

PowerWorld Simulator Data Checks



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Example Data Checks



- PowerWorld has taken auxiliary files that John Gross (Avista) and Jonathan Young (Columbia Grid) have maintained over the past several years
 - This uses many concepts such as
 - Advanced Filters
 - Calculated Fields
 - Dynamic Formatting
 - Expressions and String Expressions
 - It became quite complex to maintain though
- PowerWorld designed a new feature we call “Data Checks”
 - John and Jonathan’s auxiliary files can become Data Checks
 - WECCDataChecks.aux
 - 8 Branch, 5 bus, 17 generator, 5 load, 1 shunt, 1 zone, 2 for GENROU, GENCC, GENTPF, GENTPJ

Data Check Objects

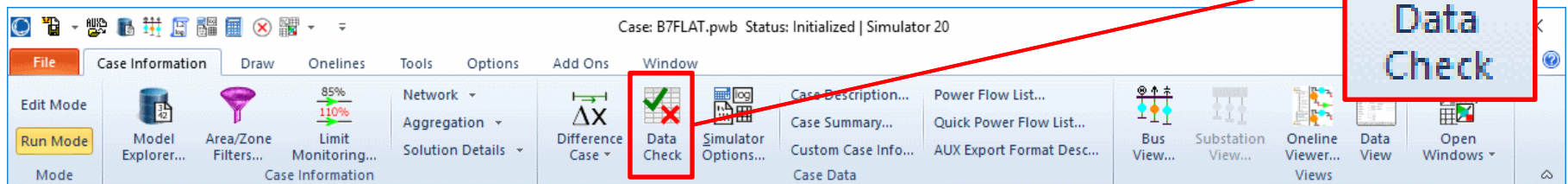


- Primary three fields of a Data Check
 - **ObjectType** (key field)
 - object type to which it applies
 - Gen, Branch, Bus, Shunt, etc...
 - **Name** (key field)
 - unique identifier across Data Checks that apply to **ObjectType**
 - **Filter**
 - criteria for which a particular object will meet the Data Check.
 - Either the name of a Filter ("Name of my filter")
 - Or string with one condition ("Vpu < 0.95")
- There are then several options the indicate how to display data check results in the user interface

Data Check Overview Dialog



- We will discuss in greater detail how to customize the use of Data Checks shortly
- We expect primary use will be the built-in Data Check Results dialog
 - Go to the Case Information Tab and click on Data Check button



- Has three primary tabs
 - Check Results: A folder for every ObjectType which has at least one Data Check assigned to it
 - Folder contains a list of those data checks with a check-box
 - Check Aggregation Results
 - Folder for Area, Data Maintainer, Owner, and Zone
 - Folder contains a list of Data Checks that would apply as aggregation checks and may have sub-folders grouping them by ObjectType if there are a lot
 - Define Checks
 - A list of all the Data Checks that have been defined.

Data Check Results Dialog









- Use check boxes to determine whether to show columns for the respective Data Check

	From Number	To Number	Circuit	From Name_Nominal kV	To Name_Nominal kV	Circuit	Label (for use in input from AUX or Paste)	EXCEED Limit	NERC LimA>LimB	POWER Bmag > 0	POWER NonTrans NomkV Diff
1	66233	14101	1						LimA>LimB		
2	15021	14931	1							Bmag > 0	
3	17002	17027	1							Bmag > 0	
4	23298	23295	1						LimA>LimB		
5	26741	26740	1						LimA>LimB		
6	30507	30506	6						LimA>LimB		
7	30522	30524	8						LimA>LimB		
8	30532	30531	3						LimA>LimB		
9	38000	30622	1					Exceed Limit			
10	31110	31120	1					Exceed Limit			
11	31315	31314	1					Exceed Limit			
12	31319	31318	1					Exceed Limit			
13	31386	31388	1					Exceed Limit			
14	31386	31392	1					Exceed Limit			
15	31992	31998	8						LimA>LimB		
16	33600	37582	1								NonTrans NomkV Diff
17	34233	34282	1								NonTrans NomkV Diff
18	35623	35622	1						LimA>LimB		
19	40007	402770	1					Exceed Limit			
20	47068	40093	1					Exceed Limit			
21	40243	45314	1					Exceed Limit			
22	40423	41139	1					Exceed Limit			
23	40539	41272	1					Exceed Limit			
24	40635	40633	2					Exceed Limit			
25	40671	40669	3					Exceed Limit			
26	47562	40843	1					Exceed Limit			
27	41341	44057	3					Exceed Limit			
28	42165	42118	1					Exceed Limit			
29	46801	46888	1					Exceed Limit			
30	46861	46827	1					Exceed Limit			

Check Results Tab



- Check box represents the field **Show** of the respective Data Check
- You can also click the folder icons to uncheck or check all the underlying Data Checks
- Folder icon check box can represent
 - All checked 
 - All Not checked 
 - A mix 

- ▼  Branch
 - EXCEED Limit
 - NERC LimA > LimB
 - NERC LimB > (3*LimA)
 - NERC Narrow Vband
 - POWER Bmag > 0
 - POWER NonTrans NomkV Diff
- ▼  Bus
 - POWER No Owner
 - POWER No Zone
- >  Generator

Check Results Tab



- Include Fields used by Data Check Filter
 - Check box at the top of this tab
 - Simulator will automatically include fields of this object type which are used in the **Filter** of any Data Check that is **Shown=YES** (checked)
- Only objects that meet one Data Check shown
 - Simulator will automatically include objects in the table only if there is at least one Data Check with **Shown=YES** for which the object meets the Data Check's **Filter**

Check Aggregation Result Tab



- Use check boxes to determine whether to show columns for the respective Data Check

Data Check Results Different Choices for **AggregationFormat**

Check Results | Check Aggregation Results | Define Checks

Use check boxes to show columns for the data checks

Records | Geo | Set | Columns | Options

Area
 Branch
 EXCEED Limit
 NERC LimA>LimB
 NERC LimB>(3*LimA)
 NERC Narrow Vband
 POWER Bmag > 0
 POWER NonTrans NomkV Diff
 Bus : POWER No Owner
 Bus : POWER No Zone
 Generator
 Load
 CASE Miss Long ID
 CASE Missing BA
 NERC Power Fact
 POWER PPA/IND LongID AGC
 POWER Stat Serv ID Issue
 Shunt : CASE Missing BA
 Zone : POWER No Zone
 Data Maintainer
 Owner
 Zone

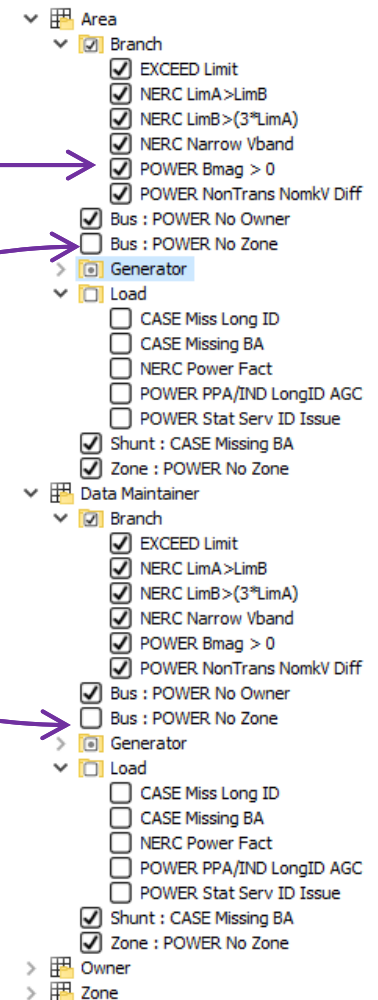
	Area Num	Area Name	Label (for use in input from AUX or Paste)	Branch : EXCEED Limit	Branch : NERC LimA>LimB	Branch : NERC LimB>(3*LimA)	Branch : NERC Narrow Vband	Branch : POWER Bmag > 0	Branch : POWER NonTrans NomkV Diff	Bus : POWER No Owner	Genera CASE M
1	10	NEW MEXICO		0 / 763	0 : 763	0	16 / 763	0 : 763	0	4 / 677	
2	11	EL PASO		0 / 390	0 : 390	0	1 / 390	0 : 390	0	0 / 289	
3	14	ARIZONA		0 / 1543	2 : 1541	1	7 / 1543	2 : 1541	0	3 / 1233	
4	18	NEVADA		0 / 959	0 : 959	0	312 / 959	0 : 959	0	0 / 746	
5	19	WAPA L.C.		0 / 357	0 : 357	0	0 / 357	0 : 357	0	0 / 206	
6	20	MEXICO-CFE		0 / 246	0 : 246	0	0 / 246	0 : 246	0	0 / 171	
7	21	IID		0 / 339	0 : 339	1	0 / 339	0 : 339	0	0 / 294	
8	22	SANDIEGO		0 / 555	1 : 554	0	0 / 555	0 : 555	0	0 / 402	
9	24	SOCALIF		0 / 1481	0 : 1481	0	1 / 1481	0 : 1481	0	0 / 1199	
10	26	LADWP		0 / 584	1 : 583	0	48 / 584	0 : 584	0	0 / 462	
11	30	PG AND E		6 / 4646	5 : 4641	0	19 / 4646	0 : 4646	2	4 / 3618	
12	40	NORTHWEST		17 / 5059	0 : 5059	6	160 / 5059	0 : 5059	0	9 / 4107	
13	50	B.C.HYDRO		15 / 3115	37 : 3078	0	112 / 3115	0 : 3115	1	0 / 2514	
14	52	FORTISBC		0 / 316	0 : 316	0	42 / 316	0 : 316	0	0 / 267	
15	54	ALBERTA		3 / 1991	2 : 1989	0	63 / 1991	0 : 1991	0	0 / 1644	
16	60	IDAHO		0 / 525	0 : 525	0	0 / 525	0 : 525	0	0 / 428	
17	62	MONTANA		0 / 701	1 : 700	0	0 / 701	0 : 701	0	0 / 565	
18	63	WAPA U.W.		0 / 51	0 : 51	0	0 / 51	0 : 51	0	3 / 45	
19	64	SIERRA		0 / 644	0 : 644	0	10 / 644	0 : 644	0	0 / 564	
20	65	PACE		0 / 1719	9 : 1710	1	50 / 1719	0 : 1719	0	0 / 1356	
21	70	PSCOLORADO		0 / 864	2 : 862	2	2 / 864	0 : 864	0	0 / 659	
22	73	WAPA R.M.		0 / 1139	2 : 1137	1	0 / 1139	0 : 1139	0	0 / 877	

Close

Check Aggregation Results Tab



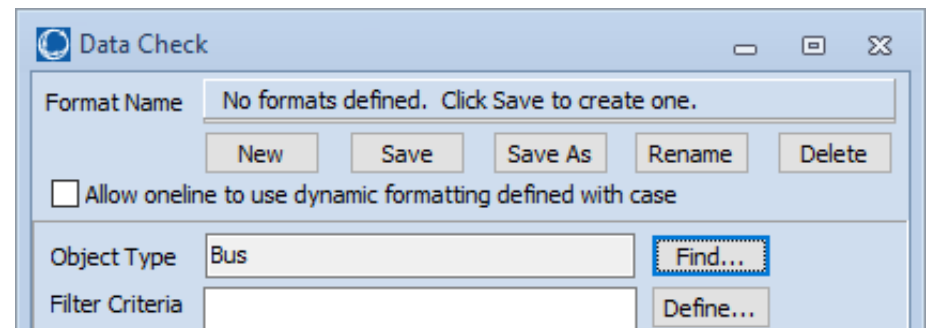
- Check box represents the field **ShowAggregation** of the respective Data Check
 - Sub-folder may be created by object type
 - The **ShowAggregation** applies across Area, Data Maintainer, Owner and Zone
 - The check boxes will always be synchronized



Define Checks Tab



- Allows you to create, delete, and edit Data Checks
- Right-click and choose Insert to add a new DataCheck
- Brings up the Data Check Dialog
 - Use **Find** button to choose an ObjectType
 - Click **Define** button to define a Filter Criteria



Data Check Dialog



The screenshot shows the 'Data Check' dialog box with the following fields and annotations:

- Name:** Format Name: Bus Bus Example Data Check
- ObjectType:** Object Type: Bus
- Filter:** Filter Criteria: Vpu < 0.95
- FilterMeetsString:** Filter Meets String: Bad Stuff
- FilterNotMeetsString:** Filter Not Meets String: All Good
- Description:** Description: This is the hint that will appear when you hover your mouse above the column header for the field for this DataCheck in a case information display
- AggregationFormat:** Aggregation Format: Meets : Not Meets
- AggregationSum:** Aggregation Sum: Count
- AggregationWeight:** Field (with Find Field button)

Buttons: New, Save, Save As, Rename, Delete, Define..., Show Dynamic Formatting Features, Show, Show Aggregation, OK, Help, Cancel.

Data Check Fields on Case Information showing ObjectType



FilterMeetsString = "Bad Stuff"

FilterNotMeetsString = "All Good"

Description is the Hover Hint

Number	Name	Example Data Check	PU V	Area Name	Nom kV	Volt (kV)	Angle (Deg)	Load MW	Load Mvar	Gen MW	Gen Mvar	Switched Shunts
2824	22430	All Good					46.73					
2825	22432	All Good					36.51	53.70	5.39			
2826	22440	All Good					38.64	58.18	5.84			
2827	22442	All Good					39.45					
2828	22444	All Good					40.23	54.86	5.51			
2829	22448	All Good	1.01133		69.00	69.782	41.59	38.34	3.85	3.20	0.00	
2830	22450	Bad Stuff	0.91269		17.50	15.972	52.70			-4.10	-106.15	
2831	22451	Bad Stuff	0.91269		17.50	15.972	52.71			-4.10	-106.15	
2832	22452	Bad Stuff	0.94203		12.00	11.304	50.61					
2833	22453	Bad Stuff	0.91689		17.50	16.046	52.68					
2834	22456	All Good	1.03679		69.00	71.538	43.80					
2835	22460	All Good	1.00801		138.00	139.105	48.36					
2836	22461	All Good	1.00746		138.00	139.029	48.00					
2837	22462	All Good	1.00714		138.00	138.985	47.82					

Field becomes available under folder "Data Check" and shows the name of the Data Check.

Data Check Aggregation Fields



AggregationFormat

Choices are

- Meets
- Meets / Total
- Meets : Not Meets
- Percentage

Example on left shows Meets / Total

The screenshot shows the 'Model Explorer: Areas' interface. On the left, the 'Fields' pane is expanded to 'Data Check' > 'Aggregation', showing a field named 'Bus : Example Data Check'. A red box highlights this field, and a red arrow points from it to the 'Bus : Example Data Check' column in the data table on the right. The data table has columns: Area Num, Area Name, AGC Status, Bus : Example Data Check, Gen MW, and Load MW. The 'Bus : Example Data Check' column contains values like '5 / 677', '45 / 289', etc., representing the aggregation format.

Area Num	Area Name	AGC Status	Bus : Example Data Check	Gen MW	Load MW
1	10 NEW MEXICO	Area Slack	5 / 677	1963.08	2379.38
2	11 EL PASO	Area Slack	45 / 289	826.37	1411.50
3	14 ARIZONA	Area Slack	96 / 1233	13799.99	11031.00
4	18 NEVADA	Area Slack	0 / 746	3000.84	3439.24
5	19 WAPA L.C.	Area Slack	0 / 206	2936.82	889.91
6	20 MEXICO-CFE	Area Slack	2 / 171	1617.35	1656.55
7	21 IID	Area Slack	13 / 294	1027.15	525.97
8	22 SANDIEGO	Area Slack	4 / 402	3543.59	3053.00
9	24 SOCALIF	Area Slack	38 / 1199	6367.52	13013.83
10	26 LADWP	Area Slack	17 / 462	2959.18	3858.05
11	30 PG AND E	Area Slack	85 / 3618	22938.23	21499.49
12	40 NORTHWEST	Off AGC	47 / 4107	36564.14	31471.12
13	50 B.C.HYDRO	Area Slack	64 / 2514	10189.11	10922.33
14	52 FORTISBC	Area Slack	4 / 267	990.04	889.99
15	54 ALBERTA	Area Slack	12 / 1644	11427.40	11344.41
16	60 IDAHO	Area Slack	3 / 428	1902.31	2649.65
17	62 MONTANA	Area Slack	4 / 565	3220.44	1992.10
18	63 WAPA U.W.	Area Slack	0 / 45	57.77	-45.10
19	64 SIERRA	Area Slack	8 / 564	1375.83	1931.31

Field available under folder "Data Check\Aggregation" and shows the "ObjectType : Name" of the Data Check.

Data Check Aggregation Fields



- These are available for across the same object types as used with Advanced Filtering and Calculated Fields
 - https://www.powerworld.com/WebHelp/#MainDocumentation_HTML/Calculated_Fields.htm
 - Example: Branch table shows either "0 / 2", "1 / 2", or "2 / 2" to indicate if 0, 1 or 2 of the terminal buses meets the Data Check

The screenshot shows the 'Model Explorer: Branches State' window. On the left, the 'Fields' pane is open, showing a tree view of available fields. A red box highlights the 'Data Check' folder, which contains an 'Aggregation' folder. Inside 'Aggregation', the field 'Bus : Example Data Check' is selected. A red arrow points from this field to the 'Bus : Example Data Check' column in the 'Branches State' table on the right. The table has columns: From Number, From Name, To Number, To Name, Circuit, and Bus : Example Data Check. The data rows show various branches with their respective bus counts.

	From Number	From Name	To Number	To Name	Circuit	Bus : Example Data Check
42	32680	BRANCH	32682	BRANCH	1	2 / 2
43	51342	BRANCH	50946	BRANCH	1	2 / 2
44	51108	BRANCH	80437	BRANCH	1	2 / 2
45	40115	BRANCH	45251	POWERBRANCH	1	2 / 2
46	15015	BRANCH	15014	BRANCH	7	1 / 2
47	32667	BRANCH	32678	BRANCH	1	1 / 2
48	73138	BRANCH	73461	BRANCH	1	1 / 2
49	50372	BRANCH	81921	BRANCH	11	1 / 2
50	80173	BRANCH	81897	BRANCH	2	1 / 2

Data Check Aggregation Fields when using AggregationWeight



- Normally the Aggregation Fields show summary information about the count of objects meeting the Filter
- AggregationWeight allows you to show information on the summation of a field across objects
 - Show the summation of generator MWMax or MVABase that meet the Filter
 - Use this to weight objects by how important you consider them

Example using AggregationWeight



Use check boxes to show columns for the data checks

- Area
 - Branch
 - Bus
 - Generator
 - CASE Min>Max
 - CASE Missing BA
 - CASE Pmax>GovMWCap
 - CASE Unapp Model
 - EXCEED Limit
 - NERC At Mvar Limit
 - NERC Limit Power Fact
 - NERC PSS No Ex
 - NERC RX Ratio
 - NERC Unreas H
 - POWER Gen at 0.0
 - POWER Gen on HV
 - POWER Miss Tag
 - POWER Miss Turbine Type
 - POWER Missing Model
 - POWER Missing PS
 - POWER No Owner

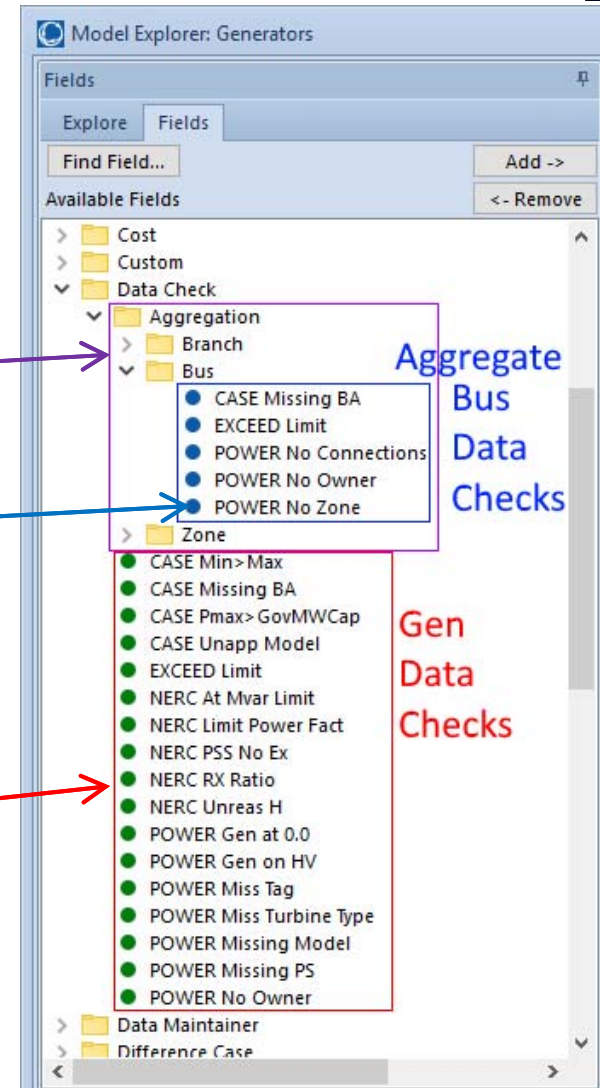
Area	Number (1<)	Name (A<)	Label (<)	DataCheckAggr:Ge 'EXCEED Limit'
1	10	NEW MEXICO		0 / 4700
2	11	EL PASO		0 / 2181
3	14	ARIZONA		43.6 / 28714
4	18	NEVADA		90.3 / 5654
5	19	WAPA L.C.		0 / 4425
6	20	MEXICO-CFE		0 / 3468
7	21	IID		0 / 2351
8	22	SANDIEGO		0 / 6036
9	24	SOCALIF		0 / 34695
10	26	LADWP		106 / 10744
11	30	PG AND E		48.5 / 43304
12	40	NORTHWEST		83.8 / 52310
13	50	B.C.HYDRO		0 / 17104
14	52	FORTISBC		0 / 1705
15	54	ALBERTA		0 / 18733
16	60	IDAHO		0 / 4152
17	62	MONTANA		0 / 4064
18	63	WAPA U.W.		0 / 160
19	64	SIERRA		0 / 3168
20	65	PACE		0 / 13191
21	70	PSCOLORADO		0 / 12648
22	73	WAPA R.M.		288 / 28179

Close

List of Available Fields for object type: Data Check and Aggregation Fields



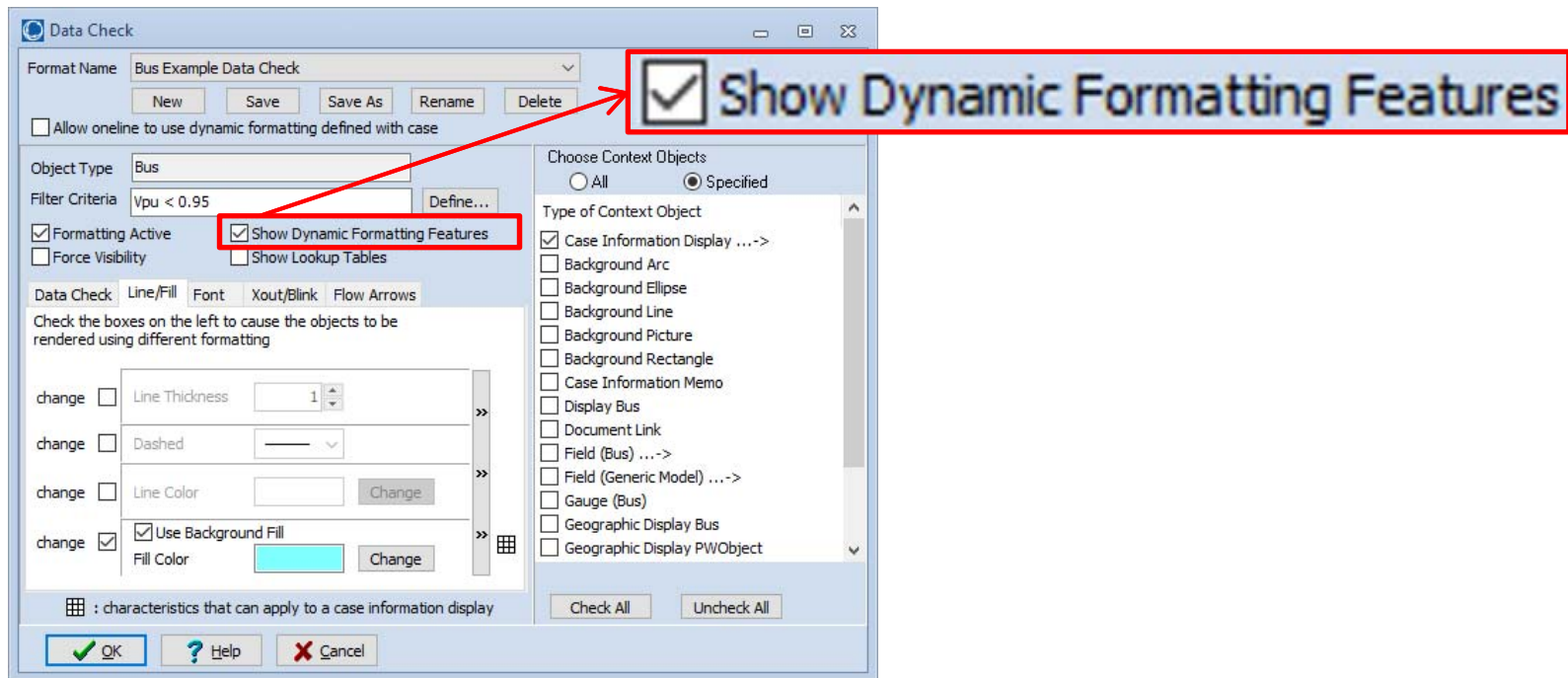
- Data Check\Aggregation folder
 - Contains a list of Data Check for other object types related to this one
 - See purple box on right
 - Sub-folders created by object type (blue box on right)
- Data Check folder
 - Contains a list of all data checks for object type
 - See red box on left



The Kitchen Sink: Apply Dynamic Formatting Features



- PowerWorld's Data Check object also includes all the features of Dynamic Formatting
 - To access this on the dialog, check “Show Dynamic Formatting Features



Referencing Fields when exporting in an AUX file



- Data Check Fields
 - Referencing data checks for the same object type as you are showing
 - Variable Name = `DataCheck:location`
 - Location can be integer indicating the index of the Data Check within the list of Data Check for that particular object type (sorted alphabetically by name)
`"DataCheck:6"`
 - Or just use the name of the Data Check (better choice!)
`"DataCheck:NERC at Mvar Limit"`
- Data Check Aggregation Fields
 - Reference data checks across object types
 - Variable Name = `DataCheckAggr:location`
 - Location can be integer indicating the index of the Data Check within the list of all Data Checks (sorted alphabetically by ObjectType and then Name).
`"DataCheckAggr:17"`
 - Better Option: just use ObjectType 'Name of DataCheck'
`"DataCheckAggr:Bus 'CASE Missing BA'"`

AUX file defining Data Check



- Define Expressions and Filters at the top
- Data Checks follow that

```

WECCDataChecks.aux - Notepad
File Edit Format View Help
Filter (ObjectType,Name,Logic,FilterPre,Enabled)
{
"Bus" "Powerflow Checks" "OR" "YES" "YES"
<SUBDATA Condition>
  _UseAnotherFilter meets "No Owner"
  _UseAnotherFilter meets "No Zone"
  _UseAnotherFilter meets "BusWithoutConnectedBranches"
</SUBDATA>
"Branch" "Powerflow Checks" "OR" "YES" "YES"
<SUBDATA Condition>
  _UseAnotherFilter meets "NonTransformer Branches with Voltage Changes"
  _UseAnotherFilter meets "Positive bmag"
</SUBDATA>
"Gen" "Powerflow Checks" "OR" "YES" "YES"
<SUBDATA Condition>
  _UseAnotherFilter meets "Missing PSS"
  _UseAnotherFilter meets "Missing Model"
  _UseAnotherFilter meets "No Owner"
  _UseAnotherFilter meets "Missing Turbine Type"
  _UseAnotherFilter meets "Generator >10 MVA On >60kV"
  _UseAnotherFilter meets "MissingGenTag"
  _UseAnotherFilter meets "Closed Gen with 0 MW Output"
</SUBDATA>
"Load" "Powerflow Checks" "OR" "YES" "YES"
<SUBDATA Condition>
  _UseAnotherFilter meets "PPA or IND LongID With AGC"
  _UseAnotherFilter meets "Pos Station Service ID Issues"
</SUBDATA>
}

DataCheck (Name,ObjectType,Filter,Show,ShowAggregation,Description,FilterMeetsString,
FilterNotMeetsString,AggregationFormat)
{
"CASE Missing Rating" "Branch" "Missing Element Rating" "YES" "YES" "Indication of whether this branch object is
"CASE Missing BA" "Gen" "<Area>Missing BA" "YES" "YES" "" "Missing BA" "" "Meets / Total"
"CASE Unapp Model" "Gen" "Unapproved Model" "YES" "YES" "" "Unapproved Model" "" "Meets / Total"
"CASE Pmax>GovMwCap" "Gen" "Pmax>MwCap" "YES" "YES" "" "Pmax>MwCap" "" "Meets / Total"
"CASE Min>Max" "Gen" "Mmin/MVrmin>Mwmax/MVRmax" "YES" "YES" "" "Min>Max" "" "Meets / Total"
"CASE Miss Long ID" "Load" "Missing Long ID" "YES" "YES" "" "Miss LongID" "" "Meets / Total"
"CASE Missing BA" "Load" "<Area>Missing BA" "YES" "YES" "" "Missing BA" "" "Meets / Total"
"CASE Missing BA" "Bus" "<Area>Missing BA" "YES" "YES" "" "Missing BA" "" "Meets / Total"
"CASE Missing BA" "Branch" "<Area>Missing BA" "YES" "YES" "" "Missing BA" "" "Meets / Total"
"CASE Missing BA" "Shunt" "<Area>Missing BA" "YES" "YES" "" "Missing BA" "" "Meets / Total"
"EXCEED Limit" "Branch" "N-0 Device Overload" "YES" "YES" "" "Exceed Limit" "" "Meets / Total"
"EXCEED Limit" "Bus" "Bus Volt Outside 0.9-1.1 p.u. (Excluding 500 kV)" "YES" "YES" "" "Exceed Limit" "" "Meets / Total"
"EXCEED Limit" "Gen" "Gen Limit Violation and Closed" "YES" "YES" "" "Exceed Limit" "" "Meets / Total"
}
    
```

Primary User Responsibility: Define Filters



- You need to define Advanced Filters which described the Filter for what “meets” a data check: For what you have done in the past
 - “Meets” = BAD
 - “Not Meets” = GOOD
- For complete training on Filtering see
 - https://www.powerworld.com/WebHelp/#MainDocumentation_HTML/Advanced_Filtering.htm (help documentation)
 - <https://www.powerworld.com/files/I03ModelExplorerAndCaseInfo.pdf> (Slide #43 - #50)
 - <https://www.powerworld.com/training/online-training/model-explorer-and-case-information-displays> (YouTube video at 47:20)

Links to Help Documentation



- Help on Data Check Definitions
 - Discusses previous dialog and fields of Data Check
 - [https://www.powerworld.com/WebHelp/#MainDocumentation HTML/Data Check Define.htm](https://www.powerworld.com/WebHelp/#MainDocumentation%20HTML/Data%20Check%20Define.htm)
- Help on Data Check Results shown in Case Information Displays
 - Discusses in more detail the following dialogs
 - [https://www.powerworld.com/WebHelp/#MainDocumentation HTML/Data Check Results.htm](https://www.powerworld.com/WebHelp/#MainDocumentation%20HTML/Data%20Check%20Results.htm)
- Help on the Data Check Overview Dialog
 - [https://www.powerworld.com/WebHelp/#MainDocumentation HTML/Data Check Overview.htm](https://www.powerworld.com/WebHelp/#MainDocumentation%20HTML/Data%20Check%20Overview.htm)

Links to Help Topics



- Calculated Fields

- <https://www.powerworld.com/WebHelp/#MainDocumentation HTML/Calculated Fields.htm>

- Dynamic Formatting

- <https://www.powerworld.com/WebHelp/#MainDocumentation HTML/Dynamic Formatting Overview.htm>