CURTISS WRIGHT Flow Control Company
SCIENTECH

PdP Modeling with FAMOS Architect Tips & Tricks

2013 Symposium: Managing Plant Assets and Performance
Clearwater Beach, Florida
August 6-9, 2013
July, 2013

Jim Herzau, Scientech

Topics Covered

- ✓ ***Quick Review of PdP Modeling Components*** ***- model and reference file structure and configuration***
- ✓ ***Reconfiguring an Existing Model*** ***– reordering and removing sensors from an existing model while preserving the reference file***
- ✓ ***Splitting an Existing Model into Submodels*** ***– and reusing reference file training data***
- ✓ ***Using Browse to Find PdP Model Info*** ***- new tables visible in Browse for fast access to configuration info***
- ✓ ***Preserving Reference file –*** ***techniques for updating rather than replacing reference files when behavior changes***

PdP Model Components

Model

Point Tag	Description	Units
WTG01-ACTIVEPOWER	WTG01-ACTIVE POWER	KW
WTG01-REACTIVEPOWE	WTG0 POWER	KVAR
WTG01-ROTORRPM	WTG0 PM	RPM
WTG01-GENERATORRPM	WTG0 OR RPM	RPM
WTG01-AMBTEMP	WTG0 TEMPERATURE	DEGC
WTG01-NACELLETEMP	WTG0 TEMP	DEGC
WTG01-CURRENTA	WTG0 MPS A	AMPS
WTG01-CURRENTB	WTG0 MPS B	AMPS
WTG01-CURRENTC	WTG0 MPS C	AMPS
WTG01-VOLTAGEA	WTG0 OLTAGE A	V
WTG01-VOLTAGEB	WTG0 OLTAGE B	V
WTG01-VOLTAGEC	WT OLTAGE C	V
WTG01-G1ATEMP	WTG0 ATOR 1 PHASE 1 C	DEGC
WTG01-G1BTEMP	WTG01- ERATOR 1 PHASE 2 C	DEGC
WTG01-G1CTEMP	WTG01-GENERATOR 1 PHASE 3 C	DEGC
WTG01-CABTOPBOXTMP	WTG01-TOP BOX CABINET TEMP	DEGC
WTG01-BTMCAPSECTMP	WTG01-BOTTOM CAPACITOR PAN	DEGC
WTG01-BTMCNTSECTMP	WTG01-BOTTOM CONTROL SECTI	DEGC

Sensors

Corresponding Reference File Data

Excluded	Index	Date	WTG01-ACTIVEPOWER	WTG01-REACTIVEPOWER	WTG01-ROTORRPM	WTG01-GENERATORRPM	WTG01-AMBTEMP	WTG01-NACELLETEMP
		Filtered Data Max:	2169.645	263.9058	16.52509	1902.808	33	41.41628
		Filtered Data M				178	-19.72869	-11.95715
		Filtered Data Avg:					9.276504	16.58364
	Filter	Filter High:						
		Filter Low:						
	1	01-Jun-08 00:00:00	666.5394	-6.863593	15.04734	181	19	26
	2	01-Jun-08 02:00:00	389.632	16.69644	14.87	1809.232	18.53069	25
	3	01-Jun-08 05:00:00	83.31233	30.07772	14.60399	1802.469	18.90375	26
	4	01-Jun-08 06:00:00	183.4952	30.14312	14.51532	1802.998	19	25
	5	01-Jun-08 12:00:00	163.4321	39.29543	14.94583	1804.235	26.12308	33.36279
	6	01-Jun-08 14:00:00	861.41	102.227	15	1819.612	27.84044	32
	7	01-Jun-08 17:00:00	236.1159	100.1207	15.04288	1804.616	27.21221	32
	8	01-Jun-08 19:00:00	163.2294	34.00213	14.71732	1802.099	25.92069	31.87477
	9	02-Jun-08 01:00:00	55.88096	35.12788	14.58841	1801.599	24.43058	30.55562
	10	02-Jun-08 05:00:00	966.0519	-0.401935	14.82958	1821.07	22.19891	28.77465
	11	02-Jun-08 07:00:00	477.6509	9.599896	14.80565	1809.553	21	27.75643
	12	02-Jun-08 19:00:00	570.9297	5.385478	15.38195	1811.101	17.15991	24
	13	02-Jun-08 22:00:00	755.8716	48.7727	15.53219	1817.433	15	22
	14	03-Jun-08 01:00:00	359.9472	84.57059	15.68243	1807.925	15	22.37209
	15	03-Jun-08 04:00:00	2124.821	-0.560972	15.16449	1877.617	14	22.66355
	16	03-Jun-08 06:00:00	478.1208	4.677035	14.8316	1810.304	15.96317	22
	17	03-Jun-08 15:00:00	299.3827	26.2548	15.46893	1807.137	17.42855	24.03267
		n-08 19:00:00	647.7647	27.5281	15.26639	1806.474	15	23

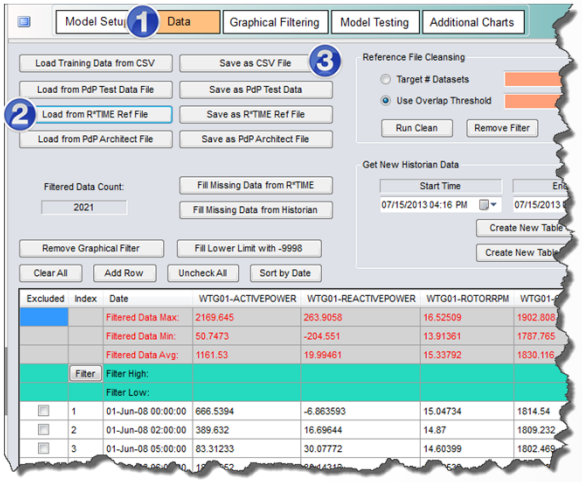
Sensors

Runtime *.ref file is binary, with data for sensors ordered just like the columns in the tabular Data tab

Reconfiguring an Existing Model

If we have invested time to create a reference file by selecting normal data for the model, it usually makes sense to perform maintenance in a manner that translates the existing reference file into a functional reference file for the reconfigured model.

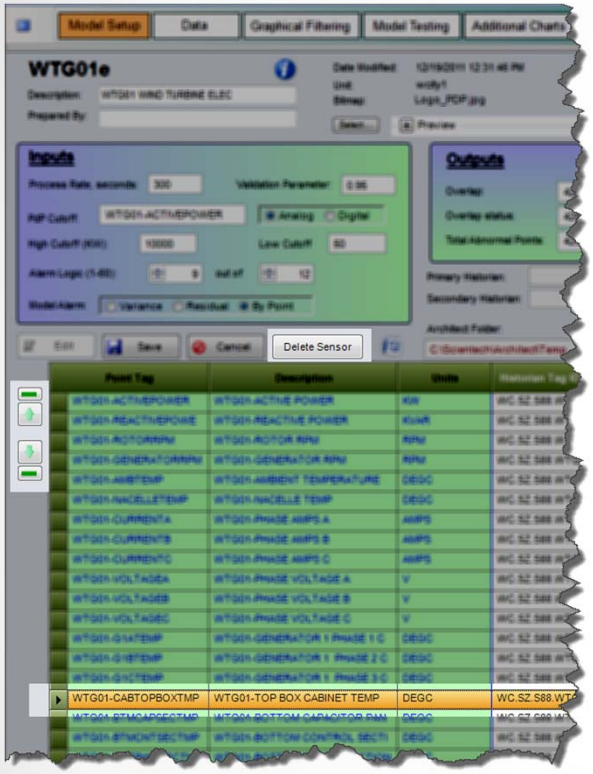
Select a Model and Open for Editing



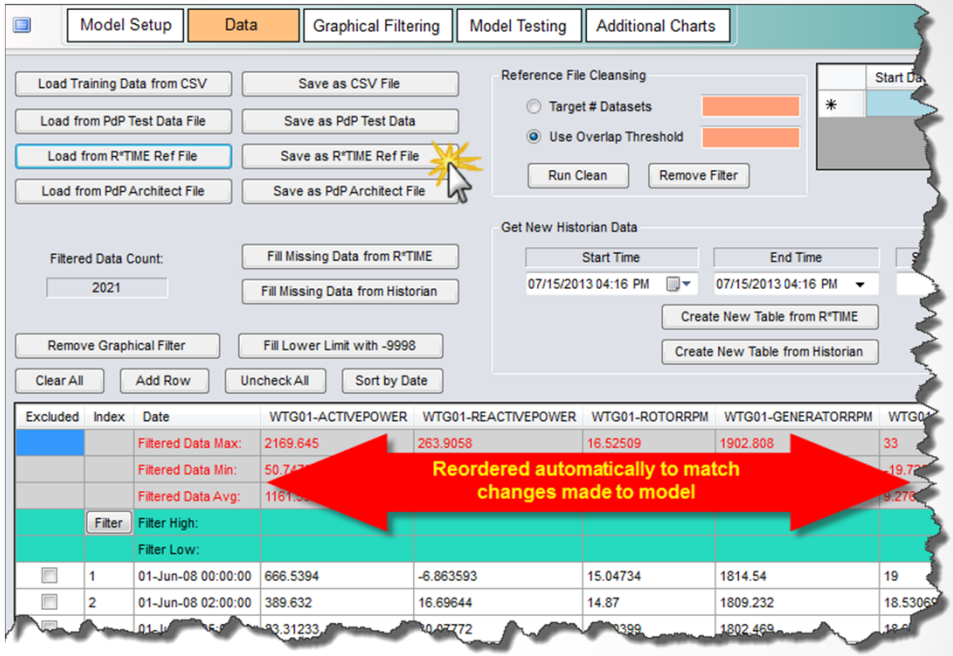
Open its reference file and save it as a *.csv

Tip: Begin any work requiring a reference file update by saving a copy of the existing reference file as a *.csv file

Reconfiguring an Existing Model (cont)



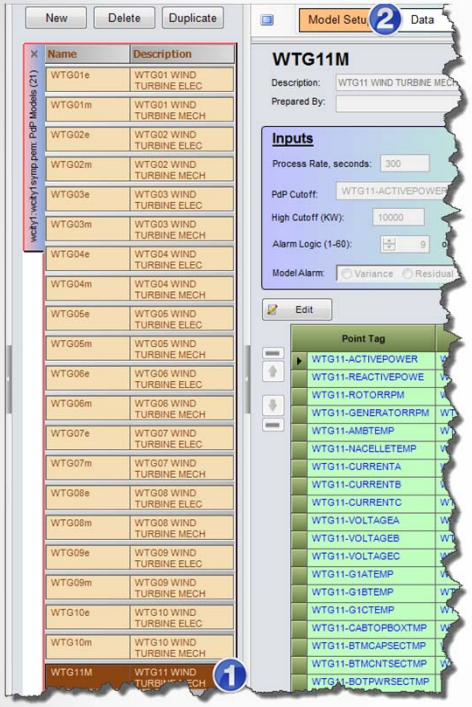
Select Sensors and Delete or reorder as desired… then save the model.



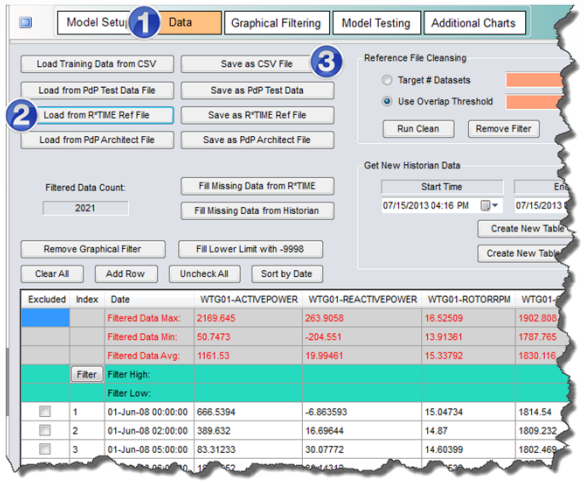
The columns have been reordered automatically to reflect the model changes. Save the reference file and download your model…. It will then be up and running.

Tip: The order of the sensors in the list is the default order they will appear in the Point Summary in runtime. Organize in groups that reflect how you like to review data.

Split an Existing Model in Two



Select the to model to be split and open the Data tab



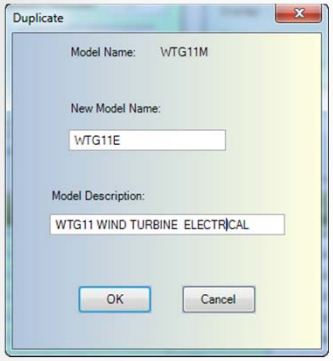
Open its reference file and save it as a *.csv

Return to Model Setup Select and Duplicate the model

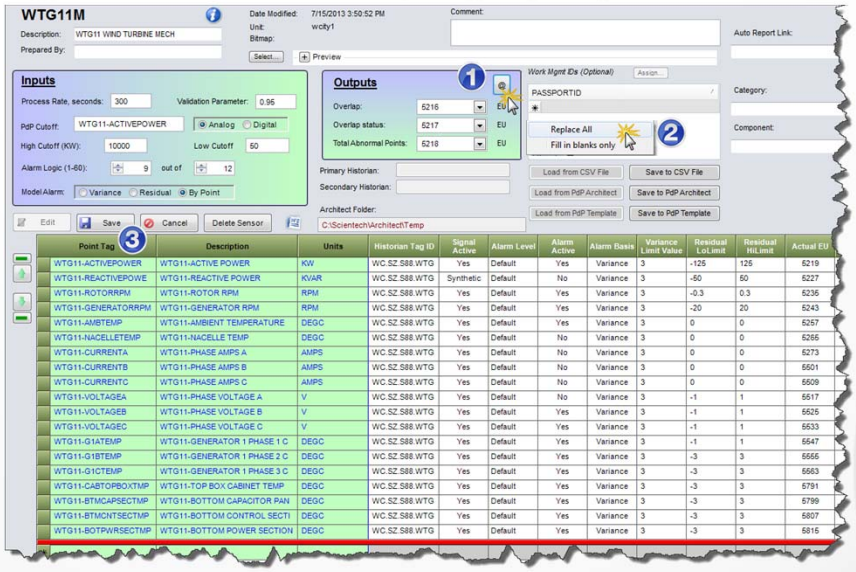
Tip: Begin any work requiring a reference file update by saving a copy of the existing reference file as a *.csv file

Split an Existing Model in Two (cont)

1. Name the new model and open for editing



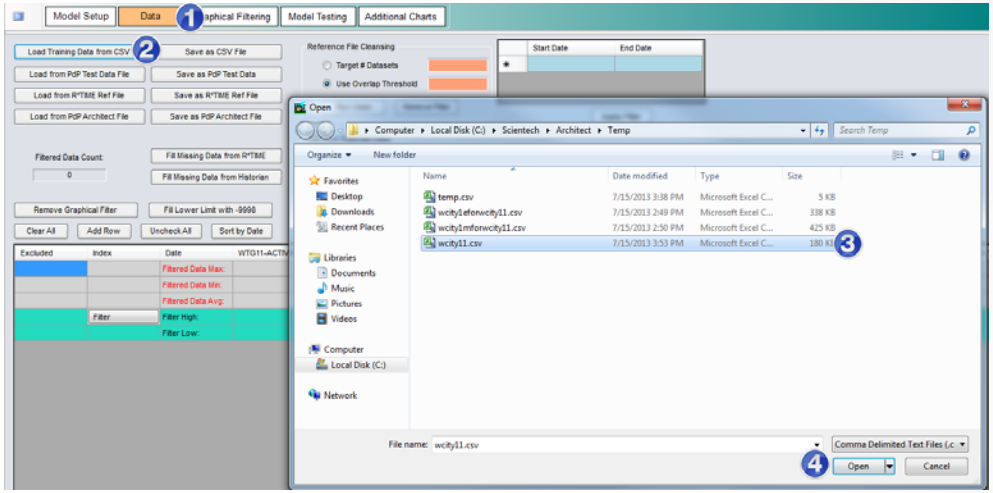
2. Delete unwanted sensors and reorder as desired, then replace PNs assigned to outputs since they are duplicates from the original model … and save the model



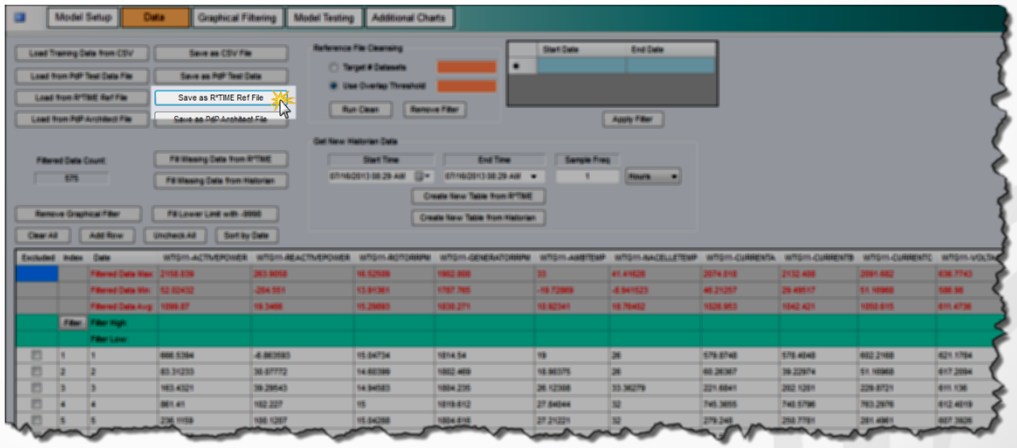
Split an Existing Model in Two (cont)

Now to create the reference file

Select the data tab and Load Training Data from CSV, opening the *.csv file you saved before you created the duplicate model



Save as R*TIME Reference file



You now have a matched model and reference file

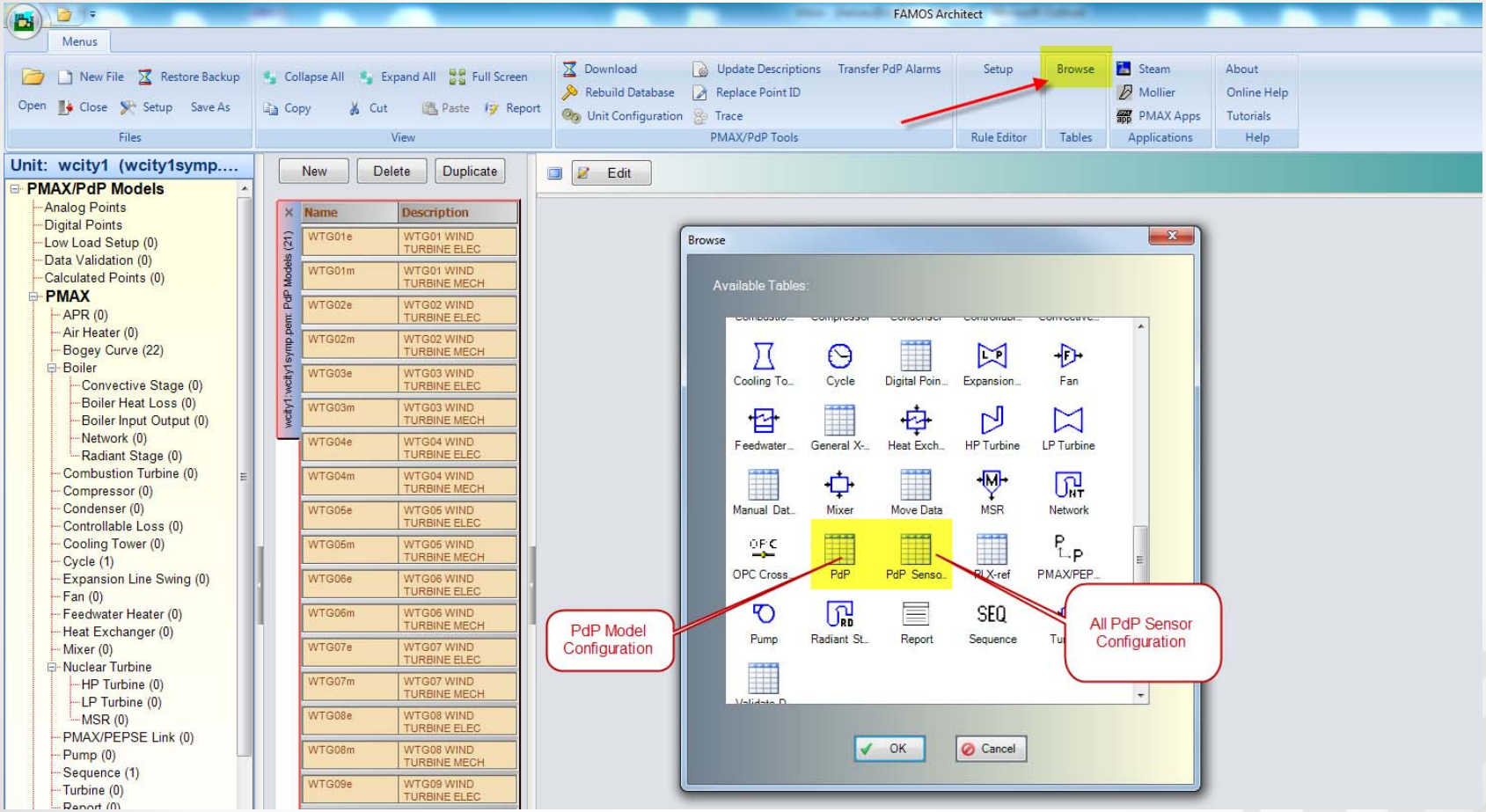
Split an Existing Model in Two (cont)

Still have to modify the original model

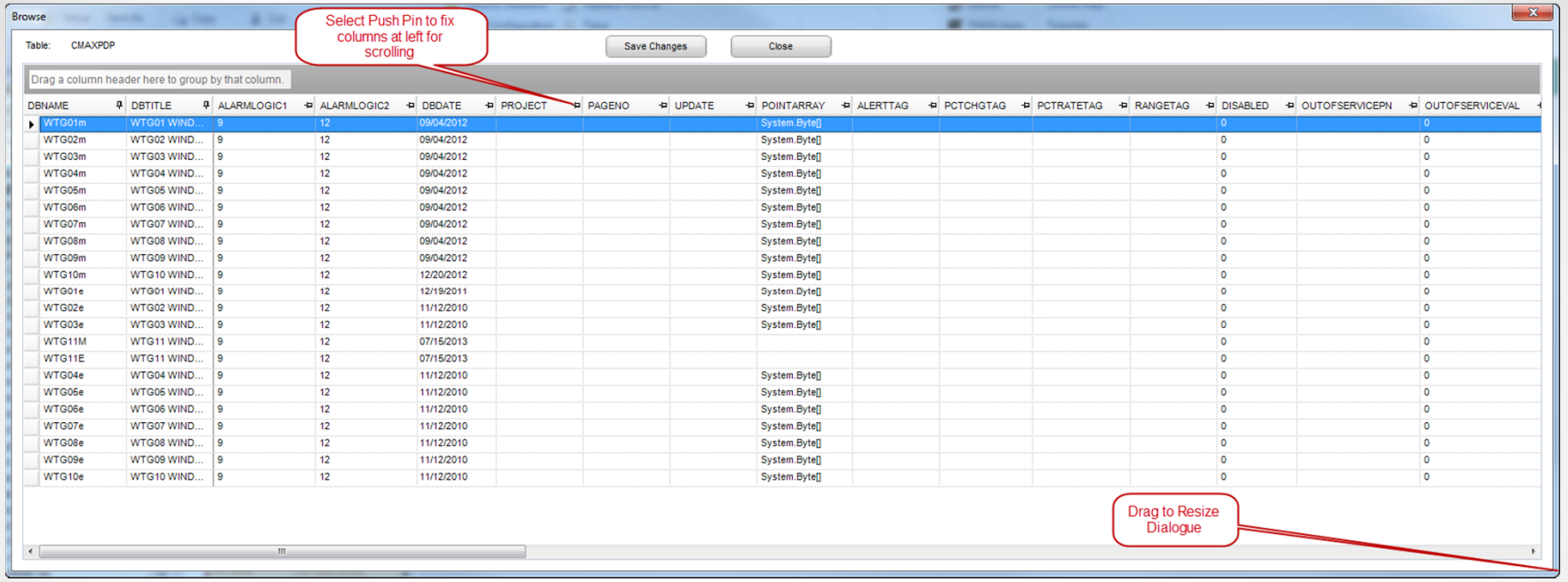
1. Select the original model and open for editing
2. Delete and reorder sensors as desired
3. For this model, you do not have to replace the output PNs …. unless you want to. They will still be unique since the PNs in the other split of the model were reassigned.
4. Save the Model
5. Open the Data tab and Load Training Data from the same CSV your created before creating the duplicate
6. Save the data as an RTIME reference file
7. Download PdP

You now have two models processing with reference files in place of one

Using Browse to Examine PdP Settings



PdP Table (Model Info)

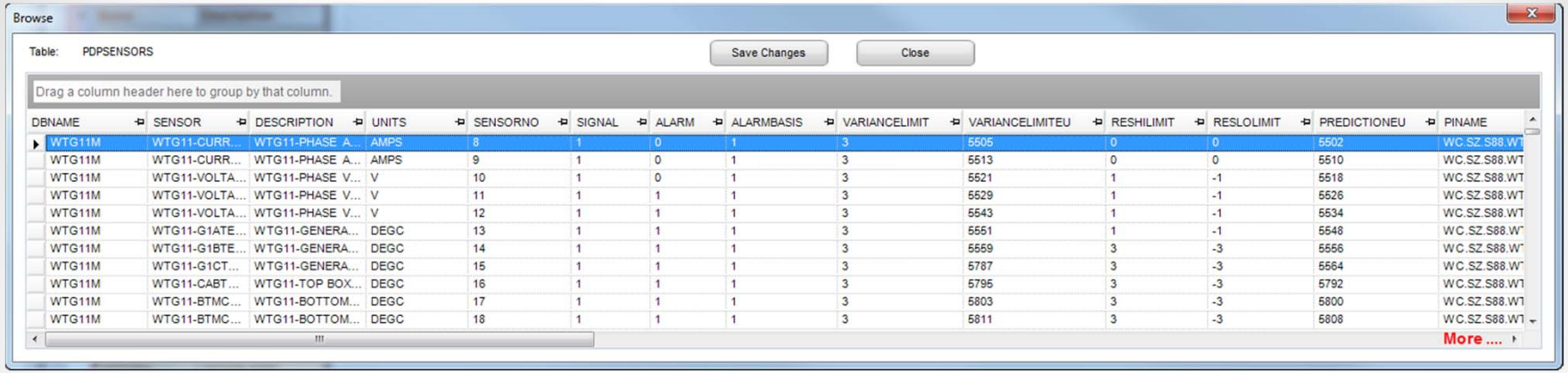


DBNAME	DBTITLE	ALARMLOGIC1	ALARMLOGIC2	DBDATE	PROJECT	PAGENO	UPDATE	POINTARRAY	ALERTTAG	PCTCHGTAG	PCTRATETAG	RANGETAG	DISABLED	OUTOFSERVICEPN	OUTOFSERVICEVAL
WTG01m	WTG01 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG02m	WTG02 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG03m	WTG03 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG04m	WTG04 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG05m	WTG05 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG06m	WTG06 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG07m	WTG07 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG08m	WTG08 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG09m	WTG09 WIND...	9	12	09/04/2012				System.Byte[]					0		0
WTG10m	WTG10 WIND...	9	12	12/20/2012				System.Byte[]					0		0
WTG01e	WTG01 WIND...	9	12	12/19/2011				System.Byte[]					0		0
WTG02e	WTG02 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG03e	WTG03 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG11M	WTG11 WIND...	9	12	07/15/2013									0		0
WTG11E	WTG11 WIND...	9	12	07/15/2013									0		0
WTG04e	WTG04 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG05e	WTG05 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG06e	WTG06 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG07e	WTG07 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG08e	WTG08 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG09e	WTG09 WIND...	9	12	11/12/2010				System.Byte[]					0		0
WTG10e	WTG10 WIND...	9	12	11/12/2010				System.Byte[]					0		0

1. Pin Columns for Scrolling (note many columns are unused)
2. Drag and Drop Grouping or reordering of columns, sort by column by clicking on header
3. With caution…. You can make edits and save changes

Overlap = EU (PN Number) for Model Health
Overlap Status = EU for Model Status
AlarmLogic1 = X (from X out of Y)
AlarmLogic2 = X (from X out of Y)

PdP Sensor Table (Model Info)



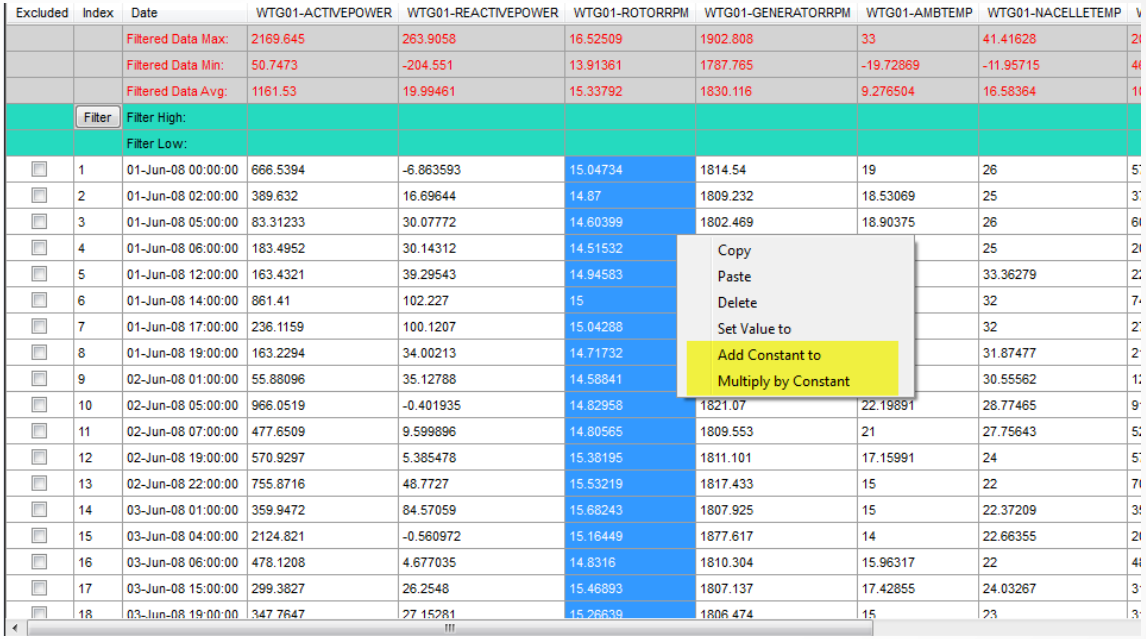
DBNAME	SENSOR	DESCRIPTION	UNITS	SENSORNO	SIGNAL	ALARM	ALARMBASIS	VARIANCELIMIT	VARIANCELIMITEU	RESHILIMIT	RESLOLIMIT	PREDICTIONEU	PINAME
WTG11M	WTG11-CURR...	WTG11-PHASE A...	AMPS	8	1	0	1	3	5505	0	0	5502	WC.SZ.S88.WT
WTG11M	WTG11-CURR...	WTG11-PHASE A...	AMPS	9	1	0	1	3	5513	0	0	5510	WC.SZ.S88.WT
WTG11M	WTG11-VOLTA...	WTG11-PHASE V...	V	10	1	0	1	3	5521	1	-1	5518	WC.SZ.S88.WT
WTG11M	WTG11-VOLTA...	WTG11-PHASE V...	V	11	1	1	1	3	5529	1	-1	5526	WC.SZ.S88.WT
WTG11M	WTG11-VOLTA...	WTG11-PHASE V...	V	12	1	1	1	3	5543	1	-1	5534	WC.SZ.S88.WT
WTG11M	WTG11-G1ATE...	WTG11-GENERA...	DEGC	13	1	1	1	3	5551	1	-1	5548	WC.SZ.S88.WT
WTG11M	WTG11-G1BTE...	WTG11-GENERA...	DEGC	14	1	1	1	3	5559	3	-3	5556	WC.SZ.S88.WT
WTG11M	WTG11-G1CT...	WTG11-GENERA...	DEGC	15	1	1	1	3	5787	3	-3	5564	WC.SZ.S88.WT
WTG11M	WTG11-CABT...	WTG11-TOP BOX...	DEGC	16	1	1	1	3	5795	3	-3	5792	WC.SZ.S88.WT
WTG11M	WTG11-BTMC...	WTG11-BOTTOM...	DEGC	17	1	1	1	3	5803	3	-3	5800	WC.SZ.S88.WT
WTG11M	WTG11-BTMC...	WTG11-BOTTOM...	DEGC	18	1	1	1	3	5811	3	-3	5808	WC.SZ.S88.WT

- ✓ Output EU (PN Numbers)
- ✓ Limit Settings
- ✓ Point and Alarm Activation
- ✓ Alarm Basis

Preserving a Reference File – Behavior Changes

For changes in behavior to a “new normal” where majority of other sensors are still predicting well…. Like a temperature or pressure step change higher or lower.

Highlight an entire column of data. Select Add Constant to or Multiply by Constant to adjust to approximate the new normal



Excluded	Index	Date	WTG01-ACTIVEPOWER	WTG01-REACTIVEPOWER	WTG01-ROTORRPM	WTG01-GENERATORRPM	WTG01-AMBTEMP	WTG01-NACELLETEMP
		Filtered Data Max:	2169.645	263.9058	16.52509	1902.808	33	41.41628
		Filtered Data Min:	50.7473	-204.551	13.91361	1787.765	-19.72869	-11.95715
		Filtered Data Avg:	1161.53	19.99461	15.33792	1830.116	9.276504	16.58364
	Filter	Filter High:						
		Filter Low:						
☐	1	01-Jun-08 00:00:00	666.5394	-6.863593	15.04734	1814.54	19	26
☐	2	01-Jun-08 02:00:00	389.632	16.69644	14.87	1809.232	18.53069	25
☐	3	01-Jun-08 05:00:00	83.31233	30.07772	14.60399	1802.469	18.90375	26
☐	4	01-Jun-08 06:00:00	183.4952	30.14312	14.51532			25
☐	5	01-Jun-08 12:00:00	163.4321	39.29543	14.94583			33.36279
☐	6	01-Jun-08 14:00:00	861.41	102.227	15			32
☐	7	01-Jun-08 17:00:00	236.1159	100.1207	15.04288			32
☐	8	01-Jun-08 19:00:00	163.2294	34.00213	14.71732			31.87477
☐	9	02-Jun-08 01:00:00	55.88096	35.12788	14.58841			30.55562
☐	10	02-Jun-08 05:00:00	966.0519	-0.401935	14.82958	1821.07	22.19891	28.77465
☐	11	02-Jun-08 07:00:00	477.6509	9.599896	14.80565	1809.553	21	27.75643
☐	12	02-Jun-08 19:00:00	570.9297	5.385478	15.38195	1811.101	17.15991	24
☐	13	02-Jun-08 22:00:00	755.8716	48.7727	15.53219	1817.433	15	22
☐	14	03-Jun-08 01:00:00	359.9472	84.57059	15.68243	1807.925	15	22.37209
☐	15	03-Jun-08 04:00:00	2124.821	-0.560972	15.16449	1877.617	14	22.66355
☐	16	03-Jun-08 06:00:00	478.1208	4.677035	14.8316	1810.304	15.96317	22
☐	17	03-Jun-08 15:00:00	299.3827	26.2548	15.46893	1807.137	17.42855	24.03267
☐	18	03-Jun-08 19:00:00	347.7647	27.15281	15.26639	1806.474	15	23

Copy
Paste
Delete
Set Value to
Add Constant to
Multiply by Constant

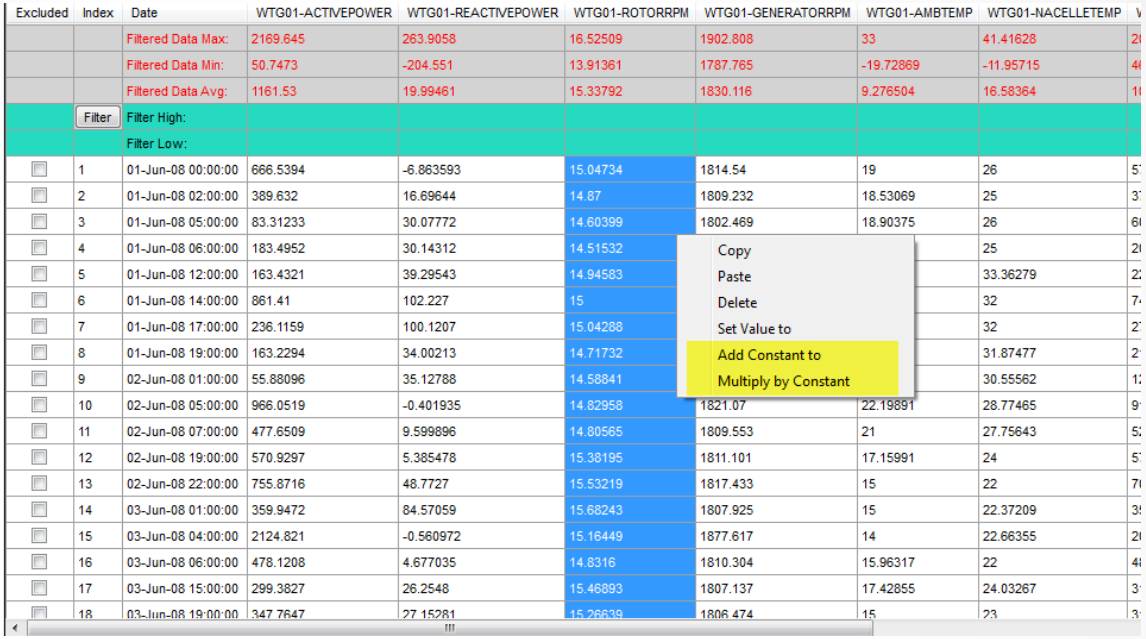
In some cases, current behavior may track another sensor value with an offset. Data can be created by copying one column of data to the other and then adjusting with the addition and/or multiplication by a constant.

Tip: Sometimes the best reference file data available for a sensor may not come from the sensor itself

Preserving a Reference File

For changes in behavior to a “new normal” where majority of other sensors are still predicting well…. Like a temperature or pressure step change higher or lower.

Highlight an entire column of data. Select Add Constant to or Multiply by Constant to adjust to approximate the new normal



Excluded	Index	Date	WTG01-ACTIVEPOWER	WTG01-REACTIVEPOWER	WTG01-ROTORRPM	WTG01-GENERATORRPM	WTG01-AMBTEMP	WTG01-NACELLETEMP
		Filtered Data Max:	2169.645	263.9058	16.52509	1902.808	33	41.41628
		Filtered Data Min:	50.7473	-204.551	13.91361	1787.765	-19.72869	-11.95715
		Filtered Data Avg:	1161.53	19.99461	15.33792	1830.116	9.276504	16.58364
	Filter	Filter High:						
		Filter Low:						
☐	1	01-Jun-08 00:00:00	666.5394	-6.863593	15.04734	1814.54	19	26
☐	2	01-Jun-08 02:00:00	389.632	16.69644	14.87	1809.232	18.53069	25
☐	3	01-Jun-08 05:00:00	83.31233	30.07772	14.60399	1802.469	18.90375	26
☐	4	01-Jun-08 06:00:00	183.4952	30.14312	14.51532			25
☐	5	01-Jun-08 12:00:00	163.4321	39.29543	14.94583			33.36279
☐	6	01-Jun-08 14:00:00	861.41	102.227	15			32
☐	7	01-Jun-08 17:00:00	236.1159	100.1207	15.04288			32
☐	8	01-Jun-08 19:00:00	163.2294	34.00213	14.71732			31.87477
☐	9	02-Jun-08 01:00:00	55.88096	35.12788	14.58841			30.55562
☐	10	02-Jun-08 05:00:00	966.0519	-0.401935	14.82958	1821.07	22.19891	28.77465
☐	11	02-Jun-08 07:00:00	477.6509	9.599896	14.80565	1809.553	21	27.75643
☐	12	02-Jun-08 19:00:00	570.9297	5.385478	15.38195	1811.101	17.15991	24
☐	13	02-Jun-08 22:00:00	755.8716	48.7727	15.53219	1817.433	15	22
☐	14	03-Jun-08 01:00:00	359.9472	84.57059	15.68243	1807.925	15	22.37209
☐	15	03-Jun-08 04:00:00	2124.821	-0.560972	15.16449	1877.617	14	22.66355
☐	16	03-Jun-08 06:00:00	478.1208	4.677035	14.8316	1810.304	15.96317	22
☐	17	03-Jun-08 15:00:00	299.3827	26.2548	15.46893	1807.137	17.42855	24.03267
☐	18	03-Jun-08 19:00:00	347.7647	27.15281	15.26639	1806.474	15	23

Copy
Paste
Delete
Set Value to
Add Constant to
Multiply by Constant

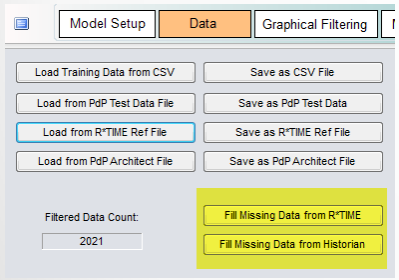
In some cases, current behavior may track another sensor value with an offset. Data can be created by copying one column of data to the other and then adjusting with the addition and/or multiplication by a constant.

Tip: Sometimes the best reference file data available for a sensor may not come from the sensor itself

Preserving a Reference File – Adding Sensor(s)

Before adding the sensors save a copy of the reference file (just in case). Modify the model by adding the sensors and ordering as desired …. Blank columns for data will appear on the data tab.

Option 1 … fill in data from historian, matching time stamps in ref file



Option 2 … copy data from another sensor and modify as needed

Option 3 … not for the feint hearted, but can very effective.

Create a new reference file with recent good data for all sensors and use model testing with new sensor in synthetic to run original reference file as test data… predicted values from output can be substituted for the sensor's missing data

Option 4…???

Tip: Sometimes the best reference file data available for a sensor may not come from the sensor itself

Questions