

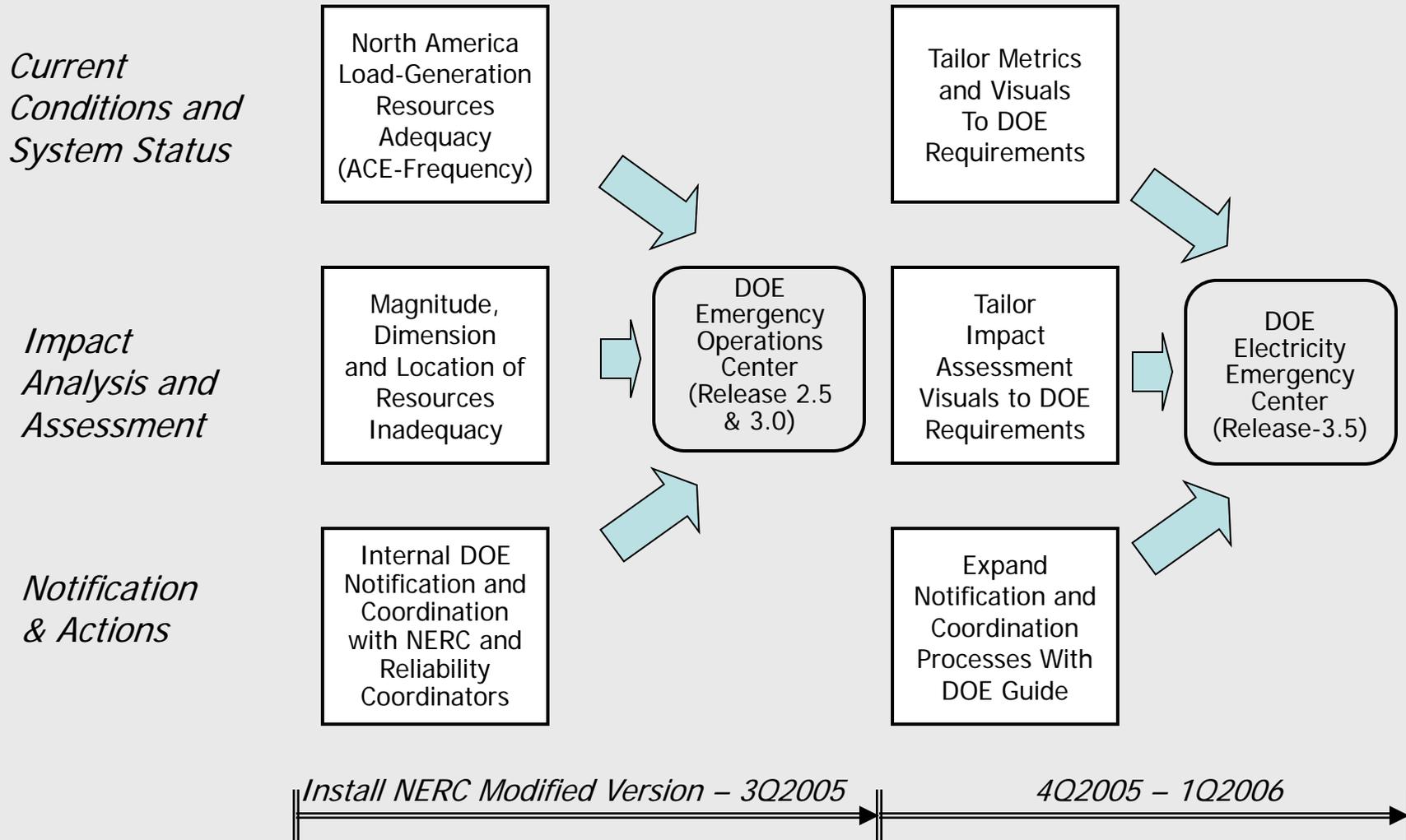
***WIDE-AREA  
RESOURCES ADEQUACY  
MONITORING AND TRACKING  
(NERC ACE-FREQUENCY)  
Release 3.0***

***Plan for DOE Deployment,  
And User Training***

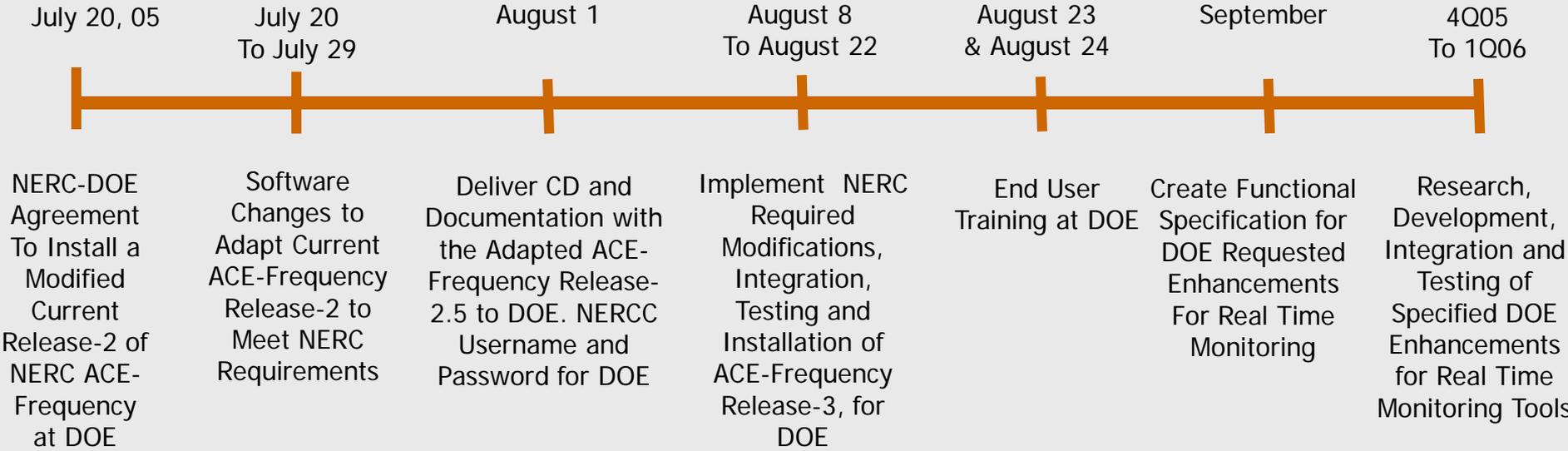
***August 23 and 24 2005***

***PLAN AND TIMELINE TO DEPLOY  
THE NERC ACE FREQUENCY APPLICATION  
AT DOE EMERGENCY CENTER***

# Recommended Approach for Enhancing DOE-EOC Electric Grid Monitoring



# Recommended Timeline for DOE Enhancements



# CERTS-NERC TOOLS PORTFOLIO ADDRESSING BLACKOUT RECOMMENDATIONS

## Blackout Causes

- Failure to maintain adequate reactive power support
- Failure to ensure operation within secure limits
- Inadequate operator training
- Failure to identify emergency conditions and communicate that status to neighboring systems
- Inadequate regional-scale visibility over the bulk power system

## Blackout Recommendations

- Develop reliability related tools and technologies
- Adopt better real time tools for operators and reliability coordinators
- Strengthen reactive power and voltage practices
- Improve quality system modeling data and data exchange practices
- Required use of time synchronized data recorders

## CERTS-NERC Tools

- Resource Adequacy – **ACE-Frequency, (AIE, CPS, Inadv.)**
- Generation Control Adequacy – **Frequency Response and Data Archiving Using Phasor Measurements**
- Transmission Adequacy – **Real Time Dynamic Monitoring System -RTDMS**
- Reactive Adequacy – **VAR Management**
- Wide Area Visibility – **Grid-3P™**

# ***POWER FUNDAMENTALS FROM NYISO TRAINING PROGRAM***

# 3 Basic Components



plus some not so obvious, but very necessary services

*From NYISO "Power Fundamentals"*

# Four basic Power System Concepts: The Physical World

#1 “Load customers” determine Demand

#2 “Dispatch” determines where it’s generated

#3 The Laws of Physics normally determine  
how the power gets there

#4 Flows must be controlled



*From NYISO “Power Fundamentals”*

# A Constant Balancing Act

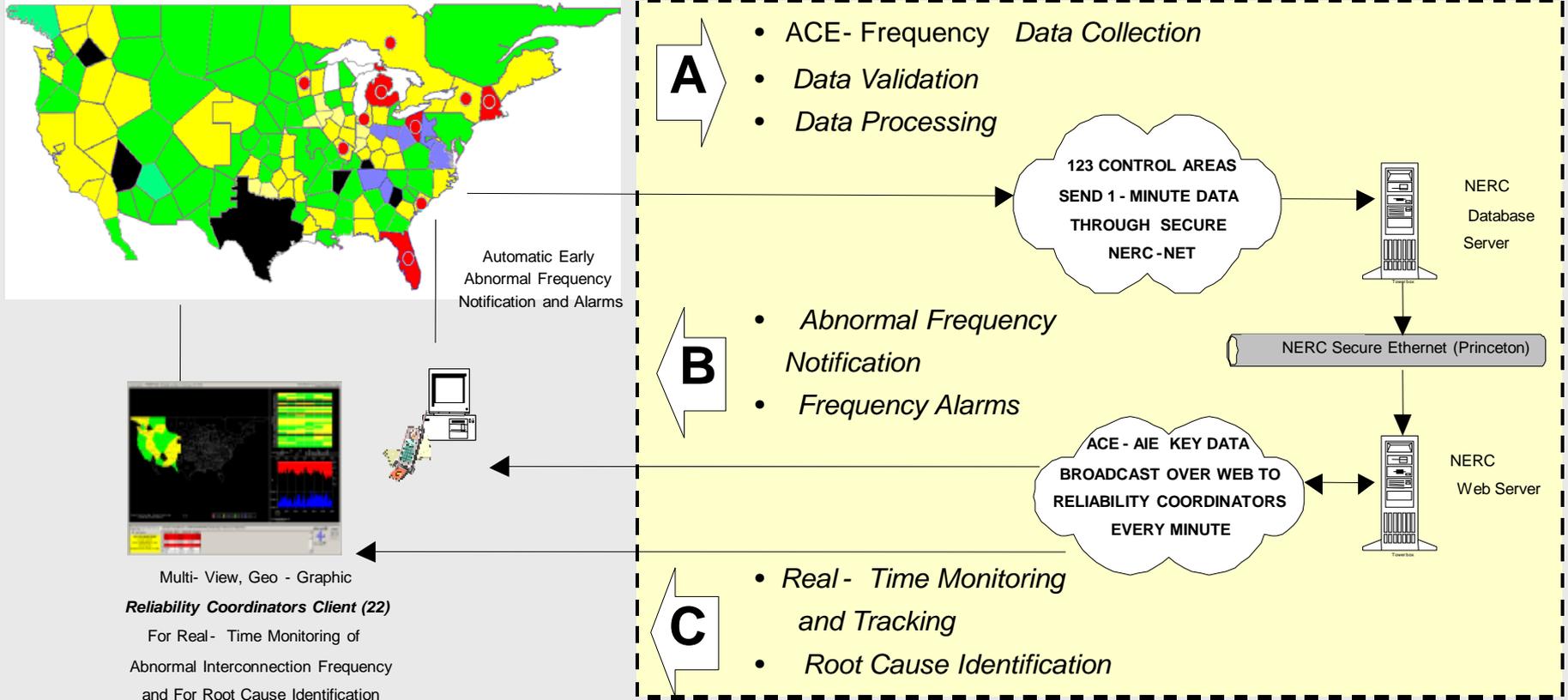
- Load changes constantly
- Generation chases load
- Available generation changes
- Flows must be controlled
- Transmission system limitations
- 24 hours a day, 7 days a week



*From NYISO "Power Fundamentals"*

***FUNDAMENTALS FOR  
DEMAND-RESOURCES ADEQUACY  
MONITORING AND TRACKING USING  
NERC-CERTS ACE-FREQUENCY  
APPLICATION (Release 3.0)***

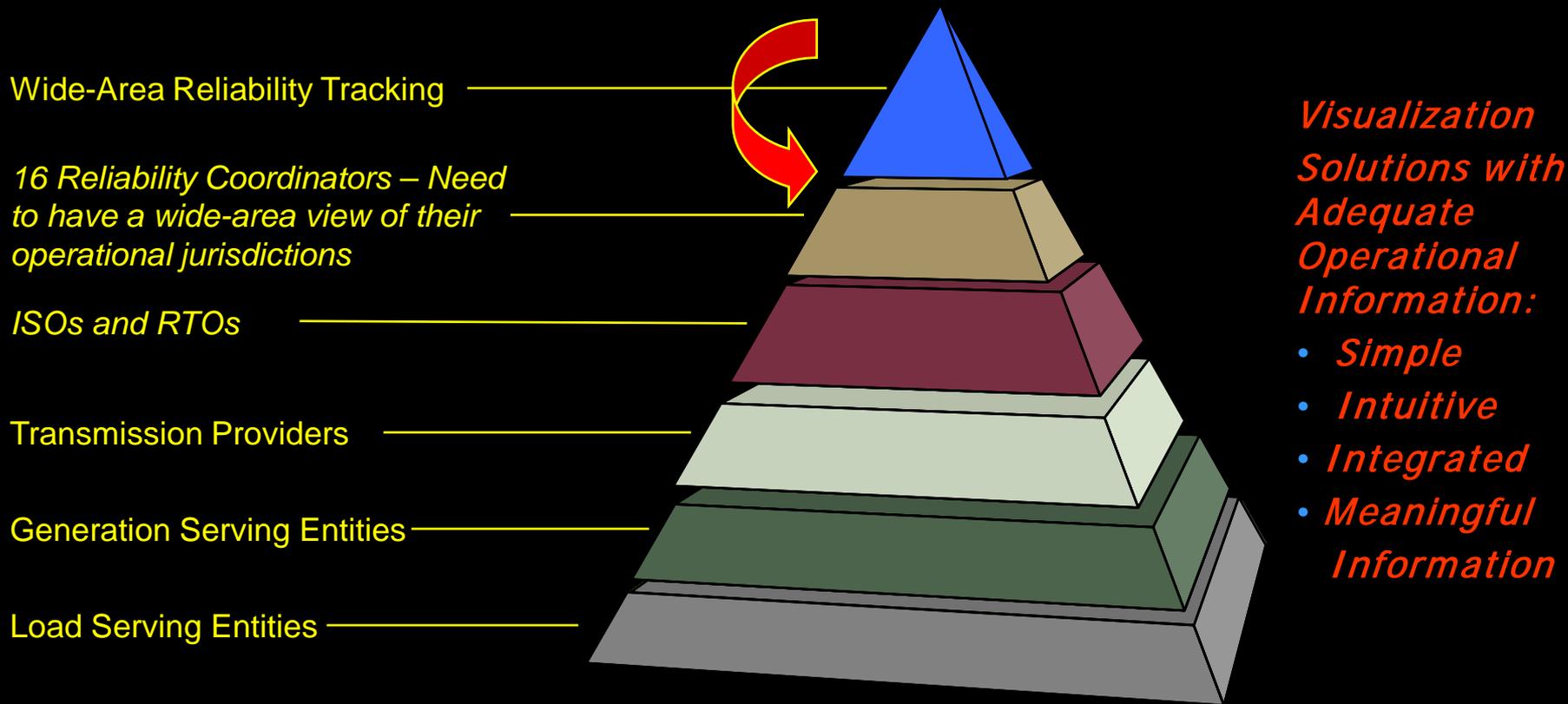
# NERC ACE-Frequency Infrastructure



# POWER INDUSTRY OPERATIONAL, MONITORING AND TRACKING HIERARCHICAL LEVELS

*Data is Produced at All Different Levels*

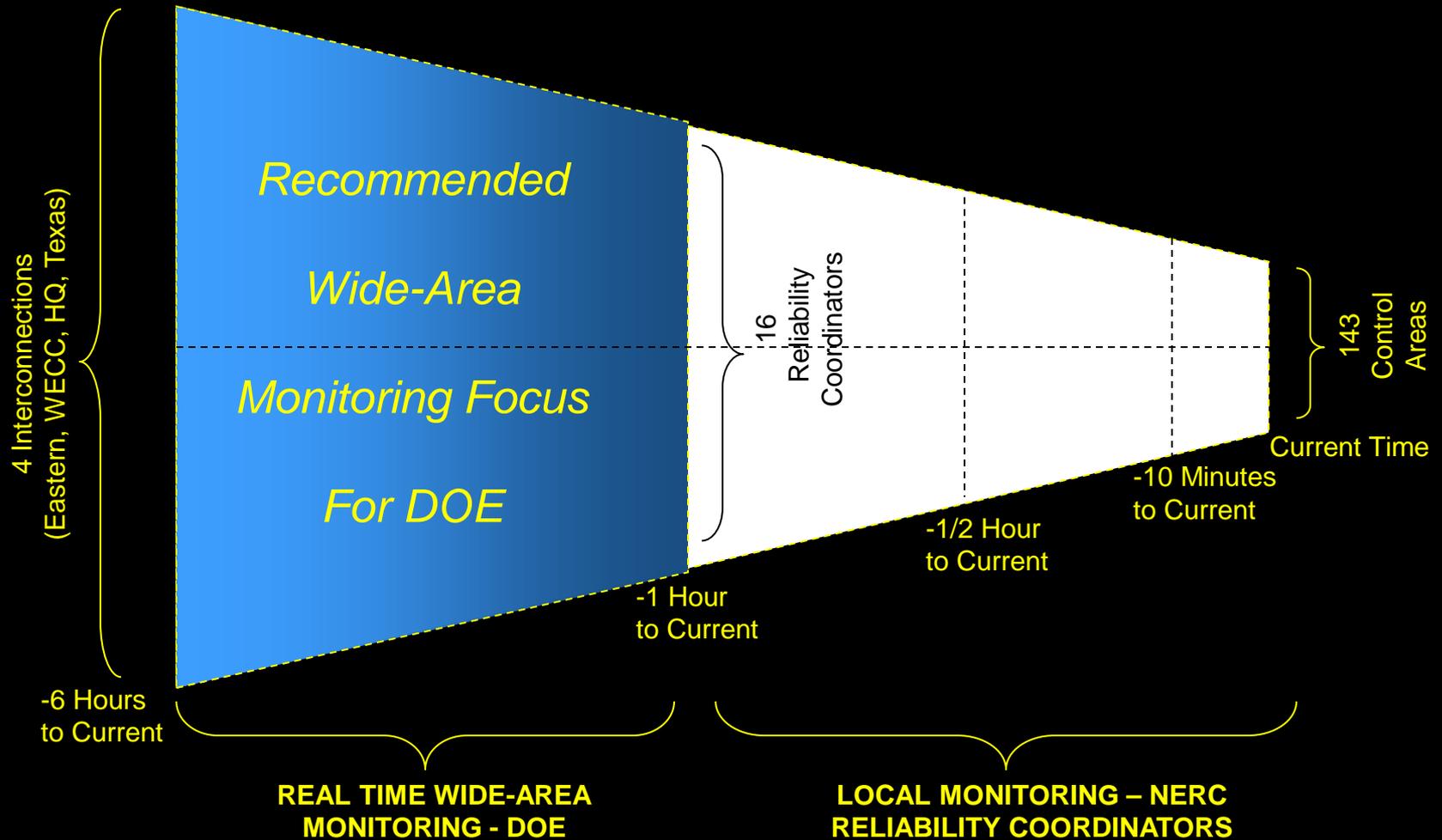
*Integrated Information Is Required at New Levels*



## ***Resource Adequacy 3 Fundamental Monitoring and Tracking Parameters:***

- ***Time***
- ***Operational Levels or Jurisdictions***
- ***Performance Metrics***

# DEMAND-RESOURCES ADEQUACY MONITORING-TRACKING USING NERC-CERTS ACE-FREQUENCY APPLICATION - TIME AND OPERATIONAL LEVELS -



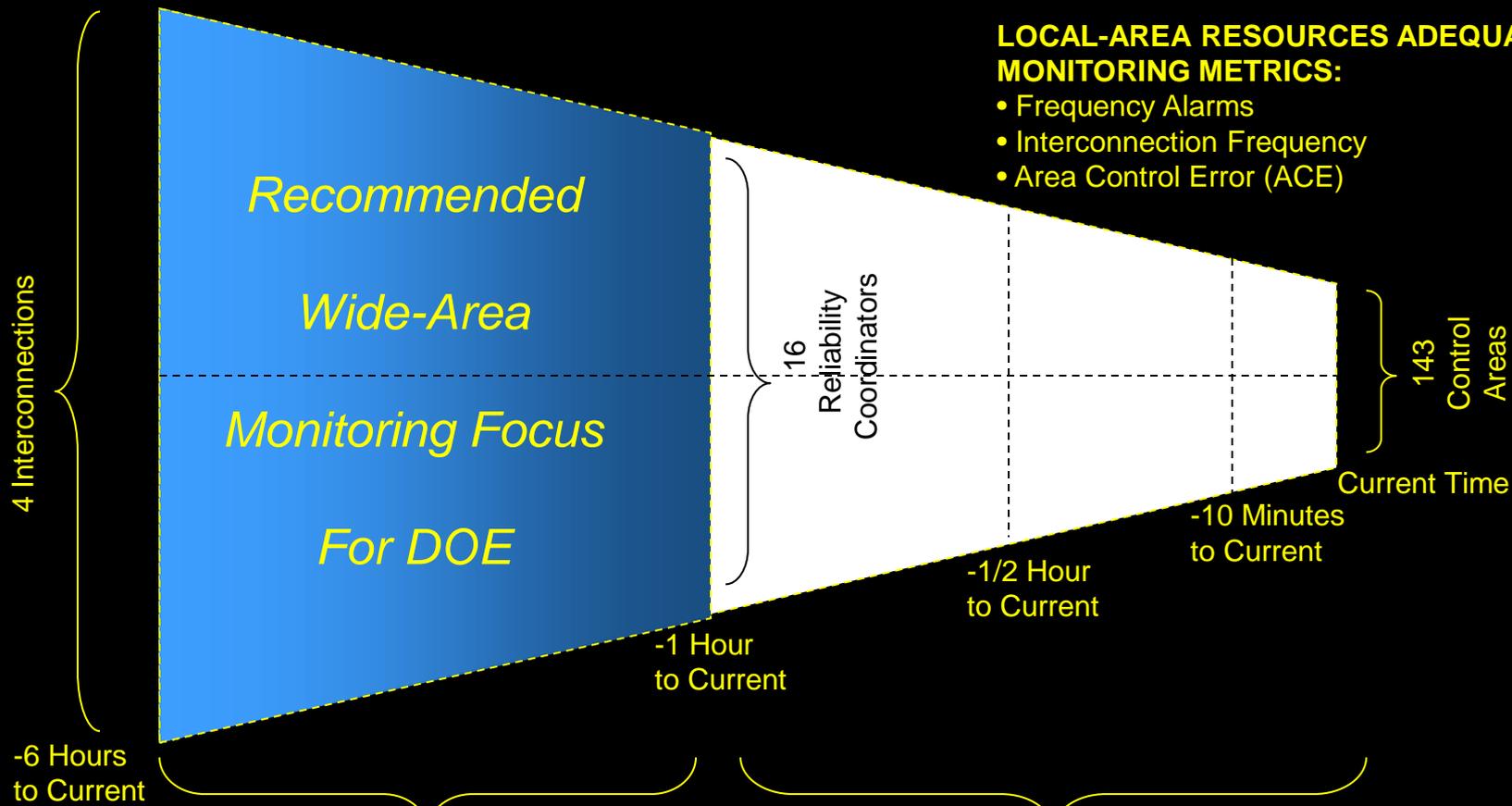
# DEMAND-RESOURCES ADEQUACY MONITORING-TRACKING USING NERC-CERTS ACE-FREQUENCY APPLICATION - METRICS

## WIDE-AREA RESOURCES ADEQUACY MONITORING METRICS:

- Real Time Interconnections Frequency Alarms
- 1-Minute Interconnections Frequency
- Last Hour 10-Min Average Jurisdictions ACE
- Last ½ Hour 1-Min Control Performance Standard (CPS1)
- Last ½ Hour 1-Min Balancing Authority ACE Limit (BAAL)

## LOCAL-AREA RESOURCES ADEQUACY MONITORING METRICS:

- Frequency Alarms
- Interconnection Frequency
- Area Control Error (ACE)



**REAL TIME WIDE-AREA MONITORING - DOE**

**LOCAL MONITORING - NERC RELIABILITY COORDINATORS**

***RECOMMENDED FUTURE  
RESOURCES ADEQUACY  
MONITORING DASHBOARD TYPE VISUAL  
AND TRACKING PROCESS***

# CERTS RECOMMENDED FUTURE WIDE-AREA RESOURCES ADEQUACY CHANGES - DASHBOARD TYPE VISUAL

EASTERN INTERCONNECTION RESOURCES ADEQUACY			
	<i>Actual</i>	<i>Contingency</i>	
	<i>Within Normal Limits</i>	<i>Outside Normal But Within Emergency</i>	<i>Outside Emergency Limits</i>
Release 3.0	<i>Within Normal Limits</i>	<b>SECURE 1</b> <i>Above 59.95 Hz *</i>	<b>INSECURE 1</b> <i>Below 59.908 Hz</i>
	<b>EMERGENCY</b> <i>Load Drop</i> <i>Below 59.82 Hz</i>		
Release 3.5	<i>Outside Normal But Within Emergency</i>	<b>SECURE 2</b> <i>Below 59.95 Hz</i>	<b>INSECURE 1</b> <i>Below 59.908 Hz</i>
	<i>Outside Emergency Limits</i>	<b>SECURE 2</b> <i>Below 59.95 Hz</i>	<b>INSECURE 2</b> <i>Below 59.908 Hz</i>

**DEFINITIONS:**

- **SECURE 1** - Operation under acceptable load-generation balance able to sustain a worst first generation contingency
- **SECURE 2** - Operation under normal load-generation balance and generation contingencies indicate risk that an abnormal second generation contingency becomes greater than acceptable
- **INSECURE 1** - Operation under risk of an abnormal second generation contingency
- **INSECURE 2** - Operation under risk of an abnormal second generation contingency and contingencies indicating risk that an abnormal second contingency becomes greater than acceptable or that load has dropped
- **EMERGENCY** - Customers load has dropped, frequency relays operated

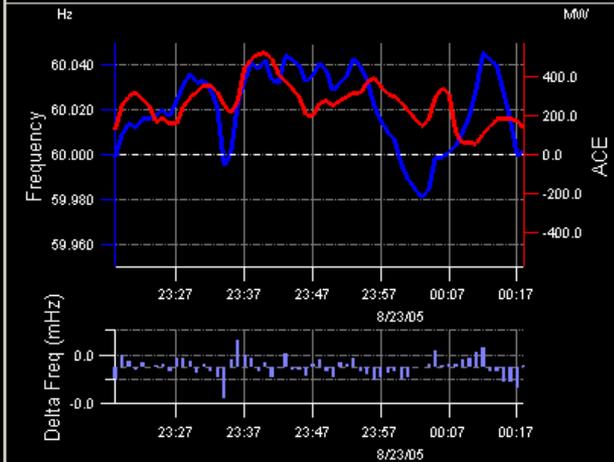
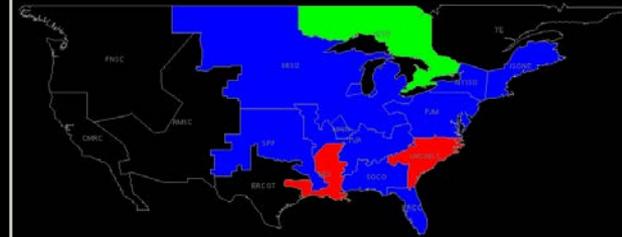
\* Frequency thresholds taken from NERC new Balancing Authority ACE Limit (BAAL) performance metric for Eastern Interconnection

# SAMPLE FOR A DOE MULTI-VIEW, GEO-GRAPHIC VISUAL

## EASTERN INTERCONNECTION RESOURCES ADEQUACY

Actual Contingency	Within Normal Limits	Outside Normal But Within Emergency	Outside Emergency Limits
Within Normal Limits	<b>SECURE 1</b> Above 59.95 Hz *	<b>INSECURE 1</b> Below 59.908 Hz	<b>EMERGENCY</b> Load Drop Below 59.82 Hz
Outside Normal But Within Emergency	<b>SECURE 2</b> Below 59.95 Hz	<b>INSECURE 1</b> Below 59.908 Hz	
Outside Emergency Limits	<b>SECURE 2</b> Below 59.95 Hz	<b>INSECURE 2</b> Below 59.908 Hz	

*(Alarms Criteria and Recipients to Be Defined)*



Hourly Case - Selected Area: MAIN

Date/Time 08/23/2005 12:18 AM

Auto Refresh

Jurisdiction ACE-Frequency Hourly  
10-Minute Avg ACE/Frequency  
**Interc. Missing ACE MW**  
E: 357 Q: -223 W: 100

Overview | Worst/Best Rel Coordinators | Interconnection Frequency\_ACE Quality | Rel Coordinator (Inner Circles) | Current Reliability Coordinator Area Map | Hourly Image

Interconnection	Date_Time	Frequency	Freq_Delta	Expected_ACE	Actual_Net_ACE	Missing_ACE	Missing_ACE_Perc
E	08/23/2005 00:18	60.001	0.001	43.9	-313.3	357.3	813
Q	08/23/2005 00:18	59.968	-0.007	-194.5	28.5	-222.9	115
W	08/23/2005 00:18	60.005	0	100.2	0	100.2	100

Home  Refresh  Print  Zoom  Full Screen

View Angle: 55.

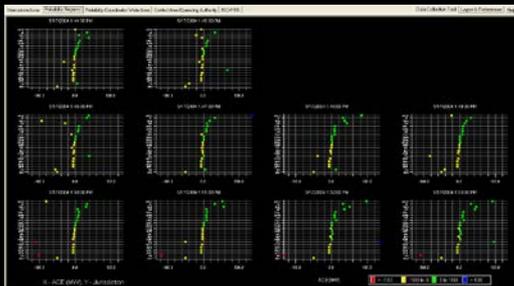
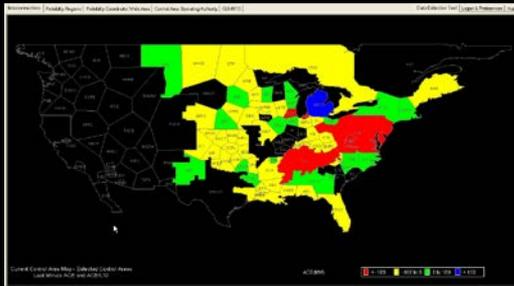
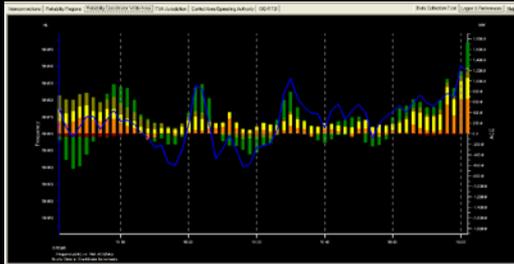
**ACE-FREQ MONITORING**  
© Electric Power Group, LLC 2005

# The A, B, C, D For Monitoring and Tracking Demand-Resources Adequacy Using ACE-Frequency

**OBJECTIVE:** Real time monitoring of demand and resources adequacy, using interconnection frequency, and quick identification and corrective action of root causes

**A**

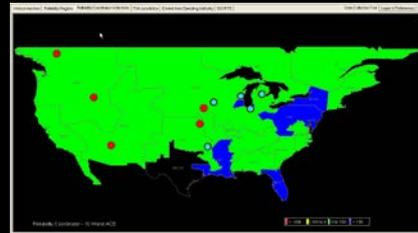
Monitor jurisdictions ACE and its impact on interconnection frequency



**B**

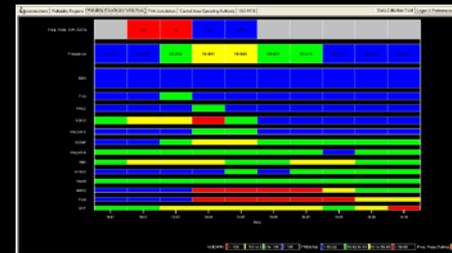
Watch for frequency and ACE alarms

SHORT-TERM: -EAST  
6/15/2005 8:04:00 AM(EDT) -  
Frequency Absolute value of  
two most recent 1-Minutes:  
ABS(59.997-  
60.034)=0.037Hz>=0.035Hz.



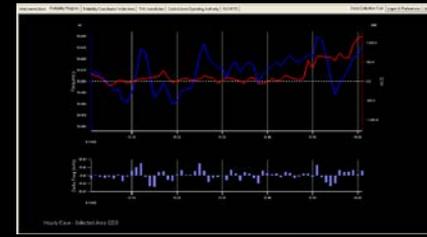
**C**

Verify Abnormalities with Disturbance Overview Display



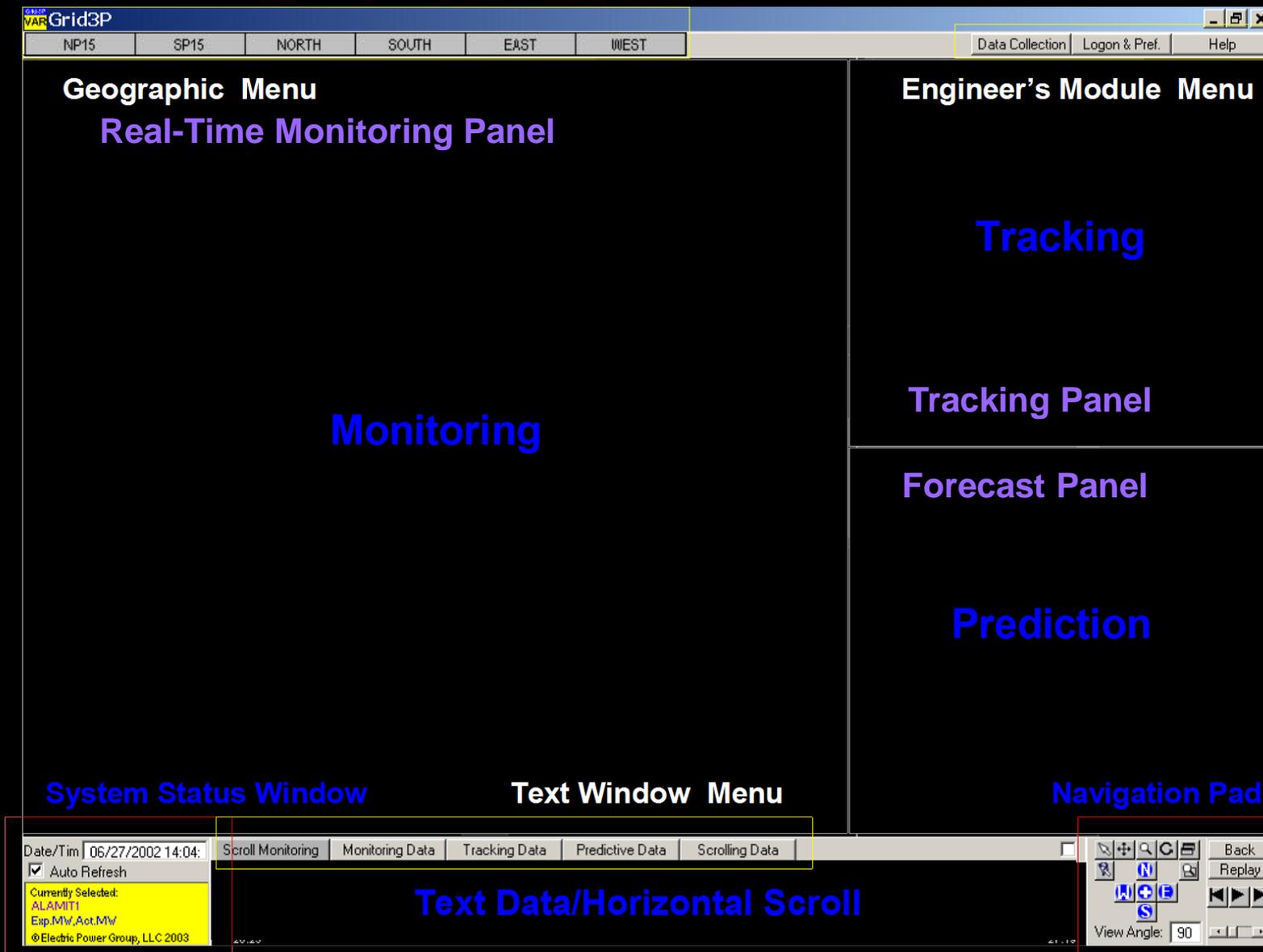
**D**

Zoom-In to identify, verify and correct root causes



***ACE-FREQUENCY MONITORING  
APPLICATION RELEASE 3.0  
VISUALS ARCHITECTURE  
MENU STRUCTURE AND NAVIGATION***

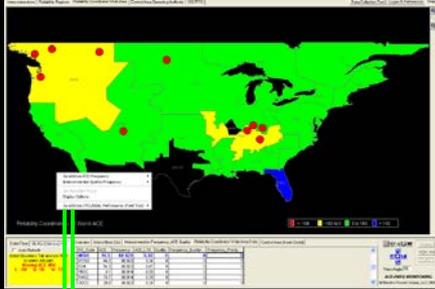
# MULTIPLE-VIEW VISUALIZATION ARCHITECTURE



# RELEASE 3.0 MENU STRUCTURE

Interconnections | Reliability Regions | Reliability Coordinator Wide Area | Control Area Operating Authority | ISO-RTO

## JURISDICTION SELECTION



Hourly 1-Min ACE/Freq Bar-Chart  
 Hourly 10-Minute Avg ACE/Frequency  
 10 min with 1 Min Resolution ACE/FREQ

## Jurisdictional ACE-Frequency Graphs:

- 1 Minute ACE Cumulative Bars – 1 Hour
- 10 Minute Average ACE – 1 Hour
- 1 Minute ACE-Frequency Plots – 10 Min

## MASTER MENU (RMB)

Jurisdiction ACE-Frequency  
 Interconnection Epsilon-Frequency

Daily / Hourly Frequency Performance

## Interconnection Frequency Plots:

- Daily Epsilon
- Monthly Epsilon

Set Boundary Focus  
 Display Options

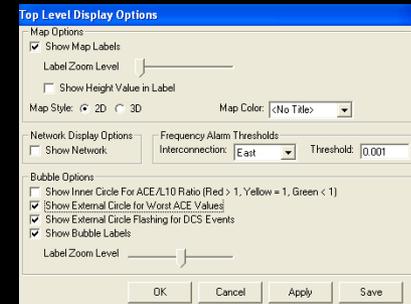
## Select & Monitor Specific Jurisdiction

Jurisdiction CPS1/BAAL Performance (Field Trial)

## Visual Presentation Options

NEW

30 Minutes



## Balancing Authority ACE Limit (BAAL)

- 30 Minutes CPS1-BAAL Monitoring
- 30 Minutes CPS1-BAAL Tracking

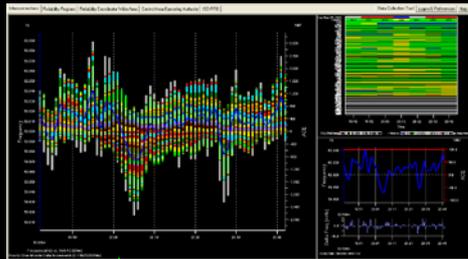
***RELEASE 3.0  
NEW FUNCTIONS AND  
ENHANCEMENTS***

# **R3 KEY FUNCTIONS AND ENHACEMENTS**

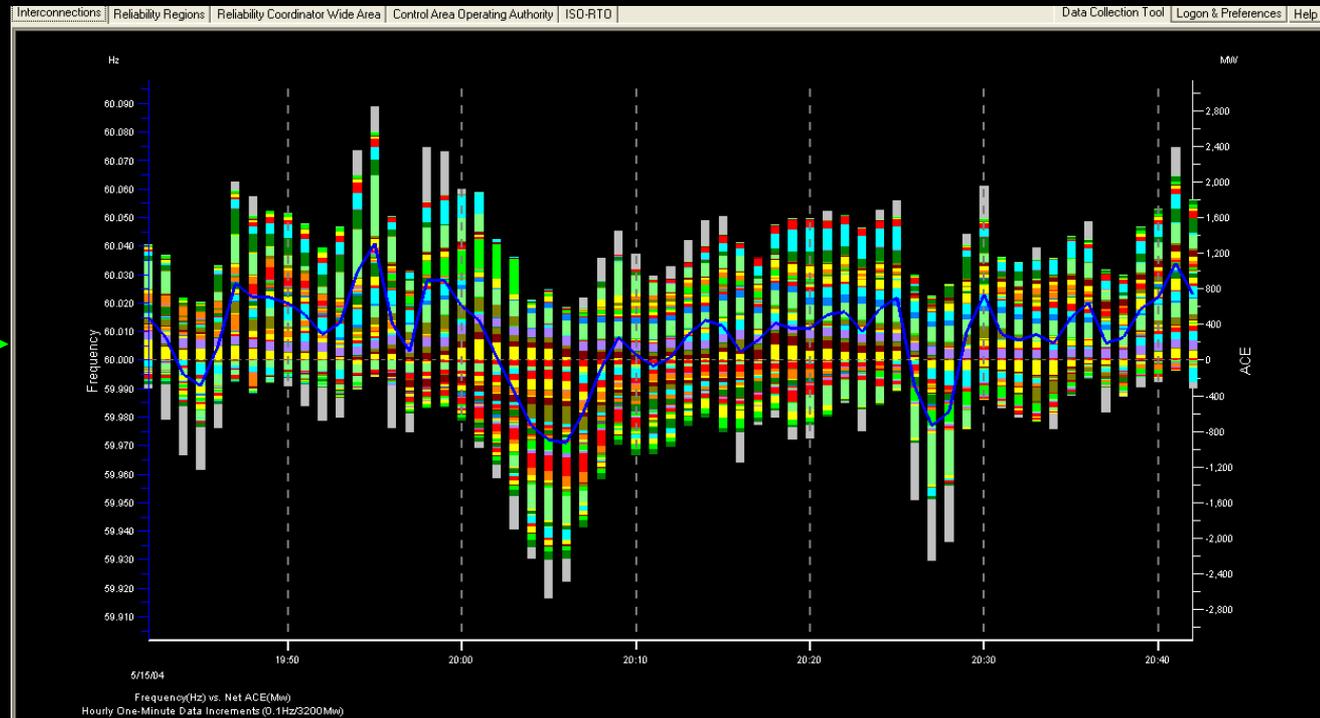
1. ACE-Cumulative Bars and Frequency Line Plots
2. Enhanced Set Boundary Focus
3. On Display Alarms and Reports
4. Online Application News and Help
5. Enterable Frequency Alarm Thresholds
6. User Adjustable Monitoring Time-Window
7. CPS1 and BAAL Monitoring and Tracking
8. Alarm and Database Enhancements

# 1- ACE-BARS AND FREQUENCY PLOTS – Release 3

Cumulative ACE bars overlapping a Frequency line-plot to show the selected jurisdiction control areas Net-ACE vs. Interconnection Frequency. The ACE value of each control area from the selected jurisdiction will be displayed as a segmented-cumulative bar chart in one-minute increments for the last hour. The summation of the entire bar for one-minute is equal to the net ACE value of the selected jurisdiction. The interconnection frequency is plotted on the same chart as a line-plot in one-minute increments for one hour on a secondary y-axis. Jurisdiction Control Areas with bad or missing ACE data are displayed in grey-color bar with a value derived from their yearly L<sub>10</sub>

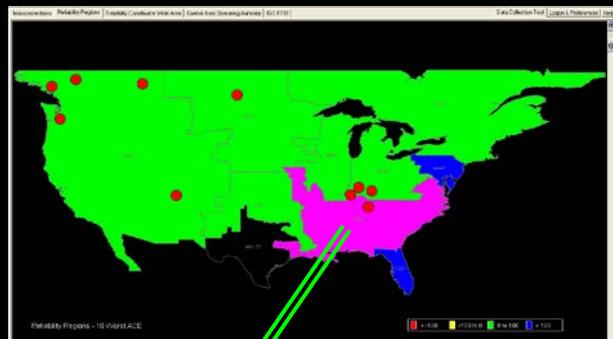


Hourly 1-Min ACE/Freq Bar-Chart  
Hourly 10-Minute Avg ACE/Frequency  
10 min with 1 Min Resolution ACE/FREQ

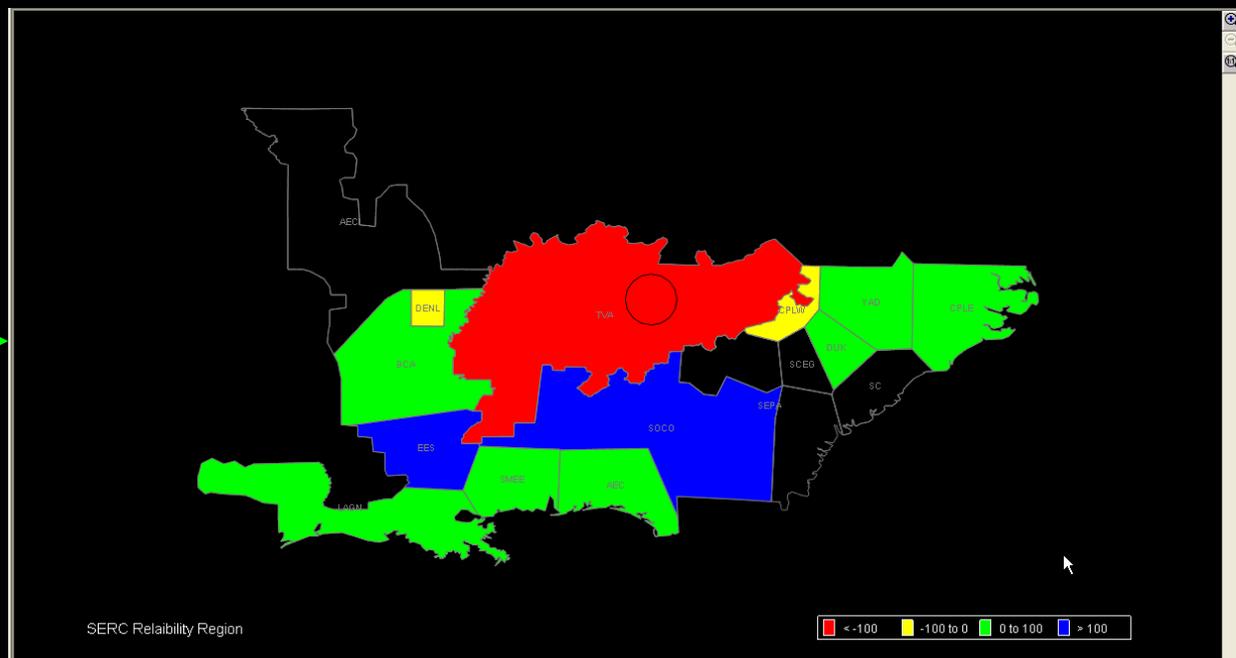


# 2 - ENHANCED SET BOUNDARY FOCUS – Release 3

The Set Boundary Focus option now allows user selection of any jurisdiction to focus user monitoring only for the control areas belonging to the user selected jurisdiction

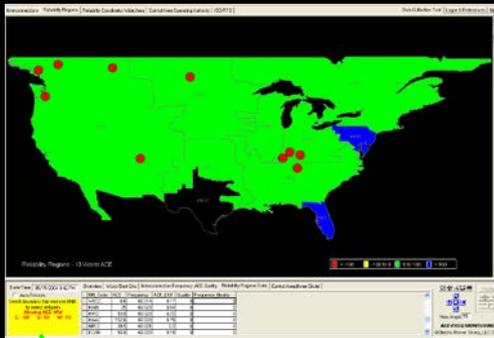


- Jurisdiction ACE-Frequency ▶
- Interconnection Epsilon-Frequency ▶
- Set Boundary Focus ▶
- Display Options ▶
- Jurisdiction CP51/BAAL Performance (Field Trial) ▶



# 3 - ON DISPLAY ALARMS AND REPORTS – Release 3

On display alarm and report capabilities have been added to the yellow information-window in the lower left-hand corner of the application to alarm two conditions: a) display the accumulated amount of missing ACE data per interconnection using Control Areas yearly L10 values for those control areas not reporting ACE data. When user clicks on the missing ACE values a report is displayed with appropriate data for users to take pro-active action to correct data quality problems, b) short, blink messages indicating “Failed Data Connection”....



**Eastern Interconnection**  
22 Control Areas Not Sending ACE Data

5/15/2004 8:42:00 PM Pacific Time

CA Code	Control Area Name	L10 Yearly	CA Missing ACE	Minutes Unavailable	Dispatch Desk
AEBN	AESC, LLC - AEBN	10.7	0.2	6453	
AECI	Associated Electric Cooperative, Inc.	61	14.7	90042	(417)885-9200
AMRN	Ameren Transmission	109.7	0.2	35298	(314)554-4037
CE	Commonwealth Edison	112.8	50.1	69103	
CWLD	Columbia Water & Light	13.1	0.7	85797	(573)874-6239
DELI	DECA, LLC - Lee County	19.1	0.2	35344	
DELO	DECA, LLC - DELO	26.6	0.2	6453	
DEVI	DECA, LLC - Vermillion	19.1	0.2	85797	(877)379-0336
EEI	Electric Energy, Inc.	18.5	1.4	35343	(618)543-9254
IP	Illinois Power Co.	53.5	11.3	69088	(217)424-6536
MCLN	McClain	17.1	0.2	6453	
MGE	Madison Gas and Electric Company	21.4	1.8	69090	(608)252-7254
MP	Minnesota Power, Inc.	43.5	7.5	90042	(218)720-2682
MPW	Muscatine Power and Water	9.3	0.3	81477	(563)242-3376
OVFC	Ohio Valley Electric Corporation	41.5	6.8	80039	(740)289-7210
SC	Santee Cooper	56.2	12.4	90042	(843)761-4033
SCEG	South Carolina Electric & Gas Company	63.7	16	90042	(803)217-8864
SEHA	Southeastern Power Administration	6.4	1.1	90042	(706)213-3864
SERU	Southeastern Power Administration	6.4	1.1	90042	(706)213-3864
SETH	Southeastern Power Administration	6.4	1.1	90042	(706)213-3864
UPFC	Upper Peninsula Power Co.	10.7	0.5	85797	(920)657-4111
WAUE	Western Area Power Administration - USPB	56.1	12.4	90042	(605)882-7584

Date/Time 05/15/2004 8:42 PM Overview | Worst/Best CAs | Interconnection Frequency ACE Quality | Reliability Regions Data | Control Area (Inner Circle)

Auto Refresh

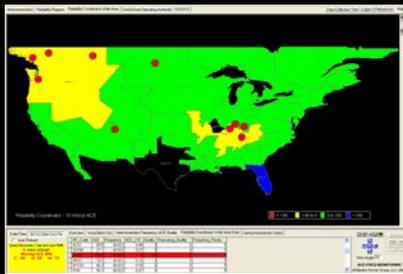
Select Boundary Tab and use **RTB** to select drill path  
**Missing ACE MW**  
**E: -68 Q: 50 W: 19**

RR_Code	ACE	Frequency	ACE_L10	Quality	Frequency_Quality
WECC	8.6	60.014	0.17	0	0
MAIN	25	60.023	0.64	0	0
MRO	10.8	60.023	0.23	0	0
MAAC	152.6	60.023	0.79	0	0
NPCC	39.5	60.021	0.3	0	0
ECAR	16.8	60.023	0.19	0	0

View Angle 55.  
**ACE-FREQ MONITORING**  
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# 4 - ONLINE APPLICATION NEWS AND HELP—Release 3

The help-tab functions have been enhanced to present an index of application related news and help documents. Double clicking on any of the documents index, will display the full document in PDF-format. Help documents are archived now in a central location to facilitate its periodic update without issuing client updates.



Data Collection Tool Logon & Preferences Help

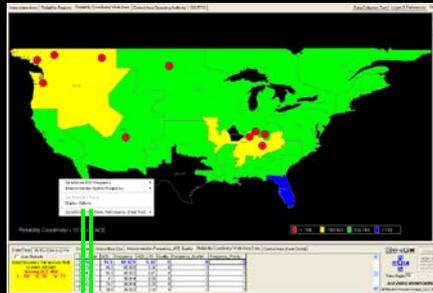
## Wide-Area ACE-Frequency Real-Time Monitoring System

### Online Information Help

Last Modified	Help Title	Description
2005-06-30T00:00:00	<a href="#">NERC ACE/Frequency Userguide 3.0</a>	This document provides a comprehensive overview of how to use the application.
2005-06-15T00:00:00	<a href="#">Scenario 1: East Texas Blackout</a>	This document illustrates what happened and how the ACE/Frequency application was used to assess the situation
2004-03-08T00:00:00	<a href="#">Scenario 2: California Blackout</a>	This document illustrates what happened and how the ACE/Frequency application was used to assess the situation

# 5-ENTERABLE FREQUENCY ALARM THRESHOLDS Release 3

The visual presentation option window have been expanded to include the capability for setting the frequency alarm threshold per interconnection to something other than the recommended thresholds from NERC.



- Jurisdiction ACE-Frequency ▶
- Interconnection Epsilon-Frequency ▶
- Set Boundary Focus
- Display Options
- Jurisdiction CPS1/BAAL Performance (Field Trial) ▶

### Top Level Display Options

**Map Options**

- Show Map Labels
- Label Zoom Level
- Show Height Value in Label
- Map Style:  2D  3D
- Map Color: <No Title> ▼

**Network Display Options**

- Show Network
- Frequency Alarm Thresholds**
- Interconnection: East ▼
- Threshold: 0.001

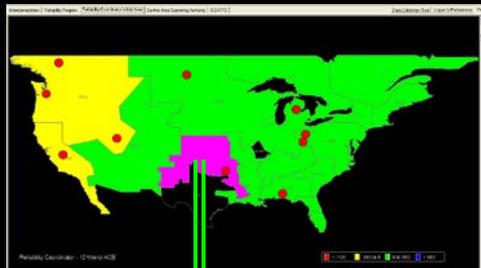
**Bubble Options**

- Show Inner Circle For ACE/L10 Ratio (Red > 1, Yellow = 1, Green < 1)
- Show External Circle for Worst ACE Values
- Show External Circle Flashing for DCS Events
- Show Bubble Labels
- Label Zoom Level

OK Cancel Apply Save

# 6 - CPS1 AND BAAL MONITORING (Field Trial)

To help monitor and track the impact of the new Balancing Authority ACE Limit (BAAL) metric during the Field-Trial in the Eastern Interconnection, a new 4-panel display has been created. Panel-1 shows last minute CPS1 geographically for the jurisdiction Control Areas selected, panel-2 shows, color-coded, the CPS1 for the last 30-minutes for all the selected Control Areas, panel-3 shows CPS1 line-plots for the last 30-minutes with thresholds indicating CPS1 and BAAL violations, and panel-4 shows the numerical values for data for the other 3 panels.



- Jurisdiction ACE-Frequency ▶
- Interconnection Epsilon-Frequency ▶

---

- Set Boundary Focus
- Display Options

---

- Jurisdiction CPS1/BAAL Performance (Field Trial) ▶

Interconnections | Reliability Regions | Reliability Coordinator Wide Area | Control Area Operating Authority | ISO-RTD
Data Collection Tool | Logon & Preferences | Help

Selected Control Areas  
Last Minute CPS1

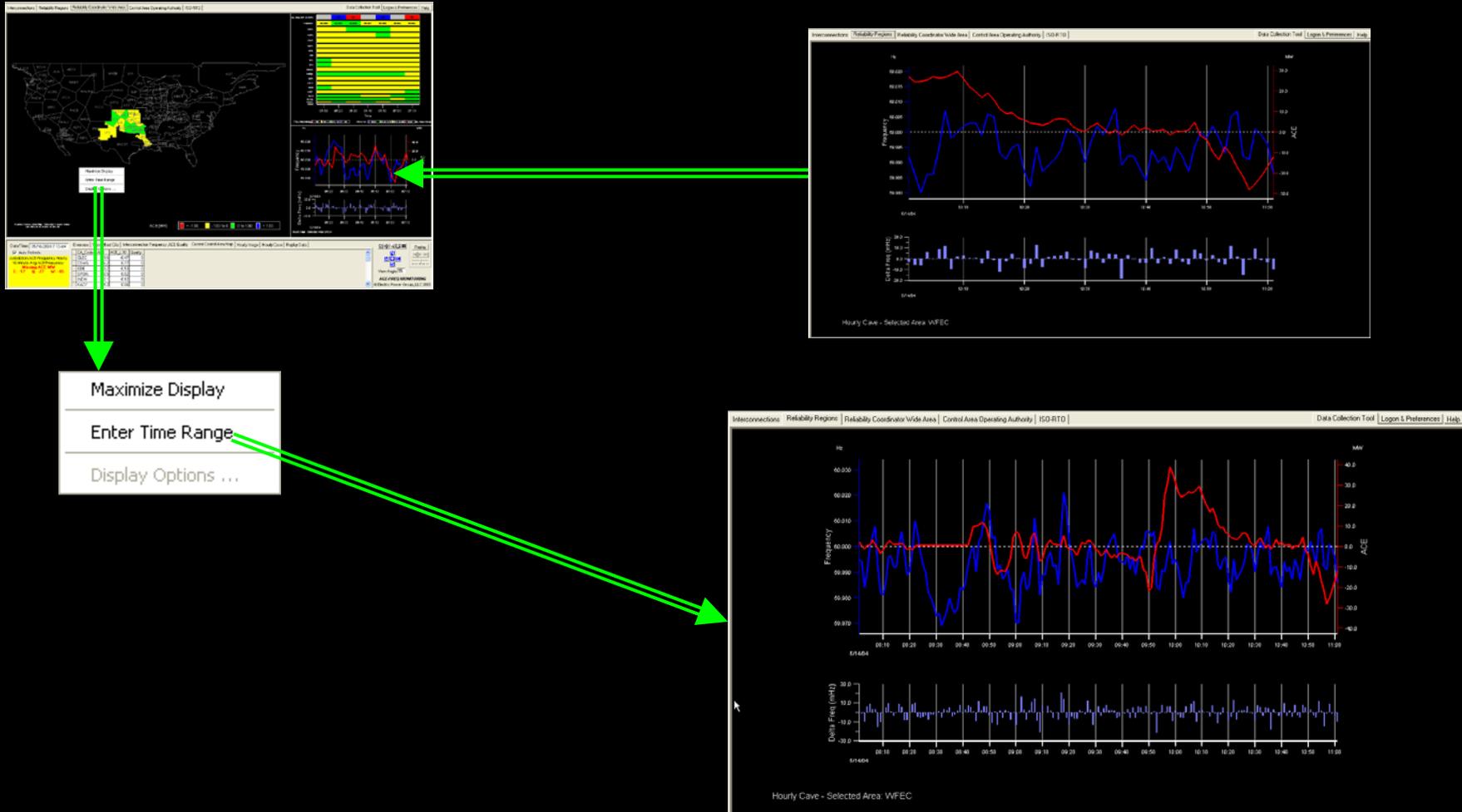
Jurisdiction	CPS1 (%)	Time
CLEC	137	30
CSWS	103	94
EDE	198	10.5
GRDA	-1043	14
INDN	1961	5
KACY	420	7

Date/Time	Overview	Worst/Best CAs	Interconnection Frequency	ACE Quality	CPS1 Minute - Last Minute	Last 30 Min (BAAL)	Last 30 Minutes - 1 BA	Replay Data																																										
05/14/2004 8:42 PM	<input type="checkbox"/> Auto Refresh <b>Jurisdiction CPS1/BAAL Performance (Field Trial) 30 Minutes</b> <b>Missing ACE MW</b> <b>E: 767 Q: 193 W: 125</b>	<table border="1" style="font-size: x-small; border-collapse: collapse;"> <thead> <tr> <th>CA_Code</th> <th>CPS1</th> <th>Freq_Bias</th> <th>ACE</th> <th>Frequency</th> <th>Quality</th> </tr> </thead> <tbody> <tr><td>CLEC</td><td>137</td><td>30</td><td>3</td><td>60.039</td><td>0</td></tr> <tr><td>CSw/S</td><td>103</td><td>94</td><td>8</td><td>60.039</td><td>0</td></tr> <tr><td>EDE</td><td>198</td><td>10.5</td><td>2</td><td>60.039</td><td>0</td></tr> <tr><td>GRDA</td><td>-1043</td><td>14</td><td>-12</td><td>60.039</td><td>0</td></tr> <tr><td>INDN</td><td>1961</td><td>5</td><td>8</td><td>60.039</td><td>0</td></tr> <tr><td>KACY</td><td>420</td><td>7</td><td>2</td><td>60.039</td><td>0</td></tr> </tbody> </table>	CA_Code	CPS1	Freq_Bias	ACE	Frequency	Quality	CLEC	137	30	3	60.039	0	CSw/S	103	94	8	60.039	0	EDE	198	10.5	2	60.039	0	GRDA	-1043	14	-12	60.039	0	INDN	1961	5	8	60.039	0	KACY	420	7	2	60.039	0						
CA_Code	CPS1	Freq_Bias	ACE	Frequency	Quality																																													
CLEC	137	30	3	60.039	0																																													
CSw/S	103	94	8	60.039	0																																													
EDE	198	10.5	2	60.039	0																																													
GRDA	-1043	14	-12	60.039	0																																													
INDN	1961	5	8	60.039	0																																													
KACY	420	7	2	60.039	0																																													

View Angle: 55  
**ACE-FREQ MONITORING**  
 © Electric Power Group, LLC 2005

# 7 - USER ADJUSTABLE TIME-WINDOW - Release 3

The application was limited to 1-hour and 10-minute monitoring windows. Now users can adjust the time window for any of the monitoring and tracking panels of the 4-panel displays for up to 6 hours with 1-minute resolution.



# 8 - ALARMS AND DATABASE ENHANCEMENTS

- **New Frequency Alarm Threshold** – Instead of using the average frequency per minute to compare with alarm thresholds, the new frequency calculation uses the maximum frequency value if frequency has been below 60 Hz during the last minute, or the minimum frequency if the frequency has been below 60 Hz for the last minute. The average frequency is only use if the sample is above and below 60 Hz during the last minute
- **New Frequency Alarms** – New frequency alarms have been created to indicate proximity to the three frequency thresholds that define the new BAAL performance metric
- **Online and Archived Data** - The primary ACE-Frequency database will keep 90-days of data available online. A secondary database has been established that will archive up to 3 years of ACE/Frequency data. A utility application is embedded in Release 3 that will allow the user to query the archive data and save it to their local computer as comma-separated values (CSV) file

***RELEASE 3.0***  
***CPS1 AND BAAL REAL TIME***  
***MONITORING AND TRACKING***

# ***CPS1 AND BAAL REAL TIME MONITORING (Field-Trial)***

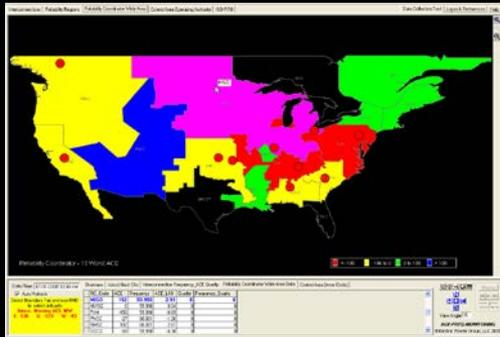
**OBJECTIVE:** Real time monitoring and tracking of 1-minute CPS1 and BAAL-Low and Baal-High violations correlating with interconnection frequency, and using CERTS ACE-Frequency Geo-Graphic, Multi-View Visualization.

Users can select any jurisdiction and monitor its 1-minute CPS1 performance, its BAAL high and low (CPS1 during last 30-minutes) correlating with interconnection frequency, and allowing users to track CPS1 and BAAL performance for any jurisdiction for the last 6-hours

# CPS1 AND BAAL REAL TIME MONITORING (Field-Trial)

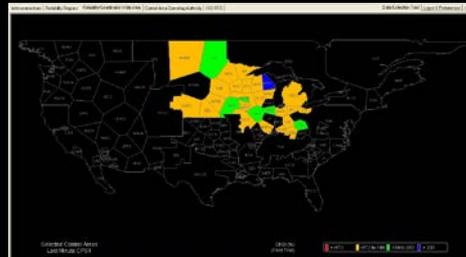
**A**

Select Jurisdiction to Monitor 1-Minute CPS1 And BAAL



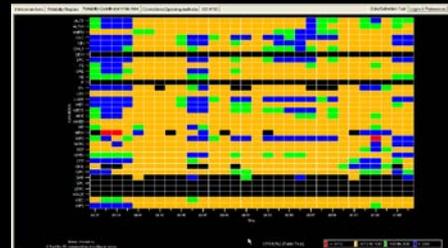
**B**

Monitor Geographically Last Minute CPS1



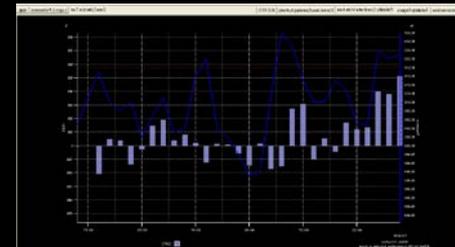
**C**

Monitor BAAL Violations Via CPS1 for the last 30-minutes or Beyond For Multi Control Areas

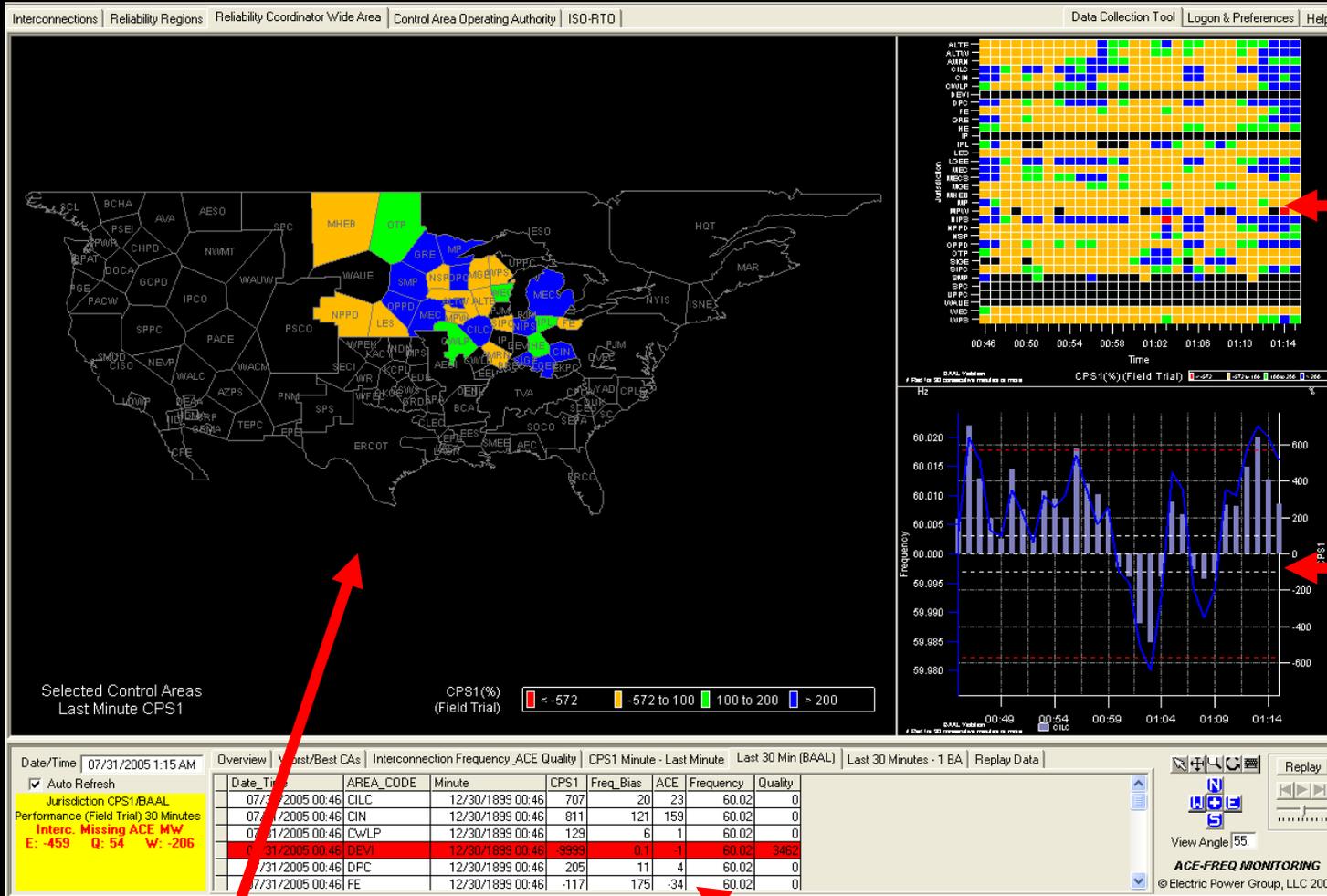


**D**

Monitor and Track CPS1-BAAL for Selected Control Area



# CPS1 AND BAAL REAL TIME MONITORING (Field-Trial)



**Panel 2:** 2D-Plot with BAAL Violation (Last 30-Minute of CPS1) for Control Areas of Selected Jurisdiction

**Panel 3:** Bar-chart for last 30-Min of CPS1 with Thresholds for CPS1 and BAAL violations correlated with frequency

**Panel 1:** Geographic View with Last Minute CPS1 for Control Areas in Selected Jurisdiction

**Panel 4:** Dynamic Data Text Window with actual data displayed in tabular fashion for each selection criteria

# ***Recommended Enhancements for DOE Emergency Center***

# ACE-Frequency Enhancements for DOE Emergency Center – Conditions, Analysis

Eastern, Western,  
and Ercot  
interconnections  
load-generation  
adequacy condition

## CONDITIONS

For Eastern and Western  
interconnections:

Normal – EI Freq >59.950 Load-  
generation under acceptable  
balance and control

Alarm – EI Freq <59.950 for  
more than 30-minutes. Risk of  
2<sup>nd</sup> contingency becomes greater  
than acceptable

Emergency – EI Freq >59.820.  
Frequency-related relays had  
tripped, load has been dropped

System analysis and  
assessment at the  
interconnection and  
Reliability Coordinator  
levels

## ANALYSIS

Magnitude - EI MW of unbalance or drop originating alarm or  
emergency condition=Delta between EI current net ACE and net  
EI Balancing Authorities ACE Limits (BAAL). 24-hours tracking-  
scale

Location – Geo-geographic color-coded map showing EI Balancing  
Authorities with the worst delta MW

Interregional Transfers – Net interregional transfer MW =  
Estimated values, calculated as the difference between region  
net ACE minus its net frequency contribution, displayed geo-  
graphically

Customers With Not Power – Estimate based on correlation  
between unbalance delta or drop MW and estimated average  
MW consumption per Balancing Authority per customer

# ACE-Frequency Enhancements for DOE Emergency Center – Actions, Events and Warnings

Notifications  
and Actions

Event summary when  
emergencies and  
blackouts occur

Advance warning and  
tracking during critical  
system conditions

## **ACTIONS**

## **EVENTS**

## **WARNING**

Notifications – Automatic cell-  
phone and/or email alarm to  
Secretary and DOE-NERC  
designees for emergency  
conditions

Actions – Immediate access  
to names and phone numbers  
for the Reliability  
Coordinator(s) with  
jurisdiction over the worst  
unbalance Balancing  
Authorities. Direct line to  
NERC

Summaries – pre and post  
emergency data as above,  
arranged chronologically  
per minute and per  
jurisdiction

Warning – Forecast data,  
Daily and Hourly Market  
Data.  
Warning and Tracking  
visuals with key parameters  
for critical days

# **SCENARIO 1**

***Pre and Post June 15, 2005***

***Eastern Texas Blackout***

***Monitoring and Analysis Using NERC-CERTS  
Wide-Area ACE-Frequency Monitoring Tool***

# Blackout Event and Impact On Customers

## CAUSE AND EFFECT

Timeline of Wednesday's Entergy Texas power outage:

**7 p.m.**

- Eight large power transmission lines near China, west of Beaumont, trip off within 20 seconds of each other, likely due to winds or lightning.

- Eight other power lines throughout the area trip off when excess power load is redirected through them.

- As many as 150,000 customers in the area lose power.

- Two power generators at the Lewis Creek plant in Willis trip off due to drop in voltage. Plant switches to DC backup power.

**8:30 p.m.**

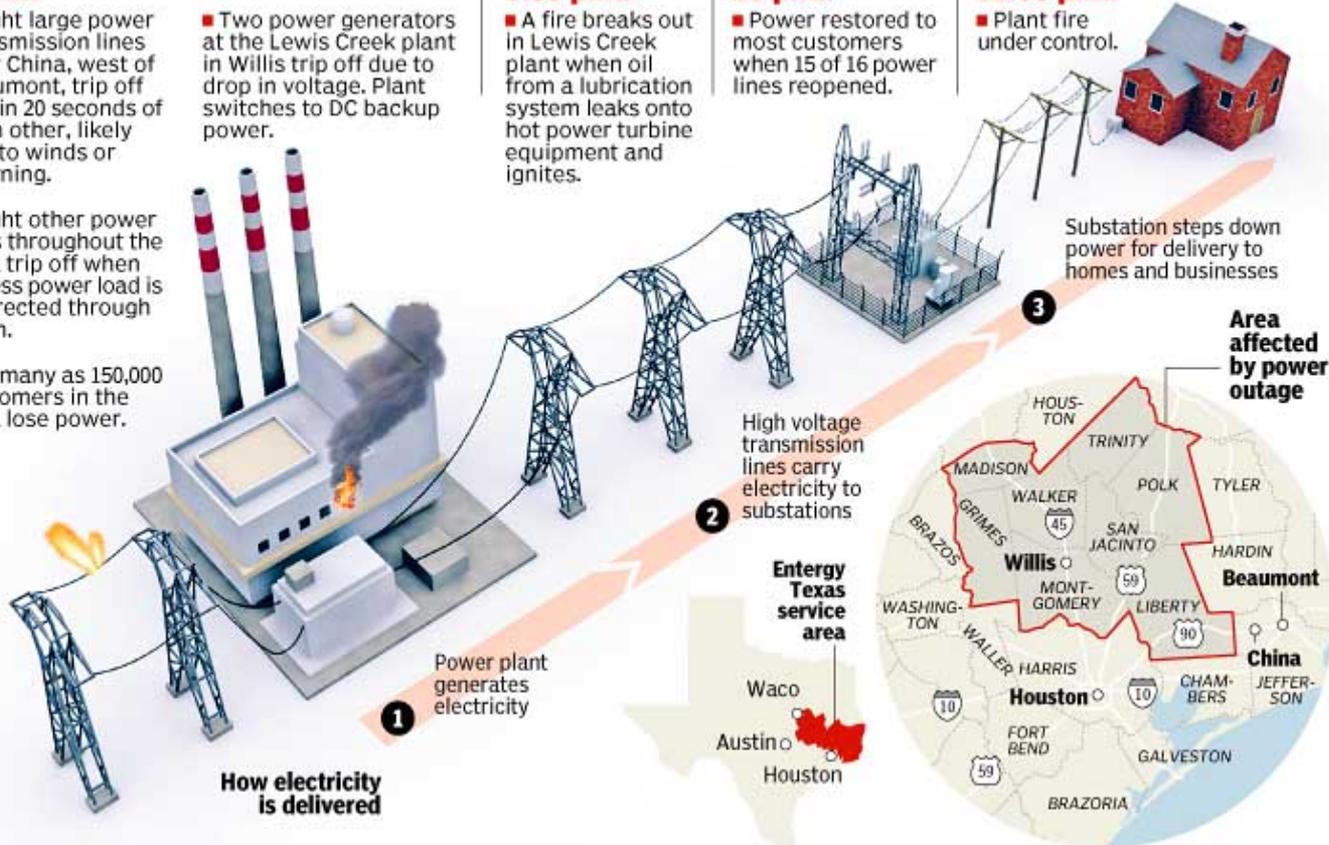
- A fire breaks out in Lewis Creek plant when oil from a lubrication system leaks onto hot power turbine equipment and ignites.

**11 p.m.**

- Power restored to most customers when 15 of 16 power lines reopened.

**11:05 p.m.**

- Plant fire under control.



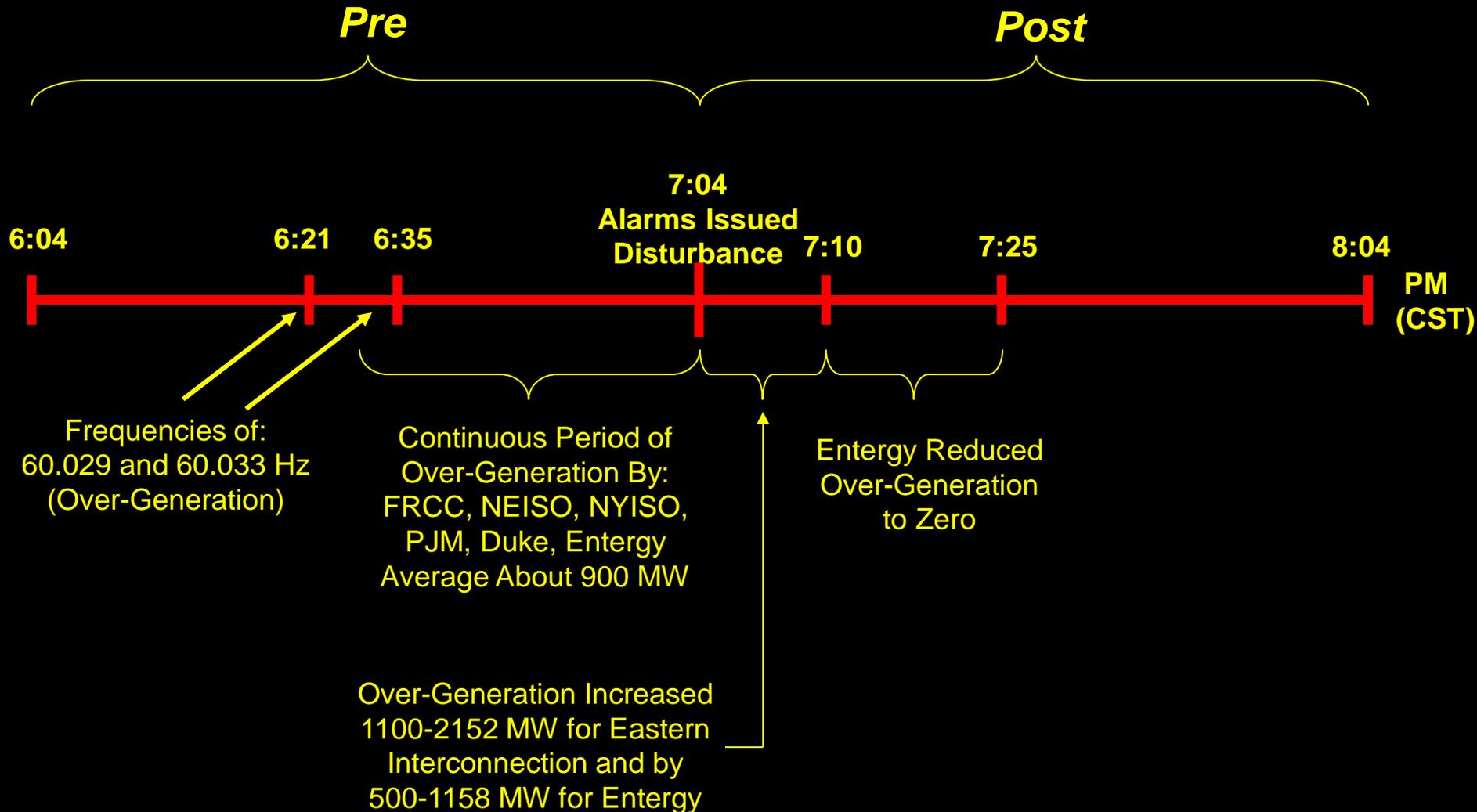
Sources: Entergy Texas; Montgomery County Fire Marshal's Office; howstuffworks.com; Chronicle research by Tom Fowler

ALBERTO CUADRA, JAY CARR : CHRONICLE

"What began as a 20-second cascade of failing power lines Wednesday evening ended with 150,000 Southeast Texas residents in the dark and a small but intense power-plant fire.

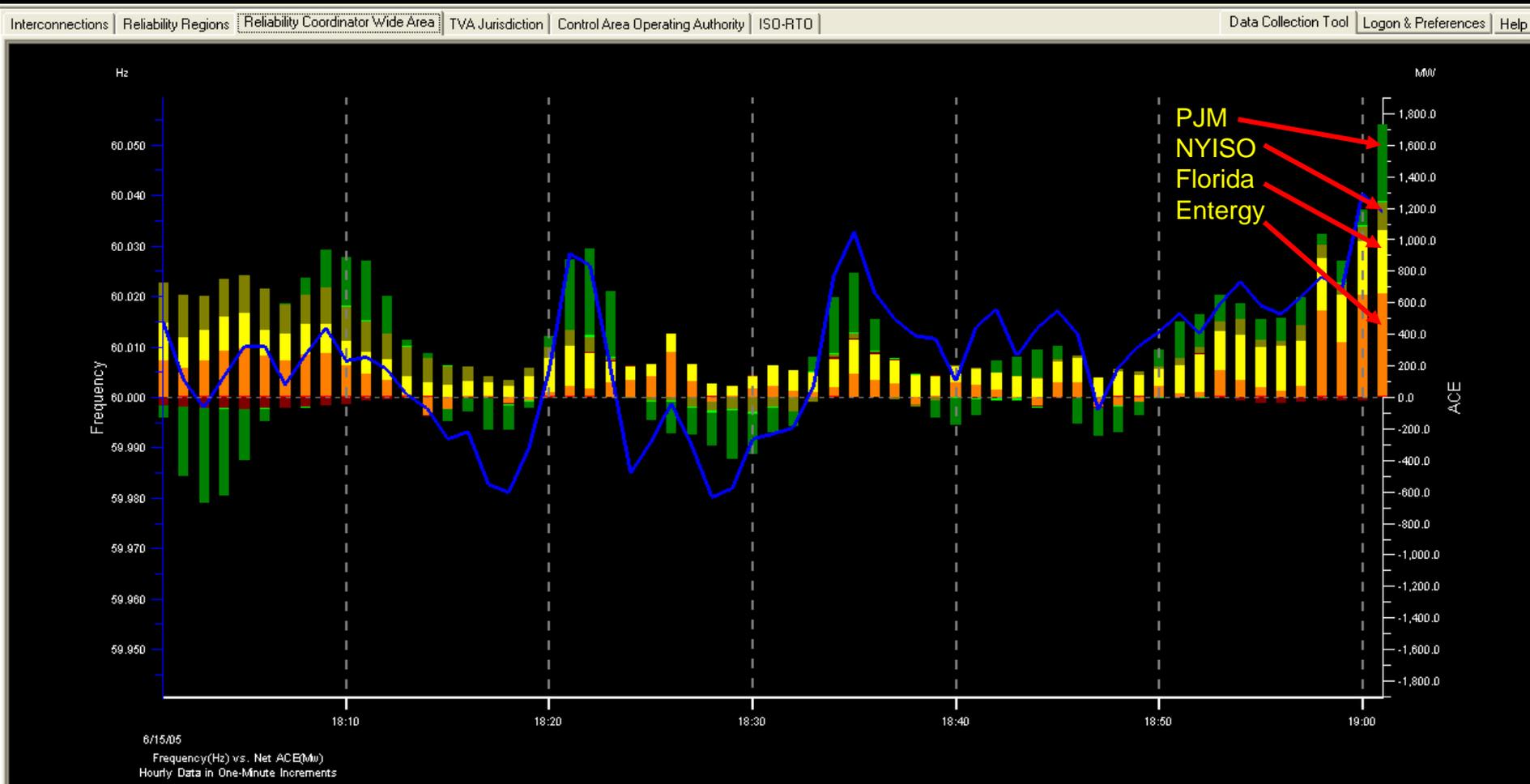
Tornadolike winds that roared through an area near China were blamed for the blackout, which stretched across eight counties served by Louisiana-based Entergy and included communities such as The Woodlands and Huntsville. By 11 that same night most of the power was restored....."

# Pre-Disturbance Monitoring, Post Assessment Using NERC-CERTS ACE-Frequency Tool



# Pre-Disturbance – Over-Generation Indication

## NERC-CERTS ACE-Frequency Tool



1750 MW of Over-Generation. It changed from about 300MW to 1724 MW from 6:50-7:04PM

# **Alarm - Sent at 7:04PM (CDT) Via Email, Pagers To RCs By NERC-CERTS ACE-Frequency Tool**

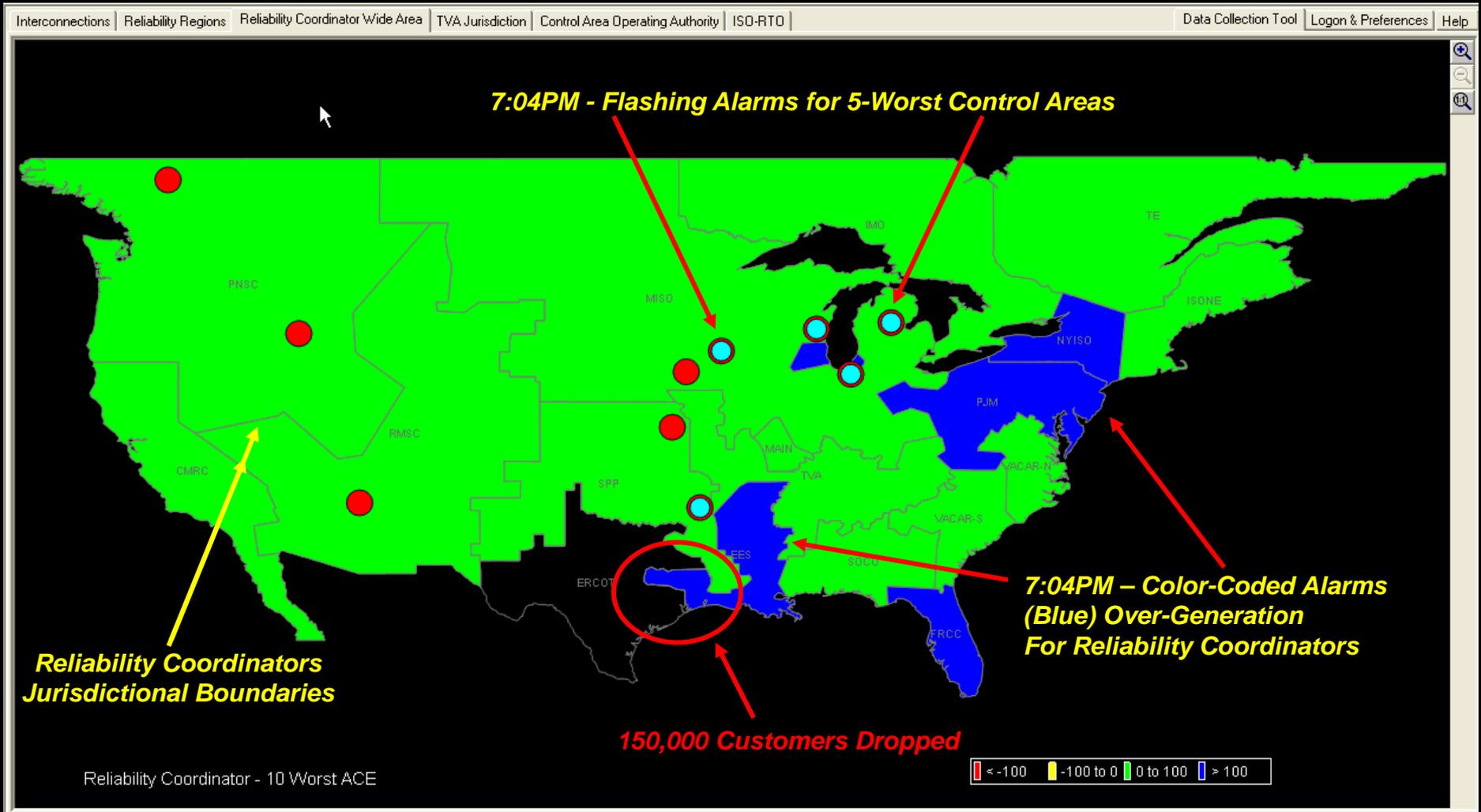
**SHORT-TERM: -EAST 6/15/2005 8:04:00 AM(EDT) - Frequency Absolute value of two most recent 1-Minutes: ABS(59.997-60.034)=0.037Hz>=0.035Hz.**

-----DISCLAIMER-----

This notice reflects the most current information available from Control Areas. These notice results depend on the quality and completeness of the data supplied and, accordingly, the accuracy of this notice cannot be assured.

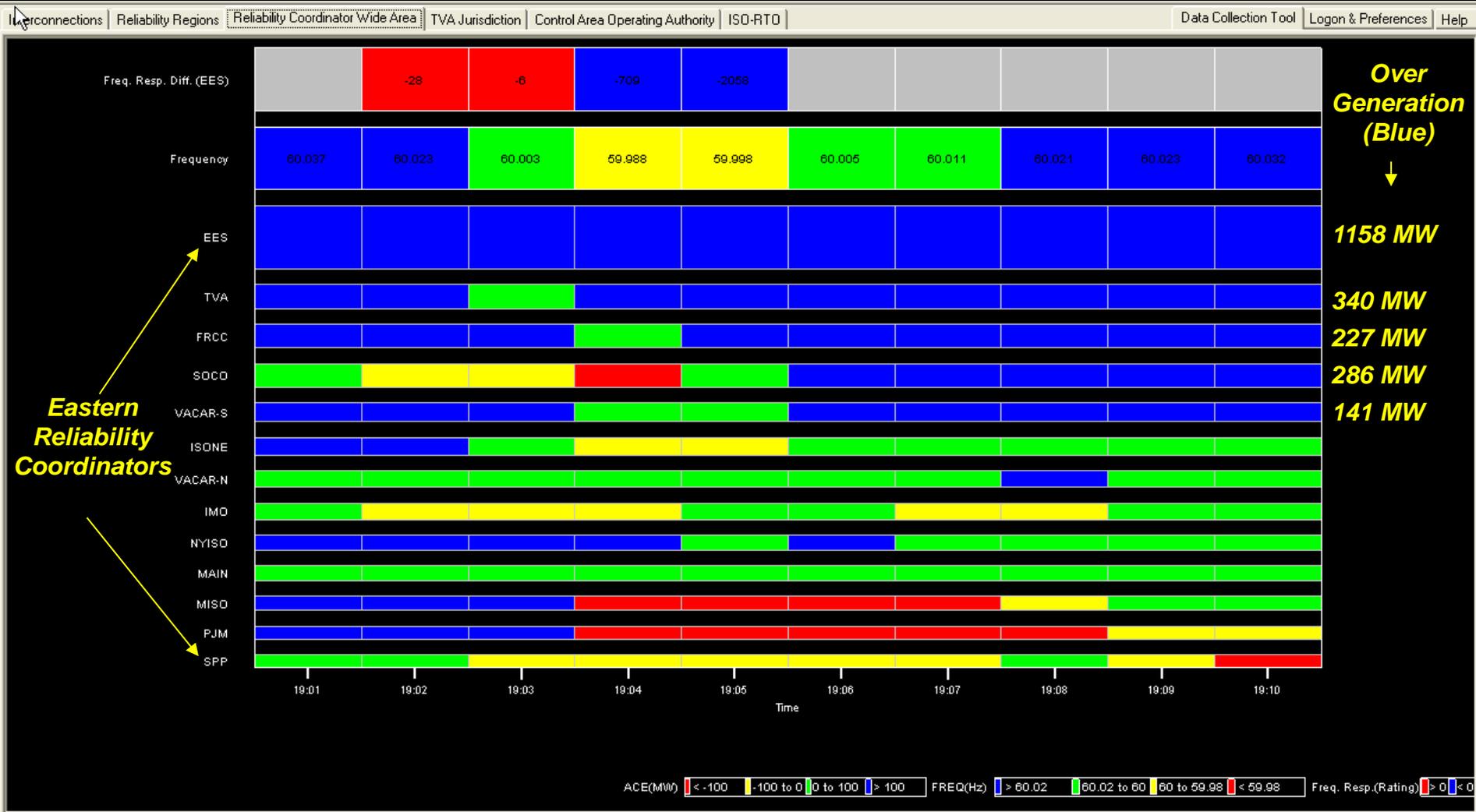
This notice is provided solely for informational purposes.

# Alarms - Worst Reliability Coordinators and Control Areas At 7:04PM by NERC-CERTS Frequency-ACE Tool



# Disturbance – Eastern Interconn. Performance

## NERC-CERTS ACE-Frequency Tool

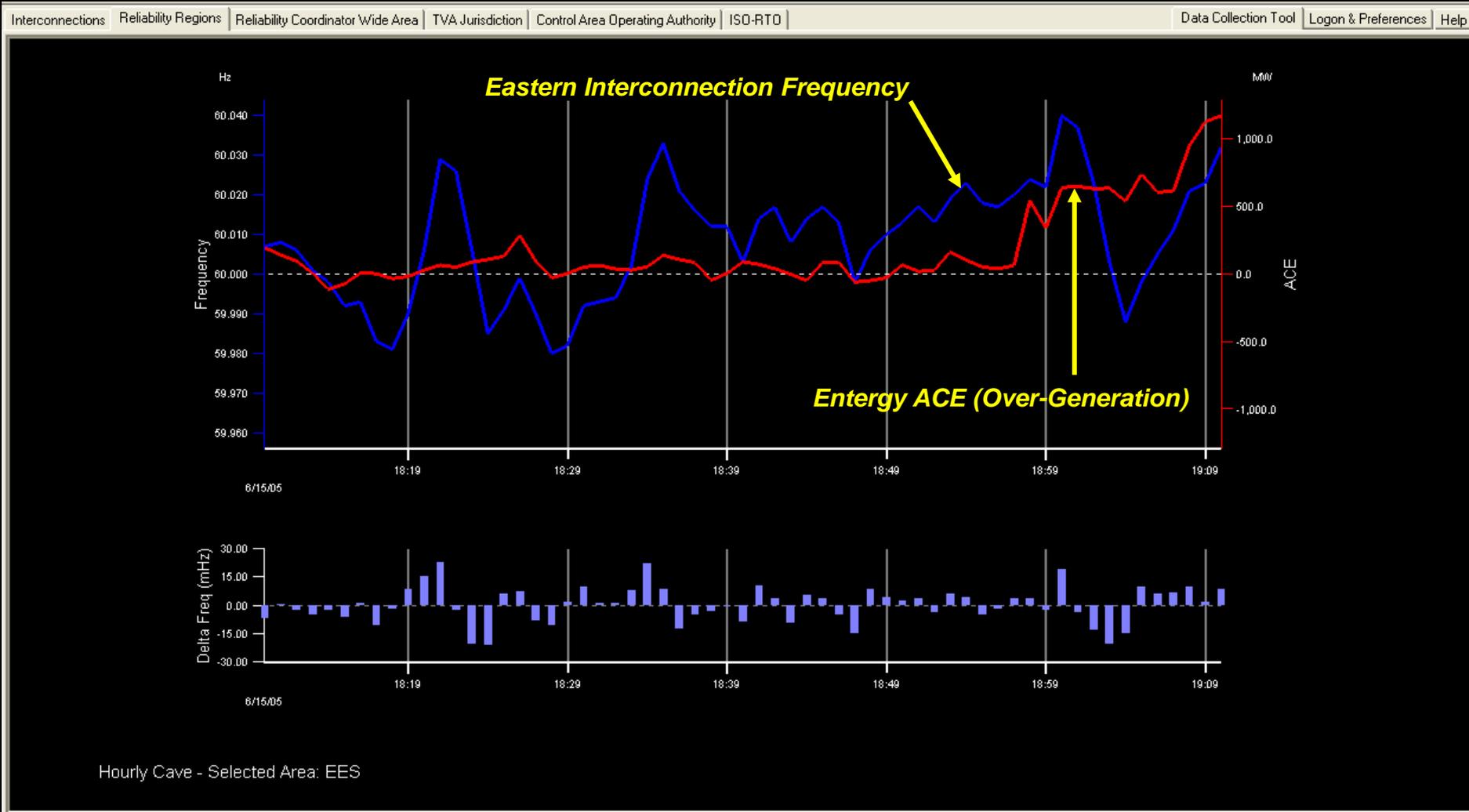


At 17:10 PM The Eastern Interconnection Reached About 2152 MW of Over-Generation

At 7:01 PM (Alarms Issued) 9 From the 13 Reliability Coordinators Jurisdiction Were Over-Generating

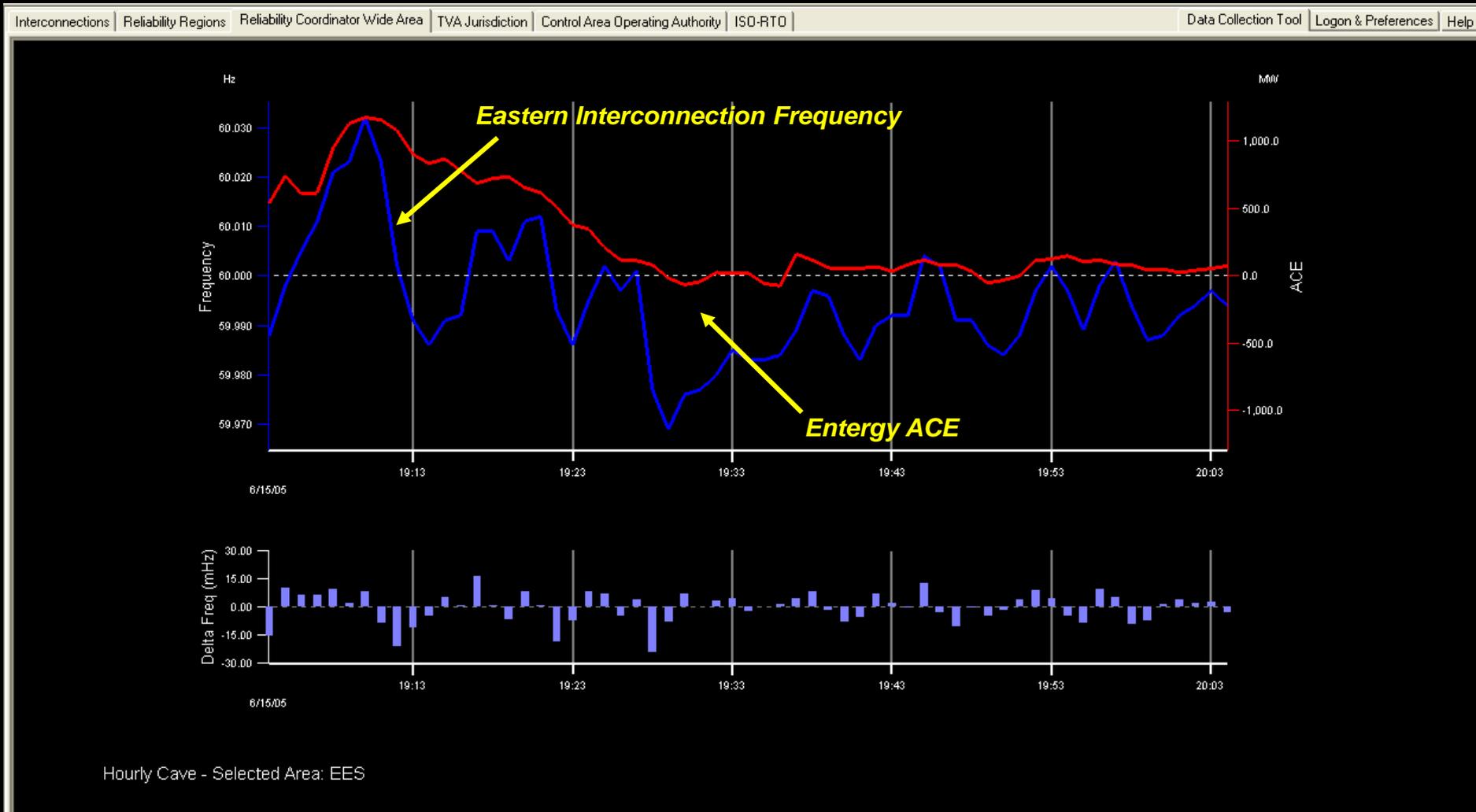
# Disturbance – Entergy Performance

## NERC-CERTS ACE-Frequency Tool



About 1158 MW of Over-Generation. It changed from about 500 MW to 1158 MW from 7:01-7:10PM

# Post Disturbance Frequency and Entergy ACE NERC-CERTS ACE-Frequency Tool



Entergy Reduced Over-Generation from 1158 MW to Zero MW in About 20-Minutes  
(Reduction Maybe Was Required Because of a Drop of 1158 MW of Customer Load)