

***Consortium for  
Electric  
Reliability  
Technology  
Solutions***

**Automatic  
Identification  
of Frequency  
Events and  
Freq. Response**

# **Research Results on Automatic Identification and Archive of Interconnections Frequency Events and Frequency Response**

For: RS and FRSDT

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# *PRESENTATION OUTLINE*

- *Research Results for Automatic Identification of Frequency Events and Calculated Frequency Response*
- *Frequency Response Data Collection and Archiving System - (FRDCA)*
- *NERC Applications Status and Outstanding Items for RS*

# ***AUTOMATIC IDENTIFICATION OF FREQUENCY EVENTS AND FREQUENCY RESPONSE – RESEARCH OBJECTIVES***

- Investigate and validate automatic methods and processes to identify interconnections frequency events by extending and validating the approach recommended by Florida Region Representatives using 1-second phasor frequency data and 10-second ACE data
- Validate the number of events and the Frequency Response estimates calculated for the events identified using:
  - FRSDT definitions for frequency values for points (A) and (B)
  - Largest BA-ACE for event loss MW
  - RS yearly list of events used for BA Frequency Bias calculations
- Archive for five years interconnections frequency events and its Frequency Response automatically identified and calculated, together with BAs entered Frequency Response survey data, for Stakeholders analysis, comparison and definition of interconnection periodic (yearly) event lists for calculating periodic BAs Frequency Bias

*Research Results on Automatic Identification  
of Frequency Events and  
Calculated Frequency Response*

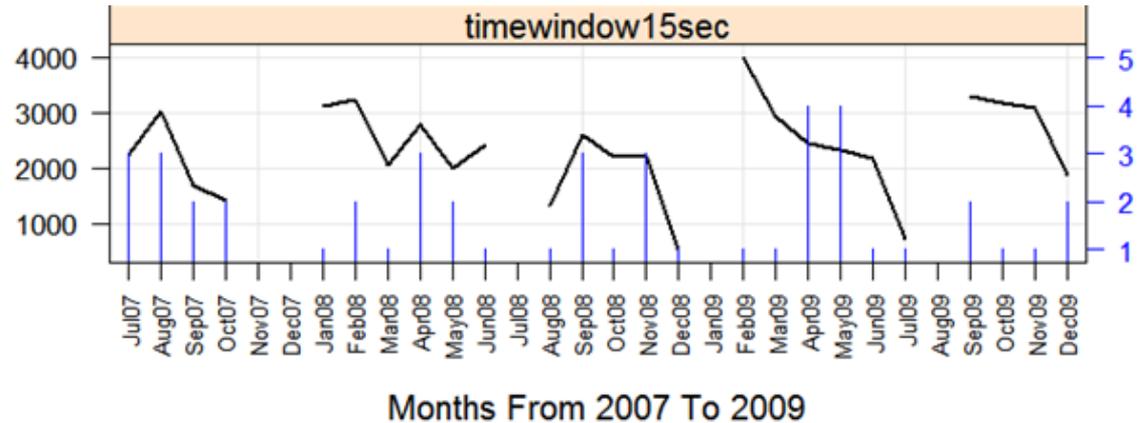
# ***AUTOMATIC IDENTIFICATION OF FREQUENCY EVENTS AND RESEARCH RESULTS AND RECOMMENDATIONS***

Project Team concluded the method recommended by the Florida Region does produce a representative and adequate set of frequency events if the size of the frequency change and/or time window is adjusted for each interconnection from the recommended 0.040 Hz and 15-second window for Eastern to the following parameters:

<b>Interconnection</b>	<b>Frequency Deviation</b>	<b>Initial Frequency for frequency declines</b>	<b>Initial Frequency for frequency increases</b>	<b>Time Windows (Sec)</b>
<b>Eastern Interconnection</b>	36 mHz	$\leq 60$ Hz	$\geq 60$ Hz	25
<b>Western Interconnection</b>	50 mHz	$\leq 60$ Hz	$\geq 60$ Hz	25
<b>ERCOT</b>	70 mHz	$\leq 60$ Hz	$\geq 60$ Hz	25

# *NUMBER OF FREQUENCY EVENTS IDENTIFIED USING FLORIDA RECOMMENDED PARAMETERS FOR EAST 0.040 Hz, 15-SECOND WINDOW AND BELOW 60.00 Hz*

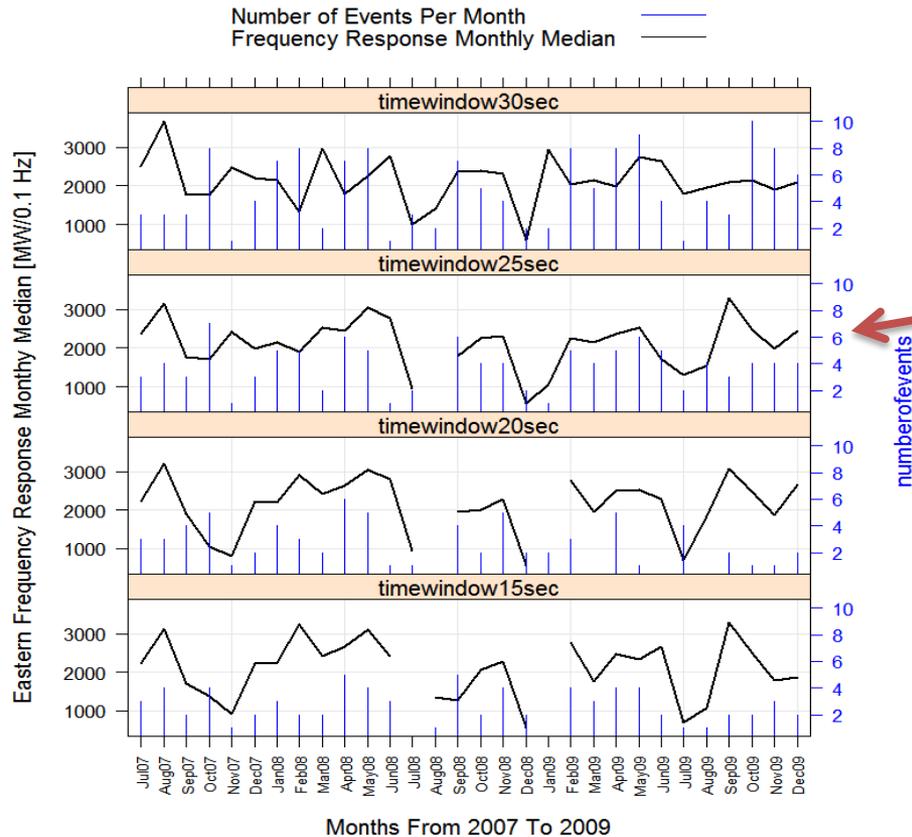
Month Year	15-Seconds Window	
	Frequency Response Median	Number of Identified Events
Jul07	2236	3
Aug07	3030	3
Sep07	1703	2
Oct07	1416	2
Nov07	NA	NA
Dec07	NA	NA
Jan08	3121	1
Feb08	3240	2
Mar08	2061	1
Apr08	2786	3
May08	2000	2
Jun08	2425	1
Jul08	NA	NA
Aug08	1338	1
Sep08	2608	3
Oct08	2193	1
Nov08	2251	3
Dec08	528	1
Jan09	NA	NA
Feb09	3993	1
Mar09	2930	1
Apr09	2460	4
May09	2334	4
Jun09	2175	1
Jul09	705	1
Aug09	NA	NA
Sep09	3305	2
Oct09	3185	1
Nov09	3091	1
Dec09	1883	2



Research results indicate Florida recommended parameters to identify and define Eastern Interconnection frequency events do not produce a representative, adequate set of frequency events.

The proposed method is capable of producing a representative and adequate set of frequency events for each interconnection if the size of the frequency change and/or time window is adjusted as recommended.

# *EASTERN NUMBER OF EVENTS USING RECOMMENDED PARAMETERS – 0.036 Hz, 25-SECOND WINDOW BELOW 60.00 Hz*

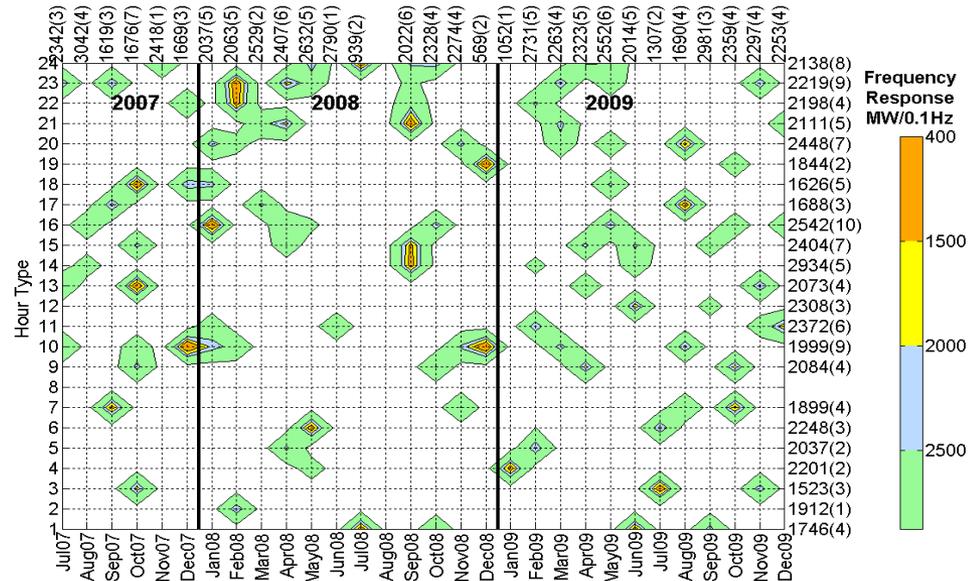
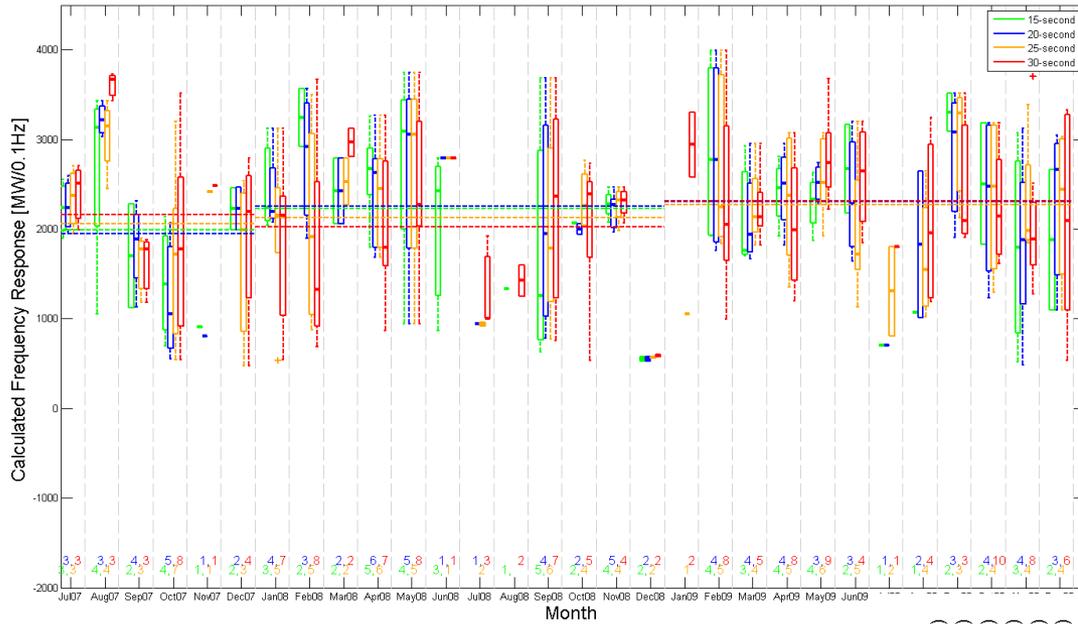


Recommended Parameters  
For Eastern Interconnection

Analysis of above results indicate that for Eastern a delta frequency of 0.036 Hz and below 60.00 Hz the 25-second event set is representative and produces an adequate list of frequency events.

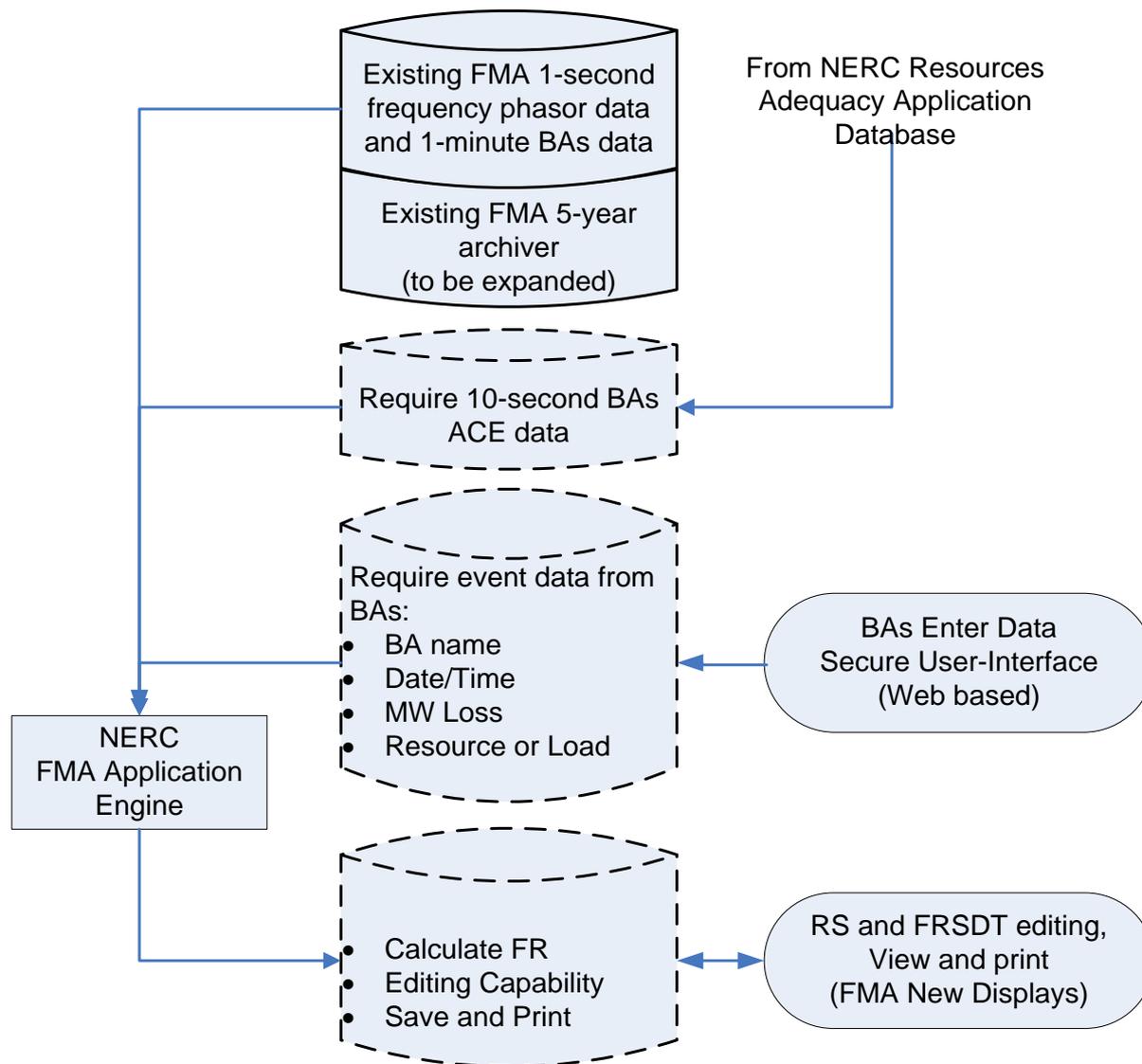
The 25-second event set contains about 4 events per month with a total of about 47 events per year, with only 1 month without events. About 50-percent of the events automatically identified match the RS produced list of events for 2009.

# CALCULATED FREQUENCY RESPONSE MEDIAN, VARIABILITY AND TIME DISTRIBUTION DURING MONTH-HOUR



*Frequency Response Data Collection  
and Archive System - FRDCA*

# FREQUENCY RESPONSE DATA COLLECTION AND ARCHIVE (FRDCA) - NERC FMA APPLICATION EXTENSION



# FRDCA-SYSTEM FOR STAKEHOLDERS EDITING OF BA ENTER EVENTS AND REAL-TIME COLLECTED EVENTS

Interconnection

Time Window For BA or Real Time Event Data

Events During Time Window

BA Entered Data for Selected Event and RS/FRSDT Editing

Frequency Response Calculated

Frequency Response Calculations for BA and Real Time Event Data

Real Time Matching Event For RS/FRSDT Editing

RS/FRSDT Save and Print

BA enter Data

Phasor 1-second and ACE 10-Second ACE Data

# FRDCA-SYSTEM FOR HISTORICAL EVENT DATA RECALL, COMPARISON AND PRINTOUT FOR ANALYSIS

Frequency Response Data Editing for FRSDT Members
Switch to FMA Client

FR Components Editing
Event Collection and Report

**Interconnection Selection**

Eastern  
  Western  
  ERCOT  
  Quebec

**Time Frame Selection**

Start Date/Time: Fri, Apr 09, 2010 12:00:00 AM  
 End Date/Time: Mon, Apr 12, 2010 7:07:47 PM

Real Time Events  
  User Entered Events  

**Sort**

Parameter Name: Date / Time  
 Order By: Descending

<input type="checkbox"/>	Date / Time	Balancing Authority	<input type="checkbox"/>
<input checked="" type="checkbox"/>	04/12/2010 18:55:14	Interconnection	<input type="checkbox"/>
<input type="checkbox"/>	04/12/2010 18:55:14	MW Loss	<input type="checkbox"/>
<input type="checkbox"/>	04/12/2010 18:55:14	Delta Frequency	<input type="checkbox"/>
<input type="checkbox"/>	04/12/2010 18:55:14	Frequency B	<input type="checkbox"/>
<input type="checkbox"/>	04/12/2010 18:46:53	PJM	<input type="checkbox"/>
<input type="checkbox"/>	04/12/2010 18:29:30	TVA	<input type="checkbox"/>
<input type="checkbox"/>	04/12/2010 18:29:27	TVA	<input type="checkbox"/>

Select All

**Frequency Response using BA data**

Data is in Eastern Prevailing Time

Area Control Error	<input type="text"/>	MW
Actual Frequency	<input type="text"/>	Hz
Scheduled Frequency	<input type="text"/>	Hz
Event Delta Frequency	<input type="text"/>	Hz
Frequency Bias	<input type="text"/>	MW / 0.1 Hz
Actual Net Interchange	<input type="text"/>	MW
Scheduled Net Interchange	<input type="text"/>	MW
MW Loss	<input type="text"/>	MW
Resource or Load	<input type="text"/>	MW
Frequency Response	<input type="text"/>	MW / 0.1 Hz

**Event Frequency Profile**

**Frequency Response using highest ACE**

DISCLAIMER - The event Frequency Response is an approximate estimate value using the best available 1-second phasor frequency data, ACE 10-Second SCADA data, and equations shown below whose definition being developed by NERC Subcommittees and Frequency Response Standard Drafting team. Provided solely for informational purposes.

<b>Event Summary :</b>		
Date/Time	4/12/2010 6:55:56 PM	
Frequency at Point A	60.0251	Hz
Frequency at Point B	60.0047	Hz
Delta Frequency	-0.0204	Hz
BA with highest Delta ACE	EES	
Highest Delta ACE	-49	MW
Frequency Bias of the BA	-227	MW / 0.1 Hz
MW Loss	-76	MW
<b>Frequency Response</b>	374	<b>MW / 0.1 Hz</b>

Sort Events from Selected Period

Events(s) Selection for Display and Print

Selected Real Time Event Time-Freq. Plot 1-Second Resolution

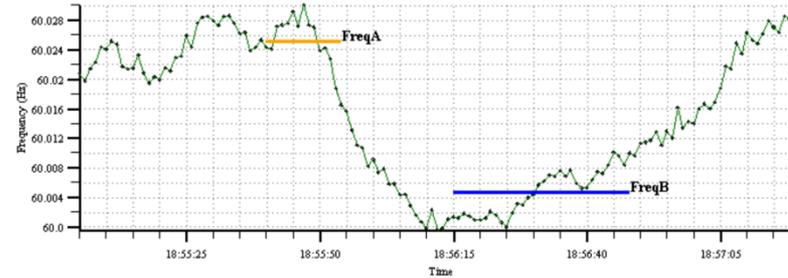
Selected Real Time Event and Frequency Response Calculation

Print Selected Events

# FREQUENCY RESPONSE DATA COLLECTION AND ARCHIVE (FRDCA) PRINTOUT OF SELECTED EVENTS – 2 EVENTS PER PAGE

## Frequency Response Event Collection Report

**Event Frequency Profile - 04/12/2010 18:55:56 EES [ EST ]**



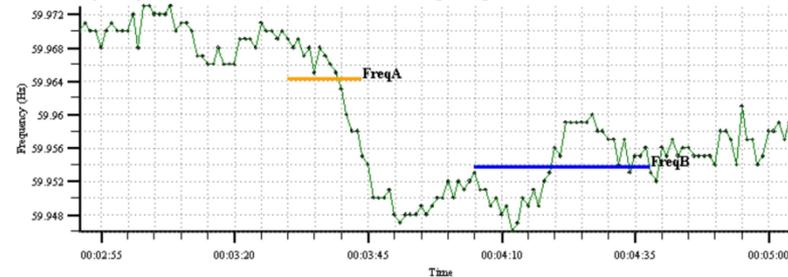
**Frequency Response using BA data**

Area Control Error : 0 MW  
 Actual Frequency : Hz  
 Scheduled Frequency : Hz  
 Event Delta Frequency : Hz  
 Frequency Bias : 0 MW/0.1Hz  
 Actual Net Interchange : 0 MW  
 Scheduled Net Interchange : 0 MW  
 MW Loss : 0 MW  
 Resource or Load : 0 MW  
 Frequency Response : NaN MW/0.1Hz

**Frequency Response using highest ACE**

Event Summary : Date/Time : 4/12/2010 6:55:56 PM  
 Frequency at Point A : 60.0251 Hz  
 Frequency at Point B : 60.0047 Hz  
 Delta Frequency : -0.0204 Hz  
 BA with highest Delta ACE : EES  
 Highest Delta ACE : -49 MW  
 Frequency Bias of the BA : -227 MW/0.1Hz  
 MW Loss : -76 MW  
 Frequency Response : 374 MW/0.1Hz

**Event Frequency Profile - 04/09/2010 00:03:46 PJM [ EST ]**



**Frequency Response using BA data**

Area Control Error : 0 MW  
 Actual Frequency : Hz  
 Scheduled Frequency : Hz  
 Event Delta Frequency : Hz  
 Frequency Bias : 0 MW/0.1Hz  
 Actual Net Interchange : 0 MW  
 Scheduled Net Interchange : 0 MW  
 MW Loss : 0 MW  
 Resource or Load : 0 MW  
 Frequency Response : NaN MW/0.1Hz

**Frequency Response using highest ACE**

Event Summary : Date/Time : 4/9/2010 12:03:46 AM  
 Frequency at Point A : 59.9643 Hz  
 Frequency at Point B : 59.9537 Hz  
 Delta Frequency : -0.0106 Hz  
 BA with highest Delta ACE : PJM  
 Highest Delta ACE : -100 MW  
 Frequency Bias of the BA : -1358 MW/0.1Hz  
 MW Loss : -186 MW  
 Frequency Response : 1755 MW/0.1Hz