

*Consortium for  
Electric  
Reliability  
Technology  
Solutions*

## **Automated Reliability Reports Project**

# **Transmission Adequacy Performance Metrics Reports (TAPMR) Prototype Project**

August 2010



**NERC**  
NORTH AMERICAN ELECTRIC  
RELIABILITY CORPORATION

**CERTS**  
CONSORTIUM FOR ELECTRIC RELIABILITY TECHNOLOGY SOLUTIONS

 **Electric Power Group**

# TAPMR Project Presentation Overview

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- Transmission Adequacy Performance Metrics Report (TAPMR) – Prototype Project Background
- Overview of Load-Generation and Transmission Adequacy Reports
- Transmission Reliability Reports Objective and Value
- Pre-Contingency Transmission Adequacy Metrics
- Data Sources and Data Communications
- Reports Typical Summary Tables
- Reports Typical Performance Charts
- TAPMR Project Schedule



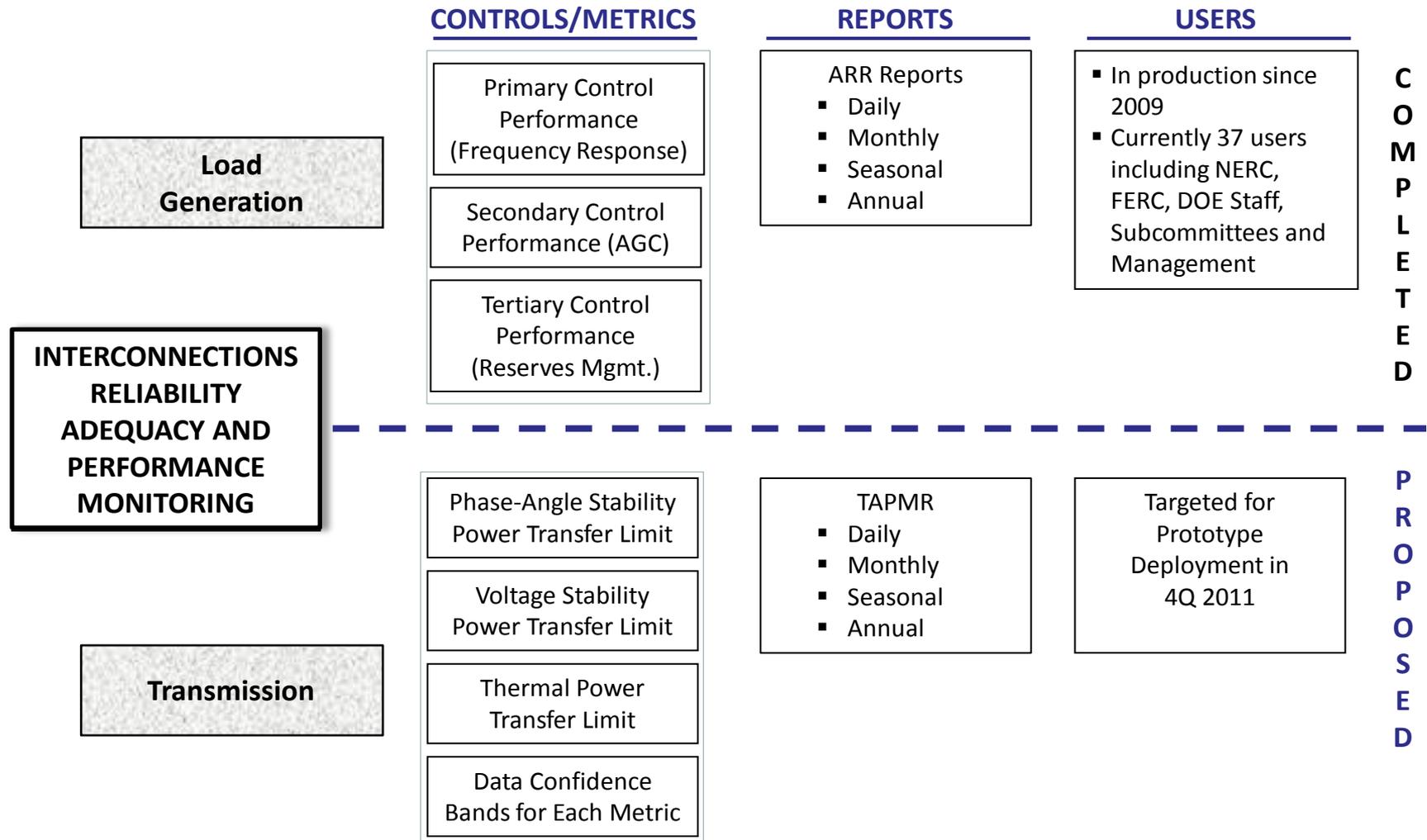
# TAPMR Prototype Project Background

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- August, 2008 – DOE, FERC and NERC Staff and Management consensus on the need and value for Load-Generation Adequacy Automated Reliability Reports (ARR) presented by CERTS/EPG
- January, 2009 – DOE and FERC agreed to fund research and prototype development of ARR, and NERC agreed to budget for ARR support and maintenance effective Jan 1, 2010
- October, 2009 – ARR production version delivered to NERC, FERC and DOE. Currently there are 37 authorized users
- October, 2009 – DOE agreed to fund CERTS research on transmission adequacy performance metrics. University of Illinois and EPG research results confirmed feasibility of creating a transmission adequacy report based on four pre-contingency metrics to complement ARR
- August, 2010 - Research results targeted for presentation to NERC, FERC and DOE
- September, 2010 – Complete research for transmission adequacy performance metrics and start TAPMR prototype project with DOE-FERC funding for research validation and prototype development. Implementation will require NERC support and maintenance contract as was the case with ARR



# Overview of Load-Generation Adequacy (ARR) and Transmission Adequacy (TAPMR) Reports



# TAPMR Prototype Objective and Value

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**Objective** – Develop and implement TAPMR to provide periodic automated reports (daily, monthly etc) for pre-contingency transmission adequacy including performance metrics on grid stress, use and adequacy: phase angle stability limits, voltage stability limits and thermal limits

**Value** - The TAPMR reports will provide:

- Comparative performance assessment of transmission performance of the three NERC Interconnections
- Identify key trends on interconnections grid adequacy performance
- Identify, track and quantify current or emerging grid reliability issues such as power transfer limits and impact on Total Transfer Capability (TTC)
- Assess grid reliability performance relative to industry established standards and statistical base control thresholds where applicable
- Assess current grid reliability performance standards adequacy and need for re-tuning or new standards



# Pre-Contingency Transmission Adequacy Metrics

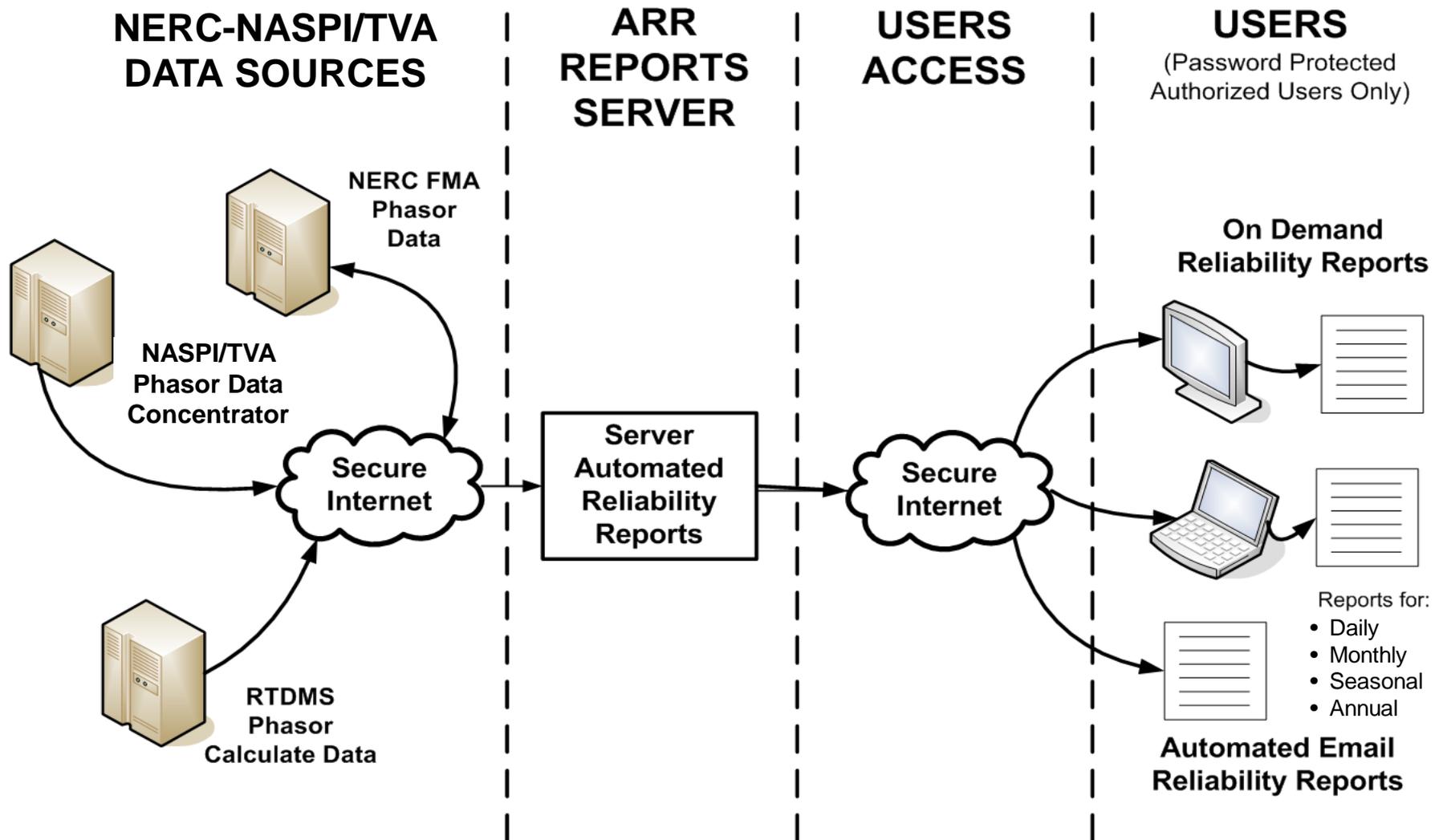
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**Three Deterministic Transmission Adequacy Performance Metrics.**  
**For each Interconnection and Reliability Region Develop Transmission Adequacy Performance Metrics Using:**

- **Phase Angle Stability (TAM1)** – Hourly metric calculated as the minimum 1-second differential between flows calculated using phasor actual phase angle minus the estimate static maximum power transfer limit.
- **Voltage Drop Limits (TAM2)** – Hourly RMS of the difference between the pre-determine allow voltage drop (rated voltage plus 5%) and the phasor measure actual voltage magnitude.
- **Thermal Limits (TAM3)** – Hourly metric calculated as the minimum 1-second differential between the flows based on measured phasor current and thermal maximum allow limit defined as 3 times the Source Impedance Loading (SIL)
- **Composite Transmission Adequacy Metric (CTAM)** – (still being researched)

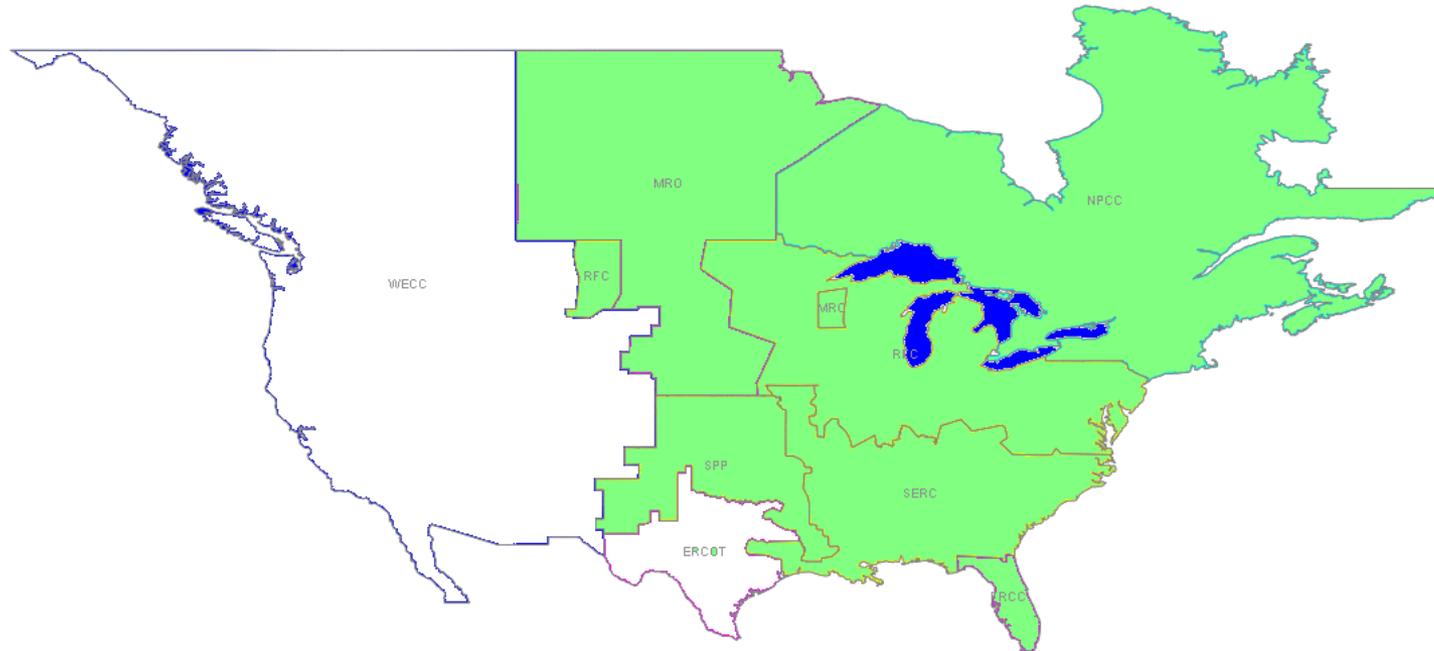


# TAPMR Data Sources & Data Communications



# TAPMR Prototype Target – Eastern Interconnection Reliability Regions

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***TAPMR Daily Report***  
***Reports Typical Summary Tables***

# ***Daily Report Summary Table Components***

## ***Interconnections Transmission Adequacy Margins***

*Illustrative*

<b>Interconnections Transmission Adequacy Margins</b>				
<b>Interconnection</b>	<b>Angle Margin %</b>	<b>Voltage Margin %</b>	<b>Thermal Margin %</b>	<b>Observations</b>
Eastern	30	80	25	Pre-Contingency



# Daily Report Components - Reliability

## Coordinators Transmission Adequacy Margins

### Illustrative

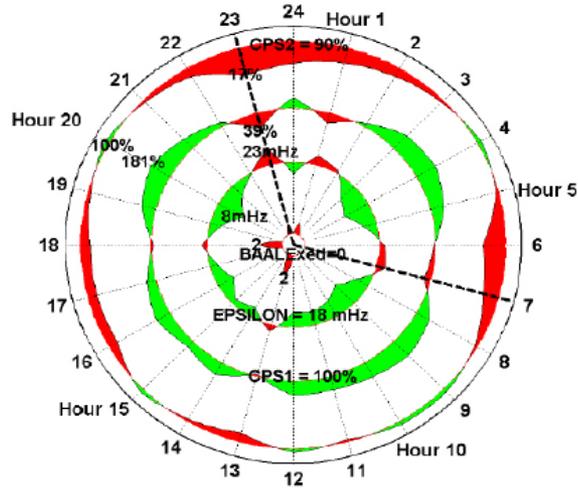
Interconnections Transmission Adequacy Margins				
Interconnection	Angle Margin %	Voltage Margin %	Thermal Margin %	Observations
ONT (IESO)	30	80	25	Pre-Contingency
ISONE	42	60	38	Pre-Contingency
NBSO	53	85	45	Pre-Contingency
NYISO	30	80	25	Pre-Contingency
PJM	42	60	38	Pre-Contingency
MISO	53	85	45	Pre-Contingency
SPRC	30	80	25	Pre-Contingency
VACAR	42	60	38	Pre-Contingency
TVA	53	85	45	Pre-Contingency
SOCO	30	80	25	Pre-Contingency
FRCC	42	60	38	Pre-Contingency
SPP	53	85	45	Pre-Contingency
ICTE	30	80	25	Pre-Contingency



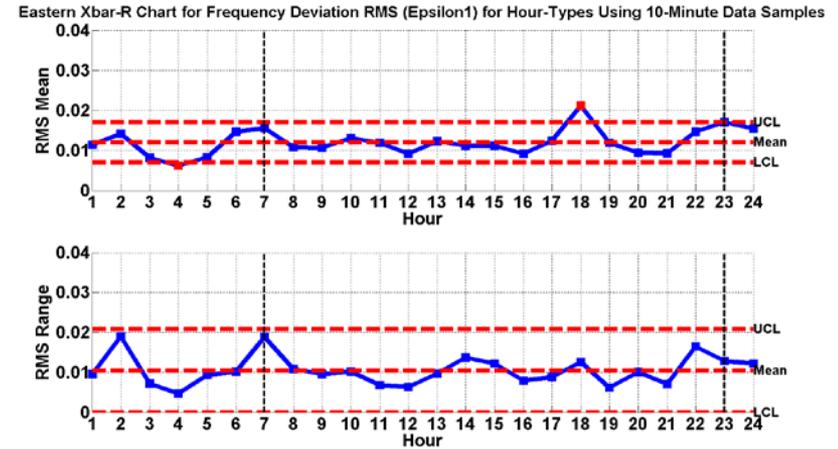
***TAPMR Daily Report***  
***Samples of Typical Performance Charts***

# Daily Report - Chart-Types for 24-Hour Transmission Adequacy Performance - Illustrative

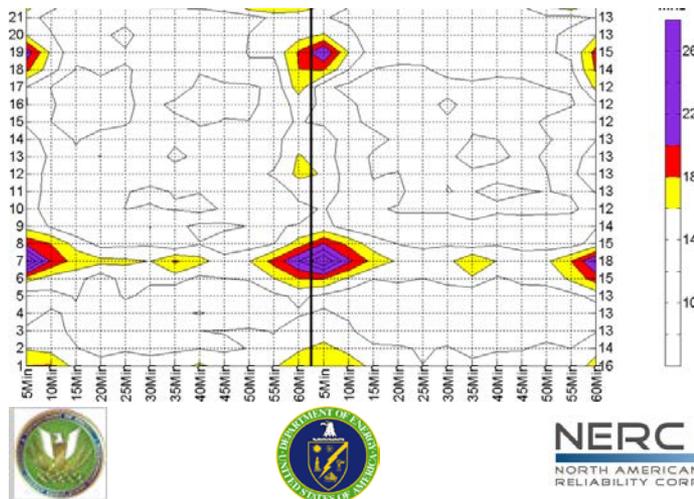
## Chart-Type for Overlapping Performance Metrics



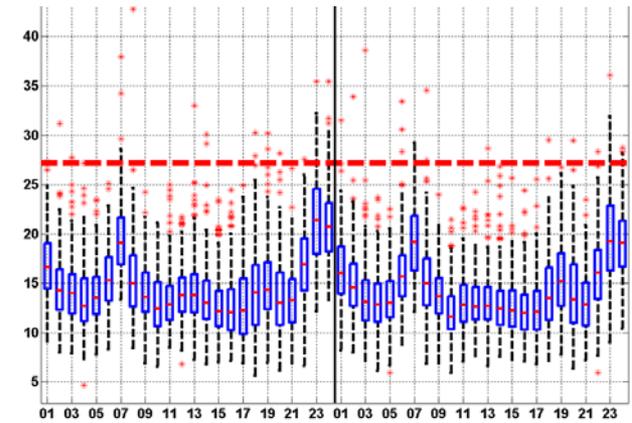
## Chart-Type to Show Hourly Metrics Performance



## Chart-Type to Show 5-Minute Metrics Performance



## Chart-Type to Show Metrics Statistical Assessment



***TAPMR Daily Report***  
***Similar Structure as Production***  
***Load-Generation Adequacy ARR Report***

# Daily Report Layout - Introduction and Summary

## Illustrative

### INTERCONNECTIONS DAILY RELIABILITY REPORT

Report from: 04/02/09-7AM  
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<sup>1</sup> (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 imbalance 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				
Interconnection	NORMAL	ALERT	EMERGENCY	Observations
Eastern	22	2-Hours Energy Imbalance	No Customers Dropped	Max. Imbalance 1,681 MW

##### 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.

Interconnection	Interconnections 24-Hours Performance Metrics - Actual vs Recommended										Observations
	CPS2 - Hour Daily		CPS1 - % Daily		BAAL Exceeds Daily		DCS Minutes to Return to Normal				
	Rac	Actual	Rac	Actual	Rac	Actual	Std. Max	Actual	Std. Max	Actual	
Eastern	2.4	12	100	39	0	5	15	5			CPS1-2, BAAL Exceeded

<sup>1</sup> 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 an 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

Interconnection	Interconnections Alert State Performance Metrics						Observations
	Frequency Trigger Limit Minutes		Frequency Alert Limit Minutes		Frequency Relay Limit Minutes		
	Std. Max	Actual	Std. Max	Actual	Std. Max	Actual	
Eastern	30	5	1	0	1	0	No Violations

#### 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.

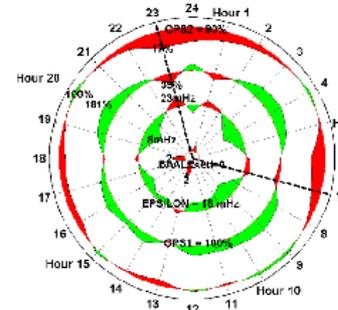


Fig 1 - Eastern Load-Generation Adequacy Performance Metrics

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

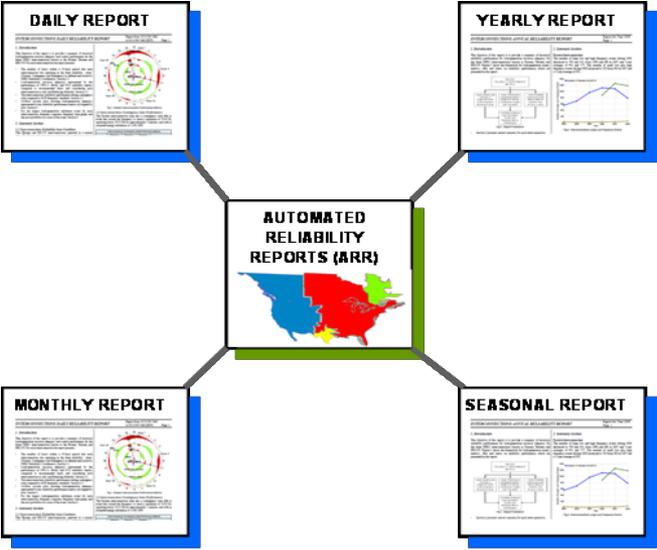
DISCLAIMER - Report is automatically generated by CERTS Automated Reliability Report application utilizing historical data from NERC. Provided solely for informational purposes  
CONFIDENTIAL - Covered under NERC Data Confidentiality Agreement



***TAPMR User Interface for Searching  
5-Year Archives, Access and Review***

# User Interface to Collect and View Reports For Last 24-Hours and 5-Year Archive

FERC Automated Reliability Reports (ARR), Release 1.0
ARR Settings
Help



**AUTOMATED RELIABILITY REPORTS (ARR)**

**Create and View Last 24-Hour Report**

Available From: MM/DD/YY HH To: MM/DD/YY HH

Create and View Last 24-Hour Report

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**Daily Reports Available, Selection and View Reports Available:**

Daily From: MM/DD/YY HH To: MM/DD/YY HH

**Select Range:**

Start Date/Time

End Date/Time

Get Reports for Selected Range:

**Reports Selected:** (Click to View in PDF Format)

03/30/2009 07:57:00 PM[STL]

03/29/2009 11:37:00 PM[STL]

03/29/2009 06:14:00 AM[STL]

03/28/2009 08:23:00 PM[STL]

03/27/2009 08:11:00 PM[STL]

03/26/2009 08:08:00 AM[STL]

03/26/2009 03:53:00 AM[STL]

03/25/2009 09:03:00 PM[STL]

03/25/2009 04:06:00 AM[STL]

03/23/2009 11:23:00 AM[STL]

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Grid 3P. U.S. Patent 7.233.483  
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# ***TAPMR Project Schedule***

# TAPMR FY 2011 Project Schedule

