

EXCEL WORKBOOK INFORMATION

February 03, 2010

The Excel workbooks use a calculation of the Balancing Authority ACE Limit as defined in the draft Standard BAL-007. Significant detail about the calculations can be found in the Eastern Interconnection Field Trial document Attachments A and F (provided also in this document for convenience). In all cases, “E” files are applicable to BAs in the Eastern Interconnection and “W” files are applicable to BAs in the Western Interconnection. Please check the NERC website periodically for updated versions of the files and additional tools as they are made available. The Balancing Authority should only use the files designated for its Interconnection. Workbooks should be updated yearly as the Interconnection Frequency Bias changes.

QUICK VIEW OF BOUNDS: The EB and WB workbooks display the CPS1, CPS2 and Balancing Authority ACE Limit (BAAL) bounds based upon the Frequency Bias entered for the appropriate Interconnection. The “Parameters” page allows entry of the BA acronym and Frequency Bias (negative value). Tabs are provided for displaying the bounds for Scheduled Frequency at 59.98Hz, 60 Hz, and 60.02 Hz. Some variables in the workbook contain formulas specific to the Interconnection.

AFTER-THE-FACT REVIEW: The ED and WD workbooks can be used for quick review of daily performance under draft Standard BAL-007. The workbooks are protected (no password) to avoid inadvertent modification of protected cells. The “Parameters” tab contains unprotected cells to allow for entry of needed information in cells B1-B7 (Balancing Authority fields) and cells B12-B15 (Interconnection-specific fields). The “Data” worksheet contains cells with formulas updated with scan-rate data from an OSI PI DataLink server. To avoid errors in opening any of the workbooks for the first time, the workbooks are initially set up with the manual calculation option in Excel. Enhancements have been added to the ED and WD documents to better enable the use of the file to gather daily data for use in the monthly report. As the data quality codes AQC and FQC are not updated, the user should update the workbook to flag the “bad” clock-minutes as described in Attachment A of the Field Trial document. A clock-minute not included in current CPS1 reporting should not be included (unless flagged) in the data evaluated.

The EM and WM workbooks provide a simple approach for after-the-fact review of performance under draft Standard BAL-007 and provision of monthly clock-minute data in the Field Trial format. An example of the file is provided in the group of screenshots below. Some variables in the workbook contain formulas specific to the Interconnection. As an option to writing code to recreate the calculations described in Attachment A below, the workbook allows the user to input clock-minute data for the month and then copy formulas (to the right in the worksheet) which calculate the low and high Balancing Authority ACE Limit (BAAL) bounds and increment the clock-minutes whenever ACE is outside the BAAL bounds. The worksheet can be saved in CSV format for submittal of monthly data under the Field Trial.

REAL-TIME MONITORING: The E1, E2, E3, W1, W2, and W3 workbooks contain cells with formulas updated either from an OSI PI DataLink or eDNA (InStep Software, LLC) server. To avoid errors in opening any of the workbooks for the first time, the workbooks are initially set up with the manual calculation option in Excel.

The Excel workbooks are protected (no password) to avoid inadvertent modification of protected cells. The “Parameters” tab is the only worksheet with unprotected cells to allow for entry of needed information in cells B1-B7 (Balancing Authority fields) and cells B12-B15 (Interconnection-specific fields). Excel workbooks E1, E2 and E3 have Eastern Interconnection parameters already entered in cells B12-B15. Excel workbooks W1, W2, and W3 have Western Interconnection parameters already entered in cells B12-B15 based upon Frequency Trigger Limits set at 3 times the Interconnection Epsilon1.

Project 2007-18 - Reliability-based Control

It is important to use the workbook that matches the method used to determine Scheduled Frequency: some systems store the Scheduled Frequency, other systems store a value representing the offset from 60 Hz. If your system doesn't save either variable, modifications to the workbook might be needed to ensure that CPS1, Adjusted CPS1 (described in the Eastern Interconnection Field Trial document) and BAAL are properly calculated.

Workbooks using scan-rate data: consult with your company's specialist on PI or eDNA to ensure that data is stored at intervals consistent with the scan rate of the EMS and other parameters are set so that the clock-minute averages of the data are consistent with the clock-minute averages used for NERC CPS1 compliance reporting.

Using the capability to review historic data (entry of a date and time in cell B1 of the "Parameters" tab), each user should compare the clock-minute data in the "Data" worksheet to the clock-minute data used to calculate and report monthly performance under NERC CPS1, in order to determine if the workbook will calculate real-time performance consistent with information that will be gathered and used after-the-fact for reporting performance.

The PC and Server date/time must be verified to ensure that the Excel "now()" function is acquiring real-time information. To the extent that your PI server data has clock-minute values of ACE, Actual Frequency and Scheduled Frequency, the cells in the "DATA" tab can be revised for prior clock-minutes to use that data, rather than calculate clock-minute averages each time the workbook updates.

The workbooks E1, E2, E3, W1, W2, and W3 cannot be used by Balancing Authorities using a Variable Frequency Bias. If you use a Variable Frequency Bias and would like to monitor performance under the Balancing Authority ACE Limit, please email doug.hils@duke-energy.com with "[RBC]" at the beginning of the subject line requesting additional information.

Thank you for your interest,

Reliability-Based Control Standard Drafting Team

Balancing Authority PARAMETERS		
Enter Balancing Authority Acronym		
Enter Frequency Bias (negative value)		MW / 0.1 Hz
Enter PI tag name for Raw ACE point		
Enter PI tag name for Actual Frequency point		
Enter PI tag name for time error correction Hz offset		
Enter PI Server Name		
Calculated CPS2 L10	67.87	MW (+/-)
Purpose Statement B: Upper Fixed Bound	1000	MW
Purpose Statement B: Lower Fixed Bound	-1000	MW

After all other data is entered, enter "=now()" in cell B1 and then start the timer with CTRL-T to monitor current operations. The VB macro defaults to updating every ten seconds.

For reviewing historic data, enter the date and time of the last minute of the thirty-minute period you wish to review in cell B1. CTRL-S will stop the timer if needed.

After entering the BA Frequency Bias, Interconnection Frequency Bias, and Interconnection Epsilon 10, verify that the calculated CPS2 limit agrees with the value assigned by the NERC Resources Subcommittee for the applicable period.

Reserved for future use - allows for entry of static upper and lower ACE bounds.

Interconnection PARAMETERS		
Interconnection Frequency Bias (negative value)	-6510.00	MW / 0.1 Hz
Interconnection Epsilon 1	18.0	mHz
Interconnection Epsilon 10	5.7	mHz
FTL_Low	59.950	Hz
FTL_High	60.050	Hz

IMPORTANT NOTES:
Check the NERC website periodically for updated versions of this BAAL Workbook.

INSTRUCTIONS:
Enter applicable information into cells B2-B7, B10, and B12-B14 as needed and then enter the applicable date and time, or "=now()", into cell B1.

This workbook is initially set for manual calculation - after entry of all information, go to "Tools", select "Options", select the "Calculation" tab, select "Automatic", and then click "OK". Save the workbook with your parameters.

All pages are protected without a password. The charts may need to be formatted and scaled slightly for your BA parameters

Questions? Email doug.hils@duke-energy.com with "[RBC]" in the subject line.

BA and Interconnection PARAMETERS must be entered for the applicable period.

"E1_RBCSDT_BAAL_20100203_TEC_Offset.xlsm"
Workbook designed to use an Offset From 60 Hz variable to determine Scheduled Frequency.
Displayed is a sample of the "Parameters" page.
The small section in the upper left is used for entry of information necessary for the workbook to calculate the clock-minute values of the Balancing Authority ACE Limits and increment the clock-minute counters whenever the clock-minute ACE exceeds the corresponding clock-minute BAAL.
The W1 worksheet is similar but with Western Interconnection parameters entered.

MACROS	
Action	Enter
Start the timer (10-second update is set in macro)	CTRL-T
Stop the timer	CTRL-S

This BAAL Workbook is not intended for use by Balancing Authorities using a Variable Bias. If you use a Variable Bias and are not able to locate the BAAL Workbook for Variable Bias, please email doug.hils@duke-energy.com with "[RBC]" at the beginning of the subject line.

Reference Information

	Eastern Interconnection	Western Interconnection PCE report	3 x epsilon1	ERCOT	Hydro-Québec
2009 Interconnection Frequency Bias	-6510	-2088		-660	-364
Epsilon 1 (mHz)	18	22.8	22.8	30	21
Epsilon 10 (mHz)	5.7	7.3	7.3	7.3	24.9
FTL_Low (Hz)	59.950	59.856	59.932	59.932	TBD
FTL_High (Hz)	60.050	60.144	60.068	60.068	TBD

FTL in PCE report page 9

DISCLAIMER:
THE USE OF THIS BAAL WORKBOOK IS PROVIDED FREE OF CHARGE AND NEITHER DUKE ENERGY CORPORATION, NOR ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS MAKE ANY CLAIMS, PROMISES OR GUARANTEES ABOUT THE ACCURACY, COMPLETENESS, OR ADEQUACY OF THE RESULTS OBTAINED THROUGH THE USE THEREOF AND HEREBY DISCLAIMS ANY RESPONSIBILITY OR LIABILITY WHATSOEVER FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY SUCH RESULTS OR IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK. BY USING THE BAAL WORKBOOK THE USER AGREES TO THE TERMS OF THE DISCLAIMER AND WILL NOT HOLD DUKE ENERGY CORPORATION, ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS LIABLE FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK.

Balancing Authority PARAMETERS		
Balancing Authority Acronym		
Frequency Bias		MW / 0.1 Hz
PI Raw ACE		<- tag name
PI Actual Frequency Point		<- tag name
PI Time-Error Correction Hz Offset		<- tag name
PI Server Name		
Calculated CPS2 L10	67.87	MW (+/-)
Purpose Statement B: Upper Fixed Bound	1000	MW
Purpose Statement B: Lower Fixed Bound	-1000	MW
Interconnection PARAMETERS		
Interconnection Frequency Bias	-6510.00	MW / 0.1 Hz
Interconnection Epsilon 1	0.0180	Hz
Interconnection Epsilon 10	0.0057	Hz
FTL_Low	59.950	Hz
FTL_High	60.050	Hz

Values entered on the "Parameters" Page

The OSI PI DataLink tag names and server are entered on the "Parameters" page. The "Data" page shown here from the E1 workbook reflects the information entered in the top left, and displays the necessary data for each clock-minute in order to calculate the corresponding values for the Balancing Authority ACE Limit, CPS1 and Adjusted CPS1. The ACE and Actual Frequency fields are repeated to the right for the chart format. All charts use information from the "Data" worksheet.

3/1/09 13:34
0:00:36
0:01

BAAL BAAL MAXIMUM
CALC EXCEEDED DURATION

	Raw ACE	Actual Freq	Sched Freq			0	0	FREQ	ACE	CPS1	BAAL ADJ	CPS1
13:34:36	13	59.998	60.00		-1000.55	0	0	59.9980	12.70	209.79		209.79
13:34:36	-4.011498769	59.99550035	60	1	-444.479	0	0	59.9955	-4.01	193.04		193.04
13:34	-9.822795868	59.99638303	60	2	-552.949	0	0	59.9964	-9.82	186.29		186.29
13:33	4.044122314	60.00418307	60	3	478.118	0	0	60.0042	4.04	193.47		193.47
13:32	-9.251937103	59.99756648	60	4	-821.854	0	0	59.9976	-9.25	191.31		191.31
13:31	0.033238983	60.00003332	60	5	600.33	0	0	60.0000	0.03	200.00		200.00
13:30	120.1133723	60.01065025	60	6	187.789	0	0	60.0107	120.11	-293.53		-293.53
13:29	115.6631622	60.00481707	60	7	415.19	0	0	60.0048	115.66	-14.95		-14.95
13:28	103.1185097	60.00501696	60	8	398.648	0	0	60.0050	103.12	0.41		0.41
13:27	95.92253469	60.00771675	60	9	259.176	0	0	60.0077	95.92	-85.57		-85.57
13:26	81.66111069	60.00761663	60	10	262.595	0	0	60.0076	81.66	-39.95		-39.95
13:25	67.91831385	59.99684995	60	11	-634.911	0	0	59.9968	67.92	282.54		282.54
13:24	65.43372142	60.00020014	60	12	9992.78	0	0	60.0002	65.43	194.95		194.95
13:23	86.60530955	60.00899938	60	13	222.238	0	0	60.0090	86.61	-100.69		-100.69
13:22	91.30012945	60.00918363	60	14	217.779	0	0	60.0092	91.30	-123.48		-123.48
13:21	78.81713053	60.00854963	60	15	233.928	0	0	60.0085	78.82	-59.98		-59.98
13:20	64.82619654	60.00690788	60	16	289.525	0	0	60.0069	64.83	27.23		27.23
13:19	65.44010696	60.0126249	60	17	158.417	0	0	60.0126	65.44	-118.74		-118.74
13:18	50.65652898	59.99723358	60	18	-722.956	0	0	59.9972	50.66	254.07		254.07
13:17	53.87934341	59.99410019	60	19	-338.994	0	0	59.9941	53.88	322.64		322.64
13:16	43.89682098	59.99288425	60	20	-281.067	0	0	59.9929	43.89	320.48		320.48
13:15	57.70932515	59.9999169	60	21	-24068.3	0	0	59.9999	57.71	201.85		201.85
13:14	72.08134486	60.00998344	60	22	200.332	0	0	60.0100	72.08	-77.63		-77.63
13:13	83.04733683	60.01408374	60	23	142.008	0	0	60.0141	83.05	-251.24		-251.24
13:12	71.19786352	60.01117442	60	24	178.98	0	0	60.0112	71.20	-106.94		-106.94
13:11	66.30512721	60.00175867	60	25	1137.22	0	0	60.0018	66.31	155.01		155.01
13:10	77.17271576	60.01168327	60	26	171.185	0	0	60.0117	77.17	-147.85		-147.85
13:09	72.31082001	60.01351687	60	27	147.963	0	0	60.0135	72.31	-177.09		-177.09
13:08	74.8032163	60.01479471	60	28	135.183	0	0	60.0148	74.80	-226.96		-226.96
13:07	60.6916537	60.00773871	60	29	258.441	0	0	60.0077	60.69	18.80		18.80
13:06	63.44534582	60.00018323	60	30	10915.1	0	0	60.0002	63.45	195.51		195.51
13:05	62.43295441	60.00488396	60	31	409.504	0	0	60.0049	62.43	82.36		82.36
13:04	40.7438385	60.00572465	60	32	349.366	0	0	60.0057	40.74	110.01		110.01
13:03	15.3471049	59.99934127	60	33	-3036.12	0	0	59.9993	15.35	203.90		203.90
13:02	1.935511525	59.9988163	60	34	-1689.62	0	0	59.9988	1.94	200.88		200.88
13:01	-16.30310084	59.99898364	60	35	-1967.8	0	0	59.9990	-16.30	193.61		193.61
13:00	22.62503103	60.0066501	60	36	300.747	0	0	60.0067	22.63	141.95		141.95
12:59	-6.05389328	59.99395008	60	37	-330.583	0	0	59.9940	-6.05	185.87		185.87
12:58	-1.995325979	60.00124957	60	38	1600.55	0	0	60.0012	-2.00	200.96		200.96
12:57	2.612124379	60.00568301	60	39	351.926	0	0	60.0057	2.61	194.27		194.27
12:56	17.39252192	60.00940037	60	40	212.758	0	0	60.0094	17.39	136.92		136.92
12:55	4.71932958	60.00166658	60	41	1200.06	0	0	60.0017	4.72	196.97		196.97
12:54	-19.22996241	60.00373332	60	42	535.717	0	0	60.0037	-19.23	227.70		227.70
12:53	-14.62152532	60.0159996	60	43	125.003	0	0	60.0160	-14.62	290.25		290.25
12:52	1.851935832	60.02758293	60	44	72.5086	0	0	60.0276	1.85	180.29		180.29
12:51	17.14543686	60.02555046	60	45	78.2765	0	0	60.0256	17.15	30.99		30.99
12:50	6.706852214	60.01140003	60	46	175.438	0	0	60.0114	6.71	170.50		170.50
12:49	17.95505015	59.99726645	60	47	-731.65	0	0	59.9973	17.96	218.94		218.94
12:48	24.51967494	59.98949213	60	48	-190.334	0	0	59.9895	24.52	299.40		299.40
12:47	-0.652260335	59.98497559	60	49	-133.117	0	0	59.9850	-0.65	196.22		196.22
12:46	-15.6151652	59.98535875	60	50	-136.6	0	0	59.9854	-15.62	111.80		111.80
12:45	-8.776388041	60.00370833	60	51	539.326	0	0	60.0037	-8.78	212.56		212.56
12:44	-8.020743815	60.00899105	60	52	222.443	0	0	60.0090	-8.02	227.82		227.82
12:43	-4.658792877	60.00914116	60	53	218.78	0	0	60.0091	-4.66	216.43		216.43
12:42	-5.266266123	60.011483	60	54	174.17	0	0	60.0115	-5.27	223.33		223.33
12:41	-2.015081024	60.02298292	60	55	87.0212	0	0	60.0230	-2.02	217.87		217.87
12:40	8.610824839	60.01888339	60	56	105.913	0	0	60.0189	8.61	137.27		137.27
12:39	-1.514744568	60.00344938	60	57	579.815	0	0	60.0034	-1.51	202.02		202.02
12:38	11.51333694	60.00818392	60	58	244.382	0	0	60.0082	11.51	163.65		163.65
12:37	27.78761139	60.00488319	60	59	409.568	0	0	60.0049	27.79	147.65		147.65
12:36	-5.822913106	59.98964958	60	60	-193.229	0	0	59.9896	-5.82	176.75		176.75

Balancing Authority PARAMETERS		
Enter Balancing Authority Acronym		
Enter Frequency Bias (negative value)		MW / 0.1 Hz
Enter PI tag name for Raw ACE point		
Enter PI tag name for Actual Frequency point		
Enter PI tag name for Scheduled Frequency point		
Enter PI Server Name		
Calculated CPS2 L10	67.87	MW (+/-)
Purpose Statement B: Upper Fixed Bound	1000	MW
Purpose Statement B: Lower Fixed Bound	-1000	MW

After all other data is entered, enter "=now()" in cell B1 and then start the timer with CTRL-T to monitor current operations. The VB macro defaults to updating every ten seconds.

For reviewing historic data, enter the date and time of the last minute of the thirty-minute period you wish to review in cell B1. CTRL-S will stop the timer if needed.

After entering the BA Frequency Bias, Interconnection Frequency Bias, and Interconnection Epsilon 10, verify that the calculated CPS2 limit agrees with the value assigned by the NERC Resources Subcommittee for the applicable period.

Reserved for future use - allows for entry of static upper and lower ACE bounds.

Interconnection PARAMETERS		
Interconnection Frequency Bias (negative value)	-6510.00	MW / 0.1 Hz
Interconnection Epsilon 1	18.0	mHz
Interconnection Epsilon 10	5.7	mHz
FTL_Low	59.950	Hz
FTL_High	60.050	Hz

IMPORTANT NOTES:
Check the NERC website periodically for updated versions of this BAAL Workbook.

"E2_RBCSDT_BAAL_20100203.xlsm"
Workbook designed to use a variable for Scheduled Frequency
Displayed is a sample of the "Parameters" page.
The small section in the upper left is used for entry of information necessary for the workbook to calculate the clock-minute values of the Balancing Authority ACE Limits and increment the clock-minute counters whenever the clock-minute ACE exceeds the corresponding clock-minute BAAL.
The W2 worksheet is similar but with Western Interconnection parameters entered.

INSTRUCTIONS:
Enter applicable information into cells B2-B7, B10, and B12-B14 as needed and then enter the applicable date and time, or "=now()", into cell B1.

This workbook is initially set for manual calculation - after entry of all information, go to "Tools", select "Options", select the "Calculation" tab, select "Automatic", and then click "OK". Save the workbook with your parameters.

All pages are protected without a password. The charts may need to be formatted and scaled slightly for your BA parameters

Questions? Email doug.hils@duke-energy.com with "[RBC]" in the subject line.

BA and Interconnection PARAMETERS must be entered for the applicable period.

Consult NERC O
Using the
minute of
to calcul
the work
gathered
The PC
acquiring
values of
can be r
minute a

This BAAL Workbook is not intended for use by Balancing Authorities using a Variable Bias. If you use a Variable Bias and are not able to locate the BAAL Workbook for Variable Bias, please email doug.hils@duke-energy.com with "[RBC]" at the beginning of the subject line.

MACROS	
Action	Enter
Start the timer (10-second update is set in macro)	CTRL-T
Stop the timer	CTRL-S

Reference Information

	Eastern Interconnection	Western Interconnection PCE report	3 x epsilon1	ERCOT	Hydro-Québec
2009 Interconnection Frequency Bias	-6510	-2088		-660	-364
Epsilon 1 (mHz)	18	22.8	22.8	30	21
Epsilon 10 (mHz)	5.7	7.3	7.3	7.3	24.9
FTL_Low (Hz)	59.950	59.856	59.932	59.932	TBD
FTL_High (Hz)	60.050	60.144	60.068	60.068	TBD

FTL in PCE report page 9

DISCLAIMER:
THE USE OF THIS BAAL WORKBOOK IS PROVIDED FREE OF CHARGE AND NEITHER DUKE ENERGY CORPORATION, NOR ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS MAKE ANY CLAIMS, PROMISES OR GUARANTEES ABOUT THE ACCURACY, COMPLETENESS, OR ADEQUACY OF THE RESULTS OBTAINED THROUGH THE USE THEREOF AND HEREBY DISCLAIMS ANY RESPONSIBILITY OR LIABILITY WHATSOEVER FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY SUCH RESULTS OR IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK. BY USING THE BAAL WORKBOOK THE USER AGREES TO THE TERMS OF THE DISCLAIMER AND WILL NOT HOLD DUKE ENERGY CORPORATION, ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS LIABLE FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK.

Balancing Authority PARAMETERS		
Enter Balancing Authority Acronym	BA01	
Enter Frequency Bias (negative value)	-100.00	MW / 0.1 Hz
Enter eDNA PointID for Raw ACE point	heren.scada1.sa021903	
Enter eDNA PointID for Actual Frequency point	heren.scada1.sa000222	
Enter eDNA PointID for Scheduled Frequency point	heren.scada1.sa021905	
Enter Server Name (not used for eDNA)		
Calculated CPS2 L10	77.44	MW (+/-)
Purpose Statement B: Upper Fixed Bound	2000	MW
Purpose Statement B: Lower Fixed Bound	-2000	MW
Interconnection PARAMETERS		
Interconnection Frequency Bias (negative value)	-6510.00	MW / 0.1 Hz
Interconnection Epsilon 1	18.0	mHz
Interconnection Epsilon 10	5.7	mHz
FTL_Low	59.950	Hz
FTL_High	60.050	Hz

INSTRUCTIONS:
Enter applicable information into cells B2-B7, B10, and B12-B14 as needed and then enter the applicable date and time, or "=now()", into cell B1.

This workbook is initially set for manual calculation - after entry of all information, go to "Tools", select "Options", select the "Calculation" tab, select "Automatic", and then click "OK". Save the workbook with your parameters.

All pages are protected without a password. The charts may need to be formatted and scaled slightly for your BA parameters

Questions? Email doug.hils@duke-energy.com with "[RBC]" in the subject line.

BA and Interconnection PARAMETERS must be entered for the applicable period.

MACROS	
Action	Enter
Start the timer (10-second update is set in macro)	CTRL-T
Stop the timer	CTRL-S

Reference Information

	Eastern Interconnection	Western Interconnection PCE report	3 x epsilon1	ERCOT	Hydro-Québec
2009 Interconnection Frequency Bias	-6510	-2088	-2088	-660	-364
Epsilon 1 (mHz)	18	22.8	22.8	30	21
Epsilon 10 (mHz)	5.7	7.3	7.3	7.3	24.9
FTL_Low (Hz)	59.950	59.856	59.932	59.932	TBD
FTL_High (Hz)	60.050	60.144	60.068	60.068	TBD

FTL in PCE report page 9

After all other data is entered, enter "=now()" in cell B1 and then start the timer with CTRL-T to monitor current operations. The VB macro defaults to updating every ten seconds.
For reviewing historic data, enter the date and time of the last minute of the thirty-minute period you wish to review in cell B1. CTRL-S will stop the timer if needed.

After entering the BA Frequency Bias, Interconnection Frequency Bias, and Interconnection Epsilon 10, verify that the calculated CPS2 limit agrees with the value assigned by the NERC Resources Subcommittee for the applicable period.

Reserved for future use - allows for entry of static upper and lower ACE bounds.

IMPORTANT NOTES: (SEE ALSO AMEREN NOTES ON SHEET AMEREN)
Check the NERC website periodically for updated versions of this BAAL Workbook under Reliability-based Control Standard Project 2007-18.

Consult with consistent minute average NERC CP
Using the minute data to calculate the work gathered
The PC acquires values of minute av
This BAAL

"E3_RBCSDT_BAAL_20100203_eDNA.xlsm"
Workbook designed to use variables for Scheduled Frequency and other data from an eDNA server.
Displayed is a sample of the "Parameters" page.
The small section in the upper left is used for entry of information necessary for the workbook to calculate the clock-minute values of the Balancing Authority ACE Limits and increment the clock-minute counters whenever the clock-minute ACE exceeds the corresponding clock-minute BAAL.
The W3 worksheet is similar but with Western Interconnection parameters entered.

Bias. If you use a Variable Bias and are not able to locate the BAAL Workbook for Variable Bias, please email doug.hils@duke-energy.com with "[RBC]" at the beginning of the subject line.

DISCLAIMER:
THE USE OF THIS BAAL WORKBOOK IS PROVIDED FREE OF CHARGE AND NEITHER DUKE ENERGY CORPORATION, NOR ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS MAKE ANY CLAIMS, PROMISES OR GUARANTEES ABOUT THE ACCURACY, COMPLETENESS, OR ADEQUACY OF THE RESULTS OBTAINED THROUGH THE USE THEREOF AND HEREBY DISCLAIMS ANY RESPONSIBILITY OR LIABILITY WHATSOEVER FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY SUCH RESULTS OR IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK. BY USING THE BAAL WORKBOOK THE USER AGREES TO THE TERMS OF THE DISCLAIMER AND WILL NOT HOLD DUKE ENERGY CORPORATION, ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS LIABLE FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK.

DISCLAIMER
ALL MODIFICATIONS OF THE ORIGINAL BAAL WORKBOOK PERFORMED BY AMEREN ARE PROVIDED FREE OF CHARGE AND NEITHER AMEREN CORPORATION, NOR ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS MAKE ANY CLAIMS, PROMISES OR GUARANTEES ABOUT THE ACCURACY, COMPLETENESS, OR ADEQUACY OF THE RESULTS OBTAINED THROUGH THE USE THEREOF AND HEREBY DISCLAIMS ANY RESPONSIBILITY OR LIABILITY WHATSOEVER FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY SUCH RESULTS OR IN ANY WAY ASSOCIATED WITH THE USE OF THIS MODIFIED BAAL WORKBOOK. BY USING THE MODIFIED BAAL WORKBOOK THE USER AGREES TO THE TERMS OF THE DISCLAIMER AND WILL NOT HOLD AMEREN CORPORATION, ITS SUBSIDIARIES, AFFILIATES, EMPLOYEES OR AGENTS LIABLE FOR ANY ERRORS, OMISSIONS, OR DISCREPANCIES IN ANY WAY ASSOCIATED WITH THE USE OF THIS BAAL WORKBOOK.

AFTER-THE-FACT REVIEW

BA	DATE	TIME	TIMEZONE	ACE	FREQERROR	FREQBIAS	ACTFREQ	SCHEDFREQ	AQC	FQC	BAALow	MinCtLow	BAALhigh	MinCtHigh	CPS1	ACPS1
BA-05	7/1/2004	23:55	EST	-77.75	-0.1	-311	59.9	60	0	0	-77.75	0	0.0	0	-571.6049	-571.6049
BA-05	7/1/2004	23:56	EST	-79.7436	-0.0975	-311	59.9025	60	0	0	-79.74	0	0.0	0	-571.6049	-571.6049
BA-05	7/1/2004	23:57	EST	-81.8421	-0.095	-311	59.905	60	0	0	-81.84	0	0.0	0	-571.6049	-571.6049
BA-05	7/1/2004	23:58	EST	-84.0541	-0.0925	-311	59.9075	60	0	0	-84.05	0	0.0	0	-571.6049	-571.6049
BA-05	7/1/2004	23:59	EST	-86.3889	-0.09	-311	59.91	60	0	0	-86.39	0	0.0	0	-571.6049	-571.6049
BA-05	7/2/2004	0:00	EST	-88.8571	-0.0675	-311	59.9125	59.98	0	0	-88.86	0	0.0	0	-395.2381	-571.6049
BA-05	7/2/2004	0:01	EST	-91.4706	-0.065	-311	59.915	59.98	0	0	-91.47	0	0.0	0	-390.0508	-571.6049
BA-05	7/2/2004	0:02	EST	-94.2424	-0.0625	-311	59.9175	59.98	0	0	-94.24	0	0.0	0	-384.5492	-571.6049
BA-05	7/2/2004	0:03	EST	-97.1875	-0.06	-311	59.92	59.98	0	0	-97.19	0	0.0	0	-378.7037	-571.6049
BA-05	7/2/2004	0:04	EST	-100.323	-0.0575	-311	59.9225	59.98	0	0	-100.32	0	0.0	0	-372.4811	-571.6049
BA-05	7/2/2004	0:05	EST	-103.667	-0.055	-311	59.925	59.98	0	0	-103.67	0	0.0	0	-365.8436	-571.6049
BA-05	7/2/2004	0:06	EST	-107.241	-0.0525	-311	59.9275	59.98	0	0	-107.24	0	0.0	0	-358.7484	-571.6049
BA-05	7/2/2004	0:07	EST	-111.071	-0.05	-311	59.93	59.98	0	0	-111.07	0	0.0	0	-351.1464	-571.6049
BA-05	7/2/2004	0:08	EST	-115.185	-0.0475	-311	59.9325	59.98	0	0	-115.19	0	0.0	0	-342.9813	-571.6049
BA-05	7/2/2004	0:09	EST	-119.615	-0.045	-311	59.935	59.98	0	0	-119.62	0	0.0	0	-334.1880	-571.6049
BA-05	7/2/2004	0:10	EST	-124.4	-0.0425	-311	59.9375	59.98	0	0	-124.40	0	0.0	0	-324.6914	-571.6049
BA-05	7/2/2004	0:11	EST	-129.583	-0.04	-311	59.94	59.98	0	0	-129.58	0	0.0	0	-314.4033	-571.6049

INSERT DATA FOR THESE FIELDS FOR ALL CLOCK-MINUTES FOR THE MONTH

COPY THESE CELLS DOWN FOR ALL CLOCK-MINUTES

As an option to writing code to recreate the calculations described in Attachment A below, the user can also make use of the following:
 The workbooks entitled "EM - RBCSDT BAAL Monthly Data and Calculations FTL 59950.xls" and "WM - RBCSDT BAAL Monthly Data and Calculations FTL 59932.xls" allow the user to input clock-minute data for the month and then copy formulas (to the right in the worksheet) which calculate the low and high Balancing Authority ACE Limit (BAAL) bounds and increment the clock-minutes whenever ACE is outside the BAAL bounds. The worksheet can be saved in CSV format for submittal of monthly data under the Field Trial.

Please note that in the example above, the ACE is set exactly at the calculated bound for the Balancing Authority ACE Limit (BAAL) to demonstrate that the BAAL corresponds to an Adjusted CPS1 (ACPS1) compliance value of -571.6% in the Eastern Interconnection (-689.5% in the Western Interconnection with the Frequency Trigger Limit set at 59.932 Hz). As illustrated above, when Scheduled Frequency is not equal to 60 Hz, the clock-minute ACPS1 value differs from the clock-minute CPS1 value.

The use of ACPS1 is described further in Attachment F below as it provides additional flexibility to the user for monitoring performance under the Field Trial.

ATTACHMENT A

Field Trial Data Submittal Format

For analysis of Control Performance Measure and Balancing Authority ACE Limit (“BAAL”) performance under the Field Trial, clock-minute data will be provided in monthly files under the following Comma-Separated-Variable (“CSV”) format:


BA, Date, Time, TimeZone, ACE, FreqError, FreqBias, ActFreq, SchedFreq, AQC, FQC, BAAL_Low, MinCtLow, BAAL_High, MinCtHigh, <EOL>

<u>Field Name</u>	<u>Description/Type</u>
BA	BA acronym in NERC Registry (up to 4 characters)
Date	Date format (MM/DD/YY),
Time	24-hour time format (hh:mm),
TimeZone	3-character time-zone abbreviation (EST, EDT, CST, CDT, etc)
ACE (REAL)	Clock-minute average Area Control Error (MW) (minimum of 1 digit to right of decimal point)
FreqError (REAL)	Clock-minute average Frequency Error (Hz) <i>Frequency Error is equal to Actual Frequency minus Scheduled Frequency.</i> (minimum of four digits to right of decimal point)
FreqBias (REAL)	Clock-minute average Frequency Bias (MW/0.1 Hz) (same precision as implemented in EMS)
ActFreq (REAL)	Clock-minute average Actual Frequency (Hz) (minimum of four digits to right of decimal point)
SchedFreq (REAL)	Clock-minute average Scheduled Frequency (Hz) (minimum of two digits to right of decimal point)
AQC* (INTEGER)	ACE Quality Code (0=valid data, 1=bad data)
FQC* (INTEGER)	Frequency Quality Code (0=valid data, 1=bad data)
BAAL_Low (REAL)	BAAL _{Low} (MW) (minimum of 1 digit to right of decimal point)
MinCtLow (INTEGER)	Count of the consecutive minutes of negative ACE < BAAL _{Low} when Actual Frequency is < 60 Hz.
BAAL_High (REAL)	BAAL _{High} (MW) (minimum of 1 digit to right of decimal point)
MinCtHigh (INTEGER)	Count of the consecutive minutes of positive ACE > BAAL _{High} when Actual Frequency > 60 Hz.

*If no quality code is available, then write 0 for all records. Ideally, the user should have the capability to update the quality code for the ACE and Frequency with each sample to flag whether that sample represents good or bad data. If over 50% of the samples of ACE for a given period have bad data, then AQC for that period should be flagged as "bad" for the ACE represented. If less than 50% of the samples represent bad data, then AQC for the period should be flagged as "good" using only the good samples of ACE for that period. Likewise, if over 50% of the samples of frequency for a given period have bad data, then FQC for that period should be flagged as "bad" for the frequency represented. If less than 50% of the samples represent bad data, then FQC for that period should be flagged as "good" using only the good samples of frequency for that period.

Example CSV records:

```
BA03,11/21/2004,10:00,EST, -10.2,-0.0080,-90.0,59.9920,60.00,0,0,-281.3,0,0.0,0
BA03,11/21/2004,10:01,EST, -2.5,-0.0100,-85.0,59.9900,60.00,0,0,-212.5,0,0.0,0
BA03,11/21/2004,10:02,EST, 1.6,-0.0070,-80.0,59.9930,60.00,0,0,-285.7,0,0.0,0
BA03,11/21/2004,10:03,EST, -309.0,-0.0370,-80.0,59.9630,60.00,0,0, -54.1,1,0.0,0
BA03,11/21/2004,10:04,EST, -310.4,-0.0420,-80.0,59.9580,60.00,0,0, -47.6,2,0.0,0
BA03,11/21/2004,10:05,EST, -312.5,-0.0540,-80.0,59.9460,60.00,0,0, -37.0,3,0.0,0
```



Note that the fourth row of data represents the first clock-minute record where the ACE of -309.0 MW was outside the BAAL_Low boundary of -54.1 MW. As ACE remained outside the calculated BAAL boundary for the next two clock-minutes, "MinCtLow" was incremented for each record.

Note that column headings are not to be provided in the monthly CSV files.

Monthly File Naming Convention

Data shall be provided to the RBCSDT on a monthly basis no later than the tenth working day of the month using the following naming convention:

YYYYMM_BANN.CSV, where YYYY is the four-digit year, MM is the two-digit month (01-12), and NN is the number assigned to the participating BA by the RBCSDT. For example, August 2005 data for BA03 should be written to the file named "200508_BA03.CSV" and provided to the RBCSDT.

Once the data has been stored into the monthly CSV file, the user should then compress the file, typically 3-4 MB, into a "ZIP" file with the same naming convention (**YYYYMM_BANN.ZIP**). Monthly data is to be provided via email no later than the tenth working day of the month to doug.hils@duke-energy.com

Questions should be directed to:

Doug Hils
 Duke Energy
 Midwest Control Area Operation
 513-287-2149
doug.hils@duke-energy.com

Calculation of Variables

The Balancing Authority ACE Limit (“BAAL”) should be calculated from the clock-minute averages of the data as follows:

$$FTL_{Low} = 59.95 \text{ Hz}$$

$$FTL_{High} = 60.05 \text{ Hz}$$

Frequency Trigger Limits for the Eastern Interconnection shown

$$X = \text{Actual Frequency} - 60 \text{ Hz}$$

(note: during time-error corrections, this variable is not equal to the Frequency Error which is always the sum of Actual Frequency minus Scheduled Frequency)

If $X \leq 0$ then

$$BAAL_{Low} = (-10 * \text{Frequency Bias} * (FTL_{Low} - 60 \text{ Hz})^2) / (X - 0.000000001)$$

Else

$$BAAL_{Low} = 0.0$$

End If

If $X > 0$ then

$$BAAL_{High} = (-10 * \text{Frequency Bias} * (FTL_{High} - 60 \text{ Hz})^2) / (X)$$

Else

$$BAAL_{High} = 0.0$$

End If

Needed to prevent division error when $X = 0$ but will be insignificant in the calculation when $X < 0$

The logic for the clock-minute counters (initialized at zero) would then use the logic:

If $BAAL_{Low} < 0$ then

If $ACE < BAAL_{Low}$ then

$$\text{MinCtLow} = \text{MinCtLow} + 1$$

Else

$$\text{MinCtLow} = 0$$

End If

$$\text{MinCtHigh} = 0$$

End If

If $BAAL_{High} > 0$ then

If $ACE > BAAL_{High}$ then

$$\text{MinCtHigh} = \text{MinCtHigh} + 1$$

Else

$$\text{MinCtHigh} = 0$$

End If

$$\text{MinCtLow} = 0$$

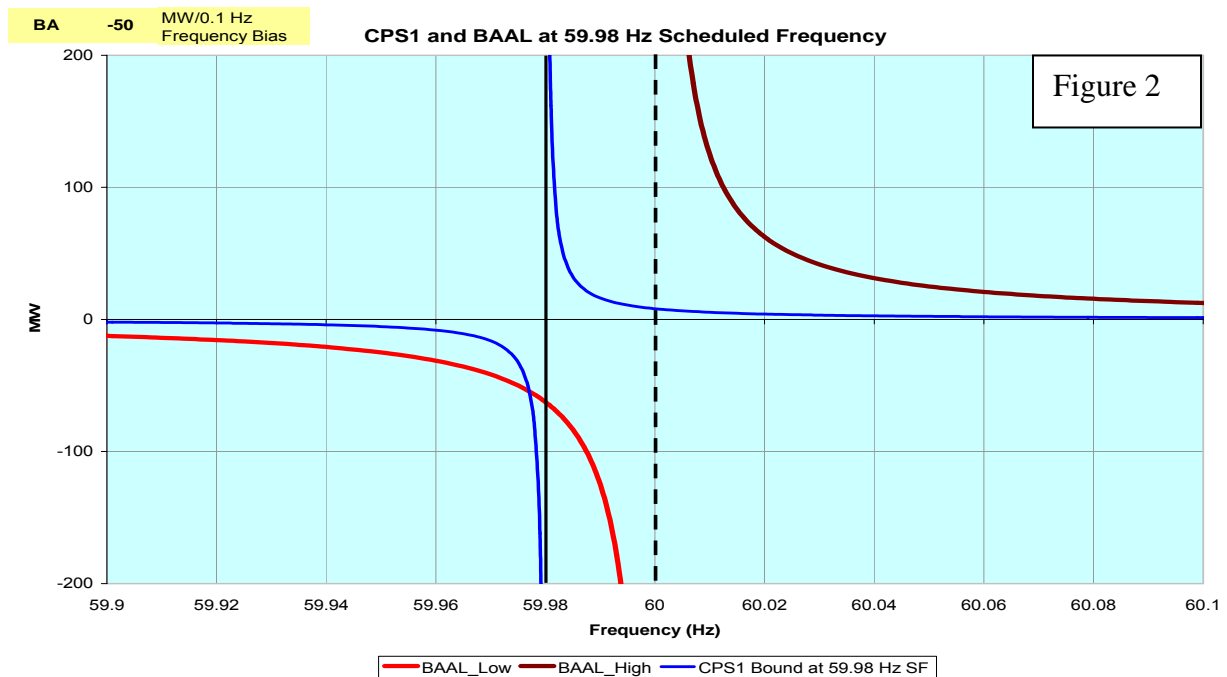
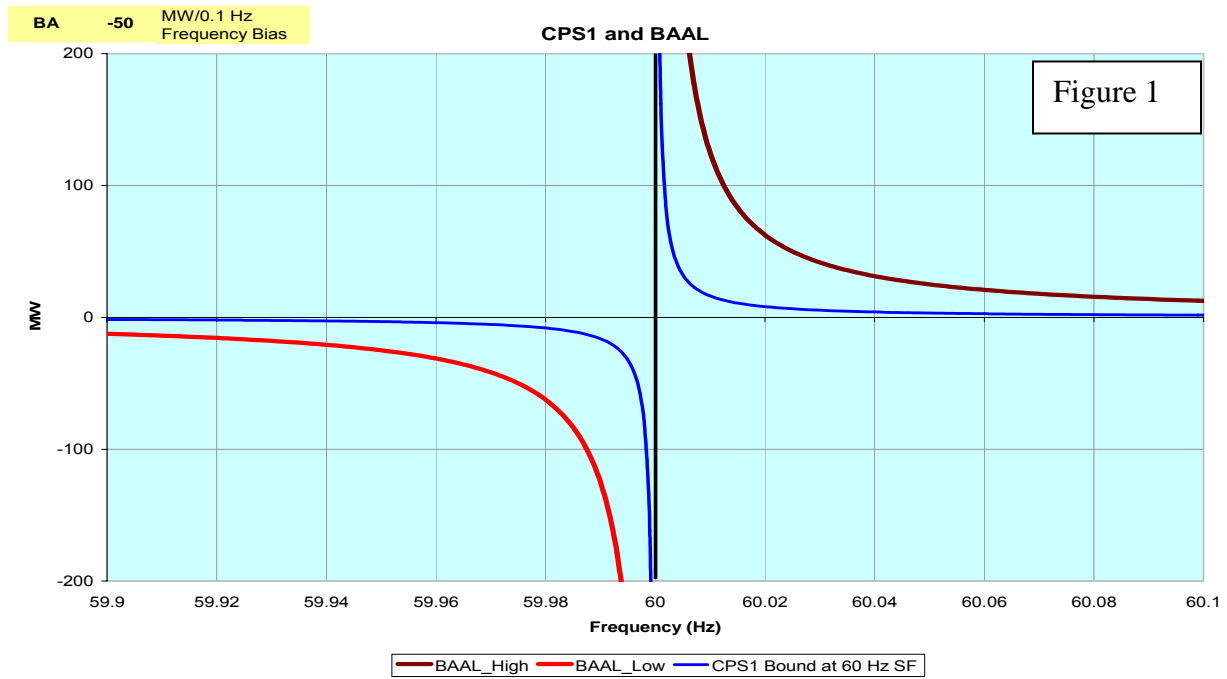
End If

Attachment taken from the Eastern Interconnection Field Trial Document.

ATTACHMENT F

Sample Calculations and Available Tools for BAL-007 Performance Evaluation

CPS1 is a calculation for control performance that considers Balancing Authority operation at all times to Scheduled Frequency. During fast or slow time-error corrections, the CPS1 curves shift in a manner symmetric about the Scheduled Frequency, as illustrated in Figures 1 and 2.



The Balancing Authority ACE Limit (“BAAL”) was developed “from the ground up”, considering the targeted research and development of Interconnection-specific Frequency Relay Limits, Frequency Abnormal Limits, and Frequency Trigger Limits. As the BAAL calculation is not a function of the Scheduled Frequency, its associated curves do not shift in a manner similar to CPS1, rather the limits remain symmetric about 60 Hz. as illustrated in Figures 1 and 2.

Though good performance in the long term under CPS1 is based upon control about the Scheduled Frequency, good performance in real-time under the BAAL is based also upon control in support of the Interconnection frequency and taking action to limit the duration of operating outside a variable bound that gets “tighter” as Actual Frequency deviates further from 60 Hz.

One type of display used to monitor when ACE exceeds the BAAL is provided below. The chart tracks the number of consecutive clock-minutes that ACE exceeds the BAAL along with displaying clock-minute ACE in relation to the clock-minute Actual Frequency.

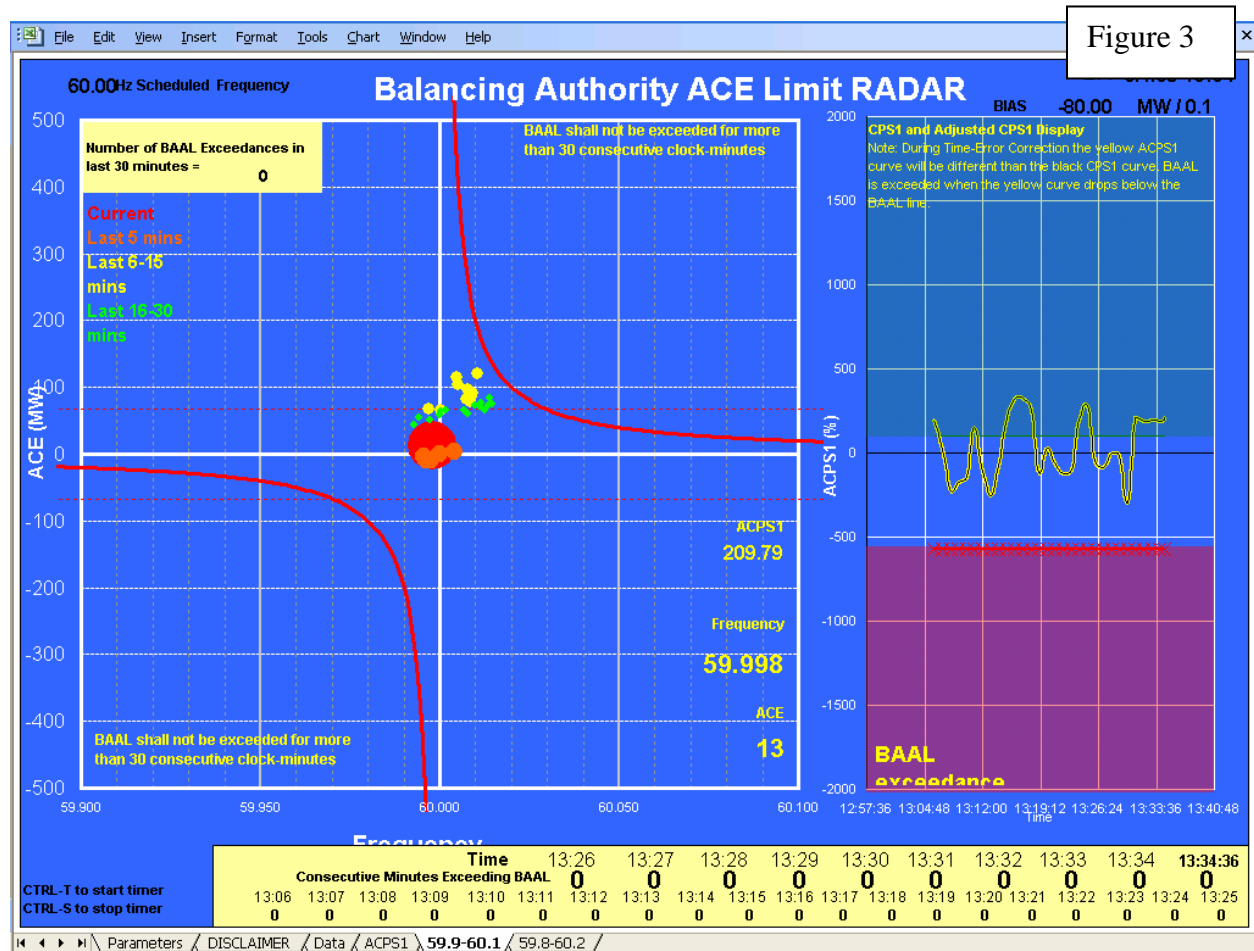


Figure 3

The screen above is from an Excel worksheet that brings in data from an OSI PI DataLink server (real-time and historic data) to display the last 30 clock-minutes of ACE where the color and size of the dots reflect the length of time passed. The Excel file is available on the NERC Reliability-Based Control website along with instructions for implementation with PI DataLink. As the duration of ACE exceeding

the BAAL is a critical aspect of BAL-007, Balancing Authorities may prefer to trend a value as a function of time similar to other operator interfaces where time is displayed on the X or Y axis, as provided below.

In Eastern Interconnection, NERC CPS1 is calculated as follows:

$$CPS1 = (2 - (ACE * \text{Frequency Error}) / (-10 * \text{Frequency Bias} * 0.018 * 0.018)) * 100$$

Note: clock-minute average values must be used for all variables

In addition to calculating real-time performance under BAL-007 by comparing the clock-minute value of ACE to the calculated clock-minute value of the BAAL, the Balancing Authority can also monitor an adjusted version of the NERC CPS1 calculation that is not dependent upon Scheduled Frequency and referred to in this document as “ACPS1”. In the ACPS1 calculation below, Frequency Error is replaced with the term “(Actual Frequency – 60)”.

$$ACPS1 = (2 - (ACE * (\text{Actual Frequency} - 60)) / (-10 * \text{Frequency Bias} * 0.018 * 0.018)) * 100$$

Note: clock-minute average values must be used for all variables

Note: when Scheduled Frequency = 60 Hz, the calculations of CPS1 and ACPS1 are identical

The BAAL calculation provided in Attachment A shows that BAAL varies as a function of the Actual Frequency. By substituting BAAL for ACE in the ACPS1 calculation for a given value of Actual Frequency, one can determine that ACE exceeds the BAAL when ACPS1 is worse than approximately minus 571.6% for any Balancing Authority in the Eastern Interconnection. This information is useful in that the operator can monitor its performance against a bound that remains fixed with the value being monitored (ACPS1) being a function of ACE and Actual Frequency.

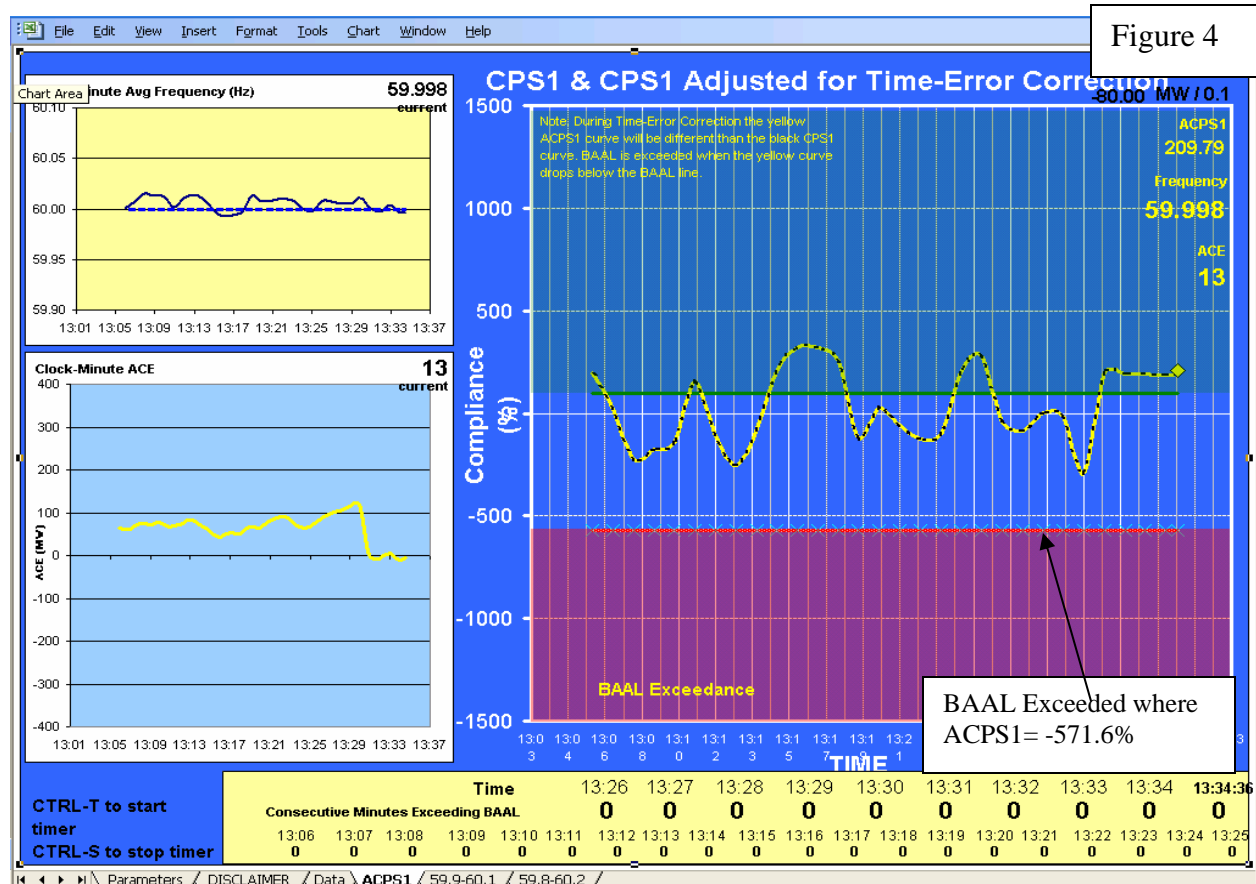


Figure 4

In the display above, the dotted line in the main chart to the right represents the CPS1 calculation and the yellow line represents the ACPS1 calculation. When Scheduled Frequency = 60 Hz, the values are identical; however, during times of fast or slow time-error correction, the curves will be different, requiring the operator to monitor operation to the long-term goal of averaging above 100% for CPS1, but also take action when the yellow line drops below -571.6% ACPS1 reflecting when the BAAL has been exceeded. The chart displayed can be selected from the same Excel worksheet as the prior display available on the NERC Reliability-Based Control website.