NERC Load-Generating and Reserves Reliability Control Standards Project

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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-deadbond 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:

<table>
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<th>droop %</th>
<th>deadband [mHz]</th>
<th>hi or low</th>
<th>time of day</th>
<th>year</th>
<th>month</th>
<th>% beyond db</th>
<th>avg duration [minutes]</th>
<th>max duration [minutes]</th>
<th>avg % response</th>
<th>max % response</th>
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<tbody>
<tr>
<td>5</td>
<td>36</td>
<td>hi</td>
<td>all</td>
<td>2015</td>
<td>1</td>
<td>0.56</td>
<td>0.40</td>
<td>9.88</td>
<td>-0.15</td>
<td>-0.80</td>
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<tr>
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<td>36</td>
<td>hi</td>
<td>all</td>
<td>2015</td>
<td>6</td>
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<tr>
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<td>hi</td>
<td>all</td>
<td>2015</td>
<td>7</td>
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<tr>
<td>5</td>
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<td>2015</td>
<td>12</td>
<td>0.49</td>
<td>0.37</td>
<td>9.88</td>
<td>-0.16</td>
<td>-0.94</td>
</tr>
</tbody>
</table>

% of Samples Beyond Deadband 5% Droop 36 mHz Db

Eastern

Western
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)
1. Enter Link on Browser. PC or Mobile

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

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
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

<table>
<thead>
<tr>
<th>Eastern</th>
<th>Western</th>
<th>ERCOT</th>
<th>H. Quebec</th>
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</thead>
</table>

Minutes

Recovery Time for 2013 Candidate Generation Events

CERTS
CONSORTIUM for ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS