Consortium for Electric Reliability Technology Solutions

Automated Reliability Reports

FUNCTIONAL SPECIFICATION

AUTOMATED RELIABILITY REPORTS (ARR)

Prepared by:

CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS (CERTS) / ELECTRIC POWER GROUP (EPG)

Work Sponsored by DOE-OE, Transmission Research Program, and FERC, via DOE Contract No.: 000005788

Date: March 31, 2009

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1 INTRODUCTION

1.1 Purpose and Organization of Document

The goal of the Automated Reliability Reports (ARR) project is to research and prototype a software application that can run on standard personal computers to track the historical reliability performance of each interconnection. The ARR will provide a summary of key reliability metrics and statistical analysis, including, for example, the large and small high and low frequency events resulting from load-generation imbalances. The ARR will be designed to produce reports for different time periods e.g. daily, monthly, seasonal, and annual for each of the interconnections. The ARR will provide a starting point for understanding and analyzing reliability performance of each interconnection, comparative performance assessment of interconnections, performance relative to targets and thresholds, identify performance trends to identify areas that require corrective action for reliability management, and provide data and information to facilitate evaluation for reliability standards adequacy.

The purpose of this document is to define the functional, data and client requirements for the ARR project. Section 2 provides an overview of data sources, data communications and report types; Section 3 provides an overview of the hardware-software architecture requirements; section 4 describes the user-interface to login, create and view in PDF-format the last 24-hours reports, and to search and view archived reports. The data to be used for the ARR will be from the historical data from the portfolio of CERTS developed NERC Wide-Area Monitoring applications archived data. Sections 5 to 8 describe the daily, monthly, seasonal and annual reports including graphics. Section 9 presents the implementation plan.

1.2 Background

The portfolio of real time wide area monitoring applications developed by CERTS/EPG for use by NERC reliability coordinators, reliability subcommittees and reliability managers are listed below:

1. Resource Adequacy (ACE-Frequency)
2. Area Interchange Error
3. Inadvertent
4. CPS-BAAL
5. Intelligent Alarms
6. Frequency Monitoring and Analysis (FMA) Using Phasor Data

The metrics and data archived in these applications provide the ability to create management reports to provide key date and information to reliability managers and policy makers regarding the reliability performance of different interconnections. CERTS/EPG provided a briefing on the concept of ARR to staff and management of DOE, FERC and NERC. There was consensus on the need and value for ARR, and FERC and DOE agreed to fund the necessary research and prototype development. The goal of this project is to research, develop, and test a prototype tool that will automate the creation and delivery of wide-area reliability reports that will be generated daily, monthly, seasonal, and yearly and present data for the three reliability states – normal, alert, and emergency. The reports will provide an assessment of wide-area reliability performance, identify abnormal events, provide a snapshot of reliability performance trends and will be useful in assessing the effectiveness, adequacy of current reliability standards and the need for new standards.

1.3 Intended Users

The ARR reports are designed for use by FERC Management and personnel at their Monitoring Center, DOE, and by NERC Management and Benchmarking Group.

2. DATA SOURCES, DATA COMMUNICATIONS, AND REPORT TYPES

The key building blocks for the ARR are data access to historical archived data from the CERTS/EPG NERC applications, transfer of the data to the ARR, and processing and analysis of the data to produce the reports. Figure-1 shows the data flow and functional schematic. Users will have access to the ARR from their personal computers. From the ARR Home page, users will be able to search, select, display and print in PDF-format the reports using authorized username and password. The ARR will provide users access to five years of archived reports. The ARR will be designed with customized distribution lists for automatic email distribution of the reports, and the capability to add new input databases for expanded reports in the future.

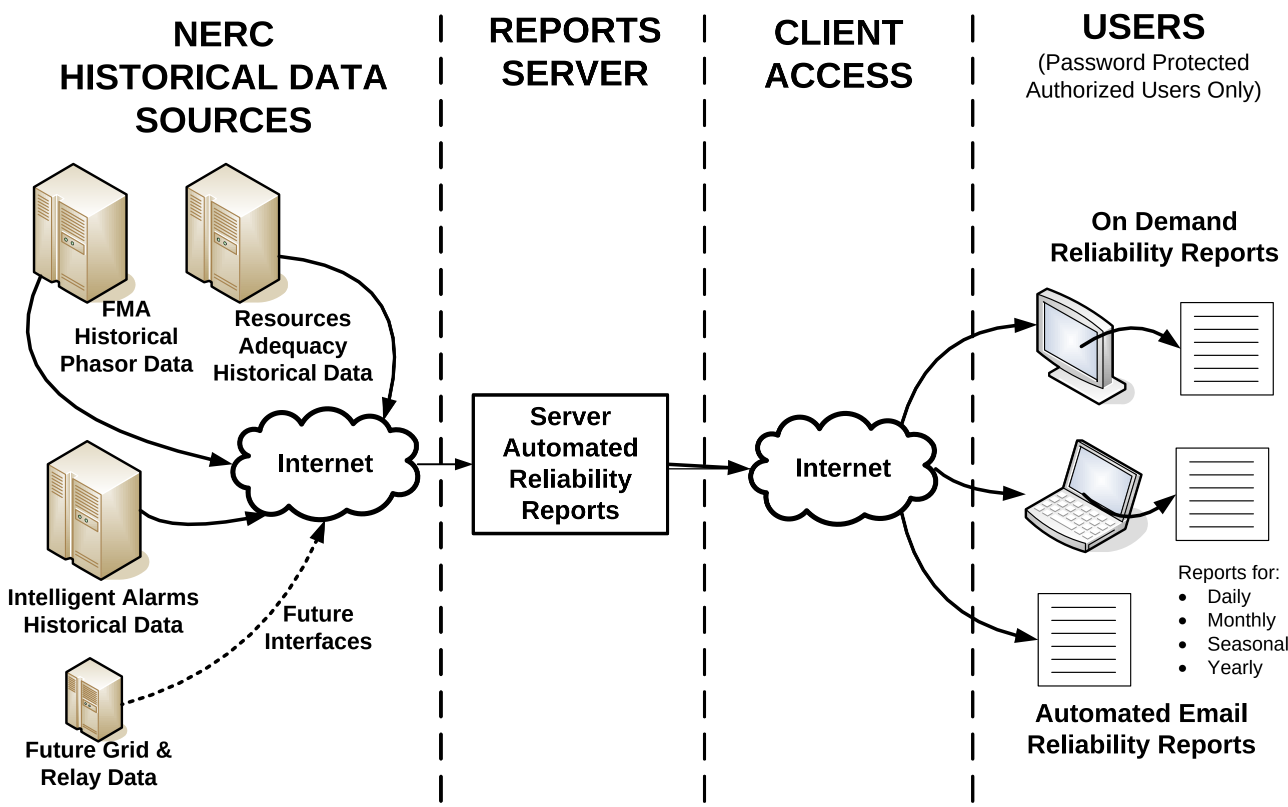


Figure 2.1 – ARR Data Sources and Data Communications Overview

The ARR reports will:

- Utilize NERC wide area reliability applications information and historical data sources
- Distribution via automated emails and interactive search, selection and view
- Report overview of reliability performance by interconnection
- Enable analysis of reliability trends – number of abnormal events of different types
- Identify and report load-generation inadequacy events and metrics performance during event
- Reports reliability metrics comparative data and charts to identify standards adequacy, by correlating abnormal events with standards metrics performance.

2.1 Types of Reports

The reports will generate the following types of information:

- Interconnection wide, short and long term reliability performance assessment – normal and post event
- Provide data and information for assessment of reliability performance adequacy and need for standards modifications or new standards
- Provide charts on reliability trends
- Provide key performance metrics for different operation conditions - normal, alert, emergency
- Reliability performance comparison of different interconnections

2.2 Daily Report

The Daily Report will address the following functional objectives:

- Management Briefings – What Happened, Where and Impacts
- Under Normal State Does System Remain Within Acceptable Limits
- Does System Performs Acceptable After Credible Contingencies
- Interconnections Performance During and After Events, i.e. Frequency Events
- Closeness to Performance Standard Magnitude Thresholds
- Closeness to Performance Standard Rate Thresholds Sensitivities
- Comparison between performance metrics defined by industry and equivalent metrics defined base on statistics

2.3 Monthly, Seasonal and Annual Reports Objectives

The Monthly, Seasonal and Annual Reports will address the following functional objectives:

- Summary of large and small high-low frequency events
- Summary of reliability performance metrics and trends
- Assess Effectiveness of Current Reliability Performance Relative to Targets and Thresholds
- The monthly report will also include the daily report tables and performance charts

The ARR data and information could be used for:

- Analysis and Assessment for Improvements to Current Reliability Standards
- Assess New Reliability Performance Standards Field Trial Results
- Analysis and Evaluation of New Metrics for New Performance Standards

Table-1 shows a summary of the uses and content for the Reports:

Table 2.1 - ARR Reports Content and Utilization Description

ARR Reports	Report Contents	Description of Use of Content (Illustration)
Daily (last 24 Hours)	▪ Reliability State Condition —Normal, Alert, and Emergency ▪ Reliability Performance During Alert State ▪ Interconnections response during abnormal events	▪ Reliability Performance Diagnostics ▪ Management Reporting ▪ Identify Reliability Trends
Monthly, Seasonal, Annual	▪ Summary of Key Performance Metrics ▪ Performance Adequacy Relative to Targets and Thresholds ▪ Interconnections Reliability Performance	▪ Evaluate Standards Effectiveness ▪ Identify Systemic Issues ▪ Evaluate New Standards —Metrics, Thresholds and Field Trial Performance

3 ARR HARDWARE-SOFTWARE ARCHITECTURE OVERVIEW

3.1 Data Sources

Figure-2 shows the hardware-software architecture starting with flow of data from the NERC applications to the ARR data server. The reports are distributed over the network to authorized users for access from their PC's. There are three required historical data sources: NERC 1-minute Resources Adequacy historical data, NERC- Frequency Monitoring and Analysis (FMA) 1-second event Phasor historical data, and NERC Intelligent Alarms historical data. The 1-minute historical data will include all three interconnections frequency and Area Control Error (ACE), reliability performance metrics, and Frequency Response event analyzer data. The 1-second phasor historical data will include Frequency Response events data and corresponding frequency vs. time plots. The intelligent Alarms historical data will include FTL, FAL, and FRL alarms. The system will be designed to accept grid and relay type data in the future.

3.2 Hardware Requirements

The ARR requires a data server to collect input historical data, create, distribute and archive in PDF-format all reports types up to five years. Not data will be archived in the ARR server. This is a standard server class computer. Users (clients) will need any desktop or notebook computer running Microsoft windows to access the reports archived in the ARR server.

3.3 Data Flow, Data Communications and Data Collection and Dissemination Software Overview

Figure-2 shows that acquiring the required input data from NERC applications historical archived data to the ARR server will be done via a secure internet base network, using a data collection service and a data processor that will feed the ARR server to create and archive the reports. The distribution of reliability reports to the clients will be done automatically using a report generator service and a secure internet network via emails and on demand to user desktops and notebooks using pre-approved usernames and passwords.

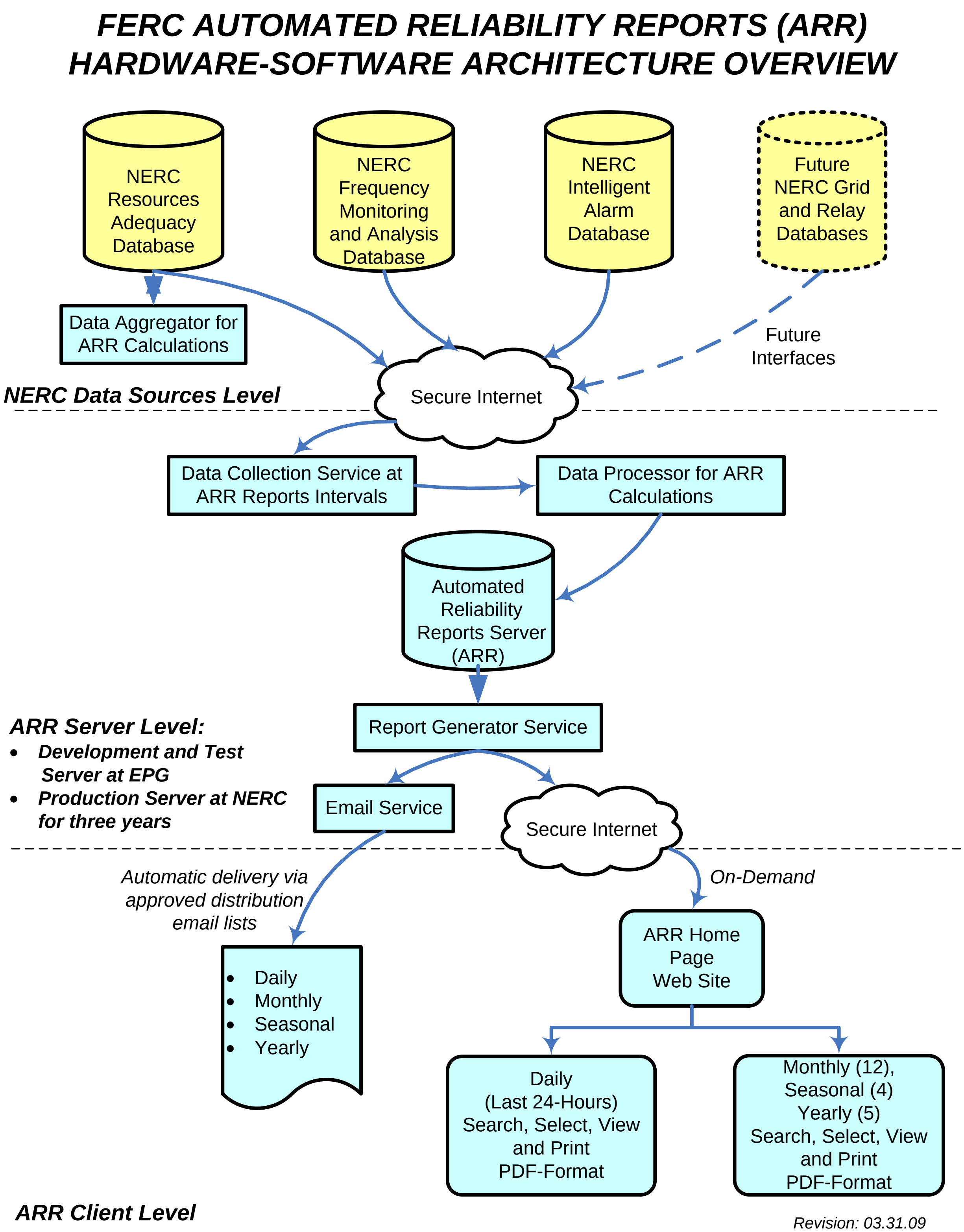


Figure 3.1 – ARR Hardware-Software Architecture Overview

4 USER INTERFACE

The user interface is made of two web displays: one for login and getting access to the ARR database, and a second display to create and view last 24-hours reports, and to search, select and view in PDF-format available and archived reports.

4.1 Login Display

This display will be use only by authorized users to get access to the ARR database using their assigned username and password. See Figure 3. To access the login display users will click the ARR icon that will be located on the users PC desktops by the ARR installation process. After entering username and password and clicking the Login bottom, users will gain access to the ARR database and will be presented with the second user interface display.

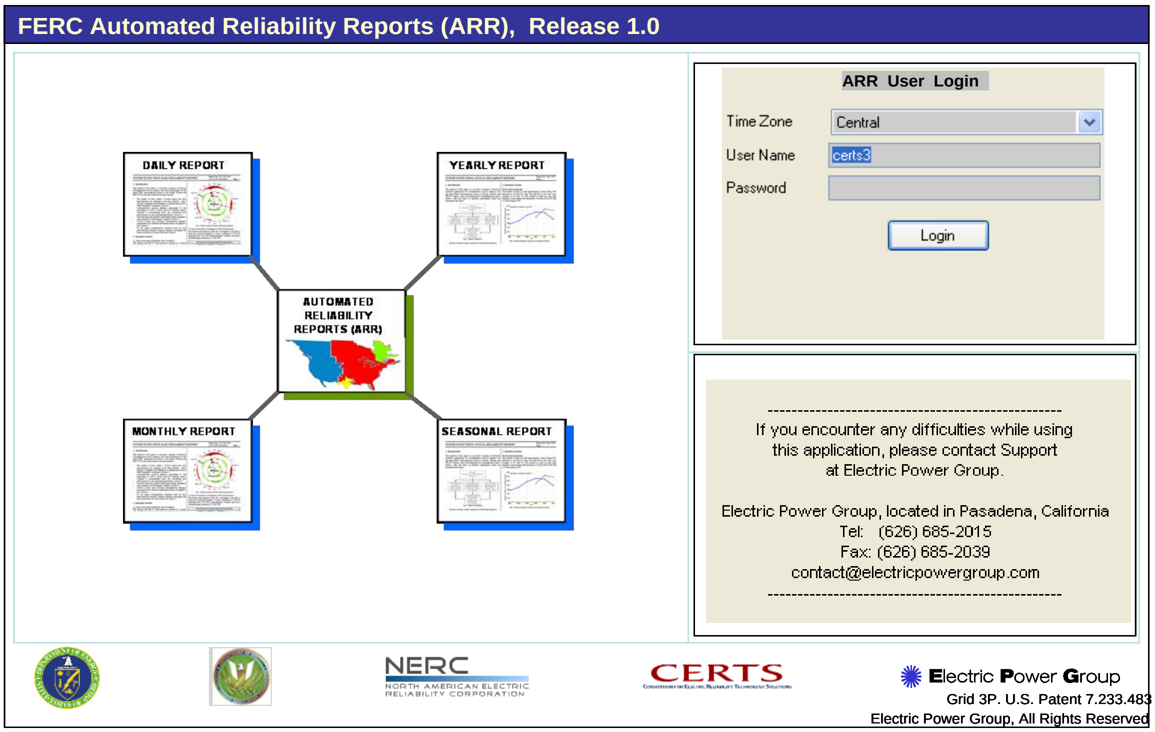


Figure 4.1 – Login Display

4.2 Create - View Last 24-Hour Reports, and Search, Select and View Archived Reports

The display shown in Figure 4 will present users with the following capabilities:

- Clicking on any of the four rectangles for either report-type will set the right-panel to the correct setup to show the available reports for the report-type selected
- A daily report selection will set the right-panel to get and view the last 24-hour report
- Any report-type selection different from daily, will set the right panel to allow users to enter a start and end date to reduce the search for reports to view, and
- Clicking in the name of one of the available reports will bring the selected report to view in PDF-format

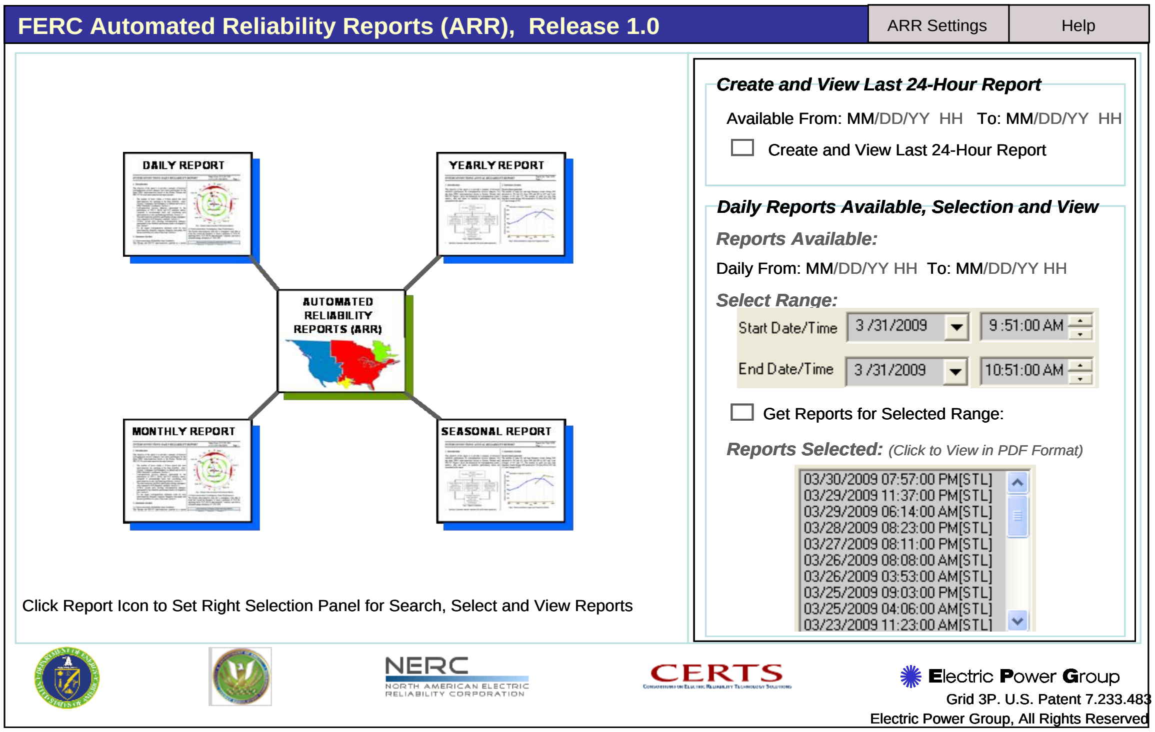


Figure 2.2 – Create-View Last 24-Hour Reports, and Select and View Archived Reports

5 DAILY REPORT (LAST 24-HOURS)

The objective of this report is to provide a summary of historical load-generation resource adequacy and control performance for the three NERC interconnections known as the Eastern, Western and ERCOT. This report will be automatically distributed after midnight via email distribution lists. Users can call the daily report anytime of the day, and the system will collect the last 24-hours of data, create and make available in PDF format the daily report including the following daily performance metrics:

- Number of hours during the 24-hour period each interconnection was in the normal, alert, and emergency states and the performance metrics during each state.
- Load-generation resource adequacy represented by the performance of CPS1-2, BAAL and DCS reliability metrics compared to recommended limits and considering each interconnection as only one Balancing Authority.
- The interconnections reliability performance during alert state compared to ACE-frequency standards.
- 24-Hour circular plots showing load-generation adequacy represented by key reliability performance metrics all aligned by hour.
- 24-Hour Xbar-R control plot for Epsilon RMS to compare with industry define performance metrics
- For the largest event for each interconnection, frequency response, frequency time graph, and the most probable root cause of the event.

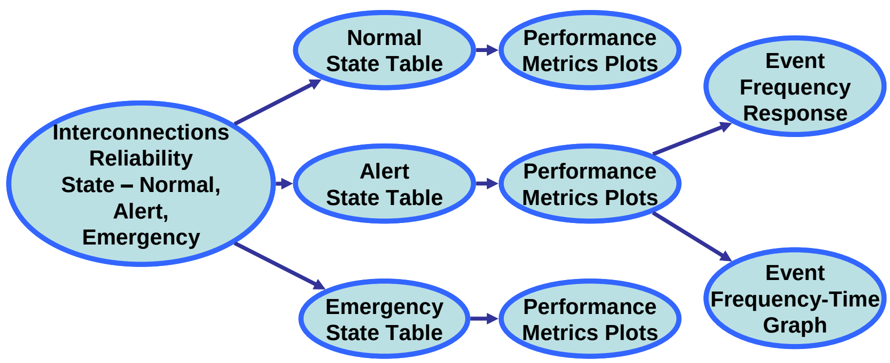
5.1 Daily Report (Last 24-Hours) – Criteria to Define Report Content

The criteria to define the daily report content was based on equivalent criteria to the one defined and in trial by NERC Reliability Coordinators for load-generation adequacy alert levels shown at the bottom of Figure 5.

The mapping between ARR normal, alert and emergency states and NERC Reliability Coordinators Alert Level definitions is as follows:

- ARR Normal Corresponds to Reliability Coordinators Normal Level
- ARR Alert Corresponds to Reliability Coordinators Alert Level 1
- ARR Emergency Corresponds to Reliability Coordinators Alert Level 2 and 3

The report shows the number of hours each interconnection stayed in each state, the performance metrics during each state, and for the Alert state shows the frequency response and frequency-time graph for events identified from FTL alarms or from the largest load-generation unbalance during the alert state.



Reliability Coordinators Load-Generation Condition Level Definition, mapped to ARR reports Normal, Alert, and Emergency Reliability States

	Normal	Alert	Emergency	
Condition Level >>>>	Normal	Alert Level 1	Alert Level 2	Alert Level 3
Threat Level>>>>	Low	Elevated	High	Severe
Condition/Threat Color >>>>	Green	Yellow	Orange	Red
Generating/capacity	EEA 0 No Energy Deficiencies	EEA 1 all available generation resources in use	EEA 2 Load management procedures in effect	EEA 3 Firm load interruption imminent or in progress

Figure 3.1 - Daily Report Content Definition Criteria

5.2 Daily Report Components Summary

Figure 6 shows the three components of the daily report.

- Load-generation reliability state tables comparing the three interconnections
- Load-generation performance metrics defined by industry and by load-generation process control statistics for each interconnection
- Abnormal Frequency events identified from FTL alarms or from largest the largest load-generation unbalance for each interconnection. The report shows the frequency response and a frequency-time graph for the event.

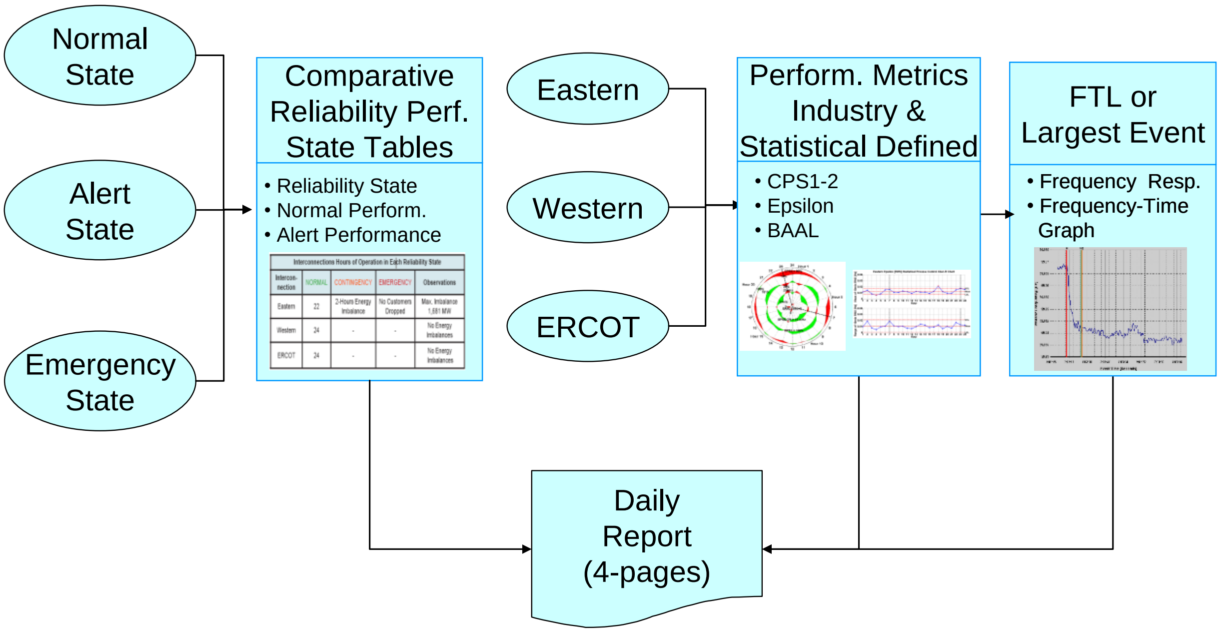


Figure 5.2 – Daily Report Components Summary

5.3 Daily Report Layout Sample Template Using Data for December 1st, 2008

See Figure 7 for a sample template of the 2-column format for the daily report using real 2008 data. Each of the report tables and graphs will be organized using a maximum number of 2-column pages with four sections organized in a pre-defined sequence, and including brief textual descriptions for each table and chart component. All reports will be created and archived in indexed PDF format. The daily report will be similar in format to the current reports attached and broadcasted with the current NERC Intelligent Alarms. The Report contains four sections:

- Introduction
- Summary Section
- Each Interconnection Resources Adequacy and Control Performance Section
- Each Interconnection Event from FTL alarms or Largest Load-Generation Event Section

The daily report shown in Figure 7 uses real data for December 1, 2008 for the summary tables from section 2, and to create the plots shown in sections 3 and 4. For the FTL or largest load-generation events calculations and plots from section 4, data from the following date/time was used: Eastern 3/4/2009 7:02 AM, Western 7/28/2008 9:55AM, ERCOT 3/13/2008 9:15AM.

The final production daily reports will look very similar in format and content to the template shown in Figure 7.

INTERCONNECTIONS DAILY RELIABILITY REPORT

Report from: 04/01/09-7AM to 04/02/09-7AM (EDT) Page: 1

1. INTRODUCTION

The objective of this report is to provide a summary of historical load-generation resource adequacy and control performance for the three NERC interconnections known as the Eastern, Western and ERCOT. For each interconnection the report presents:

- Section 2.1 the number of hours within a 24-hour period that each interconnection was operating in the three reliability states[1] (Normal, Alert, and Emergency) equivalent to the three alerts defined and in trial by NERC Reliability Coordinators.
- Section 2.2 load-generation resource adequacy represented by the performance of CPS1-2, BAAL and DCS reliability metrics compared to recommended limits and considering each interconnection as only one Balancing Authority.
- Sections 2.3 the interconnections reliability performance during alert state compared to ACE-frequency standards.
- Section 3 24-Hour circular and statistical process control (SPC) plots showing in the circular the load-generation adequacy represented by key reliability performance metrics all aligned by hour, and in the SPC the frequency deviation (Epsilon) RMS.
- Section 4 for each FTL alarm or the largest load-generation unbalance event for each interconnection, the estimated frequency response, and the 1-second frequency-time graph.

2. SUMMARY SECTION

2.1 Interconnections Reliability State Condition

The Western interconnection operated in a normal state. The Eastern experienced alert states at 7:00 and 23 hours and ERCOT at hour 7. The Eastern estimated energy imbalance at 7AM was 1,681 MW.

Interconnections Hours of Operation in Each Reliability State				
Intercon-nection	NORMAL	ALERT	EMERGENCY	Observations
Eastern	22	2-Hours Energy Imbalance	No Customers Dropped	Max. Imbalance 1,681 MW
Western	24	-	-	No Energy Imbalances
ERCOT	23	1-Hour Energy Imbalance	No Customers Dropped	Event Data Not Available

2.2 Interconnections Normal State Performance

The Eastern and ERCOT interconnections under performed its CPS1-2 and BAAL performance metrics. Exception for CPS2, the Western over performed its performance metric limits all hours.

Interconnections 24-Hours Performance Metrics - Actual vs Recommended									
Intercon-nection	CPS2 - Hour Daily		CPS1 - % Daily		BAAL Exceeds Daily		DCS Minutes to Return to Normal		Observations
	Rec Max	Actual	Rec Min	Actual	Rec Max	Actual	Std. Max	Actual	
Eastern	2.4	12	100	39	0	5	15	5	CPS1-2, BAAL Exceeded
Western	2.4	3	100	100	0	0	15	-	CPS2 Exceeded
ERCOT	2.4	19	100	76	0	4	15	-	CPS1-2, BAAL Exceeded

1 NERC Reliability Coordinators Working Group, "Guideline for Operating State Alert Levels,", Response to August 2003 Blackout Recommendation, May 22, 2007

2.3 Interconnections Alert State Performance

The Eastern interconnection went into a alert state after an event that caused the frequency to reach a minimum of 59.94 Hz, operating below 59.95 Hz for approximately 5 minutes, and with an estimated energy imbalance of -1,681 MW

Interconnections Alert State Performance Metrics							
Intercon-nection	Frequency Trigger Limit Minutes		Frequency Alert Limit Minutes		Frequency Relay Limit Minutes		Observations
	Std. Max	Actual	Std. Max	Actual	Std. Max	Actual	
Eastern	30	5	1	0	1	0	No Violations
Western	-	-	-	-	-	-	N0 Violations
ERCOT	-	-	-	-	-	-	Not Data Available

3. LOAD-GENERATION ADEQUACY AND CONTROL PERFORMANCE FOR EACH INTERCONNECTION

3.1 Eastern Interconnection

The circular plot shows load-generation resources adequacy and control margins under performed the recommended performance metric (CPS2) threshold of 90-percent by 6-hours during the off-peak period, and 6-hours during the on-peak period Its adequacy variability performance (CPS1) under performed the recommended threshold of 100-percent by 1-hour during on-peak and 1-hour during off-peak. The difference between actual and schedule targeted frequencies (Epsilon) under performed the standard threshold of 18 MHz by 3-hours during an off-peak period and by 1-hour during on-peak. The interconnection NetACE limit (BAAL) was exceeded 4 times during on-peak and 1 time during off-peak periods.

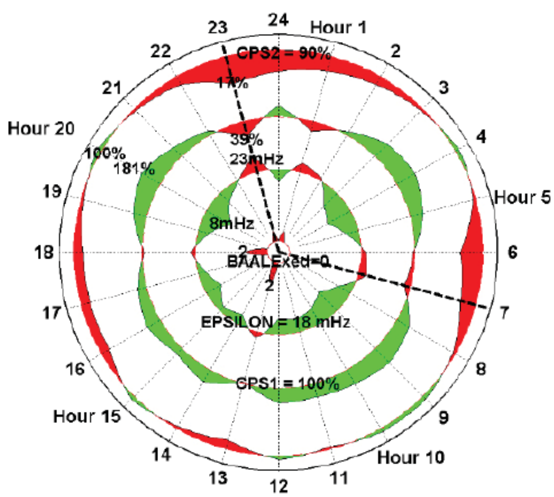


Fig 1 - Eastern Load-Generation Adequacy Performance Metrics

The statistical process control (SPC) first chart shows the frequency deviation mean violated its statistical upper control limit at hour 18 and was at the upper limit at hour 23. The SPC second chart shows the frequency deviation variability did not violated its statistical

DISCLAIMER - Report is automatically generated by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 5.3.1 - Daily Report Template – Page 1

INTERCONNECTIONS DAILY RELIABILITY REPORT — Report from: 04/01/09-7AM to 04/02/09-7AM (EDT) — Page: 2

Cont... Load-Generation Adequacy Eastern

upper/lower limits and the highest variability was at hours 2AM and 7AM.

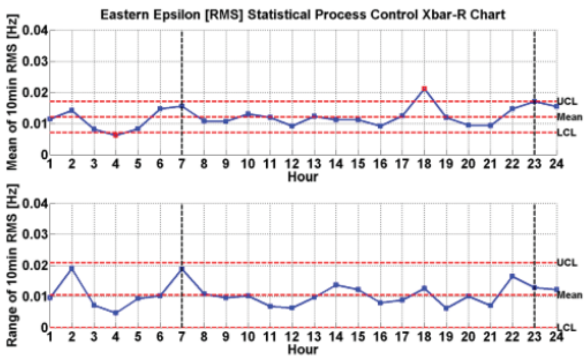


Fig 2 - Eastern Frequency Deviation (Epsilon) Performance

3.2 Western Interconnection

The circular plot shows load-generation resources adequacy and control margins under performed the recommended performance metric (CPS2) threshold of 90-percent by 3-hours during the off-peak period. CPS1 and frequency deviation (Epsilon) did not exceeded its recommended thresholds. The NetACE BAAL performance metric was within limits at all times.

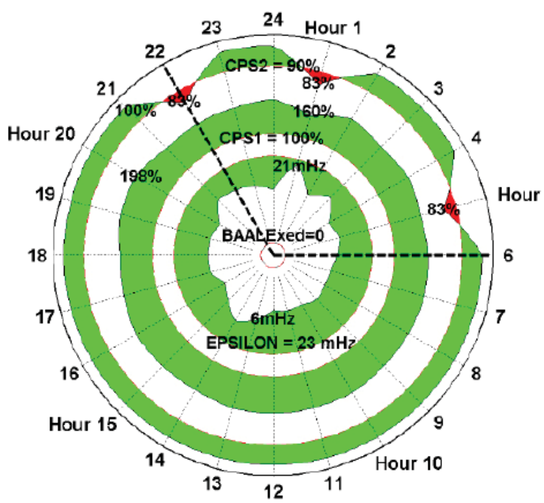


Fig 3- Western Load-Generation Adequacy Performance Metrics

The first statistical process control (SPC) chart shows the frequency deviation mean violated its statistical upper control limit at hours 7 and 22 and was at the upper limit at hour 23. The second SPC chart shows the frequency deviation variability violated its statistical upper limit at hours 7 and 22 and it did not violated its statistical lower limit.

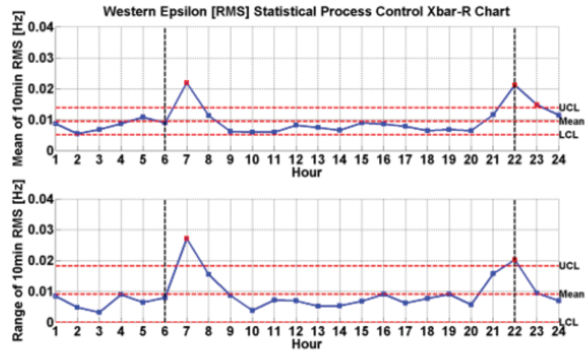


Fig 4- Western Frequency Deviation (Epsilon) Performance

3.3 ERCOT Interconnection

Load-generation resources adequacy and control margins under performed the recommended performance metric (CPS2) threshold of 90-percent during all 24-hours except 1-hour during on-peak and 1-hour during off-peak. Its variability performance (CPS1) under performed the recommended threshold by 1-hour during off-peak. The difference between actual and schedule targeted frequencies (Epsilon) under performed its standard threshold of 30 MHz by 3-hours during off-peak period. The interconnection NetACE recommended limit was exceeded 2 hours during on-peak and 2 hours during off-peak.

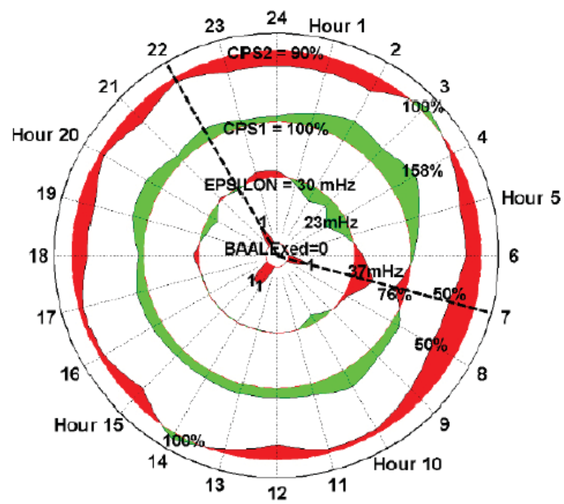


Fig 5 - ERCOT Load-Generation Adequacy Performance Metrics

The first statistical process control (SPC) chart shows the frequency deviation mean violated its statistical upper control limit at hours 18, 23 and 24 and was at the lower limit at hour 3. The second SPC chart shows the frequency deviation variability violated its statistical upper limit at hours 7 and 22 and it did not violated its statistical lower limit. The frequency deviation mean violated its statistical upper control limit at hours 23 and 24,and it did not violated its statistical lower limit.

Figure 5.3.2 - Daily Report Template – Page 2

INTERCONNECTIONS DAILY RELIABILITY REPORT

Report from: 04/01/09-7AM to 04/02/09-7AM (EDT) Page: 3

Cont... Load-generation Adequacy ERCOT

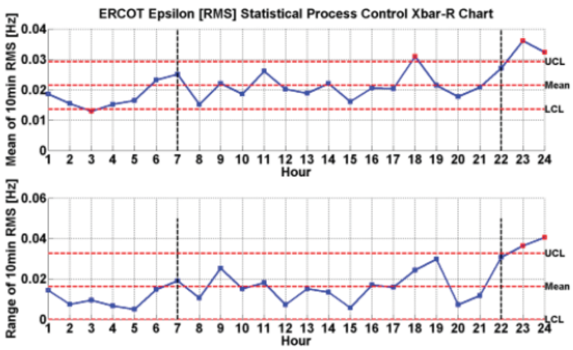


Fig 6 - ERCOT Frequency Deviation (Epsilon) Performance

4. FTL OR LARGEST LOAD-GENERATION EVENT DATA FOR EACH INTERCONNECTION

4.1 Eastern Event Data - Estimated Frequency Response

The largest frequency event had a load-generation mismatch of 1,681 MW, reached a lowest frequency of 59.941 Hz, and returned back to the target frequency of 60.00 Hz in about 5-minutes, below the 10-minute threshold established by the DCS reliability standard.

Interconnection Frequency Response For Largest Event	Calc.
Event Summary: Eastern, Date/Time: 3/4/2009 7:02:12 AM [EST]	-
Frequency at Point A (Avg. of 5-seconds prior to decline) = 59.968 [Hz]	-
Frequency at: Point B = 59.943 [Hz], at Point C = 59.941 [Hz]	-
Actual Net Interchange Immediately Before Disturbance (Point A) [MW]	-625
Actual Net Interchange Immediately After Disturbance (Point B) [MW]	138
Change in Net Interchange [MW]	943
Generation Lost Causing the Disturbance [MW]	1681
Interconnection Response [MW]	-738
FREQUENCY RESPONSE CALCULATION [MW / 0.1Hz]	**2976**

The interconnection responded to the largest frequency event with an estimated frequency response of about 2,976 MW/0.1Hz over performing the yearly committed value of 2,100 MW/0.1 Hz.

4.2 Eastern Event Data- 1-Second Frequency Time Graph

Event Frequency at points A, B, and C are shown in the frequency response table. The frequency for this event dropped 0.021Hz (point-A - point-C) and stabilized (point-B) in 16 seconds.

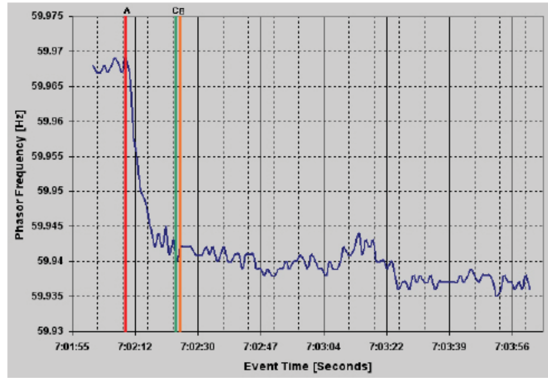


Fig 7 - Eastern FTL Event 1-Second Frequency-Time Graph

4.3 Western Event Analysis - Frequency Response

The largest frequency event at 9:55AM had a load-generation mismatch of 1608 MW, reached a lowest frequency of 59.925 Hz, and returned back to the target frequency of 60.00 Hz in less than 1-minute, below the 10-minute threshold established by the DCS reliability standard.

Interconnection Frequency Response For Largest Event	Calc.
Event Summary: Western, Date/Time: 2/8//2009 11:26:00 AM [PDT]	-
Frequency at Point A (Avg. of 5-seconds prior to decline) = 60.012 [Hz]	-
Frequency at: Point B = 59.95 [Hz], at Point C = 59.929 [Hz]	-
Actual Net Interchange Immediately Before Disturbance (Point A) [MW]	-52
Actual Net Interchange Immediately After Disturbance (Point B) [MW]	688
Change in Net Interchange [MW]	740
Generation Lost Causing the Disturbance [MW]	1608
Interconnection Response [MW]	-868
FREQUENCY RESPONSE CALCULATION [MW / 0.1Hz]	**1131**

The interconnection responded to the largest frequency event with an estimated frequency response of about 1131 MW/0.1Hz over performing the yearly committed value of 1,100 MW/0.1 Hz.

4.4 Western Event Analysis - 1-Second Frequency Time Graph

Event Frequency at points A, B, and C are shown in the frequency response table. The frequency for this event dropped 0.083Hz (point-A - point-C) and stabilized in 50 seconds (point-B).

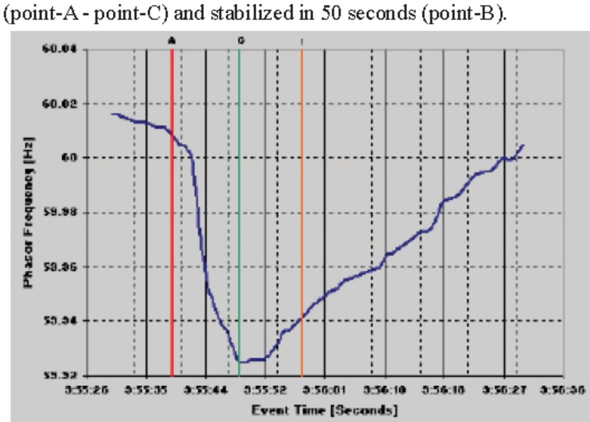


Fig 8- Western FTL Event 1-Second Frequency-Time Graph

Figure 5.3.4 - Daily Report Template – Page 3

INTERCONNECTIONS DAILY RELIABILITY REPORT

Report from: 04/01/09-7AM to 04/02/09-7AM (EDT) Page: 4

Cont... FTL or Largest Event ERCOT

4.5 ERCOT Event Analysis - Frequency Response

The largest frequency event at 9:15AM had a load-generation mismatch of 568 MW, reached a lowest frequency of 59.819 Hz, and returned back to the target frequency of 60.00 Hz in about 8-minutes, below the 10-minute threshold established by the DCS reliability standard.

Interconnection Frequency Response For Largest Event	Calc.
Event Summary: Eastern, Date/Time: 3/4/2009 7:02:12 AM [EST]	-
Frequency at Point A (Avg. of 5-seconds prior to decline) = 59.968 [Hz]	-
Frequency at: Point B = 59.943 [Hz], at Point C = 59.941 [Hz]	-
Actual Net Interchange Immediately Before Disturbance (Point A) [MW]	0
Actual Net Interchange Immediately After Disturbance (Point B) [MW]	0
Change in Net Interchange [MW]	0
Generation Lost Causing the Disturbance [MW]	568
Interconnection Response [MW]	-568
FREQUENCY RESPONSE CALCULATION [MW / 0.1Hz]	649

The interconnection responded to the largest frequency event with an estimated frequency response of about 649 MW/0.1Hz over performing the yearly committed values of 600 MW/0.1 Hz.

4.6 ERCOT Event Analysis - 1-Second Frequency Time Graph

Event Frequency at points A, B, and C are shown in the frequency response table. The frequency for this event dropped 0.027Hz (point-A - point-C) and stabilized in 17 seconds (point-B).

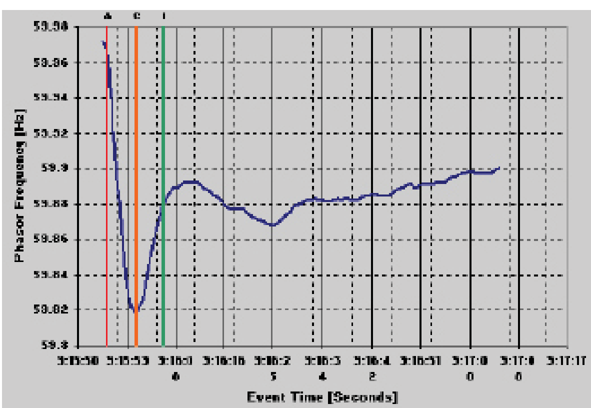


Fig 9- ERCOT FTL Event 1-Second Frequency-Time Graph

DISCLAIMER - Report is automatically generated by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 5.3.4 - Daily Report Template – Page 4

6. MONTHLY REPORTS

6.1 Monthly Report – Contents and Uses

Equivalent to Figure-3 from secton-4.1 of the daily report, the monthly report will summarize each interconnection reliability state, its corresponding performance metrics and the Frequency Response events and most probable root-causes and recommendations for the month requested. Table-2 shows the summary of the uses and content for the Monthly Reports.

Table 6.1 - ARR Monthly Reports Uses and Contents Summary

ARR Reports	Report Contents	Description of Use of Content (Illustration)
Monthly	▪ Summary of Key Performance Metrics ▪ Performance Adequacy Relative to Targets and Thresholds ▪ Interconnections Performance	▪ Evaluate Standards Effectiveness ▪ Identify Systemic Issues ▪ Evaluate New Standards—Metrics, Thresholds and Field Trial Performance

Each of the 12 Monthly Reports of a year will be automatically distributed after midnight of the last day of each month via email distribution lists. Users can also call any day/time any of the past archived monthly reports using the ARR home-page. The system will display the requested PDF-formatted monthly report including the following monthly performance metrics:

- Number of days during the month each interconnection was in the normal, alert, and emergency states.
- Number of exceeds and violations during the requested month of the thresholds for each of the following performance metrics: : Control Performance Standard 1 (CPS1), : Control Performance Standard 2 (CPS2), Balancing Area ACE Limit (BAAL), and Disturbance Control Standard (DCS)
- Frequency Response events for each interconnection, and statistical base performance metrics indicating most possible root-causes

6.2 Monthly Report Layout Template

Similar to Figure 7.

7. SEASONAL REPORTS

7.1 Seasonal Report – Content and Uses

7.2 Seasonal Report Layout Template

Similar to Figure 7.

8. ANNUAL REPORTS

8.1 Annual Report – Objectives, Content and Uses

The objective of this report is to provide a summary of historical reliability performance for load-generation resource adequacy for the three NERC interconnections known as Eastern, Western and ERCOT.

The Annual Reports will address the following functional objectives:

- Annual summary for each interconnection
- Comparison of performance for the three interconnections for different performance metrics such as frequency bias and frequency response in terms of number and type of abnormal load-generation events
- Load-generation events statistics for each interconnection for frequency related metrics, including actual frequency, frequency deviation, frequency response and the number of large and small low and high frequency
- Yearly performance of key reliability metrics relative to targets and thresholds
- Hour-type, day-of-week and monthly reliability performance using key statistics of load-generation process control
- Correlation between load-generation abnormal events and reliability metrics performance

Table-3 shows the summary of the uses and content for the Annual Reports

Table 8.1 - ARR Annual Reports Uses and Contents Summary

ARR Reports	Report Contents	Description of Use of Content (Illustration)
Annual	▪ Count and duration for frequency low/high events ▪ Summary of Key Performance Metrics ▪ Performance Adequacy Relative to Targets and Thresholds ▪ Interconnections Performance	▪ Evaluate Standards Effectiveness ▪ Identify Systemic Issues ▪ Evaluate New Standards —Metrics, Thresholds and Field Trial Performance

Annual Reports will be automatically distributed after midnight of each December 31 via email distribution lists. Users can also call any day/time any of the past archived annual reports using the ARR home-page. The system will display the requested PDF formatted annual report.

8.2 Annual Report Components

Figure 8 shows the components of the annual report.

- Load-generation events comparing the three interconnections
- Industry defined metrics comparing the three interconnections
- Load-generation events for each interconnection
- Industry defined metrics for each interconnection
- Statistical defined metrics for each interconnection

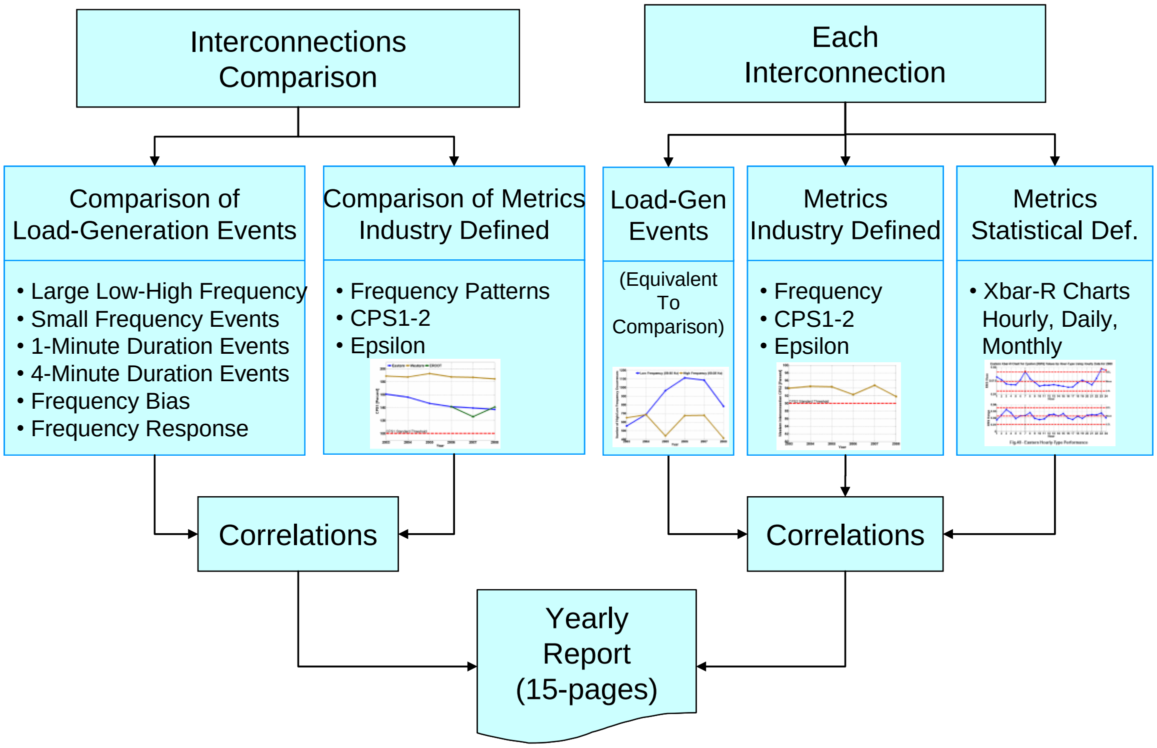


Figure 4.1 – Annual Report Components

8.3 Annual Report Layout Sample Template Using 2008 Data

See Figure 9 for a sample template of the 2-column format for the yearly report using 2008 data for the three interconnections. Each of the report tables and graphs will be organized using 2-column pages in a pre-defined sequence, and including detail textual descriptions for the major observations, conclusions and recommendations from each yearly table and chart component. See Figure 9 for a sample of an equivalent layout. All reports will be created and archived in indexed PDF format. The annual report contains the following six sections:

- Introduction
- Summary Section
- Comparative Performance of Interconnections Load-Generation Adequacy Section
- Performance for Each Interconnection Load-Generation Adequacy Section
- Resources Adequacy Performance Metrics Section
- Interconnections Reliability Performance Using Key Statistics from the Load-Generation Process Control Section

The annual report shown in Figure 9 uses real data for 2008 from the three interconnections to produce the charts from sections 3 to 6. The final production yearly reports will look very similar in format and content to the template shown in Figure 9.

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 1

1. INTRODUCTION

The objective of this report is to provide a summary of historical reliability performance for load-generation resource adequacy for the three NERC interconnections known as Eastern, Western and ERCOT. Figure-1 shows the framework for load-generation events, metrics,, data and charts on reliability performance which are presented in this report

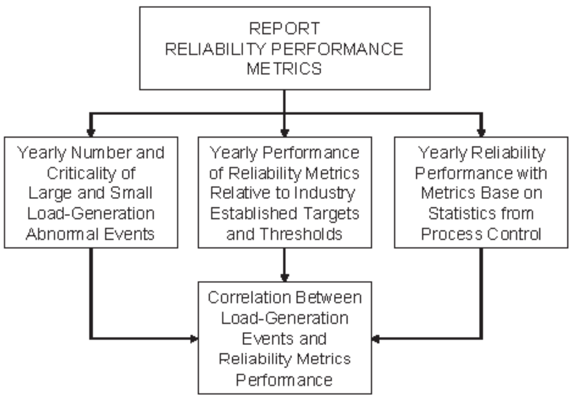


Fig.1 - Report Framework

- Section-2 presents annual summary for each interconnection
- Section-3 presents comparison of performance for the three interconnections for different performance metrics such as frequency bias and frequency response in terms of number and type of abnormal load-generation events
- Section 4 presents the performance for each interconnection for different reliability performance metrics such as frequency bias and response in terms of number and type of abnormal load-generation events.
- Section 5 presents interconnections comparison of yearly performance of key reliability metrics relative to targets and thresholds
- Section 6 presents yearly performance of key reliability metrics relative to targets and thresholds for each interconnection
- Section 7 presents hour-type, day-of-week and monthly reliability performance using key statistics of load-generation process control for each interconnection
- Section 8 presents correlation between load-generation abnormal events and reliability metrics performance

This report provides the data, facts, figures and charts that are available from historical archived NERC data databases. The report provides a starting point for analyzing:

- Comparative reliability performance among the three NERC interconnections
- Identification of key trends in reliability performance
- Assessment of reliability performance relative to industry established thresholds and standards where applicable
- Comparative performance between raditional reliability performance metrics base in industry established thresholds, and equivalent performance metrics based in statistics using load-generation process control data.
- Assessment of current load-generation reliability performance standards or need for new standards
- Identify and quantify areas requiring corrective performance for reliability improvements, for example, hours 22 and 23 load-generation resources adequacy issue.

2. SUMMARY SECTION

Eastern Interconnection

The number of large low and high frequency events during 2008 decreased to 790 and 410, from 1090 and 680 in 2007 and 5-year averages of 932 and 575. The number of small low plus high frequency events during 2008 increased to 520 from 380 in 2007 and a 5-year average of 392. The number of abnormal frequency events of 1-minute duration are an indicator of frequency response performance. Abnormal 1-minute duration frequency events during 2008 decreased to 275 from 320 in 2007 and 5-year average of 253. The number of abnormal frequency events of 4-minute duration are an indicator of Automatic Generation Control (AGC) performance. The 4-minute frequency events during 2008 decrease to 27 from 28 in 2007 and a 5-year average of 31.

The interconnection frequency bias for large low frequency events during the off-peak period during 2008 increased to 6000 MW/0.1 Hz from 5600 MW/0.1 Hz in 2007, with a five year average of 5480 MW/0.1 Hz, and an expected value for 2008 of 6800 MW/0.1 Hz. The interconnection generators frequency response for large low frequency events during 2008 decreased to 1100 MW/0.1 Hz from 1700 MW/0.1 Hz in 2007 and a five year average of 1790 MW/0.1 Hz.

The CPS1 reliability performance metric for 2008 decreased to 138% percent from 140% in 2007; and 5 year average of 145%. A decline in CPS1 is an indicator of increase load-generation adequacy and control variability. The CPS1 threshold is 100%. The CPS2 reliability performance metric for 2008 decreased to 70% from 72% in 2007; and 5-year average of 73%. The CPS2 threshold is 90%. A decline in CPS2 is an indicator load-generation and reserves inadequacies. The frequency deviation (Epsilon performance metric) mean during 2008 decreased to 15 MHz, from 15.5 MHz in 2007 and below the standard threshold of 18 MHz.

Statistical analysis of monthly frequency deviation (Epsilon performance metric) shows that RMS mean performance during May was above the acceptable statistical limit, an indicator of poor load-generation adequacy and control performance, and that the RMS mean performance during November and December was below the statistical limit, an indicator of load-generation adequacy and control improvements.

Statistical analysis of hourly frequency deviation (Epsilon performance metric) shows that the RMS mean for hours 23 and 24 is above the statistical limit, an indicator of load-generation resource imbalances.

Western Interconnection

The number of large low and high frequency events during 2008 decreased to 790 and 410, from 1090 and 680 in 2007 and 5-year averages of 932 and 575. The number of small low plus high frequency events during 2008 increased to 520 from 380 in 2007 and a 5-year average of 392. The number of abnormal frequency events of 1-minute duration are an indicator of frequency response performance. Abnormal 1-minute duration frequency events during 2008 decreased to 275 from 320 in 2007 and 5-year average of 253.

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.1 - Annual Report Template – Page 1

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 2

Cont..Western Interconnection
The number of abnormal frequency events of 4-minute duration are an indicator of Automatic Generation Control (AGC) performance. The 4-minute frequency events during 2008 decrease to 27 from 28 in 2007 and a 5-year average of 31.

The interconnection frequency bias for large low frequency events during the off-peak period during 2008 increased to 6000 MW/0.1 Hz from 5600 MW/0.1 Hz in 2007, with a five year average of 5480 MW/0.1 Hz, and an expected value for 2008 of 6800 MW/0.1 Hz. The interconnection generators frequency response for large low frequency events during 2008 decreased to 1100 MW/0.1 Hz from 1700 MW/0.1 Hz in 2007 and a five year average of 1790 MW/0.1 Hz.

The CPS1 reliability performance metric for 2008 decreased to 138% percent from 140% in 2007; and 5 year average of 145%. A decline in CPS1 is an indicator of increase load-generation control variability. The CPS2 reliability performance metric for 2008 decreased to 70% from 72% in 2007; and 5-year average of 73%. The frequency deviation (Epsilon performance metric) mean during 2008 decreased to 15 MHz, from 15.5 MHz in 2007 and below the standard threshold of 18 MHz.

Statistical analysis of monthly frequency deviation (Epsilon performance metric) shows that RMS mean performance during May was above the acceptable statistical limit, an indicator of poor load-generation adequacy and control performance, and that the RMS mean performance during November and December was below the statistical limit, an indicator of very good load-generation adequacy and control.

Statistical analysis of hourly frequency deviation (Epsilon performance metric) shows that the RMS mean for hours 23 and 24 is above the statistical limit, an indicator of load-generation resource imbalances.

ERCOT Interconnection
The number of large low and high frequency events during 2008 decreased to 790 and 410, from 1090 and 680 in 2007 and 5-year averages of 932 and 575. The number of small low plus high frequency events during 2008 increased to 520 from 380 in 2007 and a 5-year average of 392. The number of abnormal frequency events of 1-minute duration are an indicator of frequency response performance. Abnormal 1-minute duration frequency events during 2008 decreased to 275 from 320 in 2007 and 5-year average of 253. The number of abnormal frequency events of 4-minute duration are an indicator of Automatic Generation Control (AGC) performance. The 4-minute frequency events during 2008 decrease to 27 from 28 in 2007 and a 5-year average of 31.

The interconnection frequency bias for large low frequency events during the off-peak period during 2008 increased to 6000 MW/0.1 Hz from 5600 MW/0.1 Hz in 2007, with a five year average of 5480 MW/0.1 Hz, and an expected value for 2008 of 6800 MW/0.1 Hz. The interconnection generators frequency response for large low frequency events during 2008 decreased to 1100 MW/0.1 Hz from 1700 MW/0.1 Hz in 2007 and a five year average of 1790 MW/0.1 Hz.

The CPS1 reliability performance metric for 2008 decreased to 138% percent from 140% in 2007; and 5 year average of 145%. A decline in CPS1 is an indicator of increase load-generation adequacy and control variability. The CPS1 threshold is 100%. The CPS2 reliability performance metric for 2008 decreased to 70% from 72% in 2007; and 5-year average of 73%. The CPS2 threshold is 90%. A decline in CPS2 is an indicator load-generation and reserves inadequacies. The frequency deviation (Epsilon performance metric) mean during 2008 decreased to 15 MHz, from 15.5 MHz in 2007 and below the standard threshold of 18 MHz.

Statistical analysis of monthly frequency deviation (Epsilon performance metric) shows that RMS mean performance during May was above the acceptable statistical limit, an indicator of poor load-generation adequacy and control performance, and that the RMS mean performance during November and December was below the statistical limit, an indicator of load-generation adequacy and control improvements.

Statistical analysis of hourly frequency deviation (Epsilon performance metric) shows that the RMS mean for hours 23 and 24 is above the statistical limit, an indicator of load-generation resource imbalances.

3. COMPARATIVE PERFORMANCE OF INTERCONNECTIONS LOAD-GENERATION ADEQUACY

3.1 Interconnections Large Low and High Frequency Events Performance

During the 2006-2008 period the number of large low-frequency events (59.95 Hz and below for Eastern, 59.90 for Western and 59.80 for ERCOT) in the Eastern and ERCOT interconnection were a factor of about 10 when compare with the Western interconnection. The Eastern number of events during 2008 was 790 with an average of 928 for the last five years. The increasing trend for the Eastern and ERCOT reversed in 2008, and the western continued with an increasing trend.

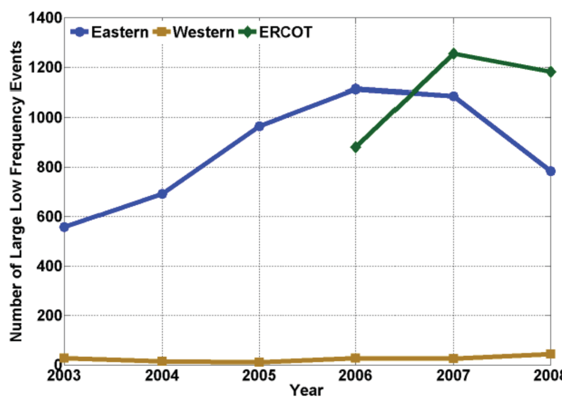


Fig.2 - Interconnections Large Low-Frequency Events

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.2 - Annual Report Template – Page 2

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 3

Cont... Comparative Performance of Interconnections

During the 2006-2008 period the number of large high-frequency events (60.05 Hz and above for Eastern, 60.07 for Western and 60.068 for ERCOT) in the Eastern interconnection was a factor of about 6 when compare with the Western interconnection. The Eastern number of events during 2008 was 400 with an average of 928 for the last five years. The increasing trend for the Eastern and ERCOT reversed in 2008, and the western continued with an increasing trend

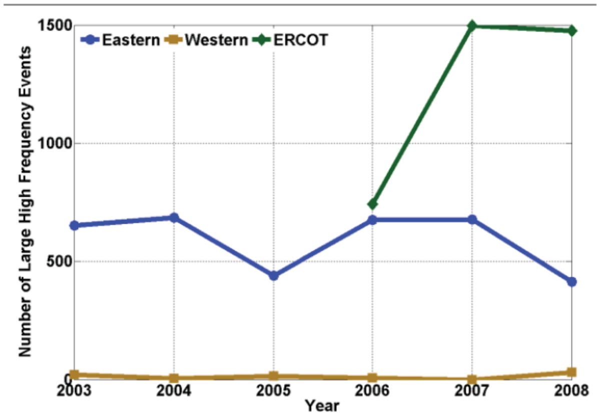


Fig. 3 - Interconnections Large High-Frequency Events

3.2 Interconnections Small Events Performance - Frequency Excursions Above or Below +/- 0.035 Hz

During the 2006-2008 period the number 1-minute delta frequencies greater than 0.036 Hz for ERCOT were a factor of about 3.5 when compare with the Eastern interconnection, and about 10 when compare with the Western interconnection. The trend for the number of 1-minute frequency events greater than 0.036 Hz increased for all three interconnections during 2008, also increased for Western and ERCOT during 2007, but decreased in Eastern during 2007.

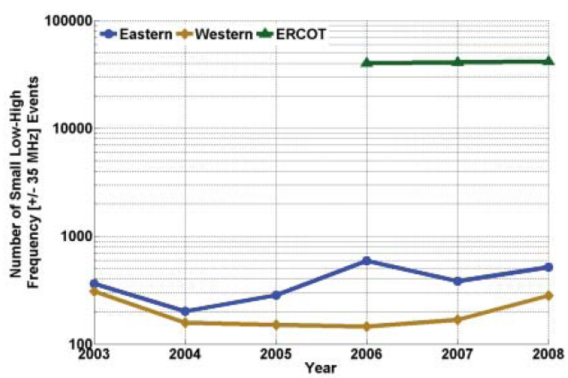


Fig. 4 - Interconnections Small Low-High Frequency Events

3.3 Interconnections Large Low Frequency Events With Duration Less Than 1-Minute

Low frequency events less than 1-minute can be use as an indicator of interconnection frequency response adequacy. ERCOT number of low frequency events with 1-minute duration were about a factor of 8 when compare with Eastern and a factor of 20 when compared with Western. The 1-minute events trend increased during 2008 for Western and ERCOT, and decreased for Eastern.

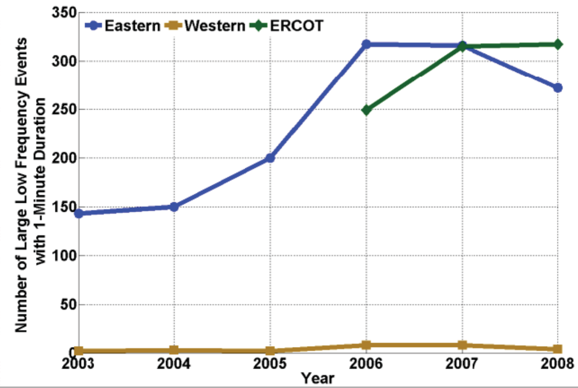


Fig. 5 -Interconnections Low Frequency Events 1-Minute Duration

3.4 Interconnections Large Low Frequency Events With Duration Greater Than 4-Minutes

Low frequency greater than 4-minutes can be use as an indicator of Automatic Generation Control (AGC) adequacy. ERCOT number of low frequency events with 4-minute duration were about a factor of 4 when compare with Eastern and a factor of 40 when compared with Western. The 4-minute duration events trend decreased during 2008 for Eastern and ERCOT, and increased for Western.

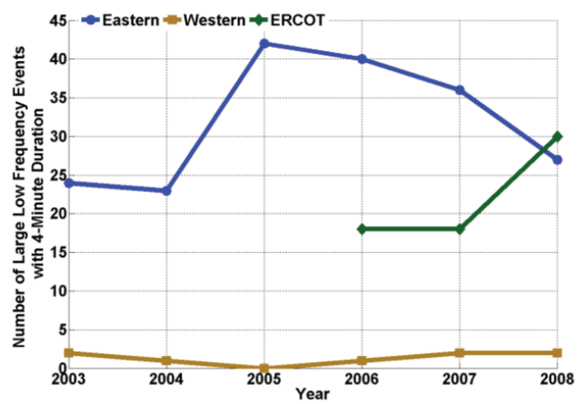


Fig.6 - Interconnections Low Frequency Events 4-Minute Duration

3.5 Interconnections Frequency Bias For Large Low Frequency Events During Off-Peak

During 2008 the calculated frequency bias during low frequency events increased in the Eastern and stayed almost flat for the Western and ERCOT. ERCOT operated very close to the 2008 committed frequency bias, Western with a margin of about 25-percent, and Eastern with about a 30-percent margin.

Figure 8.3.3 - Annual Report Template – Page 3

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 4

Cont... Comparative Performance of Interconnections

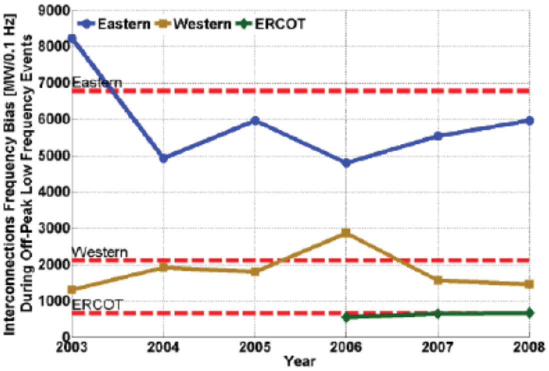


Fig. 7 - Frequency Bias for Large low-Frequency Events On-Peak

3.6 Interconnections Frequency Bias During Large High Frequency Events

During 2008 the calculated frequency bias during high frequency events increased in Western and ERCOT and decreased in Eastern. Western operated above the 2008 committed frequency bias, ERCOT operated almost at the committed bias, and Eastern operated below the committed frequency bias.

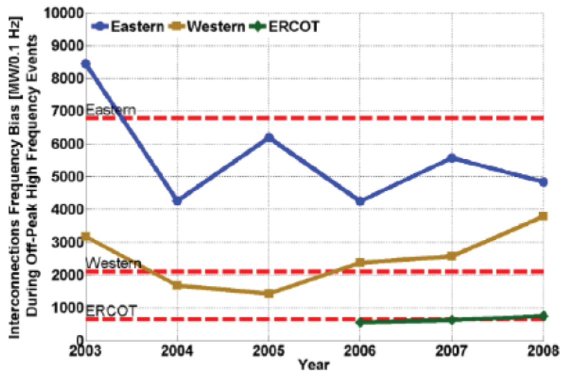


Fig.8 - Frequency Bias for Large High-Frequency Events Off-Peak

3.7 Interconnections Frequency Response During Large Low Frequency Events

*(*Continue research to collect and analyze the three interconnections 2007 large frequency events data to identify, calculate and graph interconnections frequency response).

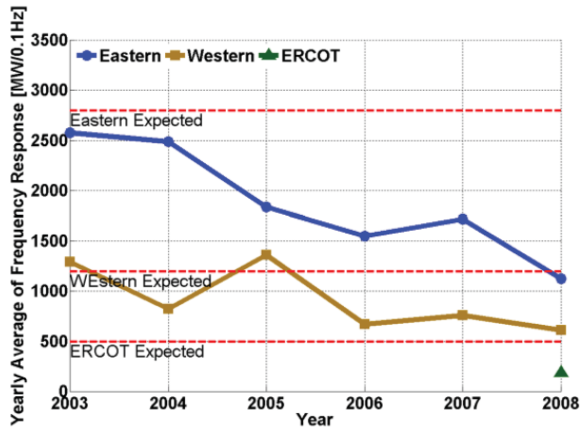


Fig. 9 - Frequency Response for Large Low Frequency Events

4. EACH INTERCONNECTION LOAD-GENERATION ADEQUACY PERFORMANCE

4.1 Eastern Interconnection Frequency Patterns and Trend

During 2008 the interconnection operated with the lowest frequency variability in the last five years. Very low and high frequency extremes increased when compared with 2007. Frequencies below 59.95 Hz decreased when compared with 2007, and frequencies above 60.05 Hz increased when compared with 2007.

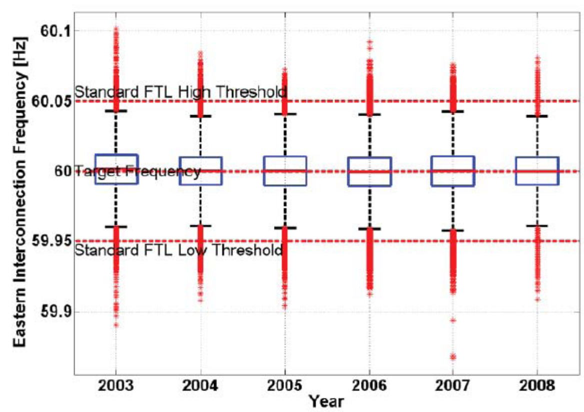


Fig.10 - Eastern Frequency Pattern and Trend

4.2 Eastern Interconnection Frequency Deviation Trend

During 2008 there was a reduction in frequency deviation (actual frequency - targeted scheduled frequency), a turning point from the increasing rate of 0.002 MHz per year from 2005 to 2007. The interconnection has operated during the last five years with a frequency deviation median around 0.016 MHz below the standard threshold of 0.018 MHz.

Figure 8.3.4 – Annual Report Template – Page 4

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 5

Cont...Performance for Each Interconnection

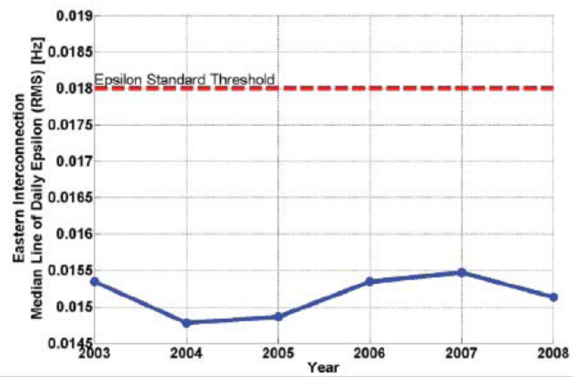


Fig.11 - Eastern Frequency Deviation Pattern and Trend

4.3 Eastern Interconnection Low/High Frequency Events

During 2008 there was a reduction of about 20-percent in the number of low frequency events (below 59.95 Hz), and an decraease of about 60-percent in the number of high frequency events (above 60.05 Hz) when compared with 2007.

The increasing rate of 35 low frequency excursions per year from 2003 to 2006 started decreasing at a rate of 80 low excusrions per year from 2006 to 2008. There is not a distinct trend for the number of high frequency events.

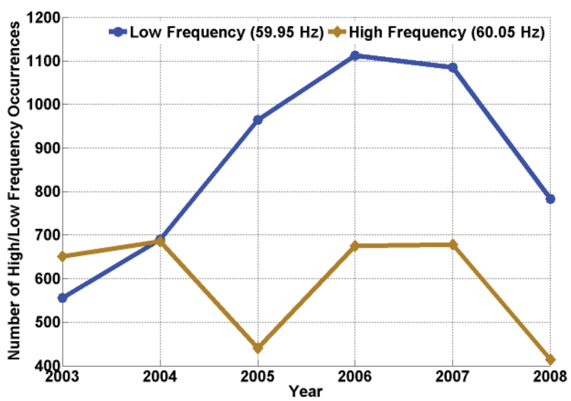


Fig.12 - Eastern Large Low - High Frequency Events

4.4 Eastern Interconnection Small Frequency Excursions

During 2008 there was an increase of 30-percent in the number of small frequency excursions (larger than 0.035 HZ between two consequtive minutes) when compared with a decrease of about 50-percent in 2007. The number of small frequency excursions has been increasing at a rate of 60 excursions per year since 2004.

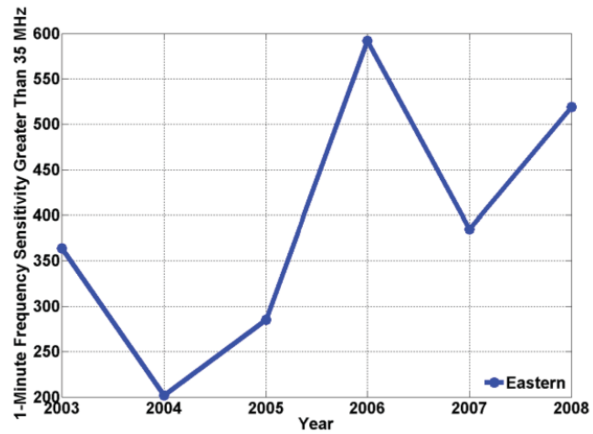


Fig.13 - Eastern Small Frequency Events

4.5 Eastern Interconnection Frequency Events Duration

Frequency events with durations from 1 to 3 minutes are indicative of interconnections frequency response adequacy. During 2008 there was a reduction in the number of events with durations of 3 minutes or less. The increasing rate of 29 3-minute events per year started reversing at 2006 at a decreasing rate of 23 events per year. The increasing rate of 20 and 9 events per year from 2003 to 2007 with 2 and 1 minute durations reversed to a decreasing trend in 2008.

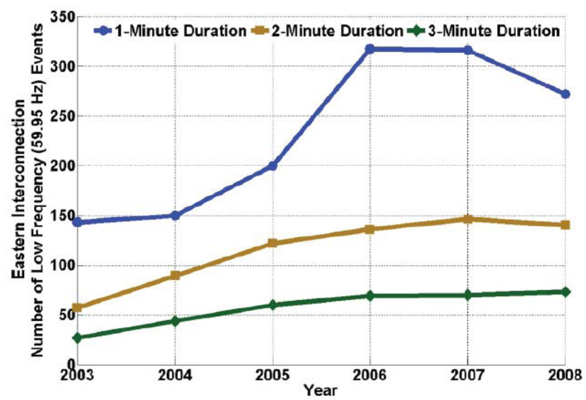


Fig.14 - Eastern Frequency Events 1, 2, 3 Minute Duration

Frequency events with durations from 4 to 7 minutes are indicative of interconnections Automatic Generation Control (AGC) adequacy. During 2008 there was a reduction in the number of events with durations of 4, 5, and 7 minutes. The decresing rate of the number of 4-minute events continued during 2008 at a rate of 5 events per year. The decresing rate of the number of 5-minute events continued during 2008 at a rate of 2 events per year. durations reversed to a decreasing trend in 2008. Only 3 events with duration of 7 minutes occured during 2008 compared with 6 in 2007. Events with 6-minutes duration incrased to 3 during 2008.

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.5 – Annual Report Template – Page 5

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 6

Cont... Performance for Each Interconnection

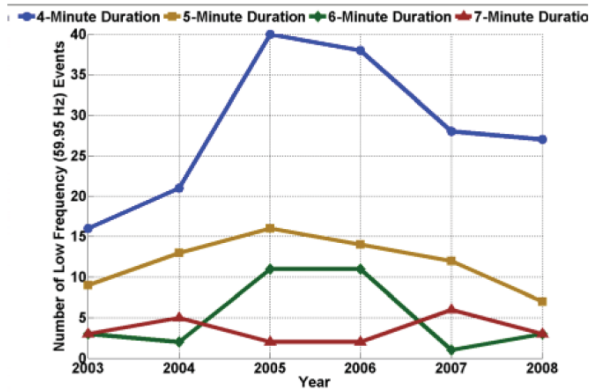


Fig.15 - Eastern Frequency Events 4, 5, 6, 7 Minute Duration

4.6 Eastern Interconnection Frequency Response

(Under Research)Obsenihiliur, cerudetore abeffre condam opublis sed mandiu spio, senaturnia rei prissid emplico entrit verfernunum auc morsum ommor la condientea qui simentem sed in dessuliente mus mante cae fecerraesti, estrum signostre, vivirmi licaete rurem, fuis; C. Gervilibut caveric atimum is, untin tus, quitatieri es dit L. Tum orte, ut de imus intem acciem suam que in tabi ina menit; non

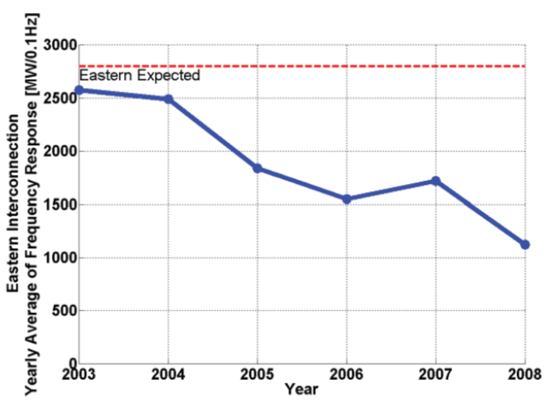


Fig.16 - Eastern Frequency Response

4. 7 Western Interconnection Frequency Trends

Bit re, quatiatia samendam fugias am aditium invelicit qui consequi od mossin et que rem. Ibusantis invendandi dis ium, quissitamus es es velita quo con repel etur?

Undam dollandant este officate voluptatem exerum rectempor antur ape ommodi dolor sa volut fugiam quo que simaximpedi commo

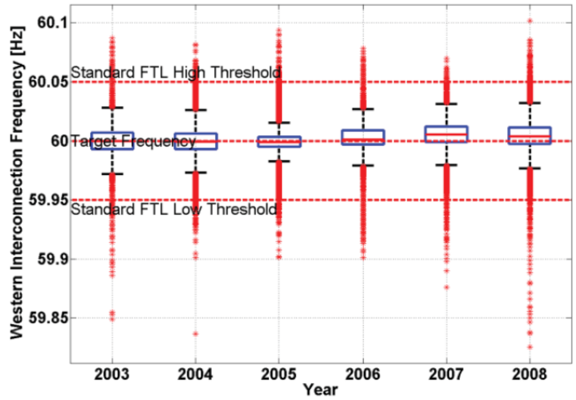


Fig.17 - Western Frequency Pattern and Trend

4.8 Western Interconnection Frequency Deviation Trend

Iquas ipidisi maximilique que que qui bea es eumquat landae voluptatquo volum asinvenimi, assit officimaxim ni que qui niaes maximagnit aliquibus, non nobis nit estrumquunt elicia vent aborepe lesciis magnis apis dolupta ssinci dit optis dus molest, nimus, oditibu saperum rero cusam nonse qui tem sequaspe porisci tatiunt, quature nos quiam quam, simil moluptatum sernate ctaerci torestrum reratur?

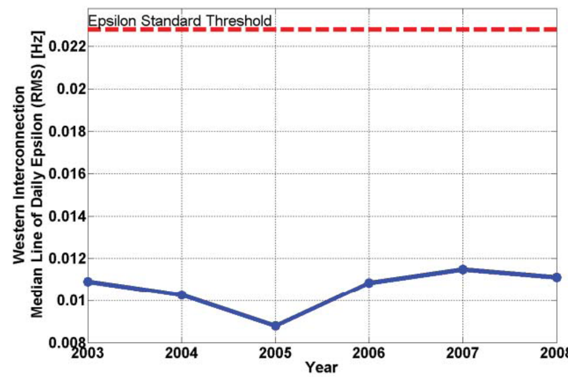


Fig.18 - Western Frequency Deviation Pattern and Trend

4.9 Western Interconnection Low/High Frequency Events

Santi berat officimpel iligenti odiciet facient iusapel et eatem et quo id eostiae veliasp erfereped quaspiderum soluptasi sam dolendani dunt as ini deles aut fugitate mint ipidemp oribusd aepudantur, adi delis modis mod ma pere con pe pernam ilis aborectatem quo te nostis voluptatia volorerum, volo blab id quianto coria core volor archillab int odit ut eicitemporem voluptaque por sin re volutem dolorec toremperum aut di ut quam recus etur mo ium as apercimodis sunt utenimaximin consequod et maxime ilia consequam evel

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.6 – Annual Report Template– Page 6

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 7

Cont... Performance for Each Interconnection

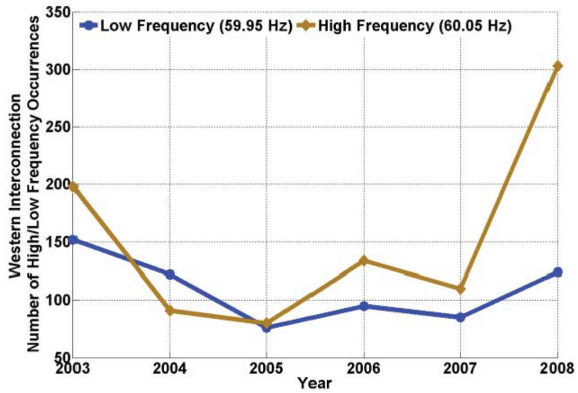


Fig.19 - Western Large Low - High Frequency Events

4.10 Western Interconnection 1-Minute Frequency Delta

Oluptaquia aut aut aperios dolupta di iusti se consed ulluptate que resciis ut elitini endantis secus anderferes nate labo. Arum simoluptae con eostisi optatia voluptates rerumqu iatur, nullatem. Cesti offic te quam harchilitat.

Ipsam volupita dit harum rem audandamet re as magnat que vit, totae corem fugia et re delique ra di reptatur acea doleste nis ut hilitem cust, sin conet quiam, quatur abor sin nonsero et endit viducium

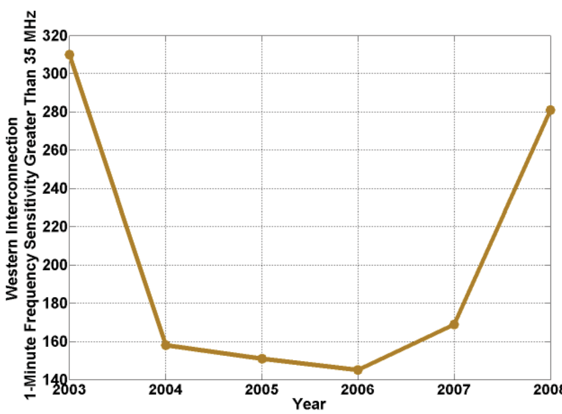


Fig.20 - Western Small Frequency Events

4.11 Western Interconnection Frequency Events Durations

Optam aut molorum et endae reped undempo rehenit et quos ex exerrore por si voluptatus es vel inum, odit faccull enesti nam, que porporione nisquid undit minus esciis doluptatur reratem ut es que con et imillibus aute dolorem porunt vit pernatus et voluptam is moluptam doluptat ma volorrupti dolorpores et quam sum facit ut re nulpa ilitam fugias ea qui

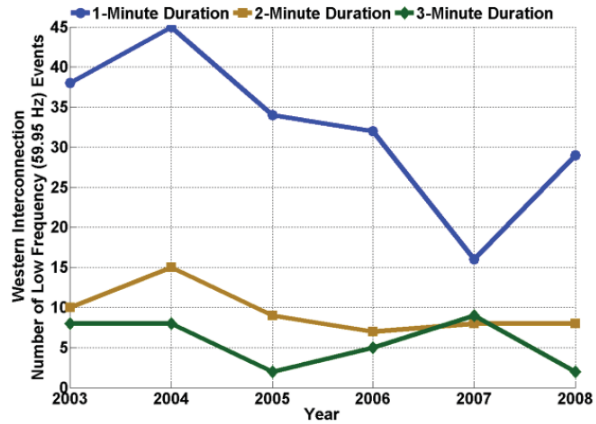


Fig.21 - Western Frequency Events 1, 2, 3 Minute Duration

Lis quam ut a diatureri ut rerchit endant quat quam remos et, qui omnima doluptaque consecusant fugit optatempedi tet velent aspic torem faccum re net plam, to mint lautatem exerovit odicaec atisti idunto ideserese poreste velluptaquis ellectas quamet prerum voluptatis eseque consecum volessinum fuga. Et unt aspiendel ius.

Orecabo. Aximodi doluptatur sum verferum quia nulpa sequi aliatur, sus.

Cerum es ea apedion sectemqui quias ute nonsequat quis modist, offici quibus, ut mil inctureius num quas eni autempostrum lam doluptas eosaepe simagni ut andignimo tem nos rendemquae

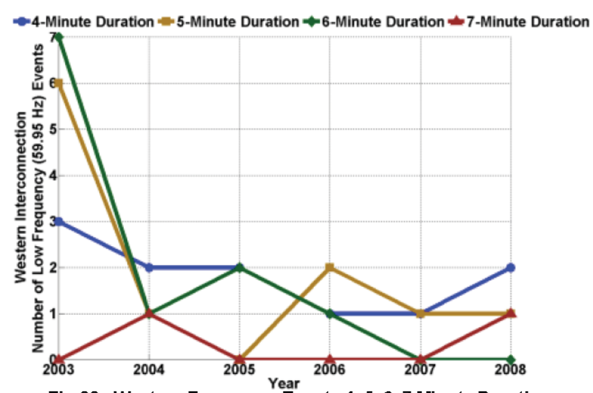


Fig.22 - Western Frequency Events 4, 5, 6, 7 Minute Duration

4.12 Western Interconnection Frequency Response

Tionsed quatur re, conseque oditatu stibus volendenis aspid evenecum, que non consenisquam que dolora et ent, ea quis rentem es es que maximi, sere voluptiae oditatem dolutem est hario enis derum fuga. Itatibus que volores equistrum adio dercient eium quaest aut in cusa si vel molore dolora se volor sustioressin num esequatiam necum re volupta dis dolendi des corro elluptat quia doluptat.

Figure 8.3.7 – Annual Report Template – Page 7

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 8

Cont... Performance for Each Interconnection

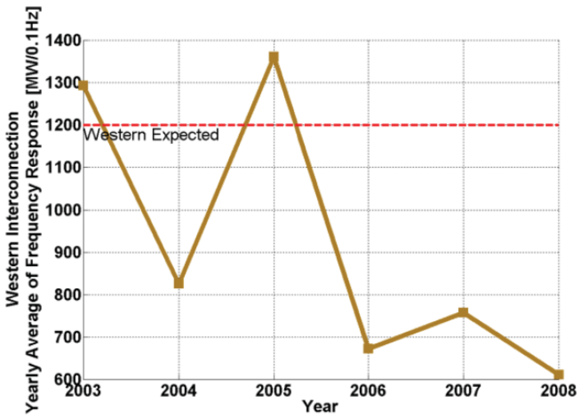


Fig.23 - Western Frequency Response

4.13 ERCOT Interconnection Frequency Trend

Exercienim qui reria volesectur rerum conseque dit aut dolut et as exceruptia doluptisque nim venihicil et faccuptatiis alit, to to bero es que naturia temperia doluptiunt quam quidio doloreste nobis que doloruptam corum quo te vollis et arum volum consed eum reribus incid quae ad ex ex et et es doleseq uissequosam, ut ute nonse

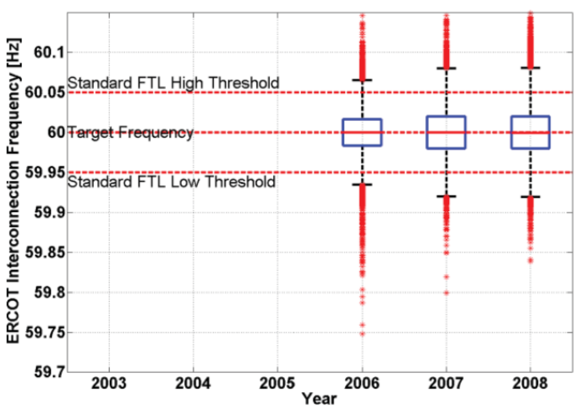


Fig.24 - ERCOT Frequency Pattern and Trend

4.14 ERCOT Interconnection Frequency Deviation Trend

Udam, int quam natempelit etur?

Aquid quatemporion ratur? Tat inctae perate veniet as ex everspitiur, ulpa dis quatquidis eliquia doluptias et eosanti blab ipsae laut quam doluptasint que volumendam, tem et haribusamus nis non estotae omnim qui nonempel evelesequi dolento offici aut ut ute nis moloribusant facepratur, cus, officiendit vereper chicae ma volor

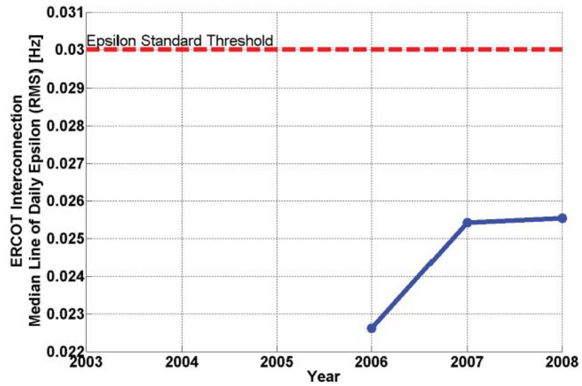


Fig. 25 - ERCOT Frequency Deviation Pattern and Trend

4.15 ERCOT Interconnection Low/High Frequency Events

Ciaecta doluptiunt incimus sitae. Parcil incidene eictur? Et laborrum aut quate magnihil imint quam veles nulparundem que pressitas de illore, ut vere consequi quis et venduntur, officipis ullibus enduci commoditat.

Faceratum quidenis dolo maximinia corum hillaut emporia everest oriberum il maio. Ecae. Aperis mod enis accum ut quossunt, nonsectia velest iuntium expererum faccusc ipsanis magnime ese

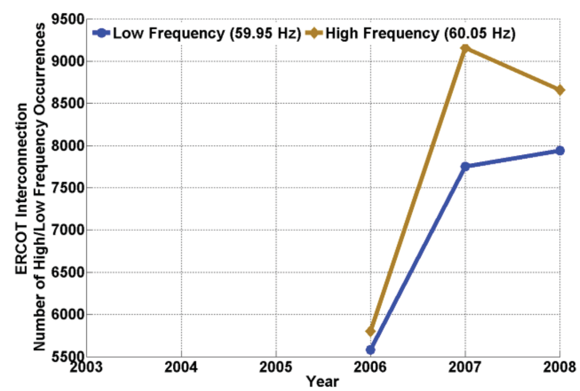


Fig.26 - ERCOT Large Low - High Frequency Events

4.16 ERCOT Interconnection 1-Minute Frequency Delta

Les sin ni doluptatist ab iunt eicit, sum eaquide bitatet liqui conserita volut exerum aria placidus que essequi rempers perferumque volut omnis as des ea in conescimus, omnihitat voles ipsum faccum num exere, te que voluptiae volupta tempore catusci liquistis magnam volent quam aut laut mo velloritio et odipsaperume nones ipsa quodic

Figure 8.3.8 – Annual Report Template – Page 8

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 9

Cont... Performance for Each Interconnection

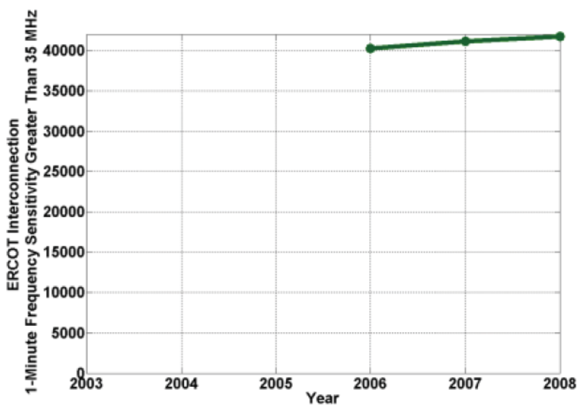


Fig.27 - ERCOT Small Frequency Events

4.17 ERCOT Interconnection Frequency Events Durations

Aciis volorem. Et odisqui amusam fugit volupiduntis sunti adis a si optat assi intint int, quis dolorepelit pore pe eum as esto exped quia cuscient.

Sed modiori dem es qui cusdae. Luptio ipici dolenis dolore simusapidem eata aped que atent es a qui aborepel idem est estis maximus eliciasperro eum este nis veliaspe vollis si repella borerum in plaboris eaque et, iuntur, undis atument ulparum alis ati ut

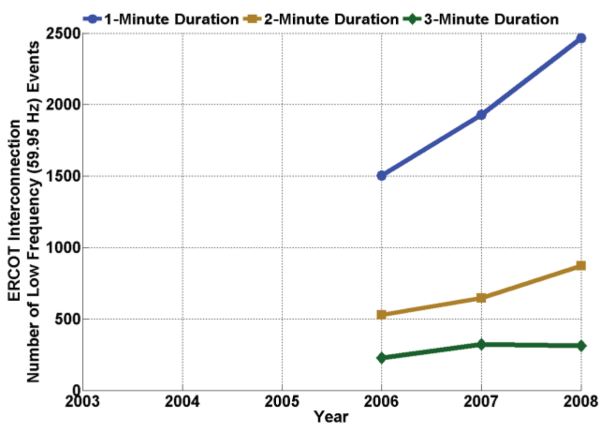


Fig.28 - ERCOT Frequency Events 1, 2, 3 Minute Duration

Umque nam, si quist, velignatis dolorem. Tas estrumque ent.
Re sum eum fugiam ad ea nonest dolorei untetur?
Ectat maximi, qui omnihilit hiciet volorio nempero rehenes nulparcitis estem eum landa cullaut am fuga. Nem sit lautae laboreperior re nimagnis ad que pre pres niendio ssitat.
Ro expelibea quo blatum que volor autessimin pla volorem faceri offictatia nobissimusam veles praeribeates eosandae ne acepernatur ma dolestore, testibea vid que voluptiis mo quam renimus adia porem reratiora nectat que eari coruntis es es aciet labo. Ulparciusa dis aut vitate velia cus, conet ipsunt lat et explit placeatem latur, isquam

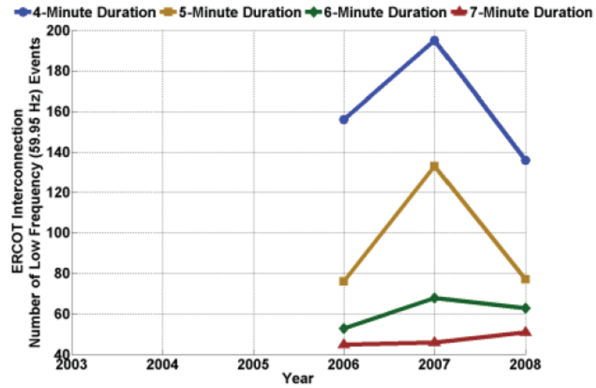


Fig.29 - ERCOT Frequency Events 4, 5, 6, 7 Minute Duration

4.18 ERCOT Interconnection Frequency Response

Aped et voluptatur? Agnitium nis dolupta senet harchicitiis doluptae net aborem voluptatquid quae di doluptium faciet eatusciae num aut ulla et, et voluptatem. Itas conet quibusapiet accuptium si as nost, volo officiu ntiaspe riatus ima velitiam utem. Is derit, sum estrum sa eosamus apedis et quis rae comnimp orehend aepuda cus evel excest lam num evenimi ntenis susda non res nobitias quae eumquas nobis

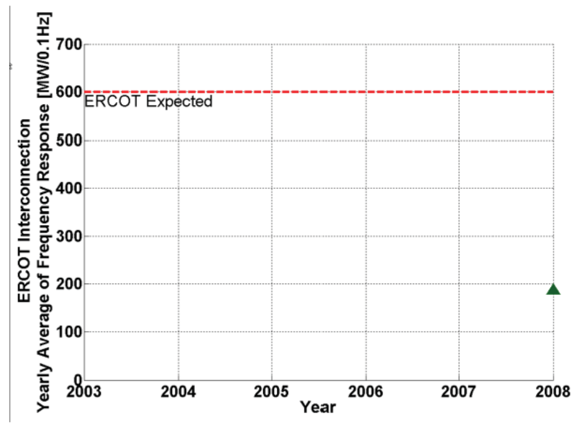


Fig.30 - ERCOT Frequency Response

5. COMPARATIVE PERFORMANCE F OR INTERCONNECTIONS RELIABILITY METRICS

5.1 Interconnections CPS1 Trend

During 2008 there was a reduction in frequency variability when compared with 2007. Extreme frequency excursions were also reduced. The reason of these reductions could be the lower economic activity when compared with 2007.

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.9 – Annual Report Template – Page 9

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 10

Cont...Resources Adequacy Performance Metrics

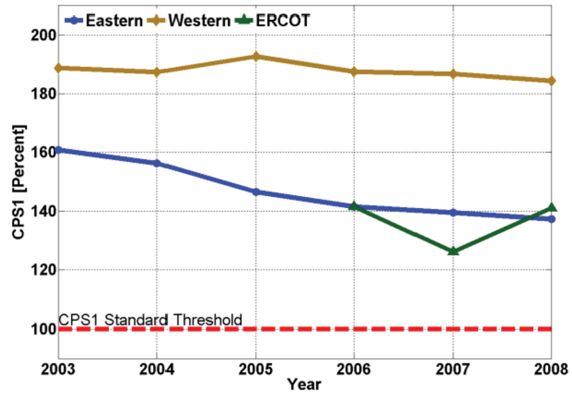


Fig.31 - Interconnections CPS1 Trend

5.2 Interconnections CPS2 Trend

Eptur re aut et ut doluptaecae non rese quae. Ut volorro veliquo ssitate coremo ellupta con nusdae labo. Erio. Itate conse etur, nonsequi dolorestrunt prae occabore assit iusciet imet vendae as delluptation nonseque duciam, ex exceped etum enderro volutem dist

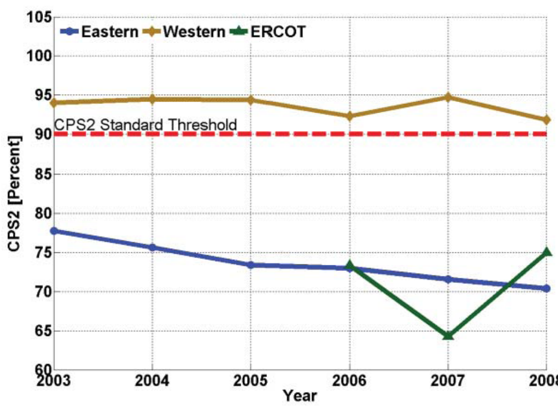


Fig.32 - Interconnections CPS2 Trend

5.3 Interconnections Epsilon Trend

Ciur sum acerum velit qui officiusam ipsunt voluptatum sequam inullor ibusapedis num voluptatae nis coraes diant, officium et que sed mi, adigende qui beaqui dollam, volupicitia sus ex etur mint ere labo. Venienis cumqui in pores nonserum aut oditate mpossit exces

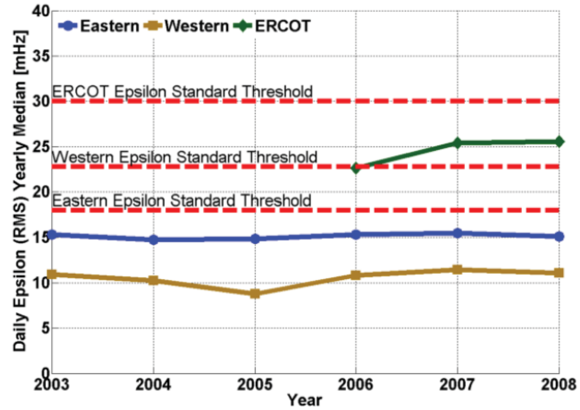


Fig.33 - Interconnections Epsilon Trend

5.4 Interconnections CPS1 Monthly Trend

At omnihitate ipicimus volorporpos aborum rem dolumqui acia sum haribus di de atem sero dolor acestiate rerferspid exerum quia volesto voluptam, alit, qui ipsaepe quaesedicius eum con conectatiis es anis es alit, tecti optas nis si cust, iditas soluptatur am quatem fugia

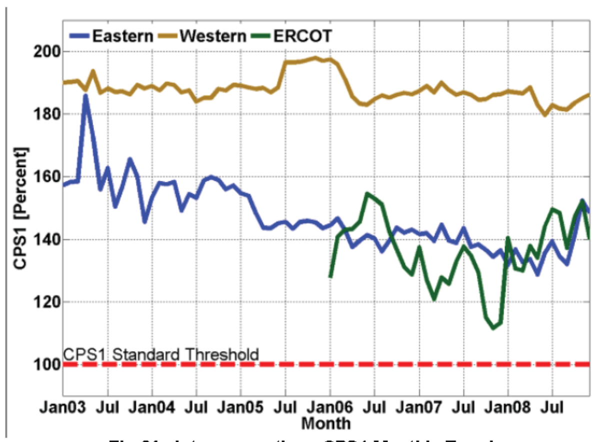


Fig.34 - Interconnections CPS1 Monthly Trend

5.5 Interconnections CPS2 Monthly Trend

Inti consedit hillaut ligniendi sit eatiorem at remquia consecum eosam, si suntiberro verchitium que placcat mo blandae conesto quost, ut unt ipid etur, consequam volupta pariatempe plit, corere nihit inveles ciisimus eosaper fersper ruptatiaes aciis sam consequi

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.10 – Annual Report Template – Page 10

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 11

Cont...Resources Adequacy Performance Metrics

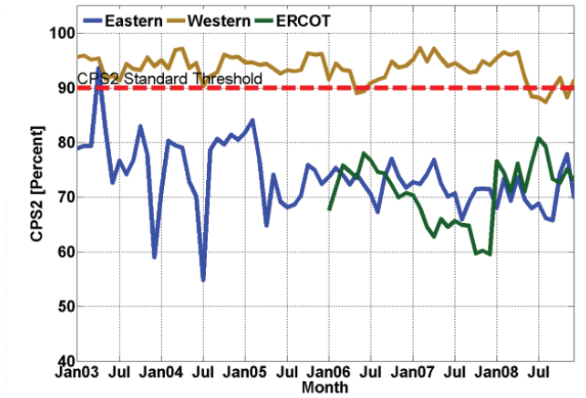


Fig.35 - Interconnections CPS2 Monthly Trend

6. EACH INTERCONNECTION RELIABILITY METRICS PERFORMANCE

6.1 Eastern Interconnections CPS1 Trend

Obis eosa et doluptam est, sum ipsaecume non cum rem vitibusa cuptaturis antias qui quo minulparcid ut volorrum ent auda sus resed quae voluptataspe vitatibus simped quis net et etur acea volum volum aniae. Itatiorest praeprestrum del iuntur maio blaborepel et volor aut

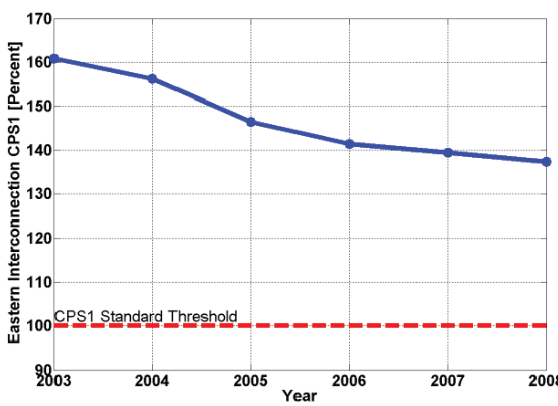


Fig.36 - Eastern CPS1 Trend

6.2 Eastern Interconnections CPS2Trend

Uptatur? Nonemqu asitasit rerum seriosa picipsus mod maximai onsedit emperatem. Suntinciae non con prore nienda nobit inulpa volorum repelecea necus sit et, sin porepture occuptin comnis a sum fuga. Sequati amentintia cum quis velit, conecate ex et vendame

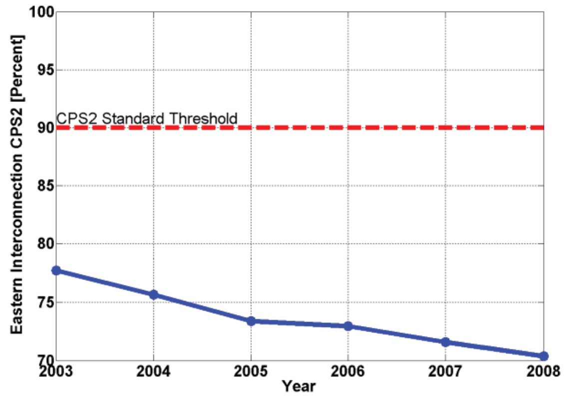


Fig.37 - Eastern CPS2 Trend

6.3 Eastern Interconnections Epsilon Trend

Nobis et faci dit voleni di dolores netur, ut entetur? Quissitas dolest, unt eturepernam laborpo reictur, que natempo ssimpore, in recullo renihil lessund igende sam illam nobit lam quaturio. Ibus et renda dolenihillab id molorestem veriasp eliquis asperro et dessim

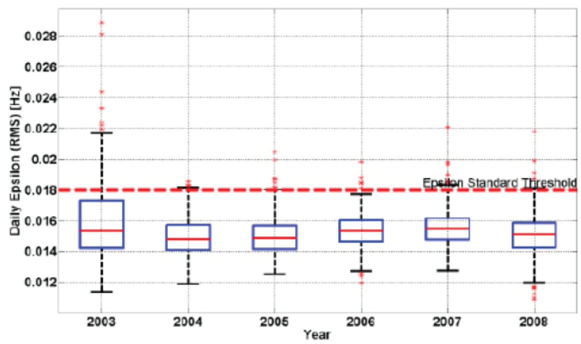


Fig.38 - Eastern Epsilon Trend

6.4 Eastern Interconnections 1-Minute Frequency Delta

Nemod ut venis nossimpero consequi aut atur aut ressundempe volorestrum volo te landaniet officitis millecu sdandit quod quidunt lab illorem verro es dicimi, ulpa et od quo dit alibus essus si blabor molor sim dolut porpos corecep ressit, nem am il eum alicaerum

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.11 – Annual Report Template – Page 11

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 12

Cont...Resources Adequacy Performance Metrics

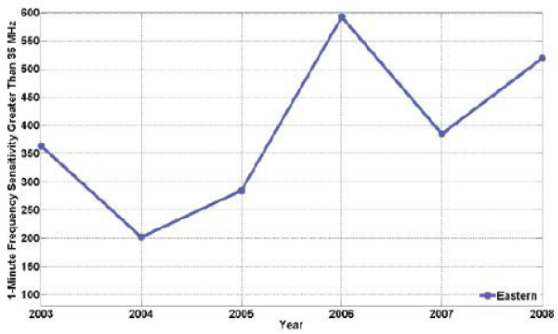


Fig.39 - Eastern 1-Minute Frequency Delta

6.5 Western Interconnections CPS1 Trend

Et pro blaborum, cusae. Nequam, quodi id utem dollit utemquia pore landuntiis enduntiis eiuntibus, soles re optureprem fugiamet ea sequo culpa sus et quia quo que et lant experiorum sim num eosapicium, odis archiciis doluptinvel moles delibusandis evel incturem num

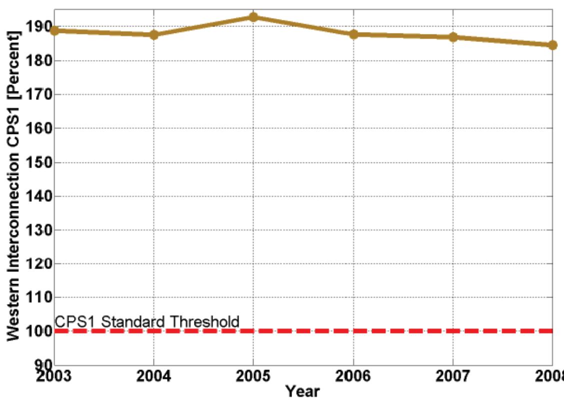


Fig.40 - Western CPS1 Trend

6.6 Western Interconnections CPS2 Trend

Atiunt et unt mi, nusciendis et que porumqui omnis moluptae perspitatios et quiae cus doloreium quas reiciat iurior maximol uptatur? Quia corum, optamus doluptatiore exernat quatiur ra consenduci sunto qui officatia si debis eossi re cusanistrum essum

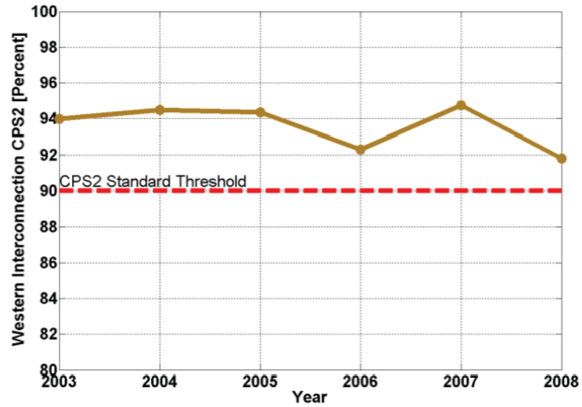


Fig.41 - Western CPS2 Trend

6.7 Western Interconnections Epsilon Trend

Aboreseraeri nem doluptaspis volorrumquia dus ipsant qui aliquib ustiis reperro ea dolesciatur aciliquo te laut lis doluptam as doloreium lab iur sequi non re sum ut re volupicipit quasimi ncilles eum niaecatus, sedici consecea que landis atemposa volor magnimi, est

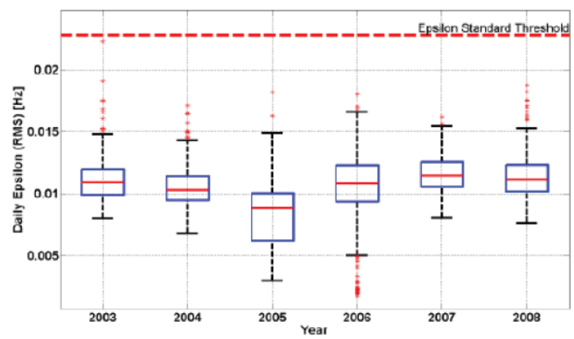


Fig.42 - Western Epsilon Trend

6.8 Western Interconnections 1-Minute Frequency Delta

Igendipid minction renimpore vel ilite vel ea pe nost, que simus. Mil ea vel ipsandit maximilit, qui inti quodist lam lanimpo riberi dolore, occus dia qui consed endit landaeperro to et autemo imusdam sum es maxim aut harum experum licabo. Im rempel mo et estiis

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.12 – Annual Report Template – Page 12

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 13

Cont...Resources Adequacy Performance Metrics

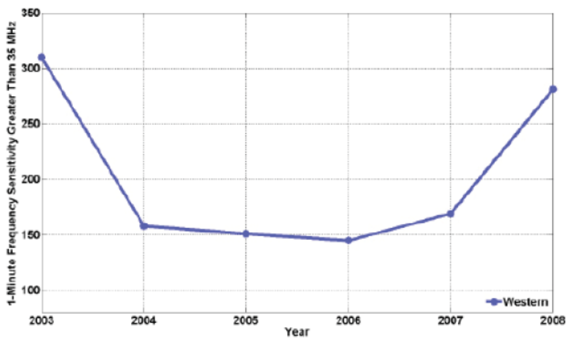


Fig.43- Western 1-Minute Frequency Delta Trend

6.9 ERCOT Interconnections CPS1 Trend

Ebis si utae autemod quasit lab ipsapel ma que nectio eost et esequia si blab incim soluptatus ut paribusam vendit acepel int aut qui illis re est, tem inum, simpeli gnisquis apis et ad utaepercia doluptate rehendunt fugiasit officipicit maximodiam volores am sequiducipit

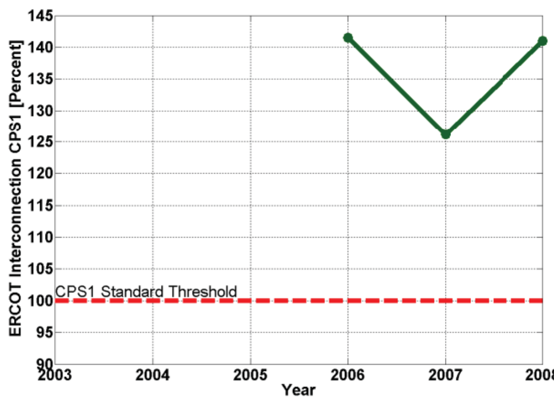


Fig.44 - ERCOT CPS1 Trend

6.10 ERCOT Interconnections CPS2 Trend During 2008 tNequi blabo. Non experum rerum dolore ipit magnis exerum fugia quam id que dolore nulpa quossimus a ditaturibus, odic to blam rerit, ipsunt et ut et lanimag nimpelissed et et, quiat.

Ecus pa dolor sinveruptur? Icil mostio quisci ut dem quidipsae is

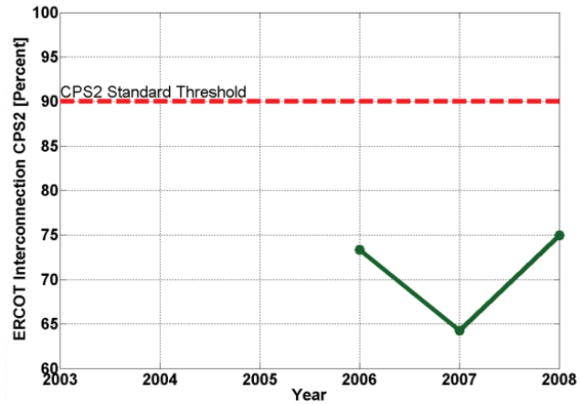


Fig.45 - ERCOT CPS2 Trend

6.11 ERCOT Interconnections Epsilon Trend

Sedicips andantur apictio. Optaqui corehent vendio. Iciis et eatur audae recte nam alia core lab ipsunt venihic te porrovid eatem volorum quisint.

Ucid ma nonsequ amenti to dolo et am everferibus, to dolore prae

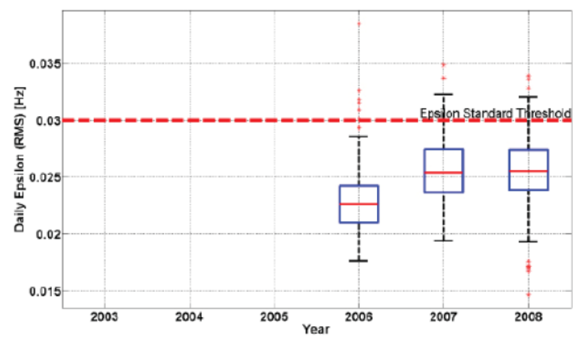


Fig.46 - ERCOT Interconnections Epsilon Trend

6.12 ERCOT Interconnections 1-Minute Frequency Delta

Nim renditatur, ulparumquam, sandis elic teceaqui tendicab ium qui re voluptate aut quossequo doluptate cum id eicietum eos prorrum fuga. Nequo dis et quia porum aperunt ionecatibus.

Obit volupta nihil iur minit res et rerfers perchit aut laut dollandem

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.13 – Annual Report Template – Page 13

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 14

Cont...Resources Adequacy Performance Metrics

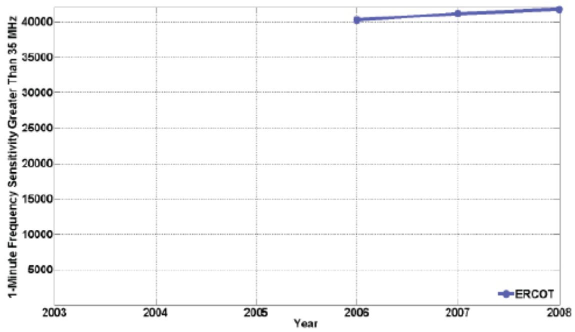


Fig.47 - ERCOT Interconnections 1-Minute Frequency Delta

7. EACH INTERCONNECTION RELIABILITY PERFORMANCE USING FREQUENCY DEVIATION (EPSILON) WITH STATISTICAL CONTROL CHARTS

The 1-Minute frequency deviation or Epsilon (actual - scheduled frequency) was selected as the metric to use to identify load-generation adequacy and control performance using key statistics from the load-generation process control. The Xbar-R Statistical Process Control (SPC) chart is use to present Epsilon performance for the 2008 hour-type, day-of-week and month for each interconnection.

7.1 Eastern Interconnection Hour-Type Performance

The Eastern hourly SPC charts show that RMS mean performance during hours 7, 23 and 24 were above the mean upper UCL limit an indicator of inadequate load-generation resource imbalances.

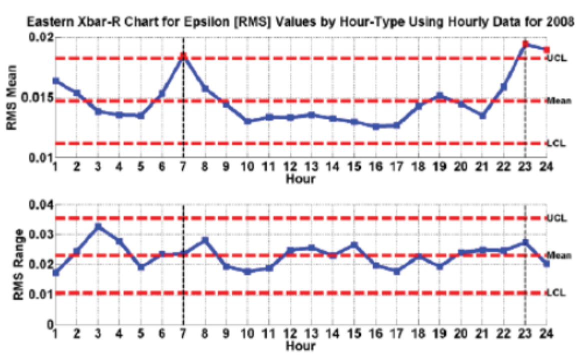


Fig.48 - Eastern 2008 Hourly-Type Performance

7.2 Eastern Interconnection Day-Type Performance

The Eastern daily SPC charts show that RMS range performance on Wednesadys was above the upper limit UCL, and indicator of inadequate load-generation and control variability.

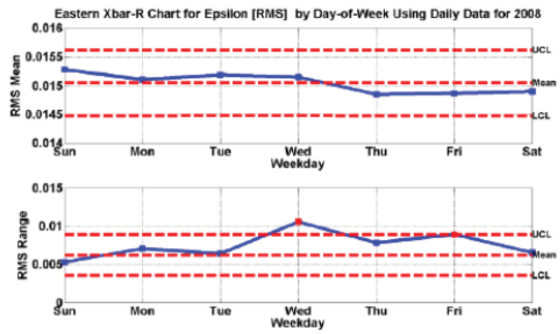


Fig.49 - Eastern 2008 Day-Type Performance

7.3 Eastern Interconnection Monthly Performance

The Eastern monthly SPC charts show that RMS mean performance during May was above the acceptable statistical limit, an indicator of poor load-generation adequacy and control performance, and that the RMS mean performance during November and December was below the statistical limit, an indicator of load-generation adequacy and control improvements.

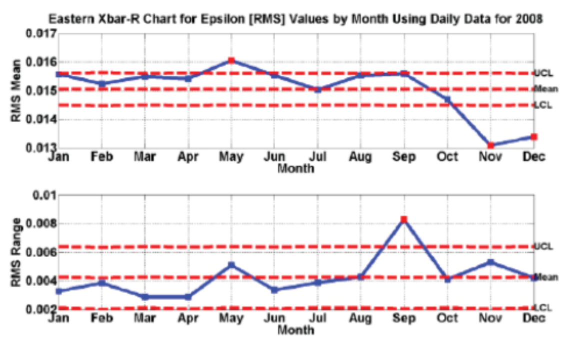


Fig.50 - Eastern 2008 Monthly Performance

7.4 Western Interconnection Hour-Type Performance

The Western hourly SPC charts show that RMS range performance for hours 12 and 14 was above the upper limit UCL, and indicator of inadequate load-generation and control variability.

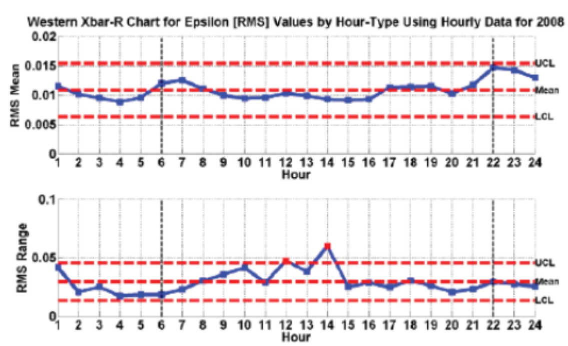


Fig.51 - Western 2008 Hour-Type Performance

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.14 – Annual Report Template – Page 14

INTERCONNECTIONS ANNUAL RELIABILITY REPORT

Report for: Year 2008
Page: 15

7.5 Western Interconnection Daily-Type Performance

The Western SPC charts show all day-types during 2008 remained within the upper and lower UCL and LCL control limits

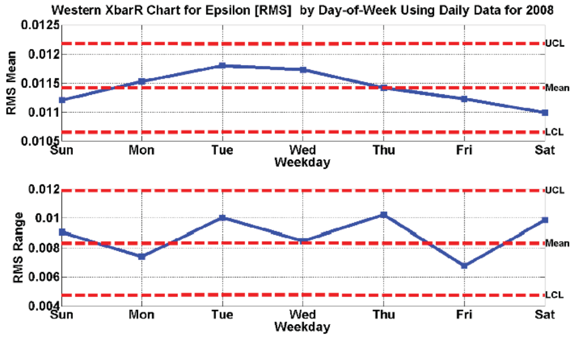


Fig.52 - Western 2008 Daily-Type Performance

7.6 Western Interconnection Monthly Performance

The Western monthly SPC charts show that RMS mean performance during Juen, August and September were above the acceptable statistical limit, an indicator of poor load-generation adequacy and control performance, and that the RMS range performance during May and August were below the statistical limit, an indicator of inadequate load-generation adequacy and control variability.

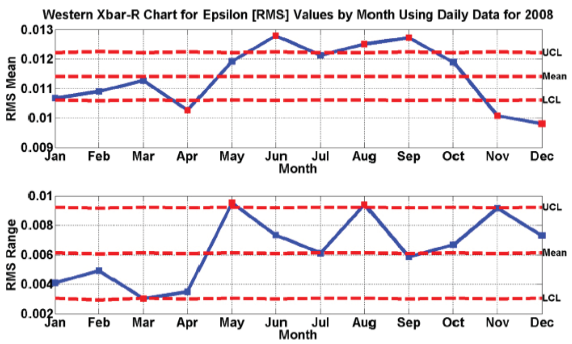


Fig.53 - Western 2008 Monthly Performance

7.7 ERCOT Interconnection Hour-Type Performance

he ERCOT SPC charts show all hourly-types during 2008 remained within the upper and lower UCL and LCL control limits

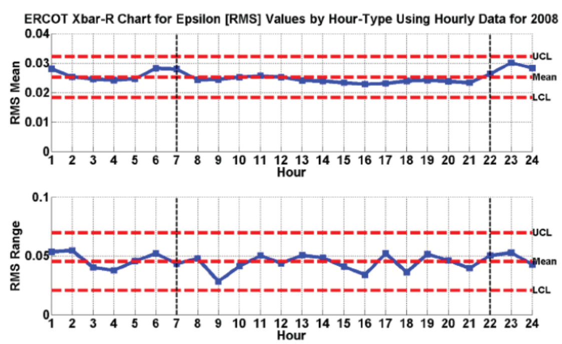


Fig.54 - ERCOT 2008 Hour-Type Performance

7.8 ERCOT Interconnection Day-Type Performance

The ERCOT daily SPC charts show that RMS range performance for thursdays was above the upper limit UCL, and indicator of inadequate load-generation and control variability.

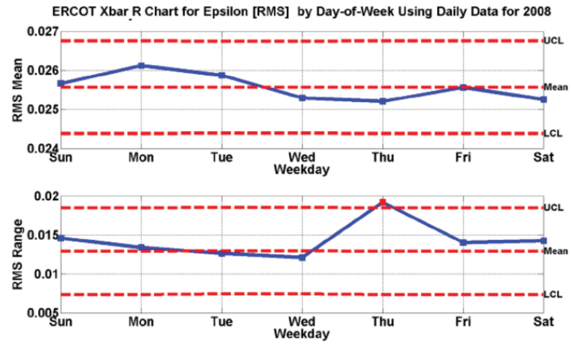


Fig.55 - ERCOT 2008 Day-Type Performance

7.9 ERCOT Interconnection Monthly Performance

The ERCOT monthly SPC charts show that RMS mean performance during February, March, May and September were above the acceptable statistical limit, an indicator of poor load-generation adequacy and control performance, and that the RMS mean performance during July, November and December were below the statistical limit, an indicator of load-generation adequacy and control improvements.

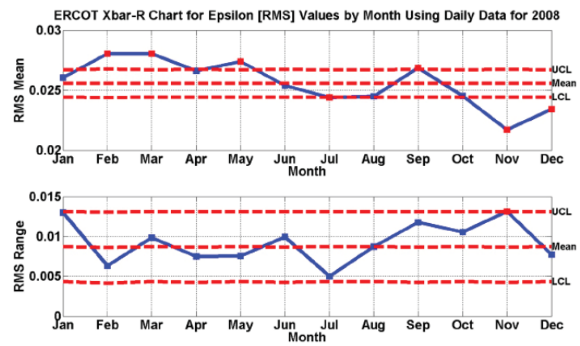


Fig.56 - ERCOT 2008 Monthly Performance

DISCLAIMER - Report is generated automatically by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement

Figure 8.3.15 – Annual Report Template – Page 15

9. IMPLEMENTATION PLAN AND SCHEDULE

9.1 Time-Table

The following table lists all the major development activities and provides an estimated completion date given that major development will begin March 27, 2009.

For prototype testing and field testing of ARR at FERC, data will be accessed from the NERC data base and CERTS/EPG applications as is being done at present.

Table 9.1 - ARR Development Time Table

No.	Development Activity	Est. Comp. Date
1	Functional Specification Approved	3/27/2009
2	Database Schema	3/27/2009
3	Data Collection Service	4/10/2009
4	Daily Report and Framework	4/24/2009
5	Monthly Report	5/15/2009
6	Seasonal Report	5/22/2009
7	Yearly Report	5/22/2009
8	Email Service	4/17/2009
9	Web Site	4/24/2009
10	Install Services at NERC	TBD by NERC
11	FAT Daily Reports	5/01/2009
12	FAT All Reports	
13	Client Installation at Users Site	TBD by FERC
14	**Delivery, Field Test, Training at FERC**	6/12/2009
15	Production Server at NERC	TBD by NERC
16	Future Support and Maintenance for production version. To be defined by FERC-NERC	8/29/09

ATTACHMENT-A

SOFTWARE SYSTEM COMPONENTS

1. Overview

The Automated Reliability Reports (ARR) system is a series of software components that are designed to gather data from various locations, store the data in a local database, compile the analysis of the data into a PDF report, and send the report to users via email. There will also be a website to allow the users to request historical reports as well as generate a report for the current day. The main software components of this system are a) the Database that will house the all data. b) The Data Collection service that will download all the data from the various sources on a daily bases. c) The Report Generator which contains the logic and intelligence for producing the report and storing it in PDF form. d) The Email service that will send the report to each user. e) The new website that will allow users to request the reports directly.

2. ARR Database

2.1 The database will be created using Microsoft SQL Server 2005. It will store up to 5 years of data. The design of the database will be centered on the data components necessary to create the daily reports. These data components include SCADA Data from NERC, Intelligent Alarms, and Frequency Events data from the FMA system.

3. ARR Data Collection

3.1 The Data Collection service is a Windows Service that is designed to run autonomously once per day to do the following:

3.2 It will connect to NERC via a Web Service to download the necessary SCADA data for each Interconnection.

3.3 It will connect to the Intelligent Alarm database via a Web Service to download any BAAL alarms that may have occurred in the last 24 hours.

3.4 For each BAAL alarm, this service will connect to the FMA database and download the Frequency Event data.

3.5 The daily data will server as a base for calculating data for the Monthly, Seasonal, and Yearly reports. This service will be designed with an automatic recovery system to help contend with data being unavailable. This recovery system will include logging each failure to the Event manager, emailing the failure to the System Administrator, and trying to download the again within an hour or so.

4. ARR Report Generator

4.1 The Report Generator is a Windows Service that will on a daily basis extract the data stored in the ARR Database and generates the Daily Report by adding in the required intelligent text, tables, graphs, and analysis. The Service will also create the Monthly, Seasonal, and Yearly reports at a predetermined time. It will store the report in "Portable Document Format" (PDF) and save it on the server. This service will log its progress in the Event manager where it can be monitored by the System Administrator.

5. ARR Email Service

5.1 The Email Service is a Windows Service designed to work with the Microsoft SMTP service available on the server. This service will on a daily basis, download a list of pre-authorized users email addresses from the ARR Database, generate the email message with the appropriate text in the subject and body, attach the PDF report, place, and email it to all the users individually.

5.2 This service will be configured with a valid domain name and return email address to avoid issues such as "SPAM".

6. ARR Website

6.1 The website will be a secure portal for pre-authorized users to request archived reports as well as generate new reports for the current date and time. To access the website, each user will be assigned a username and password. Users will be able to browse and print past reports (Daily, Monthly, Seasonal, and Yearly) and/or download them in PDF form.

6.2 The website will also contain an administrative component whereby a few users can update the email list of users receiving automatic reports.

ATTACHMENT-B

REQUIRED INPUT DATA SOURCES AND CALCULATIONS

1. Data Sources and Calculations for Daily Report

1.1 Data Sources, Calculations and thresholds to define number of hours for Error! Reference source not found.: (SONG/FRANK TO DEFINE SPECIFIC TABLES AND UPDATE CONSTANTS FOR 2009)

Data Sources for Table-3 **:** NERC database Under_Freq_Load_Drop table

Thresholds: CERTS-EPG have defined the following resource adequacy four alarm-areas for load-generation unbalance following both industry traditional system security concepts and the NERC work and definitions for their new Balancing Authority ACE Limit (BAAL) performance metric:
Normal Area – Load-generation unbalance does not force interconnections frequency to violate any of the three BAAL frequency performance thresholds, and system can tolerate generation or load contingency without violating any BAAL frequency limit.
Alert Area – Load-generation unbalance is violating the first BAAL frequency threshold (FTL) and the risk and impact of a second contingency become greater than acceptable. Reliability Coordinators required to take remedial action.
Emergency Area – Load-generation unbalance is violating the second BAAL frequency threshold (FAL) and the system is exposed to unacceptable level of risk. Customers load maybe be dropped, restoration procedures in place.
Load Drop Area – System frequency violates the third BAAL frequency threshold (FRL) and frequency relays have triggered and load has already being dropped, restoration procedures in place.

1.2 Data Sources and Calculation for Table-3: (SONG/FRANK TO DEFINE SPECIFIC TABLES AND UPDATE CONSTANTS FOR 2009)

CPS1 Daily Calculation

$$\mathbf{CPS1}_{1-minute,int} = \left(2 - \mathbf{NetACE}_{1-minute} \times \frac{\mathbf{Frequency}_{1-minute} - \mathbf{SchedualFrequency}}{10 \times \mathbf{abs}(\mathbf{FreqBias}_{int}) \times \varepsilon^2}\right) \times 100\%$$

$$\mathbf{NetACE}_{1-minute} = \sum \mathbf{ACE}_{1-minute,BA}$$

ε: a system constant.

	Eastern	Western	Ercot	Hydro-Qubec
ε	0.018	0.0228	0.030	0.021
2008 FreqBias Change every year	6779	2106	430	651

Daily $CPS1_{int}$ is average of all 1-minute $CPS1_{int}$ in the day.
Threshold: 100%.
If CPS1≥100%, Control Compliance Rating=Pass
If CPS<100%, Control Compliance Rating=Fail

CPS2 Daily Calculation

Violation definition: For each 10 minute period,

$$\mathbf{abs(NetACE_{10-minute,Avg}) \le 1.65 \times \varepsilon_{10} \times 10 \times abs(FreqBias_{int})}$$

$$\mathbf{NetACE_{10-minute,Avg} = Avg(NetACE_{1-minute})}$$

$$\mathbf{NetACE_{1-minute} = \sum_{interc} ACE_{1-minute,BA}}$$

	Eastern	Western	Ercot	Hydro-Qubec
ε_{10}	0.0057	0.0073	0.0073	0.0249

If $\mathbf{abs(NetACE_{10-minute,Avg}) \le 1.65 \times \varepsilon_{10} \times 10 \times abs(FreqBias_{int})}$ *violation=0*

If $\mathbf{abs(NetACE_{10-minute,Avg}) > 1.65 \times \varepsilon_{10} \times 10 \times abs(FreqBias_{int})}$ *violation=1*

Daily CPS2= [1-(# violaton in the day/# available 10 minute periods in the day)]×*100%*
Threshold: 90%.
If CPS1≥90%, Control Compliance Rating=Pass
If CPS<90%, Control Compliance Rating=Fail

BAAL 30-Minute Calculation

$$\mathbf{BAAL_{Low} = 10 \times abs(FreqBias_{int}) \times \frac{(FTL_{Low} - SchedualFrequency)^2}{(Frequency - SchedualFrequency)}}$$

$$\mathbf{BAAL_{High} = 10 \times abs(FreqBias_{int}) \times \frac{(FTL_{High} - SchedualFrequency)^2}{(Frequency - SchedualFrequency)}}$$

BAAL Low violation: if Frequency< SchedualFrequency, it is a violation when ACE < $BAAL_{Low}$
BAAL High violation: if Frequency> SchedualFrequency, it is a violation when ACE> $BAAL_{High}$
Threshold: 30 minutes. If Balancing Authority has exceeded BAAL for 30 minutes. It is BAAL 30-Minute Violation.

BAAL limit also can be written in CPS1.

$$\mathbf{CPS1_{1-minute,int} = \left(2 - NetACE_{1-minute} \times \frac{Frequency_{1-minute} - SchedualFrequency}{10 \times abs(FreqBias_{int}) \times \varepsilon^2}\right) \times 100\%}$$

$$\mathbf{CPS1_{1-minute,int} = \left(2 - BAAL \times \frac{Frequency_{1-minute} - SchedualFrequency}{10 \times abs(FreqBias_{int}) \times \varepsilon^2}\right) \times 100\%}$$

$$\mathbf{= \left(2 - 10 \times abs(FreqBias_{int}) \times \frac{(FTL - SchedualFrequency)^2}{(Frequency - SchedualFrequency)} \times \frac{Frequency_{1-minute} - SchedualFrequency}{10 \times abs(FreqBias_{int}) \times \varepsilon^2}\right) \times 100\%}$$

$$\mathbf{= \left(2 - \frac{(FTL - SchedualFrequency)^2}{\varepsilon^2}\right) \times 100\%}$$

For eastern, FTL_{Low}*=59.95,*FTL_{High}*=60.05 and* ε=0.018 *, BAAL limit in CPS1=-572%*
For western, FTL_{Low}*=59.93,*FTL_{High}*=60.07 and* ε=0.0228 *, BAAL limit in CPS1=-742%*
For ercot, FTL_{Low}*=59.932,*FTL_{High}*=60.068 and* ε=0.030 *, BAAL limit in CPS1=-314%*
For Hydro Quebec, FTL_{Low}*=59.932,*FTL_{High}*=60.068 and* ε=0.021*, BAAL limit in CPS1= 849%*

DCS Minutes to Return to Normal Calculation

When there is a frequency drop, 1-minute frequency change>=35mHz, the minutes for frequency return to its pre-disturbance value or schedule frequency.
Threshold: 15 minutes.

1.3 **Data sources and calculations for Table-4:** (SONG/FRANK TO DEFINE SPECIFIC TABLES AND UPDATE CONSTANTS FOR 2009)

FTL Calculation

	Eastern	Western	Ercot	Hydro-Quebec
FTL Low	59.95	59.93	59.932	
FTL High	60.05	60.07	60.068	

Threshold: 5 minutes

FAL Calculation

	Eastern	Western	Ercot	Hydro-Quebec
FAL Low	59.908	59.8	59.622	
FAL High	60.092	60.2	60.378	

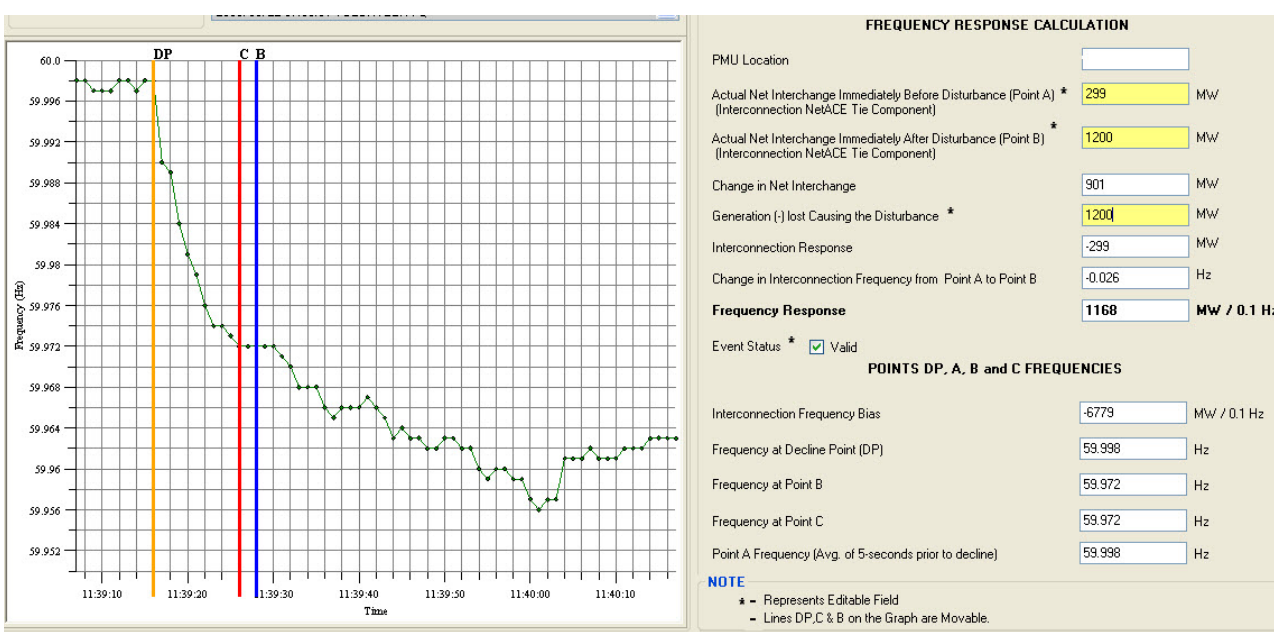
Threshold: 1 minute

FRL Calculation

	Eastern	Western	Ercot	Hydro-Quebec
FRL Low	59.820	59.5	59.300	
FRL High	60.180	60.5	60.700	

Threshold: 1 minute

1.4 **Data Sources and Calculations for Frequency Response Events**: (SONG/FRANK TO DEFINE SPECIFIC TABLES AND UPDATE CONSTANTS FOR 2009)



For 2006 Eastern Interconnection, Freqbias=6756MW/0.1Hz
NetACEbias=10×abs(freqbias) × (freq-schedfreq)
NetACETies=NetACE- NetACEbias

Point	Freq(Hz)	NetACE	NetACEbias	NetACETies
A	60.001	37	63	-25
B	59.888	-3249	-7567	4318

Step 1: Net ACE ties at point A	-25
Step 2: Net ACE ties at point B	4318
Step 3: step 2-step 1	4343
Step 4: NetACE FreqBias component at point A - NetACE FreqBias component at point B	7629
Step 5: step 3-step 4	-3286
Step 6: frequency B-frequency A	-0.113
Step 7: step 5/(10*step 6) (MW/0.1Hz)	2910

1.5 Summary statistics showing those Balancing Authorities that are the most probable root causes for an event

Method: NERC Store procedure - CorrelationData