



DOE/OE Transmission Reliability Program

NERC Load-Generating and Reserves Reliability Control Standards Project

Carlos Martinez

Advanced Systems Researchers, Inc. (ASR)

cmartinez@asresearchers.com

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Presentation Outline

- Overall Project Objectives—Close coordinated with NERC
- Background
- Interconnections Frequency Response Demand and Analysis Tool (FRDEA): Benefits, Data-Types, Metrics, Sample Case, Generator Owners/ Operators and BAs Interviews
- NERC BAL Reliability Standards Documents, Web-Base Search/Browse Tool (BALDOCS)
- NERC Interconnections Reliability Performance Using Sub-second Frequency Data



Overall Project Objectives

New Real Time Reliability Monitoring Tool (FRDEA)

- Research to define new methods and metrics to identify NERC interconnections demands for Frequency Response (FR) during 2013-15.
- Develop prototype tool to estimate the requirements for FR for any generator droop-deadband pair, scan data resolution, period of time.
- Interviews with generators Owner/Operators and BAs to share results.

New Reliability Standards Documentation Tool (BALDOCS)

- Develop web-base tool for PC/Mobile to search, browse, and download documents produced for drafting, revising and getting FERC approval for NERC BAL-classes reliability standards.

Reliability Performance and Trends

- NERC interconnections 2013-15 reliability performance and trends during frequency events for frequency deviation, inertia availability, and point C' patterns, using phasor frequency sub-second data.
- Validate NERC BAL standards adequacy and ERSDT performance metrics.



Background

BAL - LOAD-GENERATION-RESERVES CONTROL STANDARDS

Close to complete very active work during the last 6-7 years to develop, modify or retire BAL reliability standards and get FERC approvals:

- **BAL- 001** – Real Power Balancing Control Performance – Approved by FERC. Retains CPS1, will replace CPS2 with BAAL.
- **BAL- 002** – Disturbance Control Performance – FERC NOPR proposing to approve with modifications.
- ***BAL- 003 – Frequency Response and Bias – Approved by FERC***
- BAL- 004 – Time Error Correction – Propose to retire, replace with guide.
- BAL- 005 – Automatic Generation Control - ACE reporting ?
- BAL- 006 – Inadvertent Interchange - Recommended retirement



FRDEA Benefits, Data-Types, Metrics Sample Case, Generator Owners/Operators and BAs Interviews



FRDEA Tool Benefits

- Production of performance metrics, statistics and visuals on requirements for frequency response and trends on an interconnection basis for any generator deadband-droop pair, using 2013 to 2015 phasor frequency data archived at 1-second resolution during frequency events and for all seconds.
- Address the following concerns when frequency response is provided based on the typical demands for frequency response: changes in efficiency or energy production costs; increased wear and tear; greater emissions; renewable resources adequacy; violation of failure to follow dispatch rules where applicable; and any other recurring concern.
- Share frequency response requirements information with resource owner/operators, Balancing Authorities, NERC Staff, and Resources Subcommittee so that costs and reliability concerns can be addressed having the insight of useful empirical data.
- Balancing Authorities will gain insights into the costs and reliability concerns as expressed by the providers of frequency response.



FRDEA Data Types and its Benefits

Data Type-1: Phasor frequency 1-second data for 2013 to 2015 during low and high BAL-003-1 and ALR1-12 frequency events for all NERC interconnections. It is used to estimate the requirements for Frequency Response experience by generators during these events.

Benefits - Resource owners/operators and Balancing Authorities can share a quantitative understanding of the frequency response performance needed to **comply with NERC frequency response standard BAL-003.**

Data Type-2: Phasor frequency 1-second data for every second from 2013 to 2015 for all NERC interconnections. It is used to estimate requirements for Frequency Response experience by generators every second.

Benefits - Resource owner/operators can use the metrics to attempt to quantify impacts of providing sustained frequency response on **production costs or efficiency, wear and tear, emissions, failure to follow dispatch instructions, renewable resource adequacy**, and other recurring concerns. Balancing Authorities can acquire a better understanding of the impact of providing frequency response on resources



FRDEA Preliminary Performance Metrics

- 1. % beyond deadband:** Is the percentage of 1 second samples that will be below the specified deadband for low frequency analysis, or above it for high frequency analysis
- 2. average duration:** Average length in minutes of the frequency events outside of the deadband for the interconnection
- 3. maximum duration:** Duration in minutes of the longest frequency event experienced for the interconnection
- 4. average % response:** Average % change in output expected based on generator size using all frequency values outside of the deadband
- 5. maximum % response:** Largest % change in output expected based on generator size for the largest frequency event



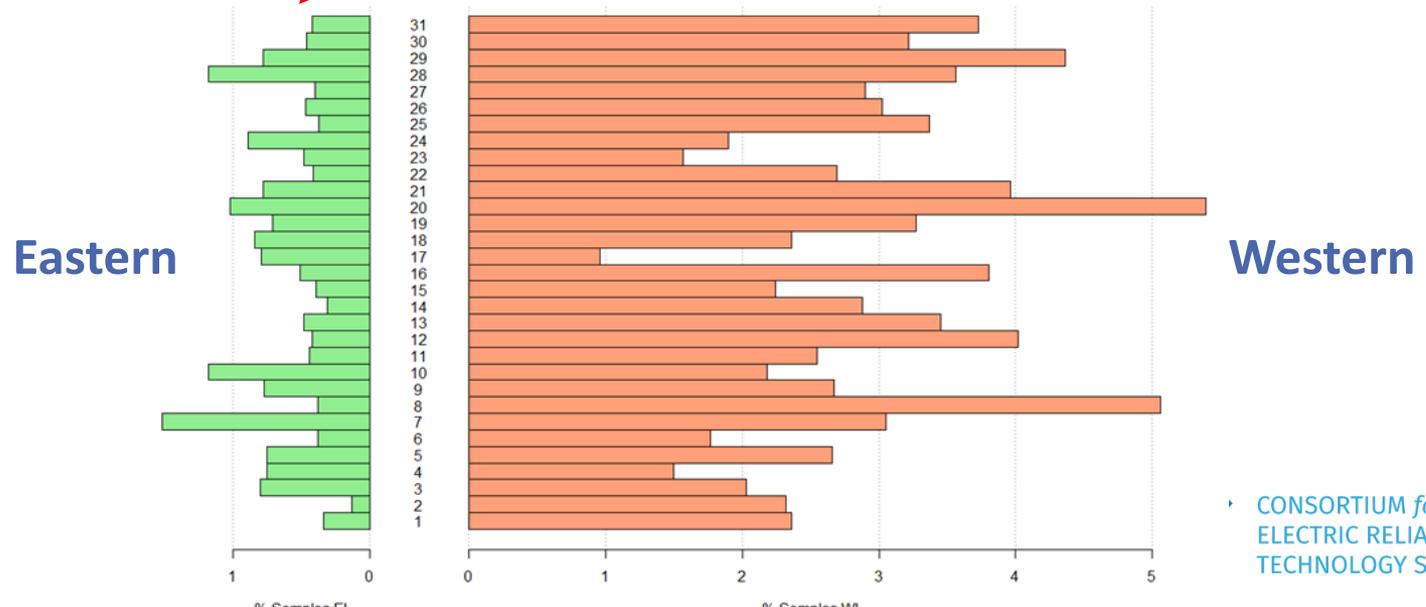
Case for Metrics Estimations and Visual

Case: Eastern Interconnection for generators with 5% Droop and 36 mHz Deadband and High Events:

droop %	deadband [mHz]	hi or low	time of day	year	month	% beyond db	avg duration [minutes]	max duration [minutes]	avg % response [% of size]	max % response [% of size]
5	36	hi	all	2015	1	0.56	0.40	9.88	-0.15	-0.80
5	36	hi	all	2015	6	0.68	0.45	8.98	-0.15	-0.64
5	36	hi	all	2015	7	0.54	0.34	9.65	-0.14	-0.91
5	36	hi	all	2015	12	0.49	0.37	9.88	-0.16	-0.94

% of Samples Beyond Deadband 5% Droop 36 mHz Db

Percent of Samples Beyond Deadband for 36 mHz Jan, 2015



Interviews Status with Generator Owners/ Operators and Balancing Authorities

- Interview forms for generators and BAs designed and basic Frequency Response (FR) requirements statistics-metrics defined
- 3 interviews with Eastern wind, combined cycle, and conventional thermal generator-owners/operators. Challenge getting their time
- Interviews with the 3 interviewees reviewed Eastern FR requirements statistics in detail and found them to be valuable as a package which are informative taken together
- Estimates of impact on Failure to Follow (FTF) dispatch penalties were covered successfully at a higher level with 2 interviewees
- All 3 interviewees found the interview process to be valuable and well-organized
- Expect to have 8 to 10 interviews completed by July 1, including renewable resources



NERC BAL Reliability Standards Docs Multi-User Search/Browse Tool (BALDOCS)



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NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

NERC BAL RELIABILITY STANDARDS DOCUMENTATION

ASR
Advanced System Research

BAL Class

- BAL-001
- BAL-002
- BAL-003**
- BAL-004
- BAL-005
- BAL-006
- BAL-013
- BAL-1-2-3-4-5-6

BAL-003 2016 (5 Docs)

- 2016 FBS and L10 Cover 3-25-16-BAL-003-2016.pdf
- BAL-003-1_Implementation_Procedure_for_2016_Revised_12-22-15-BAL-003-2016.pdf
- BAL003_Reliability_Standards-BAL-003-1_1_BAL-003_2016.pdf
- ERCOT_Sufficiency_guideline_for_inertia_BAL-003_2016.docx
- RS_Guide_Primary_Frequency_Control_DRAFT_BAL-003_2016.pdf

BAL-003 2015 (6 Docs)

- 2015_FRAA_Report_Final-BAL-003-2015.pdf
- BA_FRO_Allocation_12-21-15_Revised_BAL-003_2015.pdf
- Copy of ERCOT_2015_FRS_FORM_1.9_ERCOT_Interconnection_Final-BAL-003-2015.xlsm
- NERC_Master_Draft_for_FRI_Annual_Report_12-19-13_APPROVED_BAL-003_2015.docx
- Primary_Frequency_Control_Guideline-Version 0 DRAFT clean_BAL-003_2015.docx
- WMINAR_Documents-BAL-003_Webinar_20151021_BAL-003_2015.pdf

BAL-003 2014 and Older (18 Docs)

- ERCOT_Sufficiency_guideline_for_inertia_BAL-003_2014.pdf
- LBNL_Report_NERC_March_24_2011_Final_sent_to_NERC-BAL-003_2011.pdf
- NERC_Interconnections_FrequencyEvents_Selection_Criteria_for_BAL003_ALR1-12_DRAFT_BAL-003_2014.pptx
- NERC_RS_Position_Paper_on_Frequency_Response_Final_(May_27_2011)-BAL-003-2011.pdf
- Pages from opman_3_2012_BAL-003-1989.pdf
- Procedure_Clean_20121130-BAL-003-2012.pdf
- Project 2007-12 BAL-003-1 Standard - Clean - 2012 09 30_BAL-003-1_2007.docx
- Project 2007-12 BAL-003-1 Standard - Clean - 2012 11 30_BAL-003-1_2007.docx
- Standards Announcement_Frequency_Response_Whitepaper_Comments_Extended_to_Feb._1,_2011_BAL-003-2011.pdf

Preview Doc, Full Page Doc (right pop-up icon), Under Full-Page Display: Print Doc, Download Doc, Share Doc, and Close_DocTab for Returning to Main Display

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BAL-003-1 Frequency Bias Setting and L10 Settings for 2016

March 25, 2016

2. Click to Select BAL Class and Show All Class Docs

3. Click to Select and Preview BAL-Doc

4. Click for Full-Doc View, Download, Print

1. Enter Link on Browser. PC or Mobile



https://nercbaldocs.shinyapps.io/asresearchers_servers/

CERTS

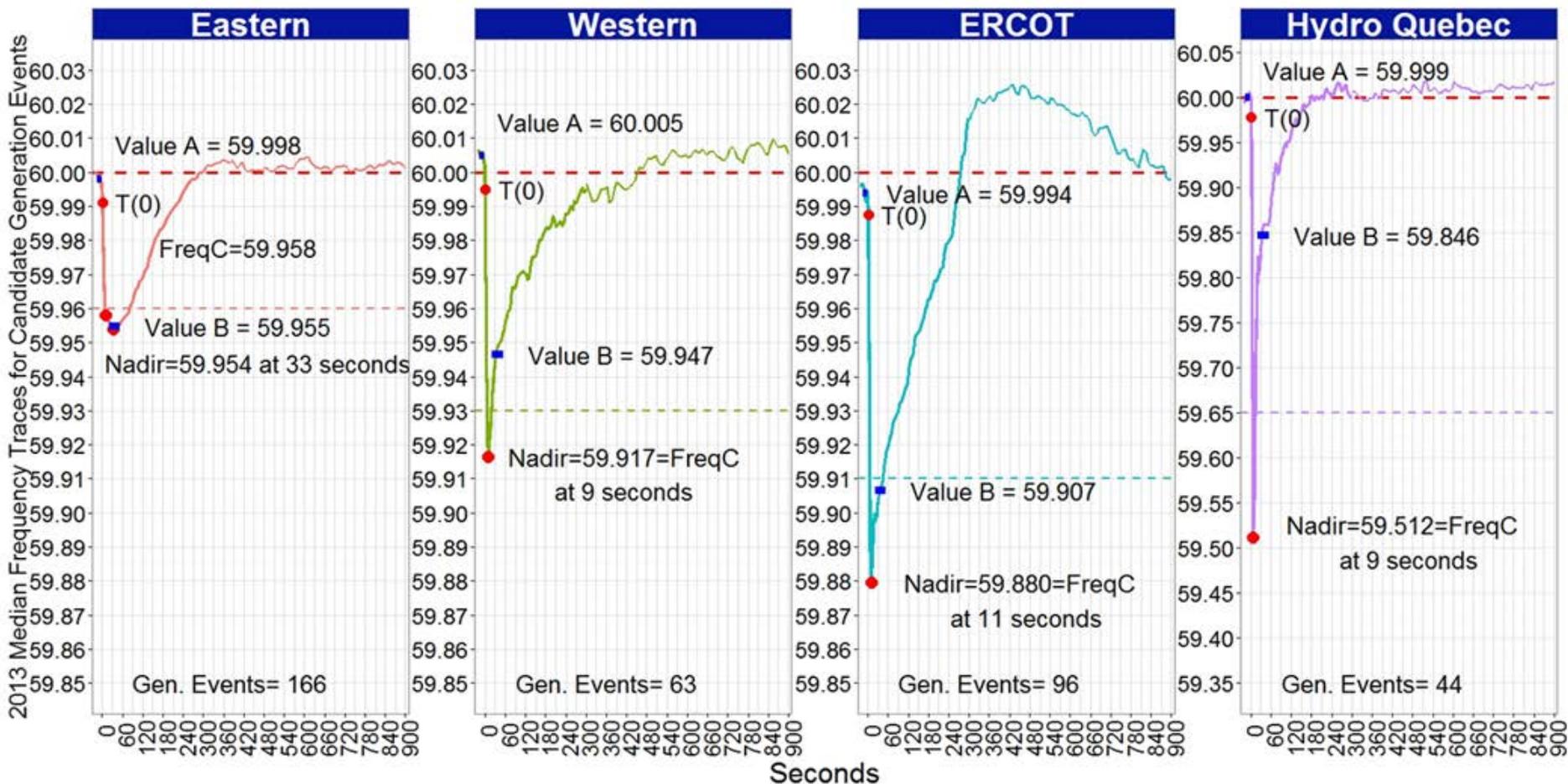
CONSORTIUM for
ELECTRIC RELIABILITY
TECHNOLOGY SOLUTIONS

Interconnections Reliability Performance Frequency Events Profiles and Recovery Time (BAL-002) Cases



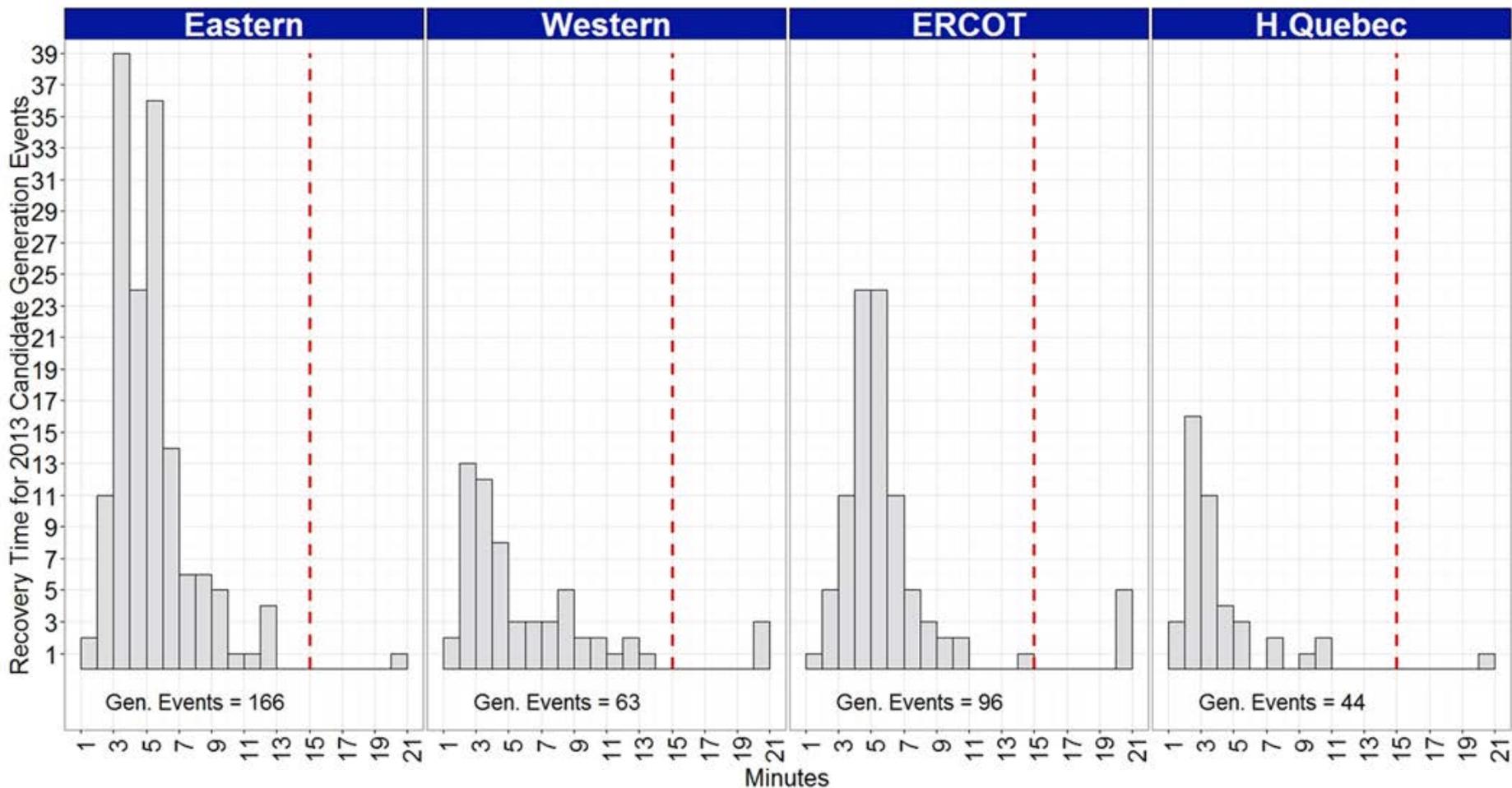
Interconnections Reliability Performance Frequency Events Profiles

Interconnections 2013-15 reliability performance and trends during frequency events for frequency deviation, inertia availability, and point C' patterns, using frequency sub-second data. Data Confidentiality Agreements with NEISO/NYISO



Interconnections Reliability Performance

Recovery Time – BAL-002



QUESTIONS?

