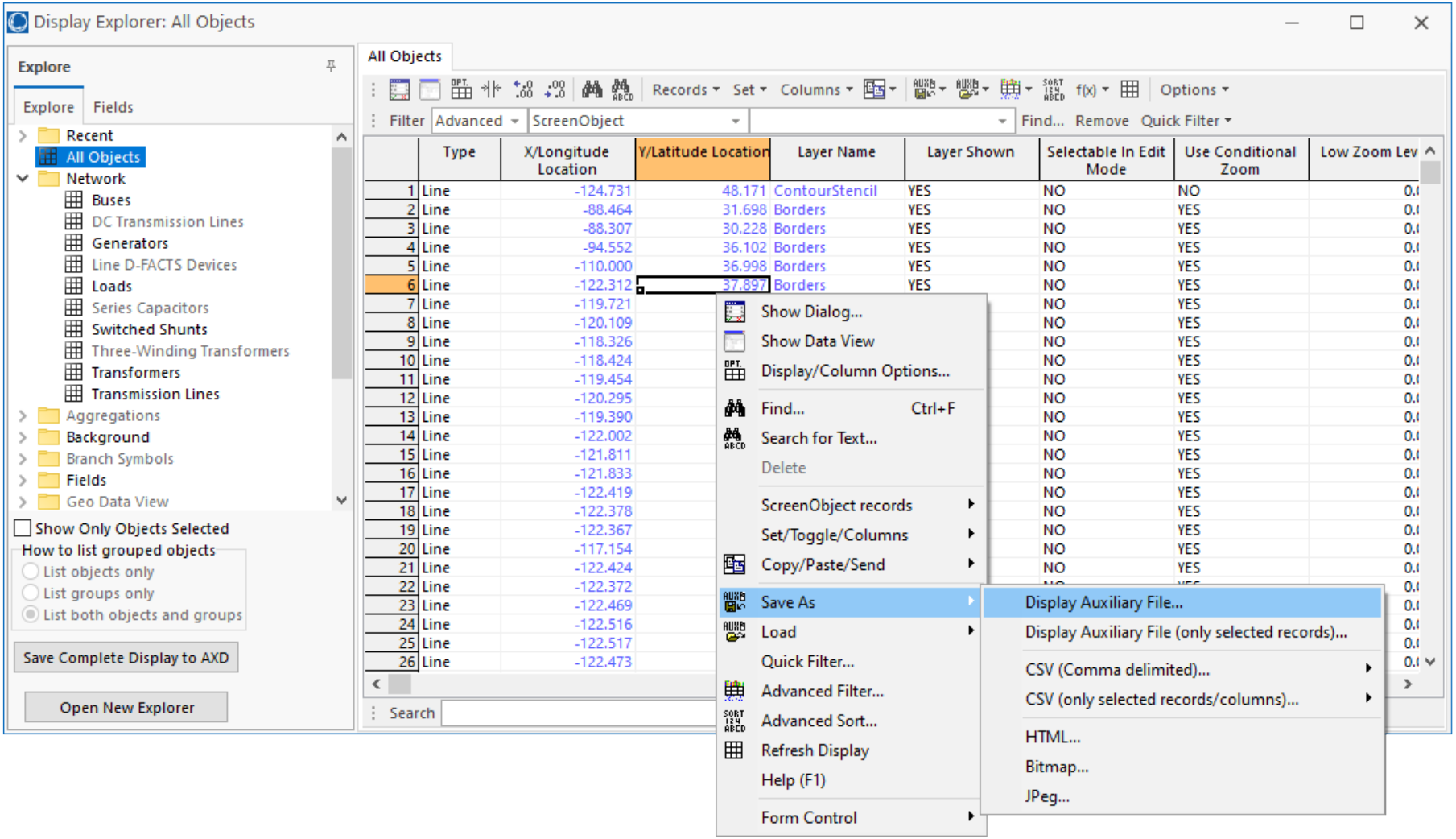



```
Gen (BusNum,BusName,ID,Status,MW,Mvar,VoltSet,AGC,AVR,MWMax,MvarMax,MWMin,MvarMin,
    CostModel,PartFact)
{
 11294 "WELLFORD 2 2" "1" "Closed"     1.60     0.81  1.03038 "YES" "YES"     1.60     0.81     0.60    -0.18 "Cubic"     1.60
 11297 "YORK 16 1"    "1" "Open"       0.00     0.00  1.04000 "YES" "YES"     2.90     1.35     1.25    -0.35 "Cubic"     2.90
 11299 "GREENVILLE 28 1" "1" "Closed"     1.02     0.52  1.04000 "YES" "YES"     1.03     0.52     0.19    -0.11 "Cubic"     1.02
 11299 "GREENVILLE 28 1" "2" "Closed"     1.02     0.52  1.04000 "YES" "YES"     1.03     0.52     0.18    -0.11 "Cubic"     1.02
 11299 "GREENVILLE 28 1" "3" "Closed"     1.02     0.52  1.04000 "YES" "YES"     1.03     0.52     0.30    -0.11 "Cubic"     1.02
}
```

Display Auxiliary Files

- One-line diagram objects can also be saved and edited in the auxiliary file format (*.axd file extension)
- Case Information Displays for one-line diagrams are accessed from **Onelines → List Display → All Display Objects…**
- Save entire one-line in axd format
  - **File → Save Oneline As…**
  - Choose *Display Auxiliary File (*.axd)* from **Save as type:**
- Open entire one-line in axd format
  - **File → Open Oneline…**
  - Choose *Display Auxiliary File* from **Files of type:**
- **Auxiliary ID** (*SOAuxiliaryID*) field used as an extra key field to uniquely identify objects

Display Objects



Example Display Auxiliary DATA Section

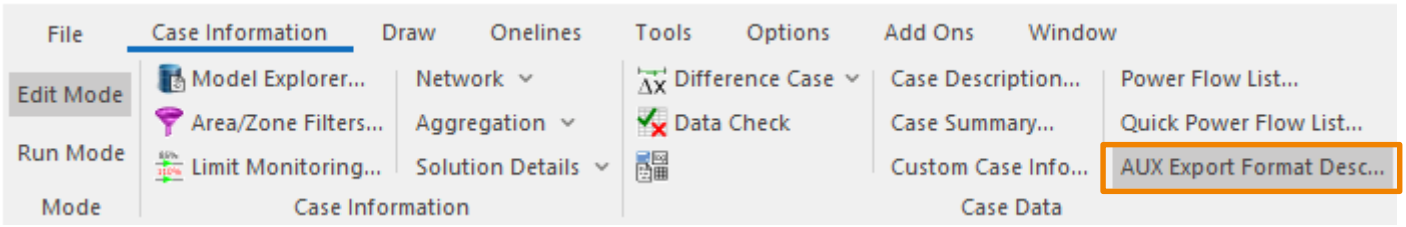
Object Type for this example is DisplayBus

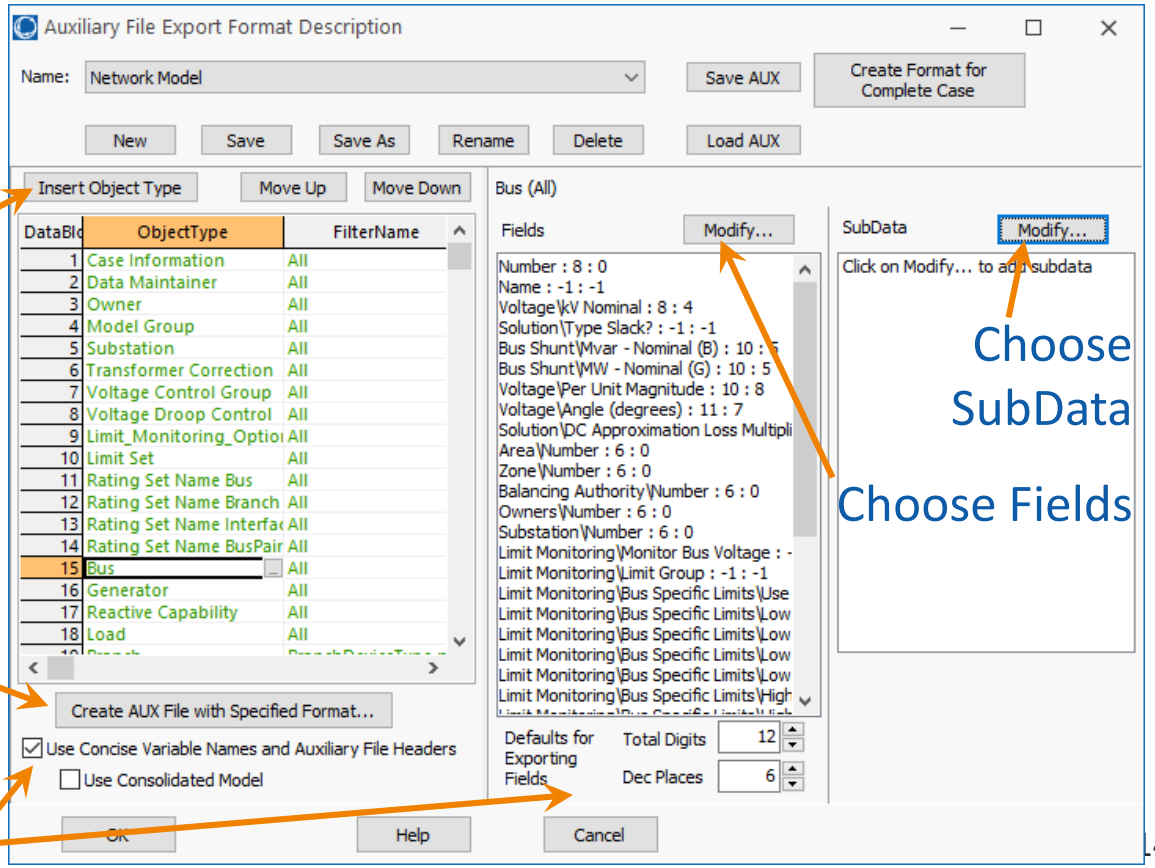
```
DisplayBus (BusNum,SOAuxiliaryID,SOX,SOY,SOThickness,SOColor,SOUseFillColor,SOFillColor,
   SOSize,SOWidth,SOOrientation,SOLevel,SOSameLevelDisplayPriority,SOImmobile,
   SLName,SOStyle,SODashed,SOBelongsToGroup,ShapeFileRecordNumber,ShapeFileName)
{
   51153 "1" -81.79920000 37.19426477        1 $00008000 "YES" $00000000     5.79     0.25 "Down"
"Middle" 74382 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 ""
   51154 "1" -81.78840000 37.19426477        1 $00008000 "YES" $00000000     1.93     0.25 "Down"
"Middle" 74381 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 ""
   51155 "1" -81.91100000 37.09425718        1 $00008000 "YES" $00000000    15.43     0.25 "Down"
"Middle" 74380 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 ""
   51150 "1" -81.64568000 37.08770262        1 $00008000 "YES" $00000000     0.77     0.15 "Down"
"Middle" 74379 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 ""
   51151 "1" -81.64136000 37.08770262        1 $00008000 "YES" $00000000     2.31     0.15 "Down"
"Middle" 74378 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 ""
   51152 "1" -81.80100000 37.03126639        1 $00008000 "YES" $00000000     9.64     0.25 "Down"
"Middle" 74377 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 ""
   51159 "1" -80.97740000 36.70196263        1 $00000000 "YES" $00000000     1.16     0.10 "Down"
"Middle" 74376 "NO " "AlwaysVisible" "Rectangle" "       0" "" -1 "〃
}
```

Auxiliary File Export Format Descriptions

- Allows the definition of a list of object types and fields to be saved in DATA sections of an auxiliary file
- These formats themselves can then be saved to an auxiliary file and used whenever needed
- Script command can be used to save an auxiliary file in a defined format
  - `SaveDataUsingExportFormat("filename", filetype, "FormatName", ModelToUse);`

Auxiliary File Export Format Descriptions





Choose Object Types

Choose SubData

Choose Fields

Save an auxiliary file with the specified data

Set formatting and file type

Special Support Sub-Types of Special Object Types

- These special object types give you access to a combination of all the “sub-object” fields and specific device fields simultaneously

Object Type	PartPoint	InterfaceElement
Special Sub-Types that provide access to two tables simultaneously	PartPointGen PartPointInjectionGroup PartPointLoad PartPointShunt	InterfaceElementBranch InterfaceElementBranchClose InterfaceElementBranchOpen InterfaceElementDCLine InterfaceElementGen InterfaceElementInjectionGroup InterfaceElementInterface InterfaceElementLoad InterfaceElementMSLine

Example: Special Support Sub-Types of Special Object Types

- PartPointGen
  - Provides access to all PartPoints that represent generator objects
  - Provides access to BOTH the list of fields for the PartPoint AND the Gen
- InterfaceElementBranch
  - Provides access to all InterfaceElements that represent branch objects
  - Provides access to BOTH the list of fields for the InterfaceElement AND the Branch

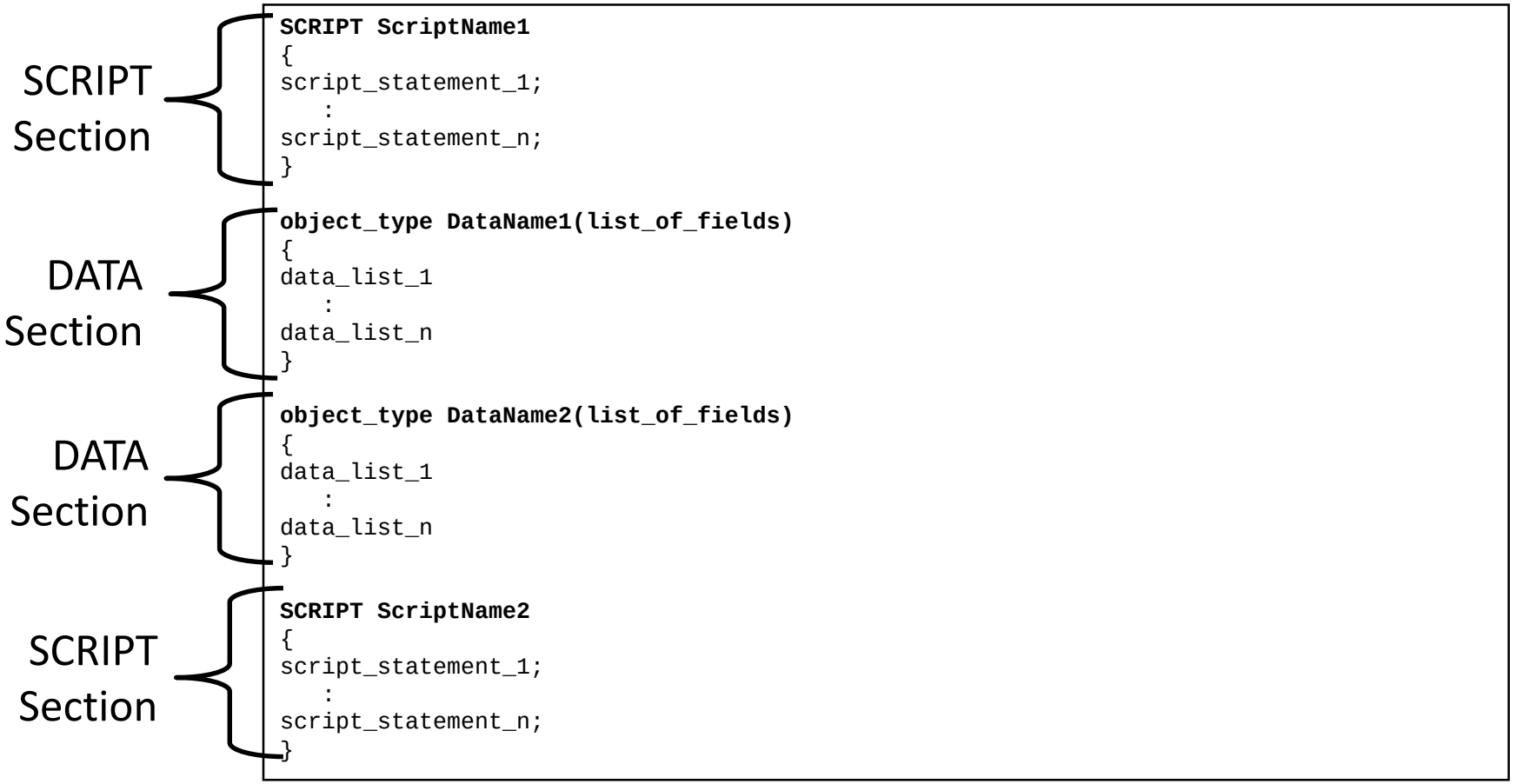
SCRIPT COMMANDS

Auxiliary File Scripting

- A scripting language is available for modifying data and automatically running PowerWorld Simulator commands
- Batch processing with no logic control
- Most functionality that is available in the GUI can be done through scripting
- Use help document for best reference for all available script commands
  - https://www.powerworld.com/WebHelp/Content/Other_Documents/Auxiliary-File-Format.pdf
  - Within Simulator can go to **Window → Auxiliary File Format**

Auxiliary File Format Overview

- Has two types of sections
  - There is no limit to the number of sections in a file



Auxiliary File SCRIPT Sections

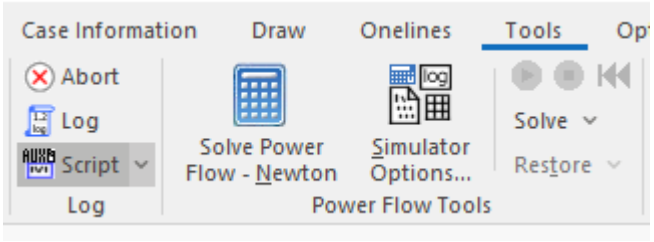
- Start with the word SCRIPT
  - An optional script name may follow
    - For use with the LoadScript action
- A block of script actions follow enclosed in curly braces { }
- Each script statement must end in a semicolon ;

```
SCRIPT ScriptName1
{
script_statement_1;
   :
script_statement_n;
}
```

Script Command Execution Dialog

- Manually enter script commands
  - Useful for testing scripts while creating auxiliary files
- Load auxiliary files
  - Validates and applies
- Validate auxiliary files
  - Receive messages in the message log if anything is incorrect in an auxiliary file before applying
- Quick Aux
  - Set up list of auxiliary files that are used frequently
  - Quickly reference a selected auxiliary file
  - Apply group of auxiliary files in a specified order

Script Command Execution Dialog

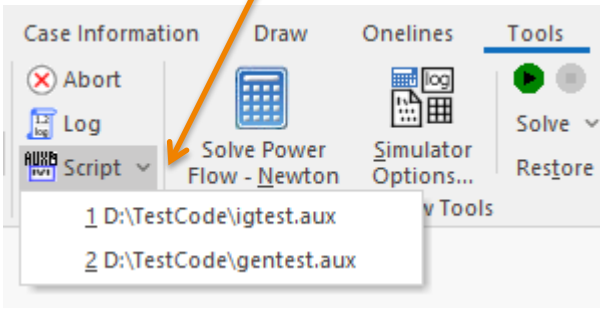


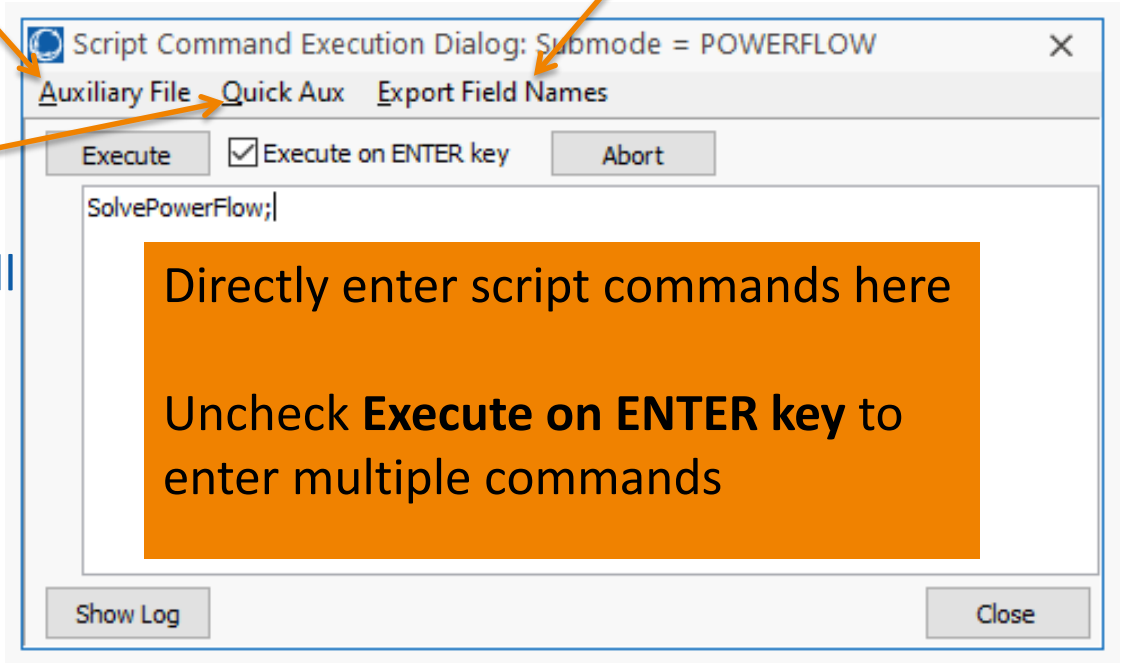
Load or validate auxiliary files

Get list of fields for each object type

Define list of frequently used auxiliary files for easy access

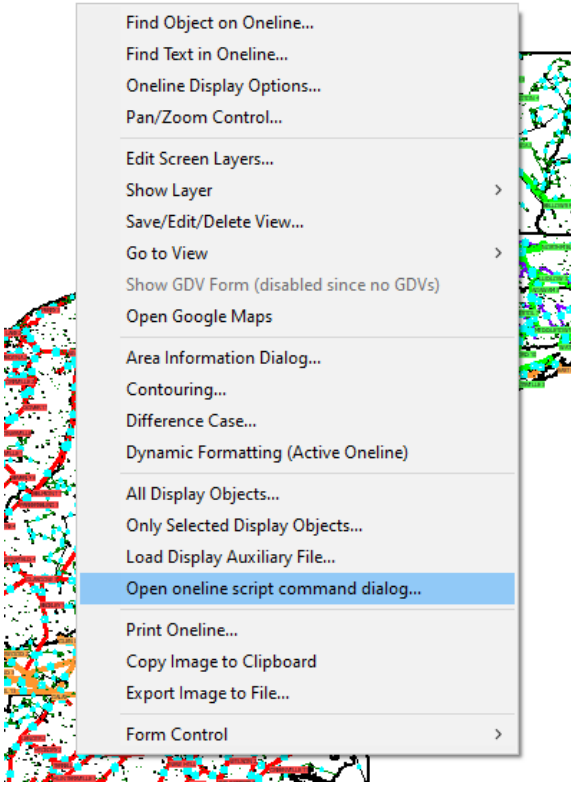
Defined list of auxiliary files will appear in dropdown





Oneline Script Command Execution Dialog

- Oneline diagrams can have script commands applied to them through a Display Auxiliary File (*.axd)
- The Script Command Execution Dialog can be accessed for a particular oneline by right clicking in the oneline background and choosing the **Open oneline script command dialog** from the local menu
  - Quick Aux option is not available for onelines



Edit and Run Mode

- The Simulator user interface has two modes
  - Edit Mode
    - For making changes to system topology
      - Adding a bus, deleting a transmission line, creating an equivalent case, etc.
  - Run Mode
    - For performing calculations and analysis
      - Solve power flow, run contingency analysis, calculate available transfer capability, etc.
- These modes must also be obeyed in scripting
  - Use `EnterMode` script action to change modes
    - `EnterMode(Run);`
    - `EnterMode(Edit);`

Very Useful Script Commands

- Available in either Edit or Run mode
- Will be used frequently to manipulate data
  - **SaveData**("filename", filetype, objecttype, [fieldlist], [subdatalist], filter, [SortFieldList]);
    - Save data to an auxiliary file or CSV file
    - Useful for recording the results of a study
  - **SetData**(objecttype, [fieldlist], [valuelist], filter);
    - Set the specified fields to the specified values
    - Can be used to quickly set a single field for all objects meeting a filter to the same value
    - Will appear in some auxiliary files saved from Simulator dialogs such as difference flows and contingency analysis