Consortium for Electric Reliability Technology Solutions

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

Release 2

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User's Guide

*Release 2.0 - **CONFIDENTIAL***
Date: May 6th, 2004

Prepared by:

Electric Power Group

for

CERTS
Consortium for Electric Reliability Technology Solutions

North American Electric Reliability Council

Wide-Area
Area Control Error and Frequency (ACE-Frequency)
Real-Time Monitoring System

The Consortium for Electric Reliability Technology Solutions (CERTS) has been working with the North American Electric Reliability Council (NERC) on research and development of tools and technologies for management of grid reliability. This is the user's guide for one such tool: Wide-Area ACE-Frequency Real-Time Monitoring System™. The Wide-Area ACE-Frequency Real-Time Monitoring System is one of the applications developed by Electric Power Group as part of Grid Real-Time **P**erformance Monitoring and **P**rediction **P**latform (Grid-3P™) to provide the capability to monitor grid reliability and market performance in real time. The Grid-3P can be used by NERC for ACE-Frequency Real-Time Monitoring System and other applications to monitor grid reliability.

Release 2 of the application contains additional monitoring functionality recommended by Reliability Coordinators, corrections to known problems in Release 1, and improvements originated from some of the recommendations from the 8/14/04 blackout final report. Following is a summary of the major changes in Release 2.

- ✓ Run in a new, faster data server and database
- ✓ Expand 10-minutes, hourly time-windows to up to 24-hours
- ✓ New tracking multivariable graphic visual – Northeast RC
- ✓ New delta ACE-Frequency plot – Most of RC
- ✓ Compatibility with Microsoft MS04-004 security update
- ✓ Streamline real time abnormal frequency alarm messages
- ✓ Update geographic jurisdiction boundaries i.e., RC, CA, etc.
- ✓ Update performance constants, Bias, L10, etc.
- ✓ Update User-Guide and three-folded brochure

This CERTS project was funded by the Department of Energy, Office of Transmission and Distribution, Phil Overholt, Reliability Program Manager. CERTS research program is managed by Lawrence Berkeley National Lab, Joe Eto, Program Manager. The CERTS development team was led by Carlos Martinez of the Electric Power Group.

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1. Introduction

The North American Electric Reliability Council (NERC) is in the process of developing mandatory compliance standards. An important aspect of a standard is the associated performance metrics that are employed to determine if the appropriate entities are in compliance. The Consortium for Electric Reliability Technology Solutions (CERTS) has been working with NERC and other organizations to research, develop, and disseminate new methods, tools and technologies to protect and enhance the reliability of the U.S. electric power system under the emerging competitive electricity market structures. In particular, CERTS has developed and demonstrated the Grid Real-Time Performance Monitoring and Prediction Platform (Grid-3P©), a platform to develop applications for monitoring grid reliability and market performance in real time. Grid 3P complements and integrates with existing SCADA systems and utilizes real time data engines and graphic-geographic visualization tools to develop reliability applications to assist operating authorities, e.g., Independent System Operators (ISOs), Regional Transmission Organizations (RTOs), Reliability Coordinators, and Control Area Dispatchers in their management of grid reliability.

The ACE-Frequency and AIE Real-Time Monitoring System applications, using CERTS' Grid-3P, will enable NERC Reliability Coordinators to monitor ACE-Frequency performance and compliance with performance operational guides within their jurisdictions, and will also allow NERC staff and subcommittees to analyze and assess control data to improve reliability performance. The Wide-Area ACE-Frequency Real-Time Monitoring System translates raw operational control data into meaningful operations performance information for end users. Should an abnormal interconnection frequency occur, a Real-Time Interconnection Abnormal Frequency Notification (AFN) is automatically issued via email or beeper describing the date, time, and magnitude of the frequency abnormality to specific Operational Authorities, NERC Resources Subcommittee members, and NERC Staff. The notification recipients using the Wide-Area ACE-Frequency Monitoring System functionality can quickly assess the abnormality's root cause by drilling down from wide-area to local-area visualization displays that include appropriate information and analysis graphs to easily identify and assess those control area(s) out of compliance and potential originators of the notified interconnection frequency abnormality.

This "User's Guide" and the companion 3-folded summary brochure have been developed for the Wide-Area ACE-Frequency Monitoring System. The AIE Monitoring System User's Guide will be developed at a later date. The main sections include the following:

- *Wide-Area ACE-Frequency Real-Time Monitoring Overview:* Provides an overview of Grid-3P as applied to the five major functional components of the Wide-Area ACE-Frequency Real-Time Monitoring System, and the geographic-graphic visualization model used to develop the user interface.
- *Wide-Area ACE-Frequency Real-Time Monitoring Visualization and Navigation:* Describes the Grid-3P visualization infrastructure including map and data display functions.
- *Wide-Area ACE-Frequency Real-Time Monitoring System – Local Monitoring:* Details various functions allowing users to drill down to the desired level of data and graphic displays, including local-visualization options covering from current time to 1-hour.
- *Wide-Area ACE-Frequency Real-Time Monitoring System – Global Monitoring:* Describes functions to access data and graphic displays for the Epsilon performance parameter for 6-hour and 30-day periods.
- *Wide-Area ACE-Frequency Complementary Functions:* Characterizes Abnormal Frequency Notification (AFN), Interactive Data Collection (IDC), and Unavailable Data Reporter (UDR).

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2. Wide-Area ACE-Frequency Real-Time Monitoring Overview

2.1. Wide-Area Grid Performance Monitoring and Prediction Platform (Grid-3P) Overview

The vertically integrated business model historically used by utilities has evolved to a segmented market dispersed among separate entities. From a control-monitoring perspective, layers 1, 2, and 3 from Figure-1 below shows the traditional control-monitoring levels. Layer 4 is surfacing as an expansion of those traditional layers responding to the need to monitor the system in a wide-area basis as the creation of electricity markets is demanding. The right side from Figure-1 shows the operational tools for the different layers including the new layer 4. The ACE-Frequency Real Time Monitoring tool is considered part of the group label as Wide-Area Load-Generation Balance Monitoring. The Grid Real-Time Performance Monitoring and Prediction Platform (Grid-3P) has been developed by CERTS to serve as the base for the development of wide-area reliability applications for real-time monitoring and prediction for the reliability performance of control areas, generation, grid, markets, and security. Control Area ACE and Interconnection frequency and interchange data on top of the Grid-3P provide a common tool to be used by NERC Reliability Coordinators, Control Area Dispatchers, and Transmission Dispatchers. The bottom of Figure 1 also shows that reliability applications developed using Grid-3P serve as complement for traditional SCADA/EMS systems and for the periodic reporting requested by NERC for post performance assessment.

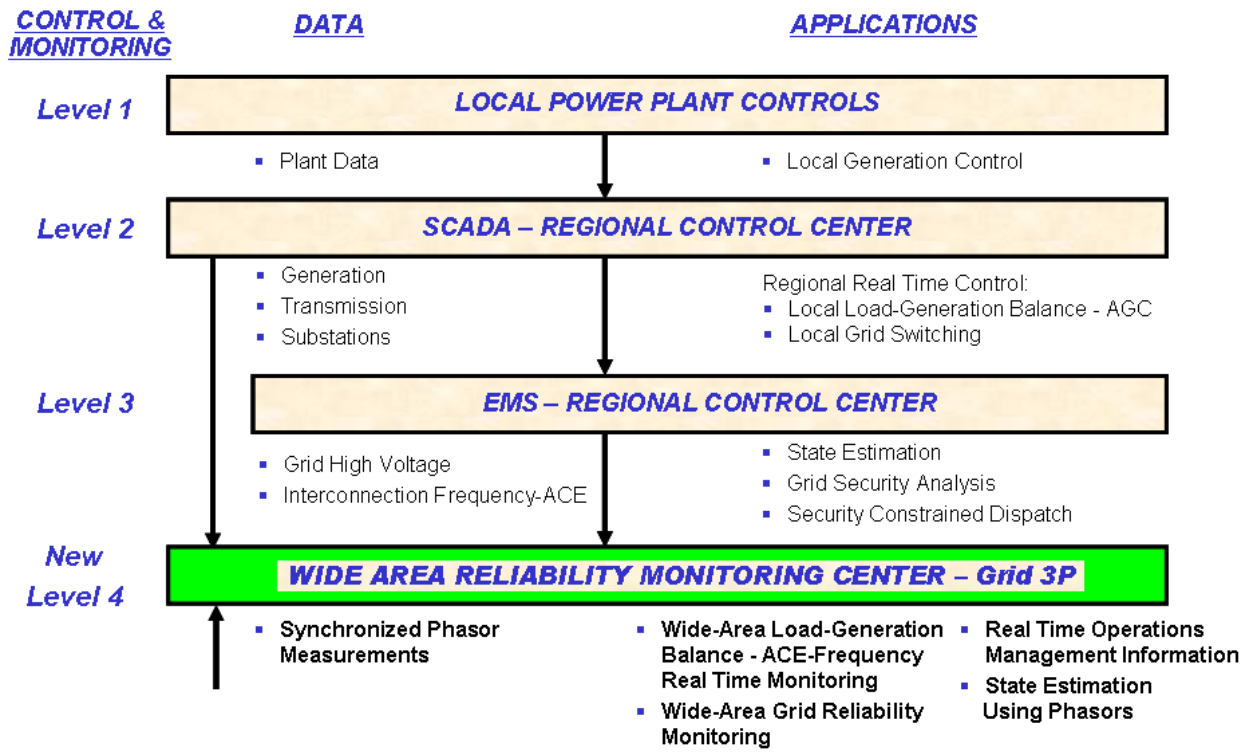

Figure 1 – Wide-Area Real Time Monitoring Center

Figure 2 shows an expansion of the Grid-3P block from Figure 1 and includes the major reliability applications for real-time reliability monitoring for NERC Reliability Coordinators and Control Area Dispatchers. The top part from Figure 2 shows the applications targeted for Reliability

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Coordinators: ACE-Frequency, AIE and Control Performance Standards (CPS). The bottom part from Figure 2 shows the applications targeted to Control Area Dispatchers: performance compliance of control areas and suppliers to AGC, FRR, and Ancillary Services markets. NERC Reliability Coordinators monitor several requirements, including ACE-Frequency, to maintain and enhance the reliability of their jurisdictions. The ACE-Frequency Monitoring System, shown in the upper applications box, provides applications for each Coordinator within each of their reliability regions. Reliability Coordinators utilize those applications to monitor performance and compliance within their regions and notify the appropriate Control Area Dispatchers as abnormalities occur. Control Area Dispatchers pinpoint problem sources by monitoring the response performance of their control areas and suppliers to the Automatic Generation Control (AGC) Monitoring System, Frequency Response Resources, and Ancillary Services.

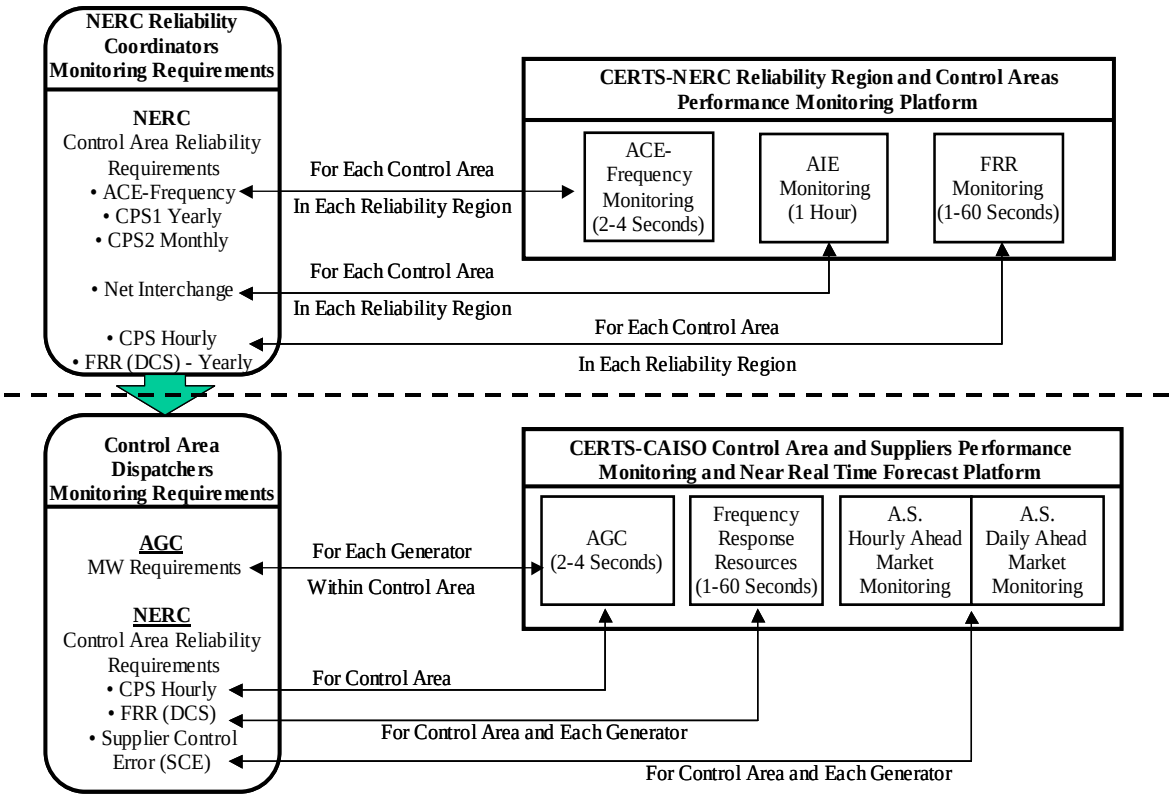

Figure 2 – Grid-3P Applications for Reliability Coordinators and Control Area Dispatchers

CERTS is developing the Reliability Coordinator applications for NERC, and the Control Area applications for the California Independent System Operators (CAISO).

Figure 3 illustrates the architecture of the Wide-Area ACE-Frequency Real-Time Monitoring System application using CERTS' Grid-3P. ACE-Frequency receives ACE and frequency data from the nation's Control Areas (Data Collection), calculates performance parameters for each reliability jurisdiction, and compares those performance parameters to NERC reliability compliance guides. The results of these comparisons are then displayed graphically (Visualization) on a geographical map (Geography) for use by each of the Reliability Organizations from each of the layers, depicted in the lower, right pyramid. The tiers of the pyramid comprise the Control Areas, Reliability Coordinators, Reliability Transmission Organizations, Reliability Regions, and Interconnections.

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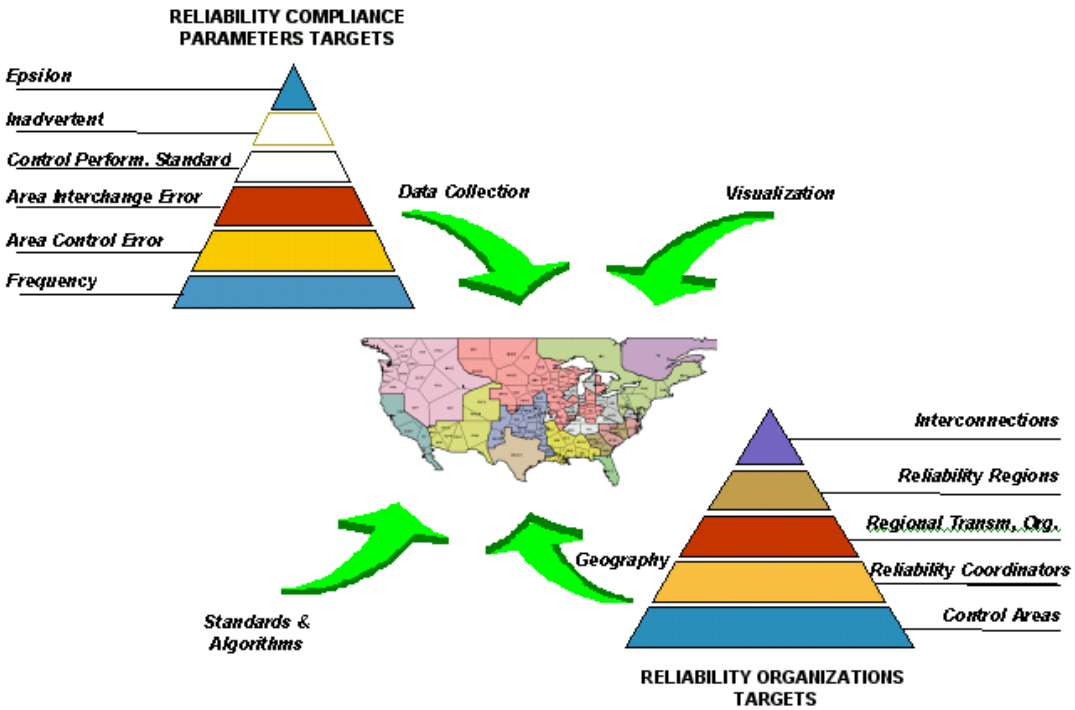

Figure 3 – Schematic Illustration of Grid-3P Application to NERC ACE-Frequency

2.2. Wide-Area ACE-Frequency Real-Time Monitoring Functional Overview

Figure 4 shows the five major functional components of the NERC Wide-Area ACE-Frequency Real-Time Monitoring System: Local Monitoring, Global Monitoring, Abnormal Frequency Notification, Interactive Data Collection, and Unavailable Data Reporting. The following are descriptions of each of the components.

Local Monitoring Geographic-Graphic Visualization

Most of the ACE-Frequency visualization is geographic-graphic oriented and covers different time windows from current time to 30-days. The local-visualization option covers from current time to 1-hour, and it offers to end users three different views of Control Area ACE and Interconnection frequency data displayable in the Grid-3P three-panel window visualization.

Global Monitoring Geographic-Graphic Visualization

This option uses the Epsilon performance parameter as an indicator of the frequency performance for each of the interconnections. It shows the performance parameter for two time windows, 6-hours and 30-days. It also uses the Grid-3P three-panel window visualization.

Abnormal Frequency Notification (AFN)

The Real Time Abnormal Frequency Notification (AFN) is a real-time monitoring component of the ACE-Frequency Monitoring System. The AFN is designed for real-time monitoring of abnormal interconnection frequencies. It automatically issue emails to specific NERC Resources Subcommittee members and NERC Staff when predefined abnormal frequency performance criteria are met. Email recipients can use the Wide-Area ACE-Frequency Monitoring System capabilities to assess root causes of the abnormal frequencies when notified.

The input data to the AFN is provided by Control Areas to NERC over a secure connection using NERCnet, XML, and SOAP technologies.

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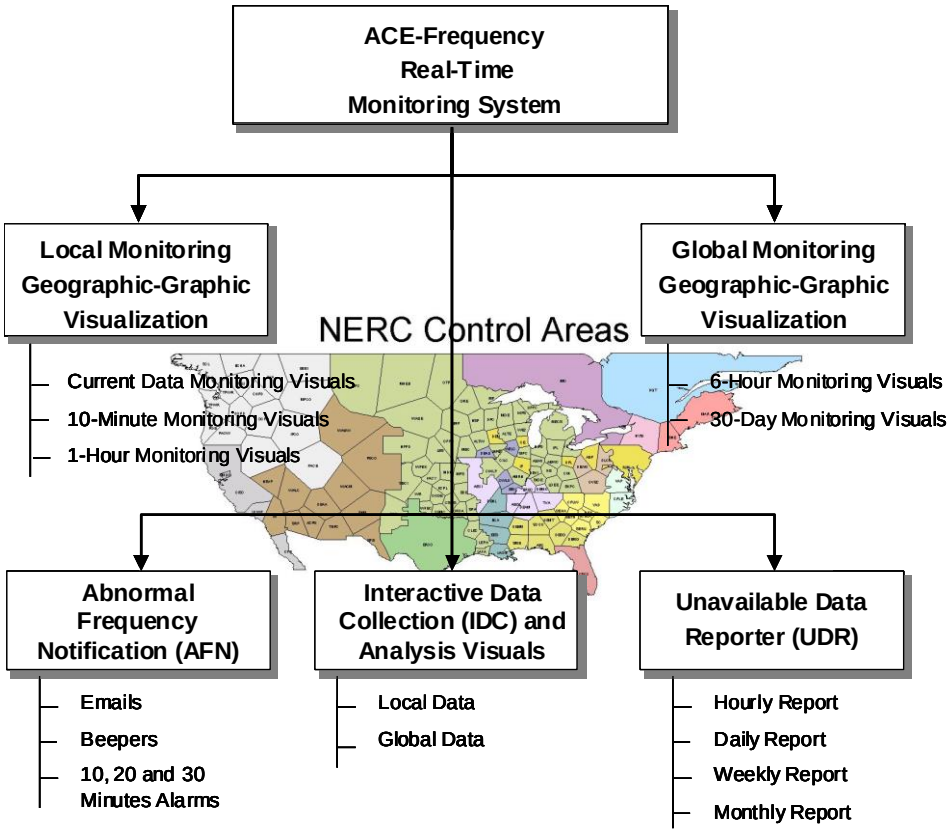

Figure 4 – Wide-Area ACE-Frequency Real-Time Monitoring System Functional Overview

Interactive Data Collection (IDC) Function

NERC Subcommittees, NERC Staff, and Operating Engineers can interactively define the historical window of time and the specific control-performance parameter they need to analyze and assess frequent disturbances via the IDC functionality,. Once data is collected from the NERC data server, the users can use equivalent reliability coordinator visualization and/or save the data in comma-delimited files.

Unavailable Data Report (UDR) Function

UDR offers the capability to interactively identify and report Control Area data transfer performance. Users can select hourly, daily, weekly, and monthly reports and select the specific data they want to assess for availability.

2.3. Wide-Area ACE-Frequency Real-Time Monitoring Visualization Overview

It has been demonstrated by Dispatchers that the more effective operational displays are those that follow a hierarchical approach to present operational data for current time and other key windows of time. The Grid-3P visualization model encompasses displays at high and low levels to meet the varying needs of different reliability application users. Thus, monitoring applications are developed for wide-area and local area users. The hierarchal structure in Figure 5 shows that Reliability Coordinators need to have a wide-area view of their jurisdictions for reliability compliance monitoring. ISOs and RTOs need the ability to assess performance and trends of their control areas. In turn, control areas need local area information to pinpoint specific suppliers reliability performance issues. The ACE-Frequency tool allows Reliability Coordinators to monitor ACE-Frequency performance and compliance for each of their jurisdictions using wide-control-area graphic-geographic visualization.

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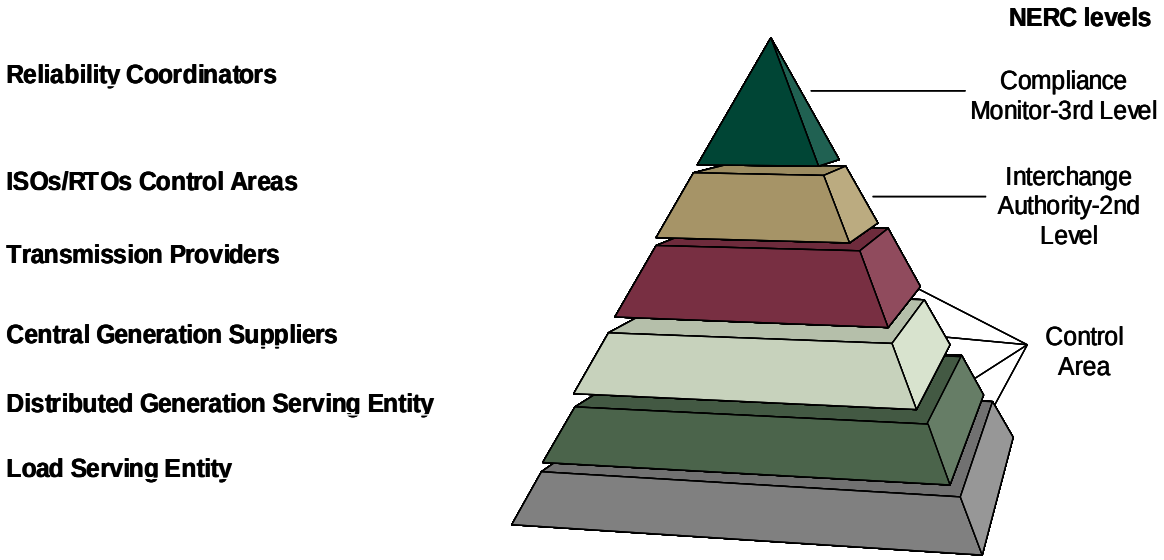

Figure 5 – Reliability Functional Levels and Visualization Hierarchy

The definition and design of the ACE-Frequency graphic-geographic visuals for each of the visualization layers shown in Figure 5 closely followed the Grid-3P data collection, computational, and visualization models shown in the first three vertical segments in Figure 6.

For the NERC ACE-Frequency Real-Time Monitoring System, about 123 Control Areas transmit ACE and frequency data to a data server located at NERC (data collection). Data is processed and performance parameters are calculated in the Grid-3P computational engines (computational model). The design and deployment of each of the displays follows the three steps shown in the display model section on Figure 6, human factors, user interaction, and composition.

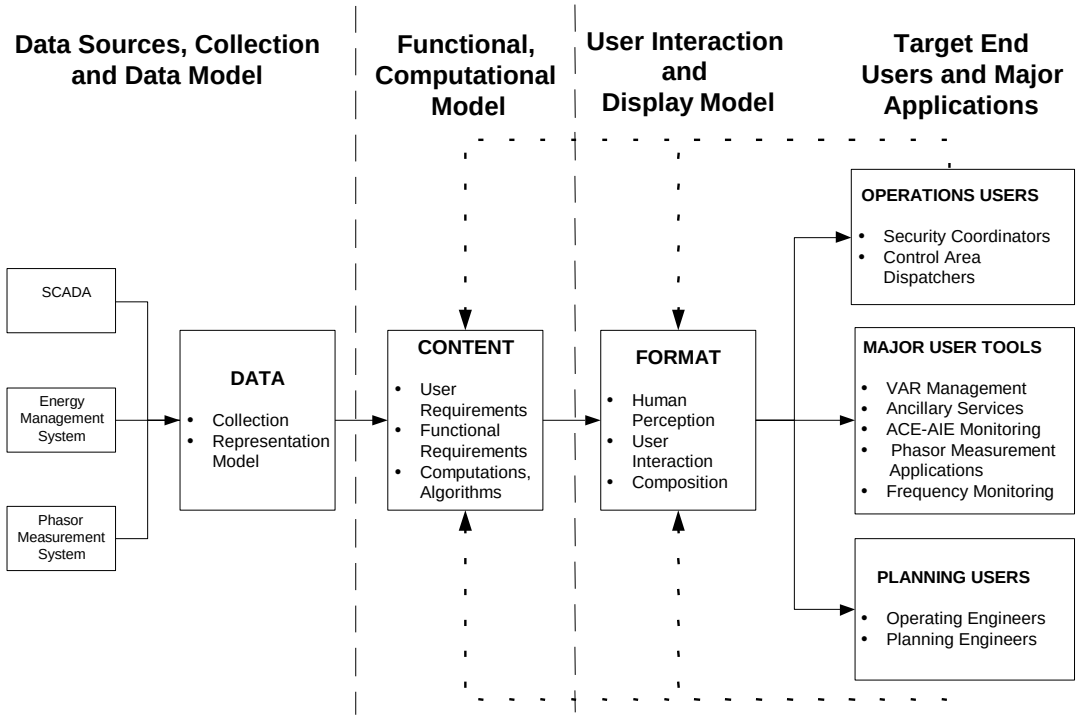

Figure 6 – CERTS Grid-3P Integrated Visualization Model

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To start the Wide-Area ACE-Frequency Real-Time Monitoring System from a Desk Top, click on the icon shown in Figure 7.

Figure 7 – Desk Top Icon used to start Wide-Area ACE-Frequency Monitoring System

Home Page

After clicking on the "Grid-3P ACE-Frequency" icon, the Grid-3P program Home Web Page is the first screen (default) to be displayed (Figure 8).

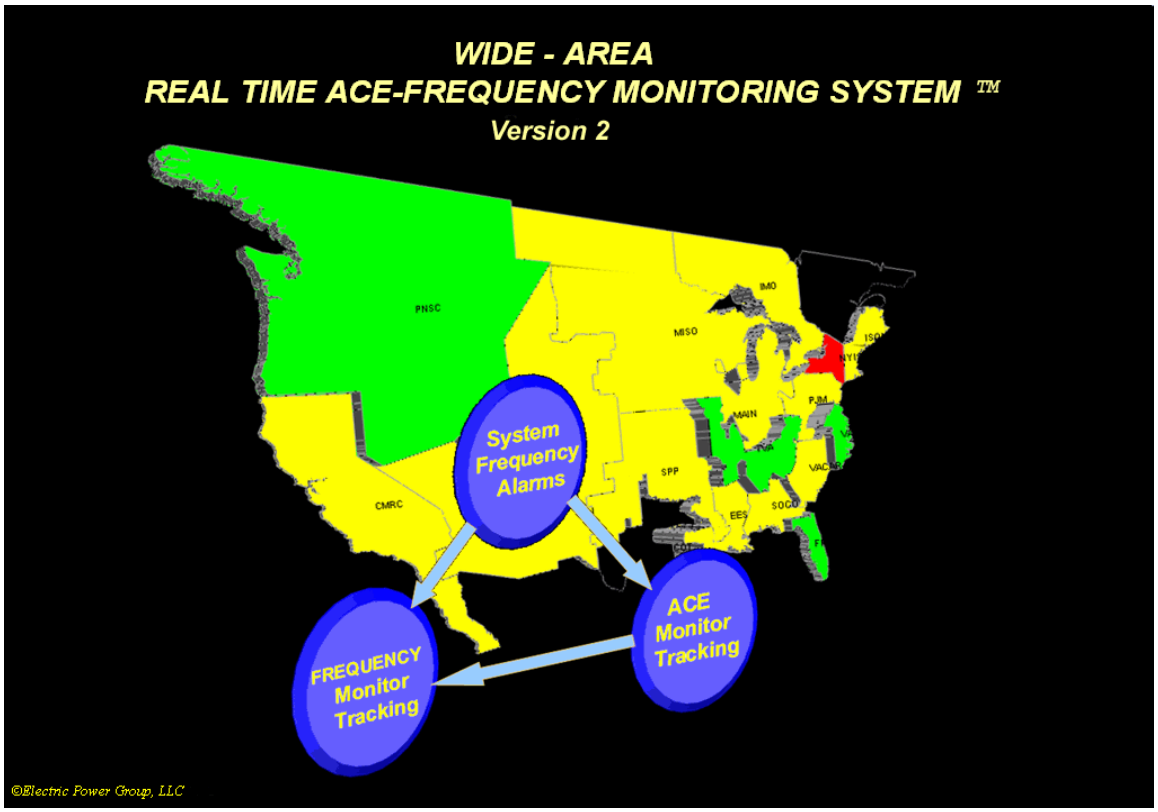

Figure 8 – Home Web Page

The background for the "Home Page" is the Reliability Coordinator graphic for all the Interconnections. The three buttons, "System Frequency Alarms", Frequency Monitoring Tracking" and "ACE Monitor Tracking" will take the user to the "Reliability Coordinator" default display (Figure 9).

The "Help" tab is the bottom button on the right side of the display. The "Help" tab is available on most of the Grid-3P displays, but it always takes the user to the Home Web Page (shown above). At the Home Page there are six areas to be selected. The "Feedback" area has been established to allow users to record and send comments to the Host.

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3. Wide-Area ACE-Frequency Real-Time Monitoring Visualization and Navigation

3.1 Grid-3P Visualization Infrastructure

Clicking the Area Control Error Monitoring icon will give the user the Master Monitoring Display, as seen below in Figure 9.

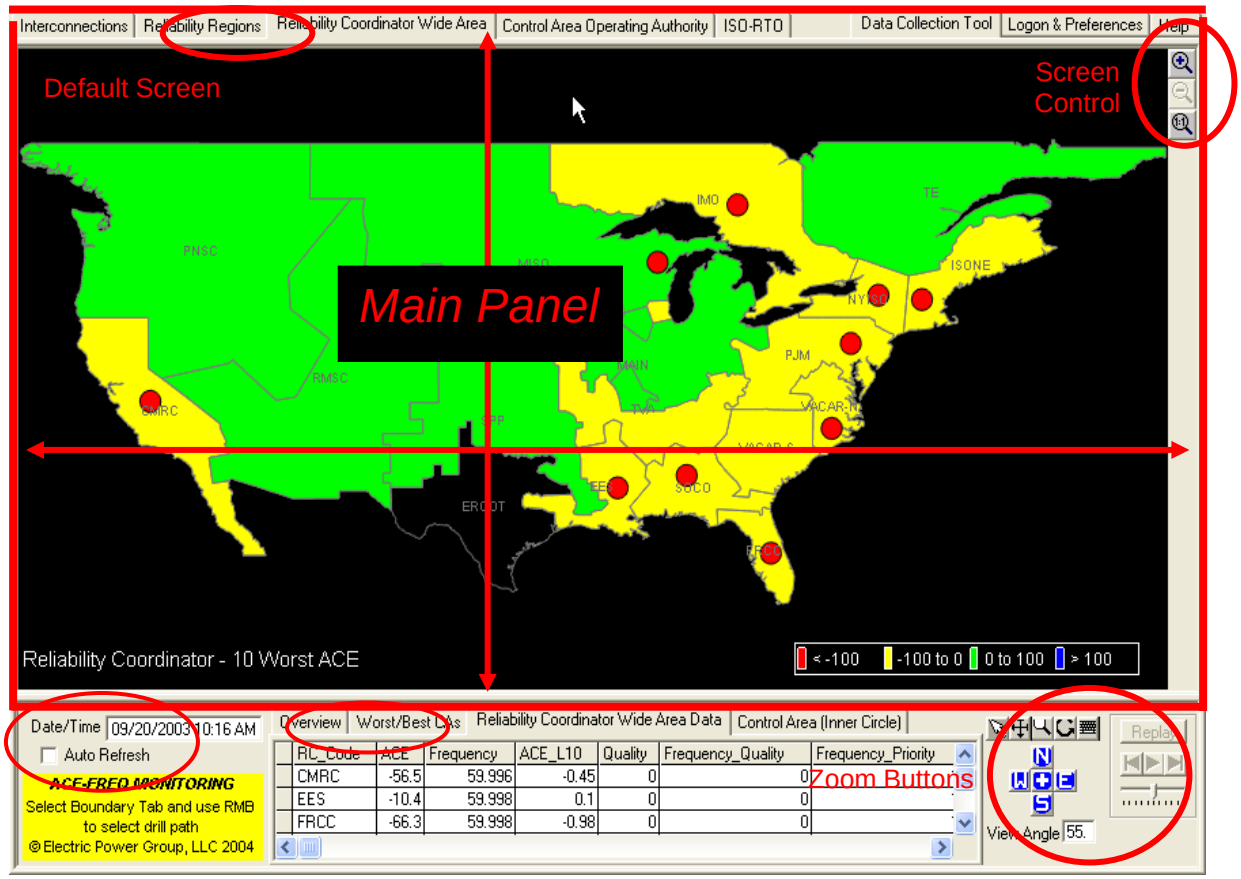

Figure 9 – The default screen is the Reliability Coordinator screen.

From this panel the user has the ability to move the screen through the use of the "Screen Controls" (circled, lower right), zoom in or out as needed (circled, upper right) or choose one of the Jurisdiction options. The default map when opening the monitoring system is the Reliability Coordinator jurisdiction (circled, upper left). The Date and Time and Auto Refresh/static option is circled in the lower left corner. The "Reliability Coordinator Data" is circled just to the right of the Date and Time.

In this jurisdiction map the 20 Reliability Coordinator Jurisdictions are drawn. The bubbles (red circles) within each jurisdiction shown represent the CA within the Reliability Coordinator areas of responsibility with the worst ACE. The data for the Reliability Coordinator's map is presented at the bottom of the main panel. The date and time are shown to the left of the data tables.

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Control Area ACE and ACE/L10 Map Color Codes

Color is used to designate the ACE for each Control Area. As the Control Area ACE changes, the color and its associated range of values change. The colors and associated ACE numerical values are as shown below in Figure 10.

Figure 10 – ACE Color Code

3.2. Display Overview – Keyboard & Mouse Functions

Zoom Function

The Zoom Buttons located at top right of display allows the user to zoom in or out.

Zoom In

By clicking the "Zoom In" button the diagram is enlarged for better observation. This button can be clicked up to four times with each click enlarging the image.

Zoom Out

After zoom in, the user can click "Zoom Out" for a wider angle views.

Reset (1:1)

Allows the operator to return the diagram to its default size.

To manipulate the panel on the screen, screen controls are provided. These controls are located on the lower right side of the screen.

Mouse Functions

Navigating with the Mouse – You can use the mouse to perform a variety of useful functions in viewing and working with the graphical display. The mouse and view controls are located in the lower right hand of the screen (See Figure 11).

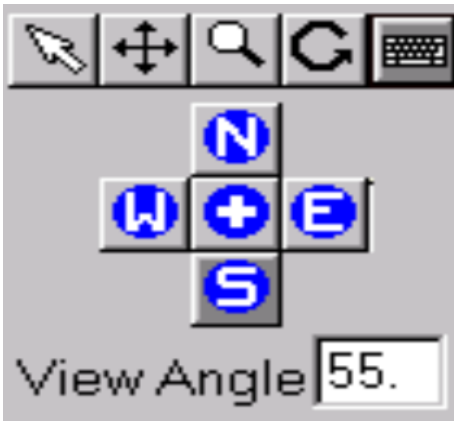

Figure 11 – Mouse Control

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The following are the features and how to launch these functions:

Function	Mouse Control Icon	What it does
Selection Arrow	- Click the selection arrow; move the cursor to the viewing panel, click the left mouse on the desired location on any of the displays.	Needs to be selected (clicked) prior to selecting the desired area to be viewed.
Reposition	- Click the crossed arrows, move the cursor to the viewing panel, click the left mouse and drag the object to the desired location in the panel.	Allows the user to reposition or center objects being displayed in the panel.
Zoom In/Out	- Click the magnifying glass to resize the image. With the mouse on the image hold down the left mouse button and slide the mouse <u>down</u> or to the left to <u>reduce</u> the size of the image or move the mouse <u>up</u> or to the right to <u>increase</u> its size.	Zoom In – Enlarge the details of a selected area Zoom Out – Provides an aerial view for a selected diagram.
Rotation	- Click on the open circle icon, move the cursor to the panel, click and hold the left mouse and move the mouse in the desired direction.	Rotate the axis of a selected panel.
Keyboard Control	This button is only used in the 3D format. Click on the keyboard icon. To <u>Rotate</u> the diagram; depress the <Alt> key. Place the cursor on the panel and depress the left mouse button. The diagram can be rotated as desired. To <u>Select</u> an object on the diagram depress the <Ctrl> key. Then select one or move area by using the left mouse button and clicking. To <u>Zoom In/Out</u> depress the <Shift> key. With the mouse on the panel click the left mouse button. Move the mouse up or to the right to Zoom In; move the mouse down or to the left to Zoom out.	Moves diagram within panel to desired angle for viewing Selects areas to be viewed Zooms In/Out as needed for better monitoring

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The displayed image can be rotated by selecting one of the direction buttons shown in Figure 12. This control was implemented specifically to rotate the 3-D diagrams.

Figure 12 – Direction Buttons

Depressing the:

North "**N**" button inverts the diagram

East "**E**" button rotates the diagram 90 degrees clockwise

South "**S**" button returns the diagram to its default position

West "**W**" button rotates the diagram counterclockwise

The "+" button will reset the diagram to it's default position, same as the 1:1 "Zoom Button" (Reset) in the upper right corner

The View Angle allows the position of the diagram to be changed (see Figure 13). A "0" degree angle gives a view of the panel on edge; "90" degrees is a flat view. The default angle is 55 degrees. The view Angle can be changed in one of two ways. First place the mouse arrow adjacent to the number and click so the cursor appears. While holding down the left mouse button highlight the number or number(s) to be changed. The second method is to click on the "Reset Keyboard Control," then use the arrow keys on the computer to move the cursor to the "View Angle" box and delete the numbers to be changed and key in the new numbers.

Figure 13 – View Angle Window

<u>Date and Time</u>

The date and time of the data being displayed is presented to the left of the text box, as shown in Figure 14.

Figure 14 – Date and Time

To view historical data, change the date and time by clicking in the box presenting the date and time. The Date/Time text box will then appear (Figure 15).

Figure 15 – Date Selection Window Function

Click on the down arrow and a calendar for the month shown will appear (Figure 16).

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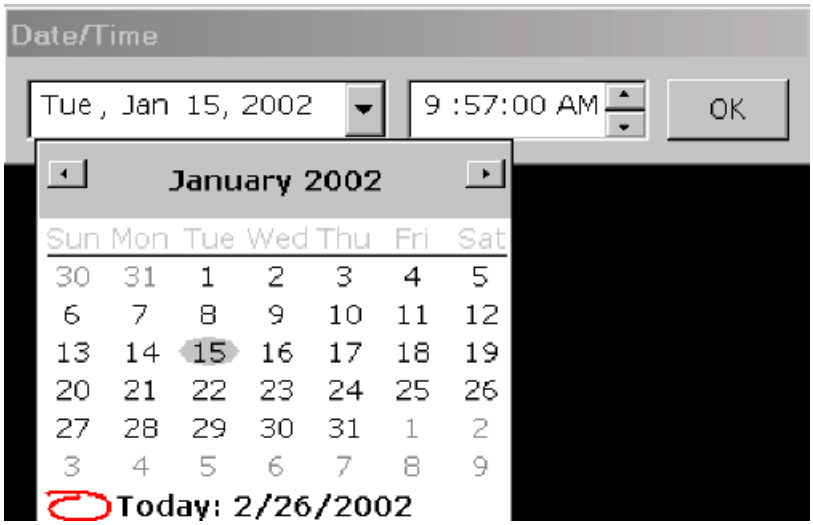

Figure 16 – Date/Time Calendar

To change the date, place the cursor over the desired date and click. The Date will change to the date desired in the text box. Should a different month be desired the arrows at the top of the calendar will move the calendar month by month. The left arrow moves the calendar back, the right arrow moves it ahead. Today's date is shown at the bottom of the calendar.

The time can be chanced by clicking either the up or down arrow to the right of the time as shown in Figure 17.

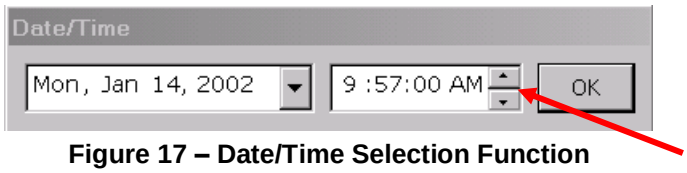

Figure 17 – Date/Time Selection Function

To change the hour, minute, seconds or AM/PM click on the number or alpha notation to be changed and it will be highlighted. Then clicking on the arrows, either up or down, will change the highlighted number. The default value is the hour number. If there isn't a highlighted value, then clicking the up/down arrow changes only the hour value. The AM/PM will toggle with the use of the arrows once highlighted. A second method of changing the time is to highlight the number to be changed and key in the desired number(s). The user has approximately two seconds to enter multiple numbers from the keyboard. That is, to enter "23" the two and three must be keyed within a two second window. To change the *ante meridiem* (AM) to *Post meridiem* (PM), highlight the area and key either an "A" for AM or "P" for PM.

Auto Refresh

Just below the date and time is the command that automatically refreshes the data and display. The display and data will automatically update every minute (Figure 18).

Figure 18 – Auto Refresh Checked

To hold the data at the present time or chose a time in history, click the "Auto Refresh" box. The auto refresh function will be cancelled and the data is frozen. The check mark is removed from the Auto Refresh box, as seen in Figure 19.

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Figure 19 – Auto Refresh Unchecked

It must be remembered that this box must be checked to return to real time. Clicking on the vacant box as seen in Figure 19 the check mark will reappear in the check box. The data will now be automatically updated every minute.

3.3 Jurisdictional Tabs and Dynamic Window

Jurisdictional Tabs

The Jurisdictional Tabs (top left side of screen) represent the Reliability Organizations Entry Points (Figure 20). The Five Jurisdictional Tabs that are used for Grid-3P are as follows:

1. Interconnections
2. Reliability Regions
3. Reliability Coordinator Wide Area (Default)
4. Control Area Operating Authority
5. ISO-RTO

Text Dynamic Window

The Text Dynamic Window (bottom left center of screen in Figure 20) has four (4) tabs. This text window shows the Control Area data in text-tabular format, corresponding to the data on the graphic-geographic displays. The four tabs are:

1. Overview
2. Worst/Best CA's
3. Reliability Coordinator Wide Area Data (This tab will change to the Jurisdiction selected)
4. Control Area (Inner Circle)

The third tab (data tab) always matches the selected map display, which in Figure 20 is the Reliability Coordinator Map. When the Interconnection Map is displayed, the third label is "Interconnection Data." This relationship between the map display and the dynamic window also holds for the Reliability Regions Map, the Control Areas Map and the ISO RTO Map. The other three tabs are always the same.

The Reliability Coordinator Map, shown below in Figure 20, is displayed when the Reliability Coordinator tab (upper left, circled) is selected.

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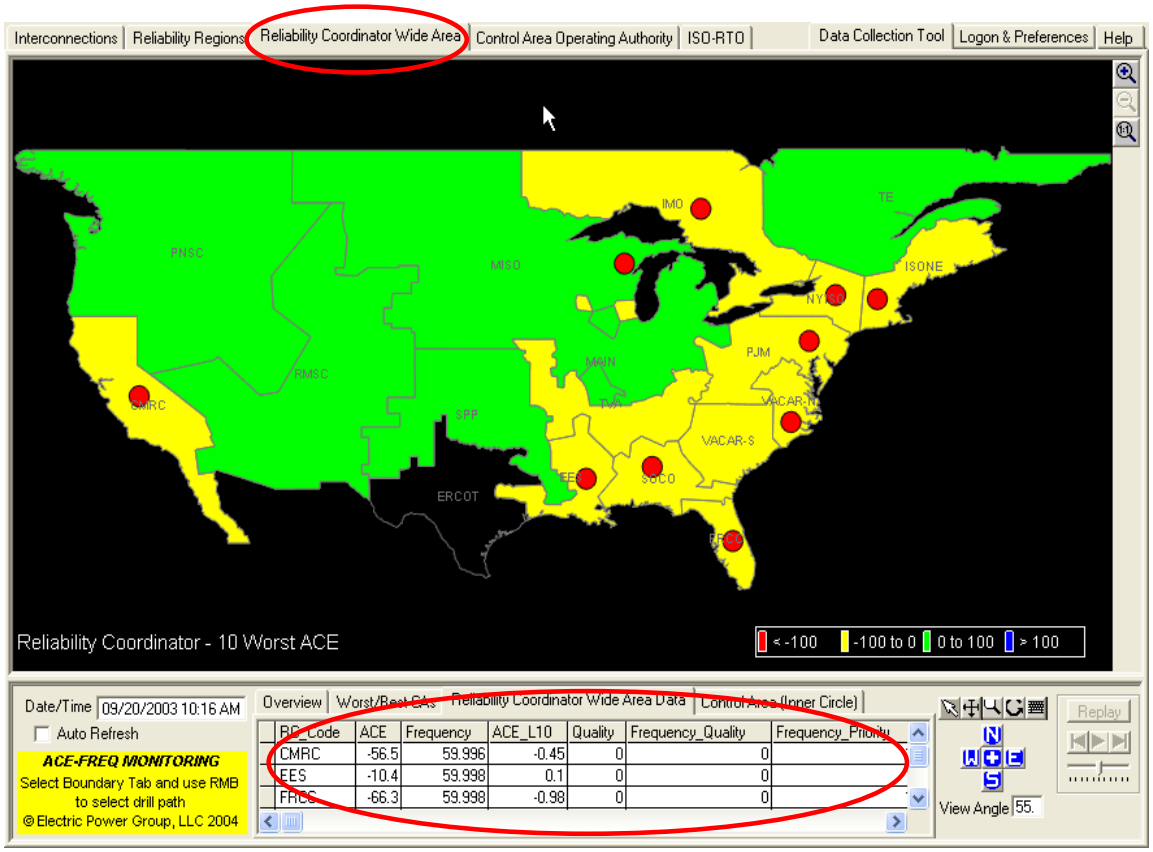

Figure 20 – Reliability Coordinator (Default Display)

The data that appears in the dynamic window depends on the tab selected. Starting with the Overview tab on the left, you will see the following when each tab is selected.

Overview Tab

Click the Overview tab to bring up a window with the four columns of data shown in Figure 21:

1. CA_Code – Control Area acronym
2. Control_Area Name – Full name of each Control Area
3. Peak_Load – (in MWs) as reported by NERC in the CPS annual report
4. Freq_Bias – in (MW/0.1Hz) (see NERC CPS annual report)
5. L10_Yearly – (in MWs) (see NERC CPS annual report)

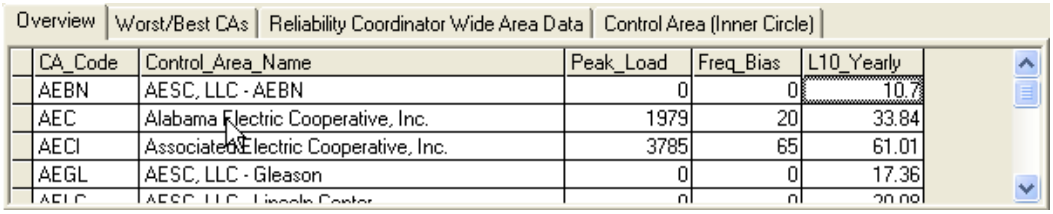

Figure 21 – Data displayed in the window with "Overview" selected

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Worst/Best Control Areas Tab

Click on the Worst/Best CA's tab and two tables appear (Figure 22). The data for the 10 Worst CA is displayed on left and 10 Best are on the right. Within each data box are four (4) columns:

1. CA_Code - Control Area acronym
2. ACE – ACE for each Control Area
3. Frequency – Frequency reported for each Control Area
4. ACE_L_{10} – ACE for each CA as compared to the L_{10} submitted by the control area

Overview | Worst/Best CAs | Reliability Coordinator Wide Area Data | Control Area (Inner Circle)

CA_Code	ACE	Frequency	ACE_L10
NYIS	-49.2	59.99	-0.37
CLEC	-45.8	59.99	-1.09
CIN	-42.5	59.99	-0.51
MGE	-41.8	59.99	-1.98
NIPS	-41.3	59.99	-0.72
TVA	-39.4	59.99	-0.31

CA_Code	ACE	Frequency	ACE_L10
CISO	296	60.02	2.69
AMRN	75.5	59.99	0.7
WEC	70	59.99	1.21
ESBI	52	60.02	1.02
FRCC	51.5	59.99	0.14
CSWS	50.3	59.99	0.69

Figure 22 – Data displayed in the window with "Worst/Best CA's" selected

Reliability Coordinator Jurisdiction Data

Clicking on the Reliability Coordinator Data tab brings up a data table showing the following five (5) columns (also, see Figure 23):

1. RC_Code – Reliability Coordinator Code
2. ACE - ACE for each Reliability Coordinator
3. Frequency – Frequency reported for each Reliability Coordinator
4. ACE_L_{10} - ACE for each Reliability Coordinator as compared to the L_{10} submitted by the individual control area
5. Quality - Number of minutes data has not been received from a Control Area ACE data
    - The CA color code for the quality of the data is as follows:
        i. Data received correctly – White background
        ii. Data not received for one (1) to three (3) minutes the background is Yellow
        iii. Data not received for three (3) to ten (10) minutes the background color is Red
6. Priority – Indicates the selected frequency source (see section 6.1.2)

Overview | Worst/Best CAs | Reliability Coordinator Wide Area Data | Control Area (Inner Circle)

RC_Code	ACE	Frequency	ACE_L10	Quality	Frequency_Quality	Frequency_Priority
MISO	-2.3	59.99	-0.11	0	0	1
NYISO	-49.2	59.99	-0.37	0	0	1
PJM	-7.4	59.99	-0.05	0	0	1
PNSC	0.6	60.02	0.01	0	0	1
RMDS	-1.5	60.017	0	0	0	1
SOCO	5.1	59.99	0.02	0	0	1

Figure 23 – Data Displayed in window with "Reliability Coordinator Data" selected

The Reliability Coordinator Jurisdiction is the default Jurisdiction that is shown in Figure 23. As explained above, should one of the other four (4) Jurisdictions be selected, then that selected Jurisdiction data would appear in the dynamic window.

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Control Area (Inner Circle)

Clicking the Control Area (Inner Circle) tab displays the data box shown in Figure 24. In this data box are the following twelve (12) columns:

1. IN_Code – An abbreviation for Interconnection
2. ISO_RTO_Code – Regional Transmission Organization
3. RR_Code – Reliability Region
4. RC_Code – Reliability Coordinator
5. CA_Code – Control Area
6. ACE – Area Control Error
7. Frequency – Frequency reported for the Interconnection.
8. ACE_L_{10} - ACE for the CA compared to the L_{10}
9. Quality – Number of minutes data has not been received from a CA
10. Longitude – Plotting coordinate
11. Latitude - Plotting coordinate
12. L_{10}_Yearly – Compares actual ACE for the past 12 months to L_{10} submitted by the CA

Overview | Worst/Best CAs | Reliability Coordinator Wide Area Data | Control Area (Inner Circle)

IN_Code	ISO_RTO_Code	RR_Code	RC_Code	CA_Code	ACE	Frequency	ACE_L10	Quality	Longitude	lattitude	L10_Yearly
W	RTOWest	WECC	PNSC	MPCO	-2	60.02	-0.09	0	-112.432	47.141	23.13
W	RTOWest	WECC	PNSC	PGE	-3.9	60.02	-0.1	0	-123.5	44.3	37.52
W	RTOWest	WECC	PNSC	PACE	-34.7	60.02	-0.78	0	-111.722	39.567	44.39
W	RTOWest	WECC	PNSC	ESBI	52	60.02	1.02	0	-112.514	50.66	50.89
W	RTOWest	WECC	PNSC	PACW	5.9	60.02	0.13	0	-122.066	42.933	43.76
W	RTOWest	WECC	PNSC	PSEI	4.4	60.02	0.12	0	-119.9	48.9	37.52

Figure 24 – Data displayed in the window with "Control Area (Inner Circle)" selected

3.4 Set Jurisdiction Focus and Display Options

Placing the mouse on the map and clicking the right mouse button will bring up the pop-up menu for the Function Text box as viewed in Figure 25.

Set Jurisdiction Focus

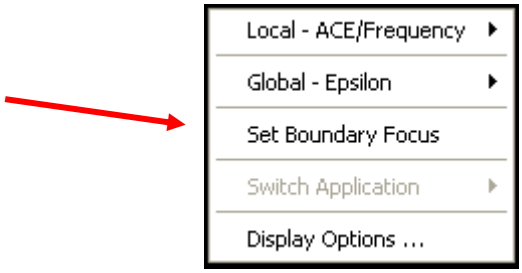

Figure 25 – Pop Up Text Box – Set Jurisdiction Focus

To focus users on a specific jurisdiction, disregarding the remaining areas, the "Set Jurisdiction Focus" has been installed for Interconnections, Reliability Regions, and Reliability Coordinators. This function is not available for Control Areas or ISO RTO. To exercise this function, click on the required tab. In Figure 26 the Interconnection has been selected and the West Interconnection has been highlighted. By right clicking the mouse the Function Pop up Box appeared.

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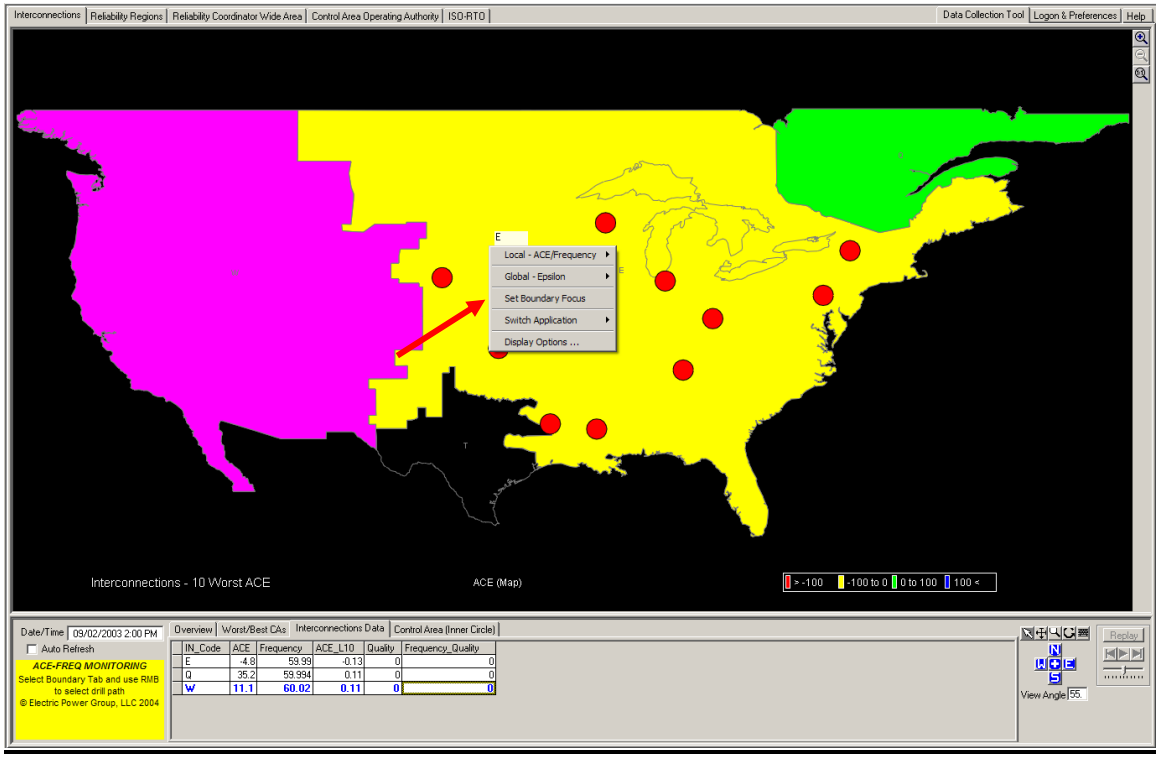

Figure 26 – Interconnection "Set Boundary Focus"

By selecting "Set Boundary Focus" the map will change to show only the highlighted area as seen in Figure 27.

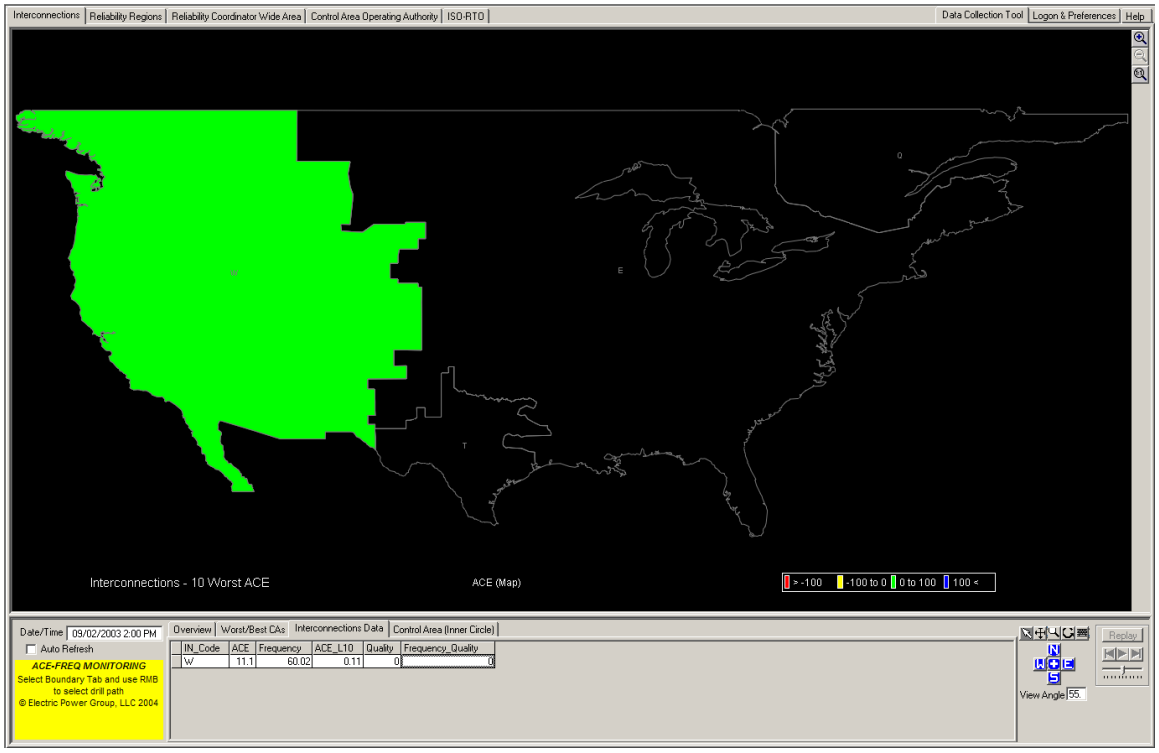

Figure 27 – Interconnection with Jurisdiction Focus Set

To return to the default view, right click and click on the check mark adjacent to "Set Jurisdiction Focus (Figure 28).

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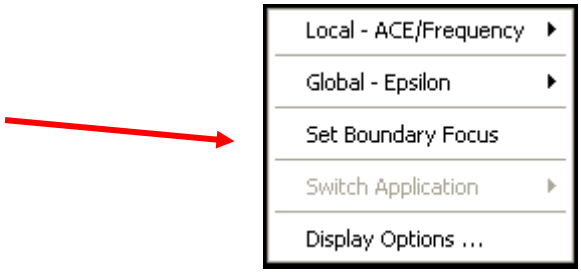

Figure 28 – Set Jurisdiction Focus Reset

Display Options

Selecting "Display Options" (Figure 29) will give the user the "Top Level Display Options" test box (Figure 30).

Figure 29 – Functions

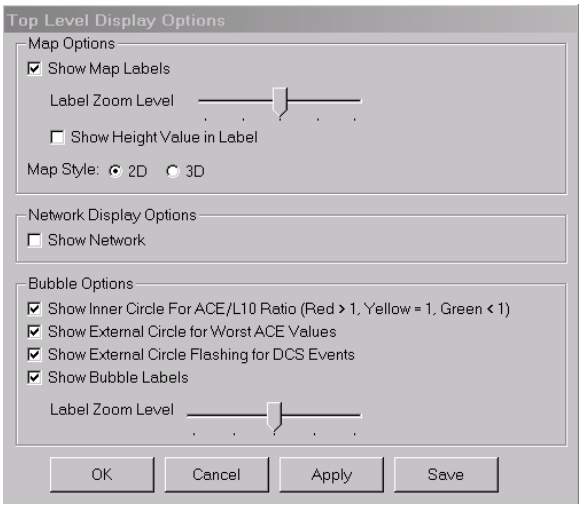

Figure 30 – Top Level Display Options

The "Top Level Display Options" text box is the same for all five (5) "Jurisdiction Tabs." There are three sections in this box: Map Options, Network Display Options, and Bubble Options. These options can be changed by clicking the check boxes or clicking and dragging one of the two "Label Zoom Level" levers. Moving the levers either right of left will change the visibility of the labels for the Jurisdiction map.

Map Options

To view the labels on the map the "Show Map Labels" box must be checked. The "Label Zoom Level" will need to be moved to the left for the label to appear on the map. The present "Label Zoom Level" is set at three (3), the default setting. Numbers will appear when the lever is moved to each graduation below the lever arrow point (note Figure 30). Once the cursor is over the arrow drag the lever to the left and the number one (1) will appear. Now the labels will appear on the map after "OK" is clicked. Moving the levers to the right of the default position will have no effect on the labels. The labels will not appear if the lever is set on three (3) or higher.

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The default “Map Style” is 2D. To change the map to 3D, the 3D box must be checked and the “OK” button clicked. This will change the view of the map as seen in Figure 31.

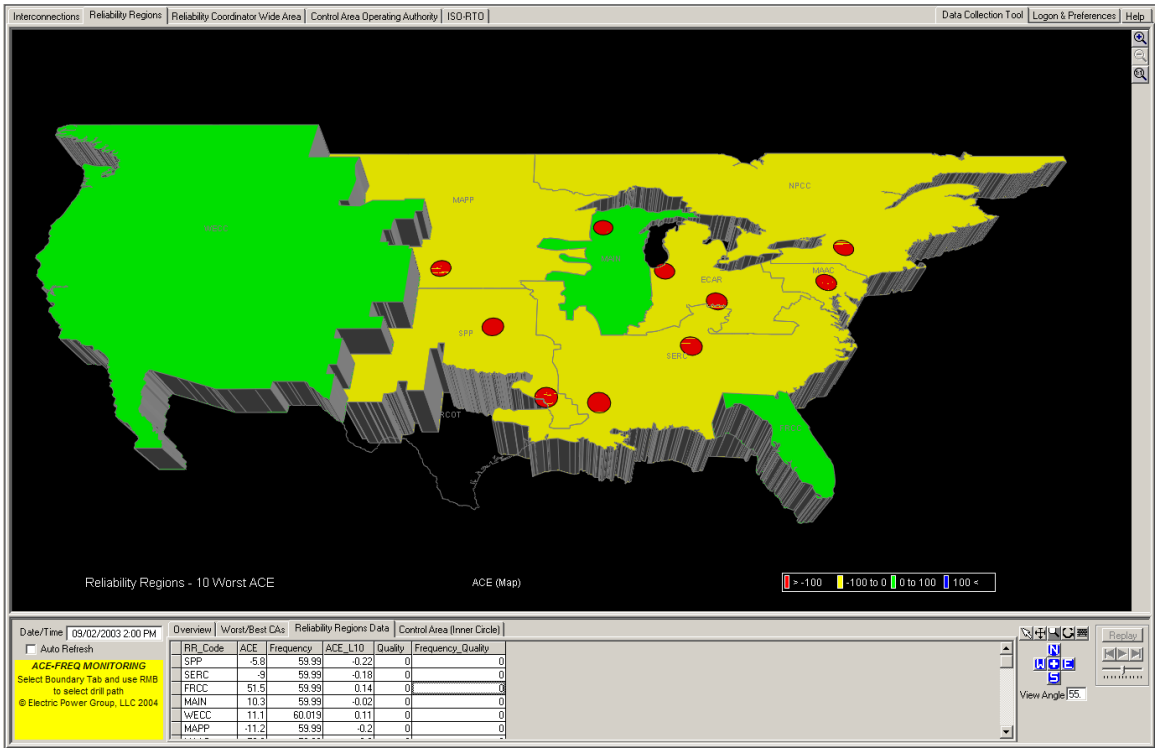

Figure 31 – 3D Map of the Reliability Regions

Network Display Options

With the “Show Network” box checked, clicking the “OK” button produces the map shown in Figure 32, on which the network lines are displayed. The network lines represent a simplified diagram of how the CA’s are electrically interconnected.

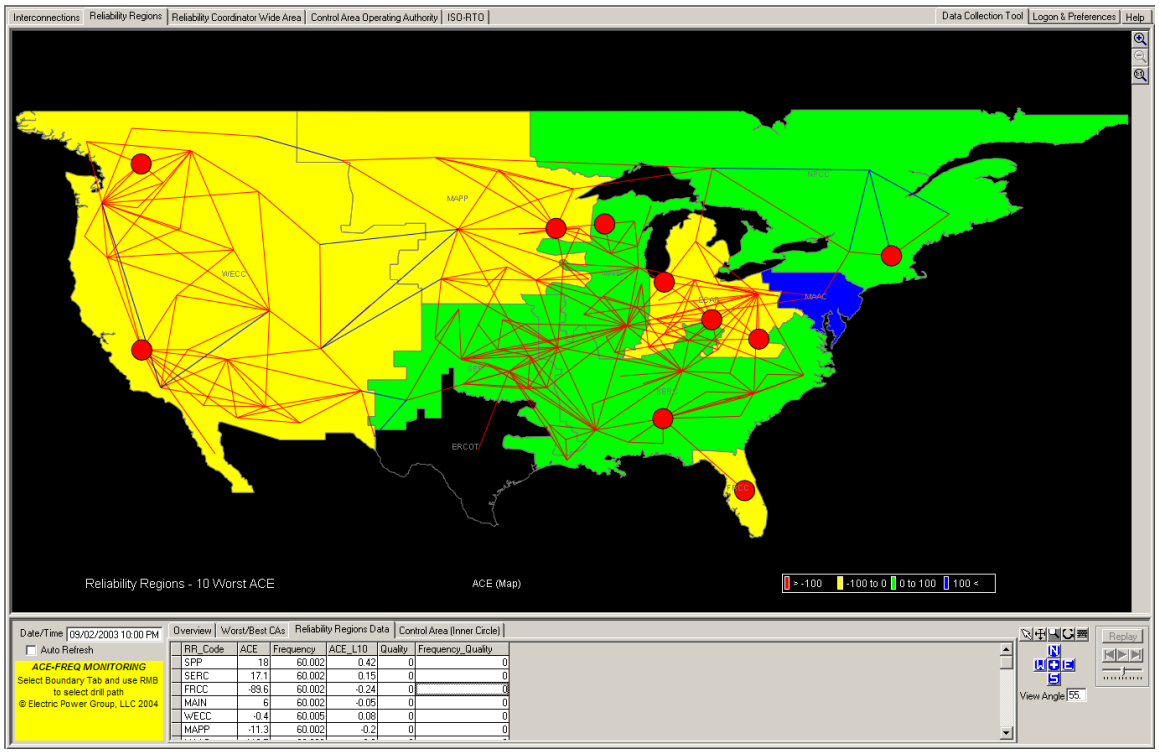

Figure 32 – Network Display

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Bubble Options

Bubble Options gives the user the five (5) choices shown in Figure 33. Each bubble on the Jurisdiction maps represents a Control Area. The inner circle represents the CA's current ACE/L_{10} ratio. If there is an outer ring (circle), this "red" circle indicates that the CA currently is one of the ten (10) worst performers. When a DCS event occurs a flashing light-blue band is present between the two circular areas.

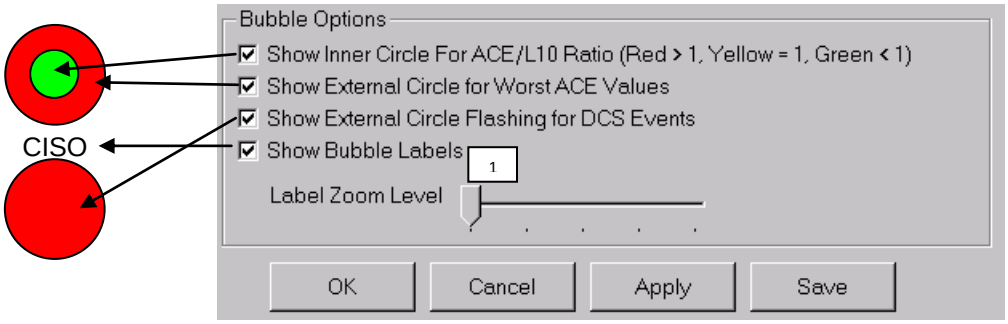

Figure 33 – Bubble Options

Note that the "Label Zoom Level" has been moved to the first graduation. At this level the Control Area labels will appear on the map. When all the options are set as desired click "OK" and the setting will change on the map.

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4. Wide-Area ACE-Frequency Real-Time Monitoring System – Local Monitoring

4.1 Current Data Monitoring Visuals

In addition to the Reliability Coordinator Jurisdiction Tab (Default) discussed in Section 3.3, current data can be viewed for Interconnections, Reliability Regions, Control Areas, and ISO RTOs by selecting the corresponding Jurisdiction Tab on the top left side of the screen.

Interconnection Map and Data Display

When "Interconnection" (upper left tab) is selected, the Interconnection Map will be displayed (see Figure 34).

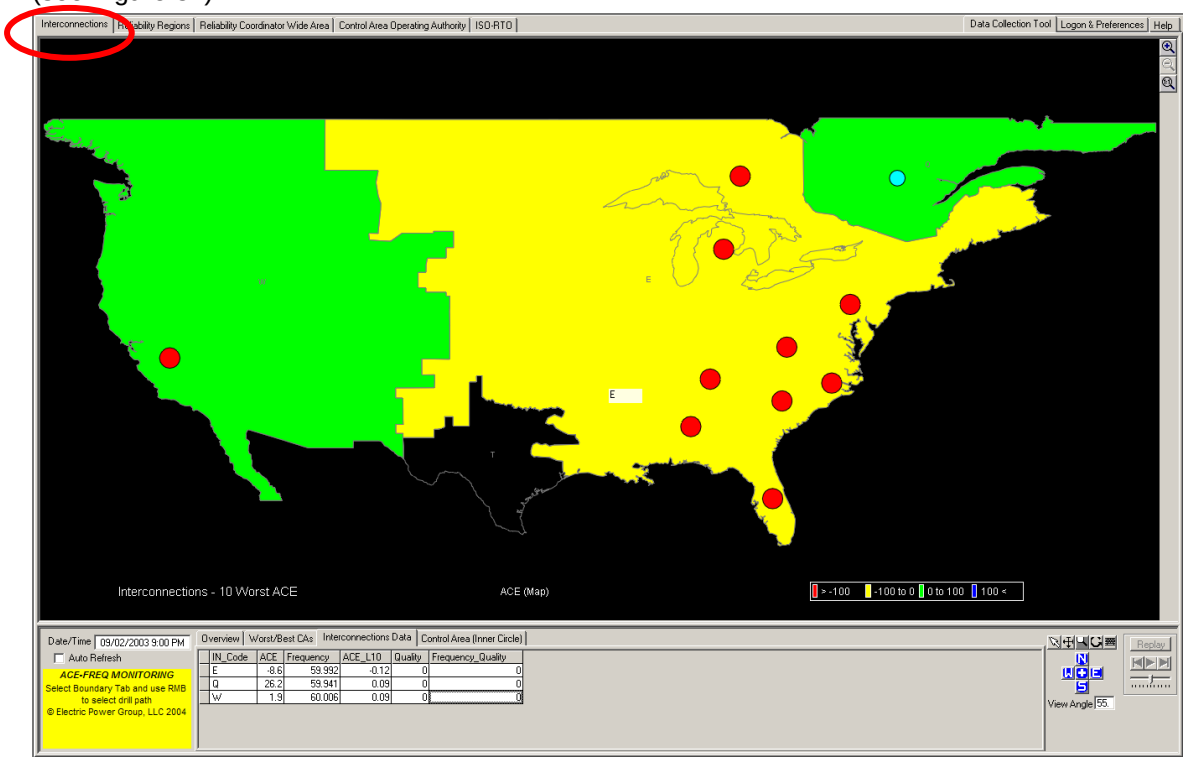

Figure 34 – Interconnection Map

The Interconnections Map is divided into the four (4) NERC Interconnections: West, East, Quebec and Texas. At this time Texas is not submitting data to Grid-3P and is shown in Black.

When the Interconnections Data tab is selected (top left of screen) the data from the map will be displayed in the following five columns (see Figure 35).

1. IN_Code – An abbreviation for the Interconnection
2. ACE – Area Control Error for the Interconnection
3. Frequency – Frequency reported for the Interconnection
4. ACE_L10 – ACE for each Interconnection as compared to the L_{10} submitted by the individual control area
5. Quality - Number of minutes data has not been received from a Interconnection

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Overview | Worst/Best CAs | Interconnections Data | Control Area (Inner Circle)

IN_Code	ACE	Frequency	ACE_L10	Quality	Frequency_Quality
E	-8.6	59.992	-0.12	0	0
Q	26.2	59.941	0.09	0	0
W	1.9	60.006	0.09	0	0

Figure 35 – Data displayed with "Interconnection Data" selected

Reliability Regions Map and Data Display

The Reliability Regions tab allows the user to view the map in a regional format. Figure 36 shows the ten (10) regions that are displayed when this tab is selected.

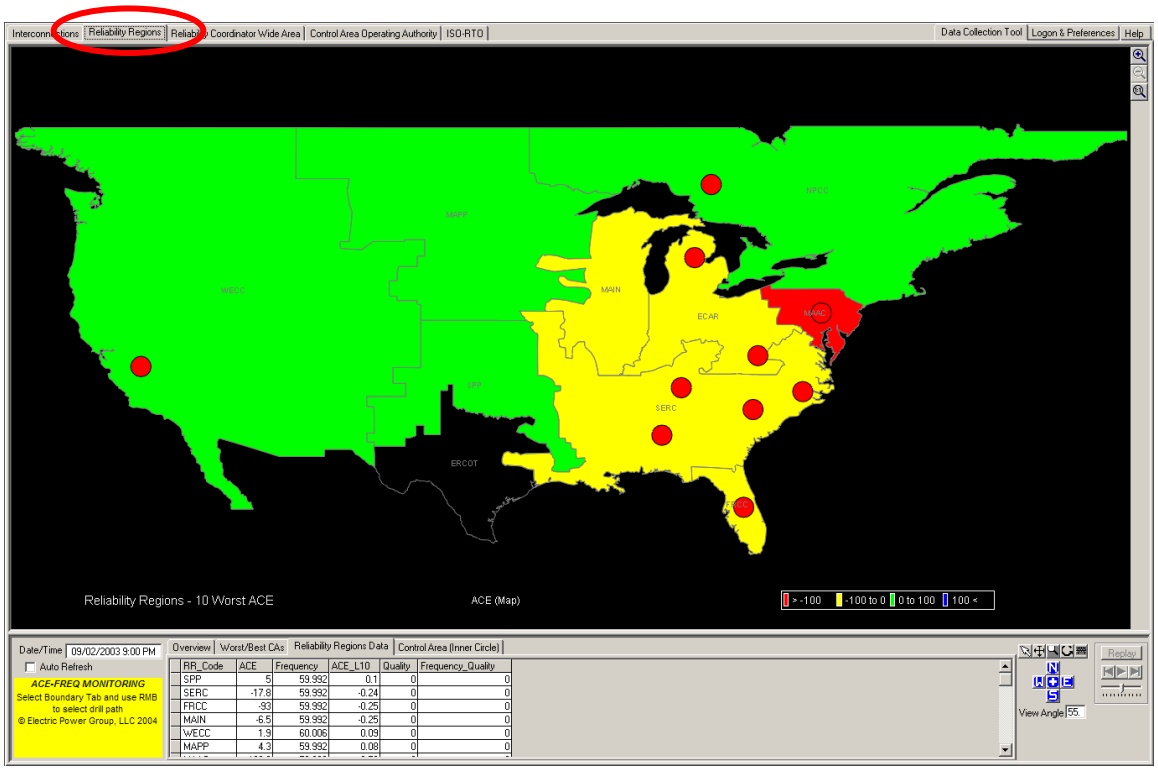

Figure 36 – Reliability Region Map

With the Reliability Regions Data tab selected, (top left of screen) the data for the map will be displayed in the five columns defined below (see Figure 37).

1. RR_Code – Reliability Region Code
2. ACE – Area Control Error for the Reliability Region
3. Frequency – Frequency reported for the Reliability Region
4. ACE_L10 – ACE for each Reliability Region as compared to the L_{10} submitted by the individual control area
5. Quality - Number of minutes data has not been received from a Reliability Region

Overview | Worst/Best CAs | Reliability Regions Data | Control Area (Inner Circle)

RR_Code	ACE	Frequency	ACE_L10	Quality	Frequency_Quality
SPP	5	59.992	0.1	0	0
SERC	-17.8	59.992	-0.24	0	0
FRCC	-93	59.992	-0.25	0	0
MAIN	-6.5	59.992	-0.25	0	0
WECC	1.9	60.006	0.09	0	0
MAPP	4.3	59.992	0.08	0	0

Figure 37 – Data displayed in the window with "Reliability Regions Data" selected

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Control Areas Map and Data Display

The Control Areas tab will give the user a map of all the NERC control areas as seen in Figure 38.

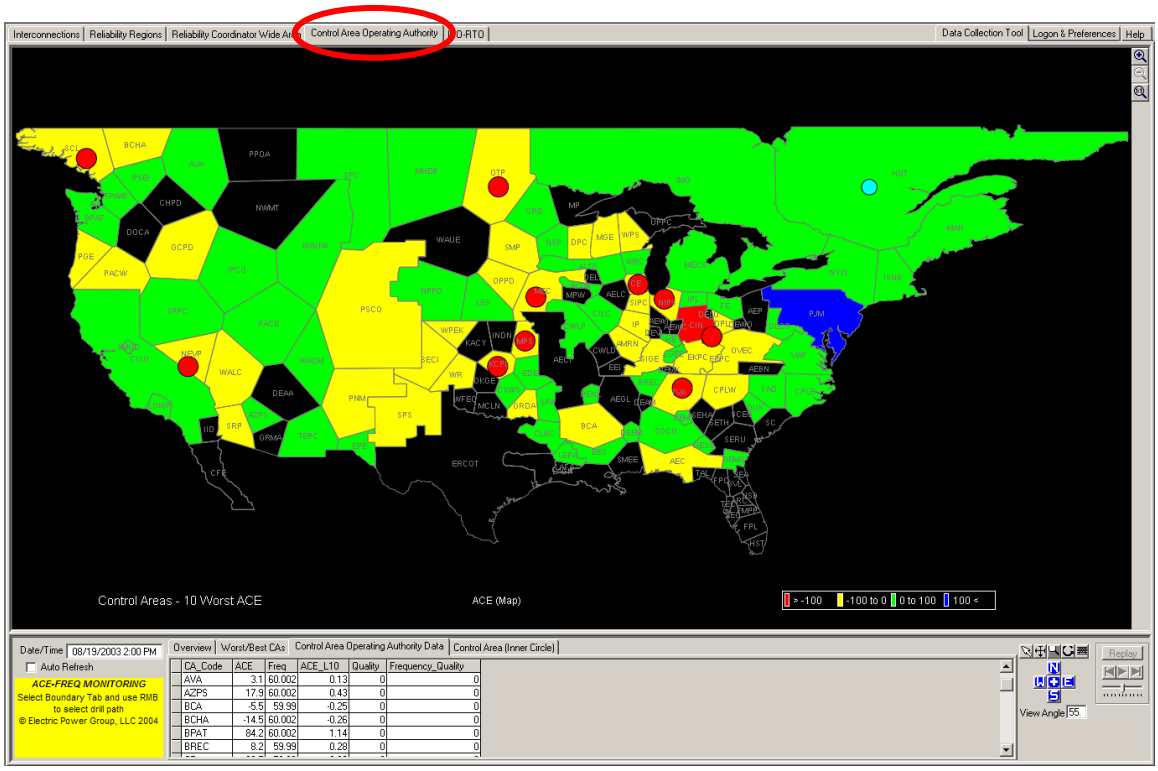
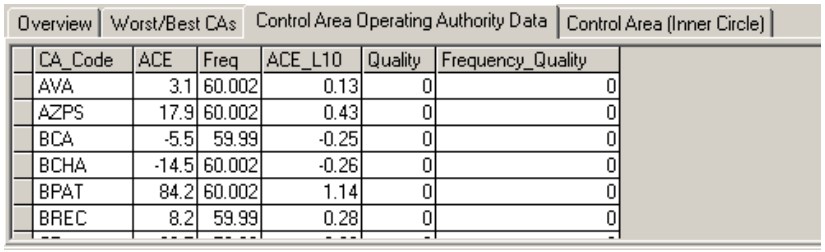


Figure 38 – Control Areas

Figure 39 shows the dynamic window that appears when the Control Area jurisdiction is selected (top left of screen). The five columns of cells in the figure are:

1. CA_Code – Control Area Code
2. ACE – Area Control Error
3. Frequency – Frequency reported for the Control Area
4. ACE_L10 – ACE for each Control Area as compared to the L_{10} submitted by the individual Control Area
5. Quality - Number of minutes data has not been received from a Control Area



CA_Code	ACE	Freq	ACE_L10	Quality	Frequency_Quality
AVA	3.1	60.002	0.13	0	0
AZPS	17.9	60.002	0.43	0	0
BCA	-5.5	59.99	-0.25	0	0
BCHA	-14.5	60.002	-0.26	0	0
BPAT	84.2	60.002	1.14	0	0
BREC	8.2	59.99	0.28	0	0

Figure 39 – Data displayed with "Control Area Data" selected

ISO RTO Jurisdiction Data Display

The ISO-RTO map displays the thirteen (13) RTOs (Figure 40).

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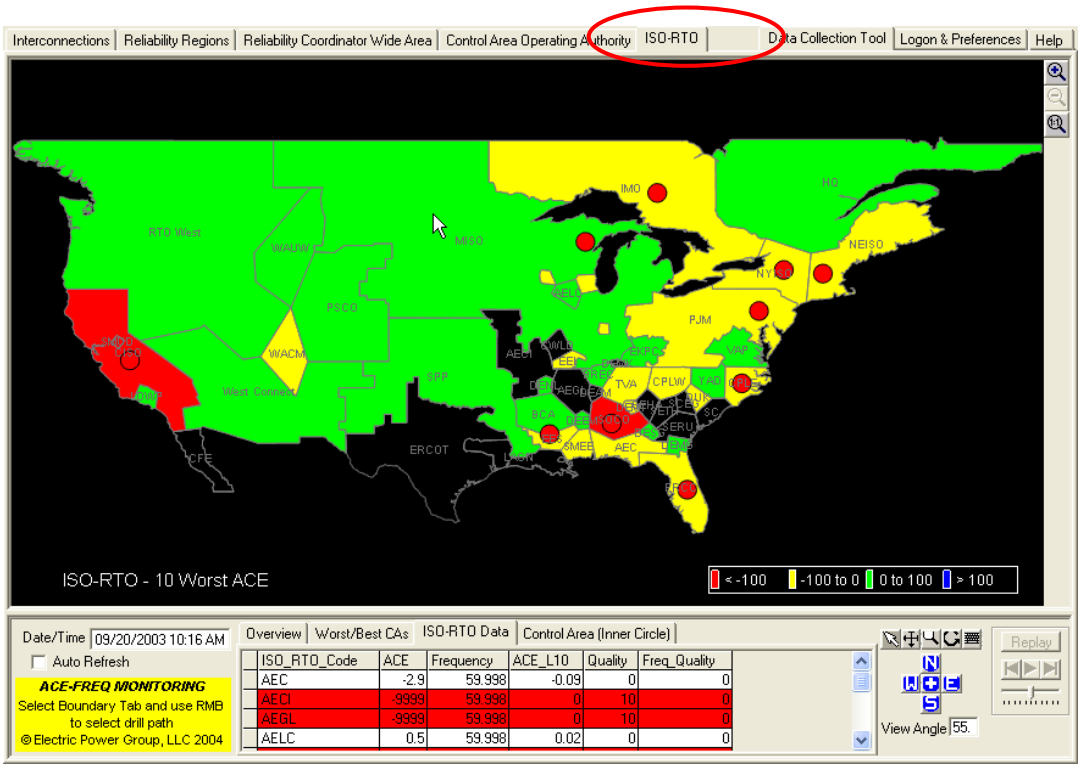
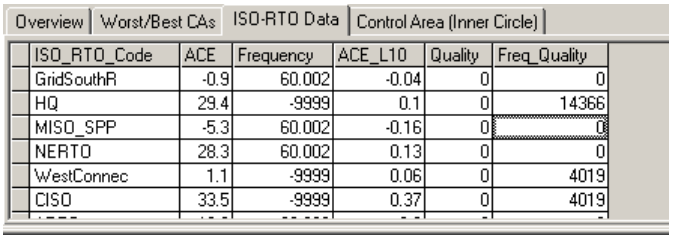


Figure 40 – ISO RTO Map

When the ISO RTO Data tab is selected, (top left of screen) the data from the map will be displayed as seen in Figure 41. The five columns of cells in the window are:

1. ISO_RTO_Code – Independent System Operator - Regional Transmission Organization
2. ACE – Area Control Error for the ISO RTO
3. Frequency – Frequency reported for the ISO RTO
4. ACE_L10 – ACE for each ISO RTO as compared to the L_{10} submitted by the individual control area
5. Quality - Number of minutes ACE data has not been received from a Control Area
6. Freq_Quality – Number of minutes Frequency data has not been received from either the primary or secondary frequency source (See Appendix for list of sources)



Overview | Worst/Best CAs | ISO-RTO Data | Control Area (Inner Circle)

ISO_RTO_Code	ACE	Frequency	ACE_L10	Quality	Freq_Quality
GridSouthR	-0.9	60.002	-0.04	0	0
HQ	29.4	-9999	0.1	0	14366
MISO_SPP	-5.3	60.002	-0.16	0	0
NERTO	28.3	60.002	0.13	0	0
WestConnec	1.1	-9999	0.06	0	4019
CISO	33.5	-9999	0.37	0	4019

Figure 41 – Data displayed in the window with "ISO RTO Data" selected

4.2 10-Minute Monitoring Visuals

From the Main Panel right click the mouse and the pop-up menu appears as seen in seen in Figure 42.

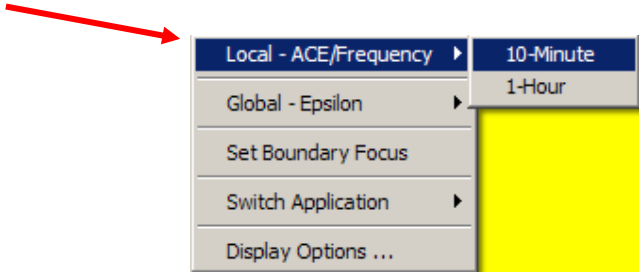


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Figure 42 – Local – ACE/Frequency – 10-Minute Pop-up

Clicking on "10-Minute ACE/Frequency–Local" moves directly to the three-panel display for analyzing the ACE/Frequency. This function is available from all Jurisdiction Tabs. Selecting the "10-Minute ACE/Frequency-Local" option while using the Reliability Coordinator tab will bring up the three-panel diagram seen in Figure 43.

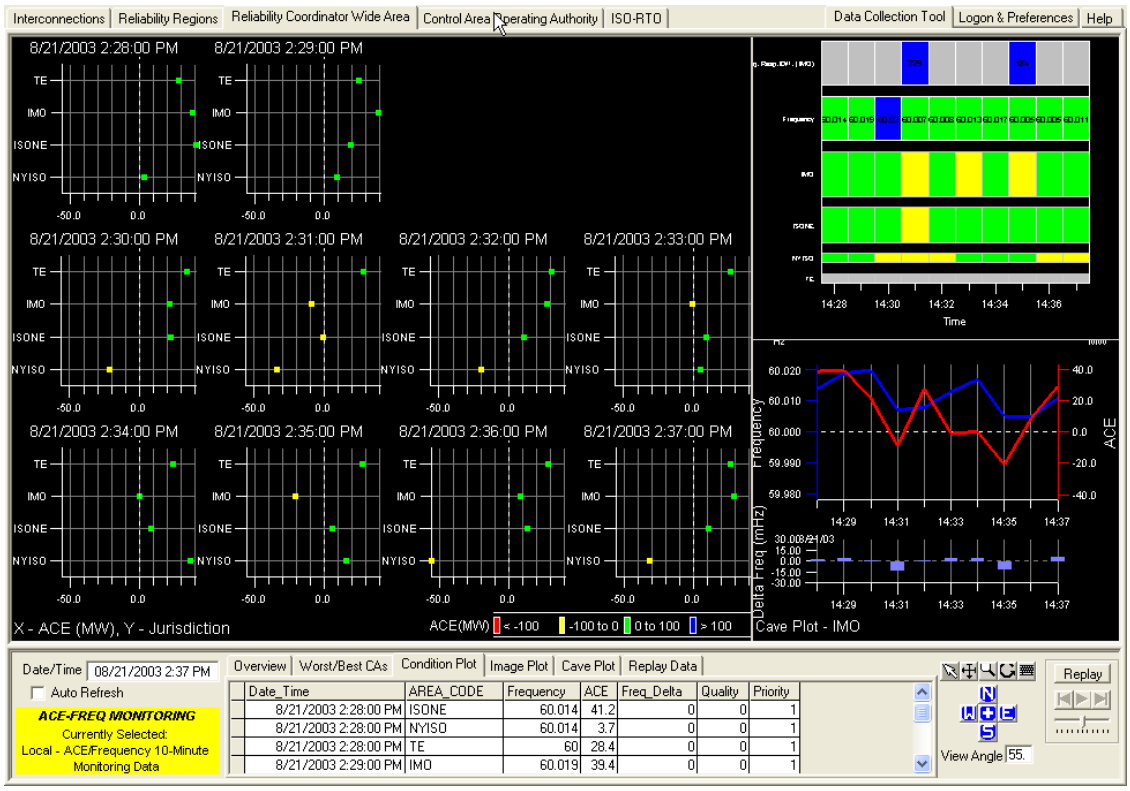

Figure 43 – Reliability Coordinators: 10-Minute ACE/Frequency-Local Plot

This graphic displays ACE-Frequency data for all Reliability Coordinators. The main panel (Panel 1) displays the ACE value for each Reliability Coordinator in one-minute intervals. The upper right hand corner shows the ACE value ranges for the last ten minutes in one-minute intervals. The Cave graph in the lower right corner displays Frequency and ACE of one Reliability Coordinator for the last ten minutes.

The default, panel (Panel 1) in Figure 43 displays is the "Unique Time Value" with ACE the title for the x-axis and Jurisdictions in the y-axis. Other display options are available by right clicking the mouse over this panel and selecting "Scatter Plot Grouping" from the pop-up menu. "Scatter Plot Grouping" contains the following three options:

1. Unique Frequency Value (X-Ace, Y-Jurisdiction)
2. Unique Time Value (X-Ace, Y-Jurisdiction)
3. Unique Jurisdiction Value (X-Frequency, Y-ACE)

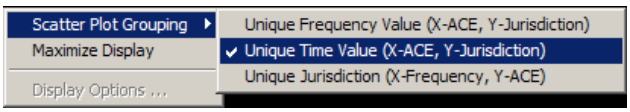

Figure 44 – Scatter Plot Grouping (Default Setting)

The "Scatter Plot Grouping" display can be changed in either the three panel or maximized format.

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To maximize any of the three displays, right click on the desired panel. A pop-up menu will appear and with the selection of “Maximize” (Figure 45) the panel will become a full screen (see Figure 46). To return to the former view, right click on the panel and the pop-up menu will re-appear. With the selection of “Minimize,” the three-panel display will reappear.

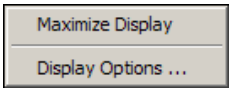

Figure 45 – Maximize/Display Options Pop-up

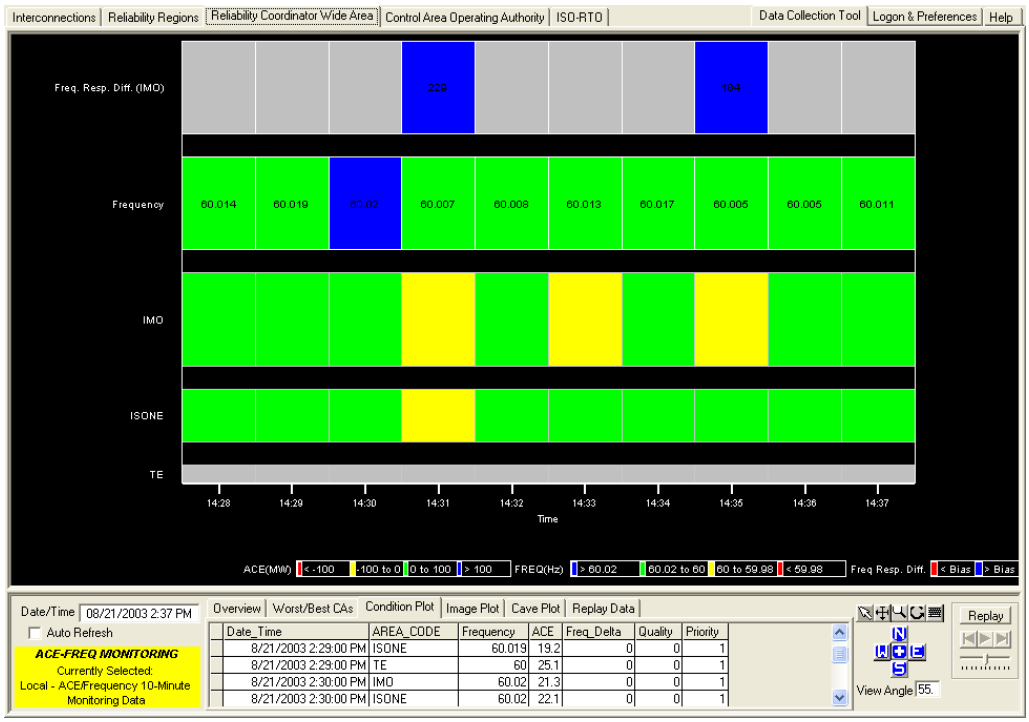

Figure 46 – 10-Minute Image of ACE: Reliability Coordinators

Figure 46 is called the “Tracking_2 Image” and it is the “default” option for this panel. This display, which is for the last 10 minutes, is demonstrating the ACE and the Frequency on a minute by minute format. The width of the horizontal bar is proportional to the size of the selected jurisdiction. The “Frequency Response” of the selected Control Area is also shown.

The original chart for this panel is now called “Trackin_1 Image. To select this option right-click on Panel 2 and Figure 47 will appear. Select the down arrow at the “Image Display” and the selection can be made for the “Tracking_1 Image” then click “OK”. Figure 48 is the “Tracking_1 Image.

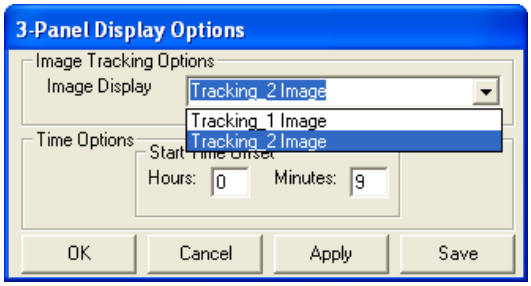

Figure 47 – 3-Panel Display Options

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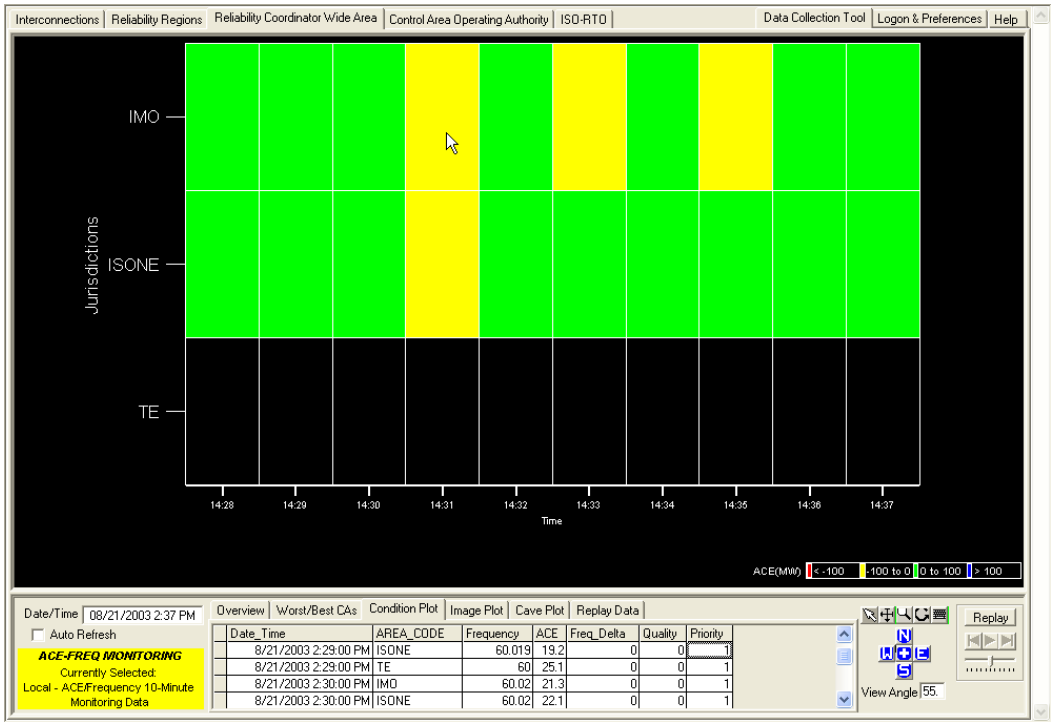

Figure 48 –Tracking_1 Image

The cave graph in the lower right hand corner of the three-panel graphic defaults to the first Reliability Coordinator listed in the 10-Minute Image Plot. Each displayed Reliability Coordinator can be clicked to change the Hourly Cave graph. Right clicking on the Cave graph will allow the user to maximize the graphic, as shown in Figure 49. The Cave graph is divided into one-minute increments with Frequency in Blue and ACE in Red shown over the same 10-minute interval. The lower bar chart shows the 1-minute frequency differential for the interconnection.

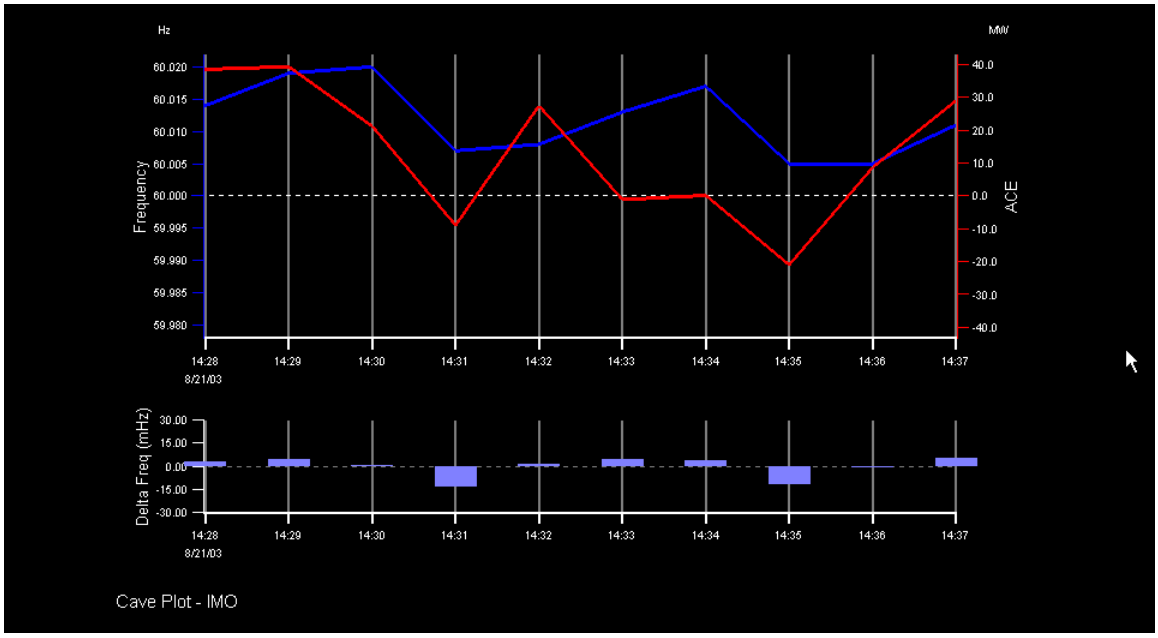

Figure 49 – 10-Minute Cave_2 Diagram Maximized – ACE-Frequency (Panel 3)

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Right clicking in Panel 2 will produce the “Maximize/Display Option” pop-up (Figure 45). Select the “Display Options” and Figure 50 will be presented. Select the “Cave Display” down arrow. Then select “Cave_1 Prediction Display” and click OK and Figure 51 will appear. This function can be performed in either the three panel display or the maximized view.

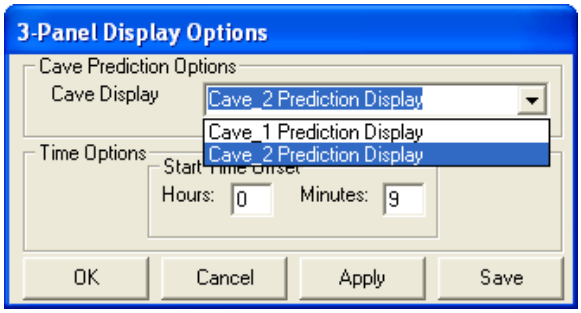

Figure 50 – 3-Panel Displays Options – Advanced Cave/Prediction Display

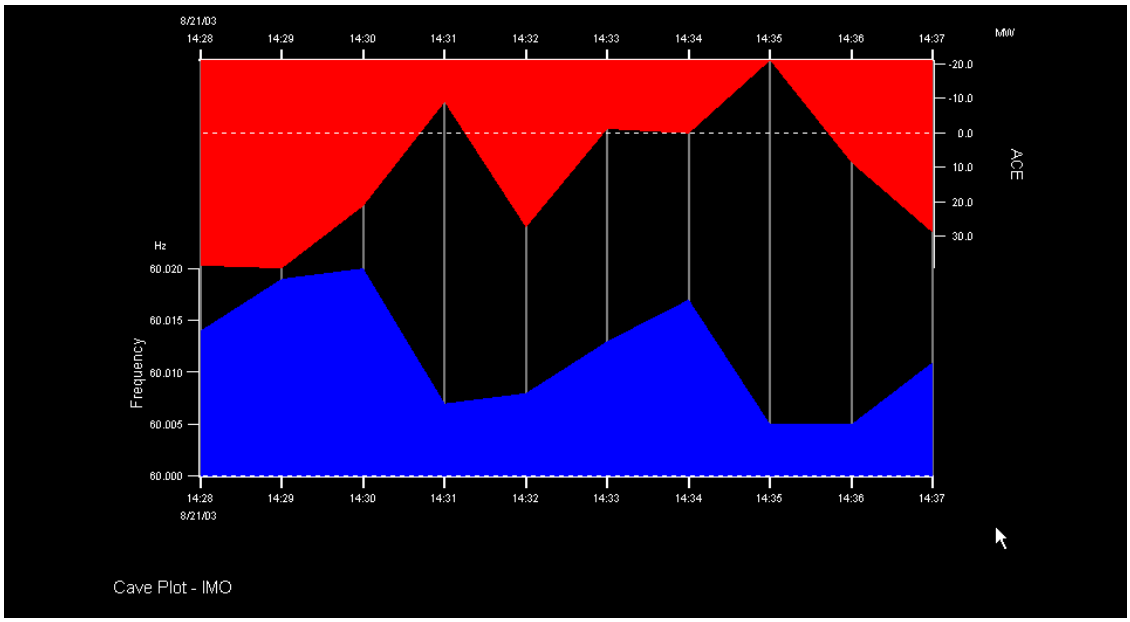

Figure 51 – Cave_1 Prediction Display

The advanced view demonstrates the “ACE” in red and the “Frequency” in blue. This 10-minute view allows the user to inspect the last ten minutes for the selected jurisdictions. The jurisdictions can be changed by left clicking on the desired jurisdiction in Panel 2. The “Delta” bar chart is reflective of the ratio between the ACE as a percentage of Maximum Capacity and the change of frequency.

4.3 One Hour Monitoring Visuals

From the Main Panel right click the mouse and the pop-up menu appears as seen in seen in Figure 52.

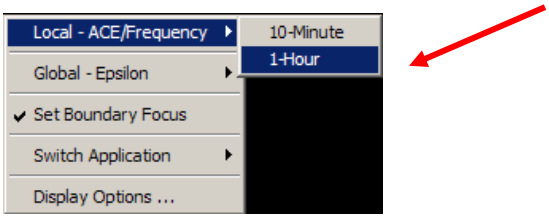

Figure 52 – Local – ACE/Frequency – 1-Hour Pop-up

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Select the Reliability Coordinators that are highlighted in Figure 53 and then select “Local – ACE/Frequency – 1-Hour and the three panel (Figure 54) will be called up.

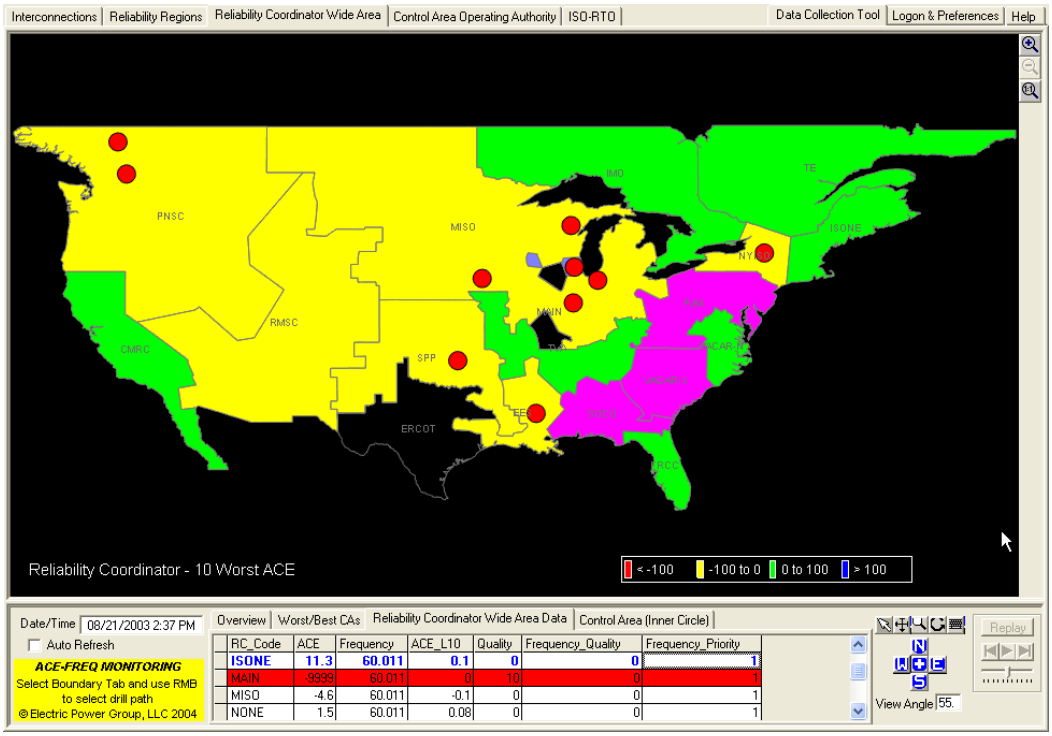

Figure 53 – Local – ACE/Frequency with Selected ISO

Panel 1 demonstrates the geographical selections from the previous selection (note Figure 53). Panel 2 and Panel 3 have the same functionality as described previously.

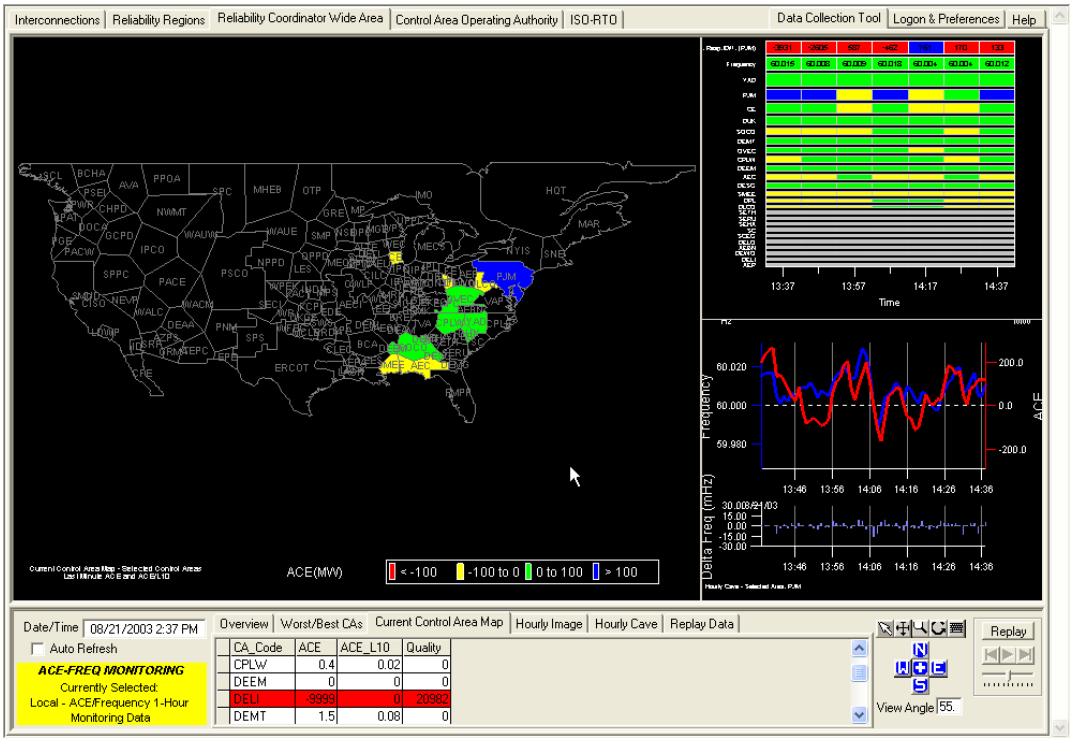

Figure 54 - Reliability Coordinators: 1-Hour ACE/Frequency-Local Plot

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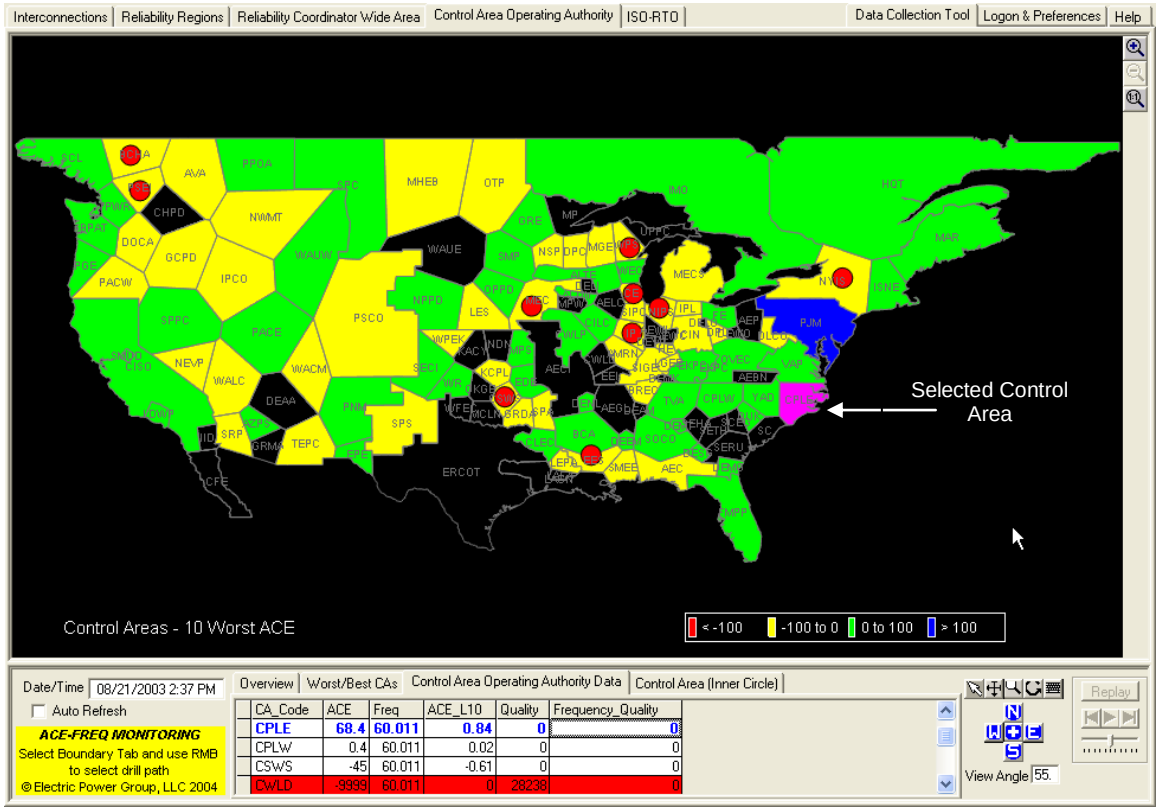
Figure 55 – Control Area Map

In the “Control Area” function the user can view a particular Control Area, e.q., the one identified in Figure 55, or as many as necessary. The functionality of the three panel is the same as described in the Reliability Coordinator section.



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The selected CA is shown in yellow on the ACE map (Figure 56). The upper right hand corner shows the last hour ACE, which in this display is broken into 10-minute increments. The Cave graph displays Frequency and ACE for the last hour.

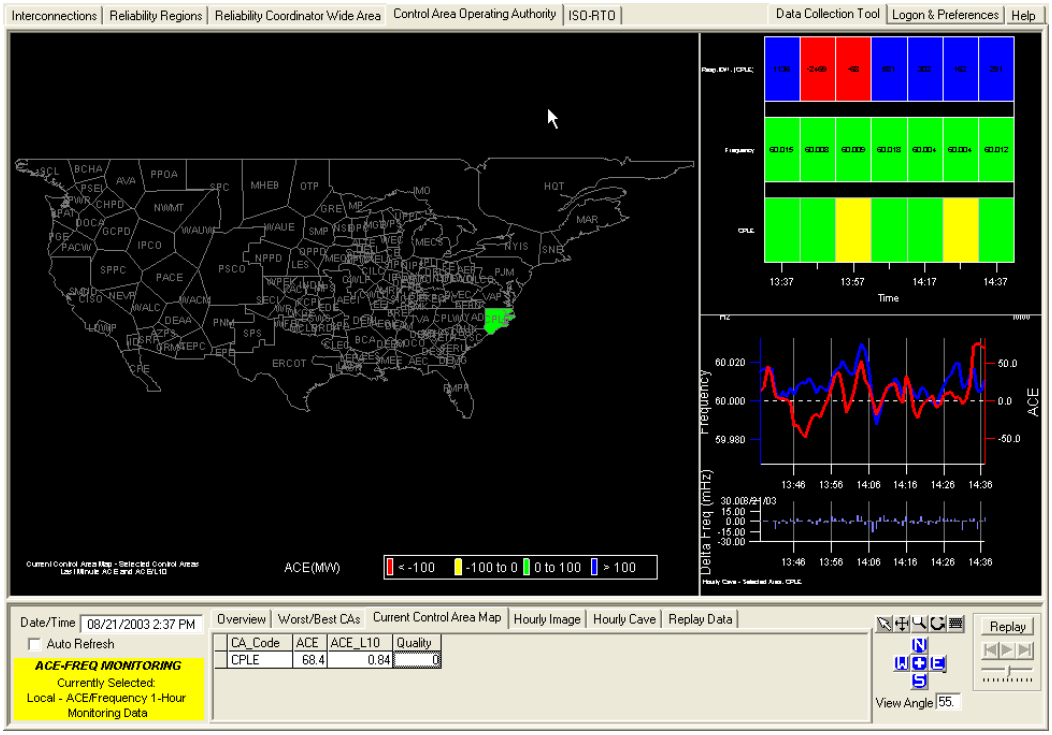

Figure 56 – Control Area Map - Selected Control Area - Last Minute ACE and ACE/L10

To maximize any of these three displays right click on the panel desired. A pop-up menu will appear and with the selection of "Maximize" the panel will become a full screen (see Figure 57). To return to the former view, right click on the panel and the pop-up menu will re-appear. With the selection of "Minimize," the three-panel display will reappear.

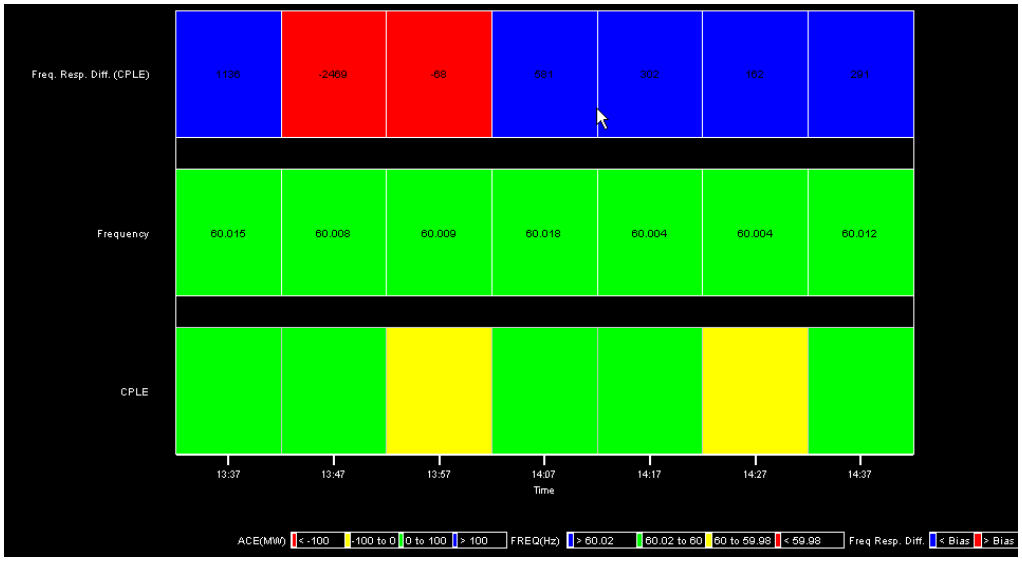

Figure 57 – Hourly Image - Selected Control Area – Last Hour ACE

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Had several CA's been selected, then all of those selected would have been displayed in this image. Each of those displayed CA's can be clicked to change the Hourly Cave graph.

The cave graph for the CA selected (CPLE) is located in the lower right hand corner of the three-panel graphic. Right clicking in the Cave graphic will allow the user to maximize the graphic, as seen in Figure 58. The Cave graph is divided into 10 minutes increments.

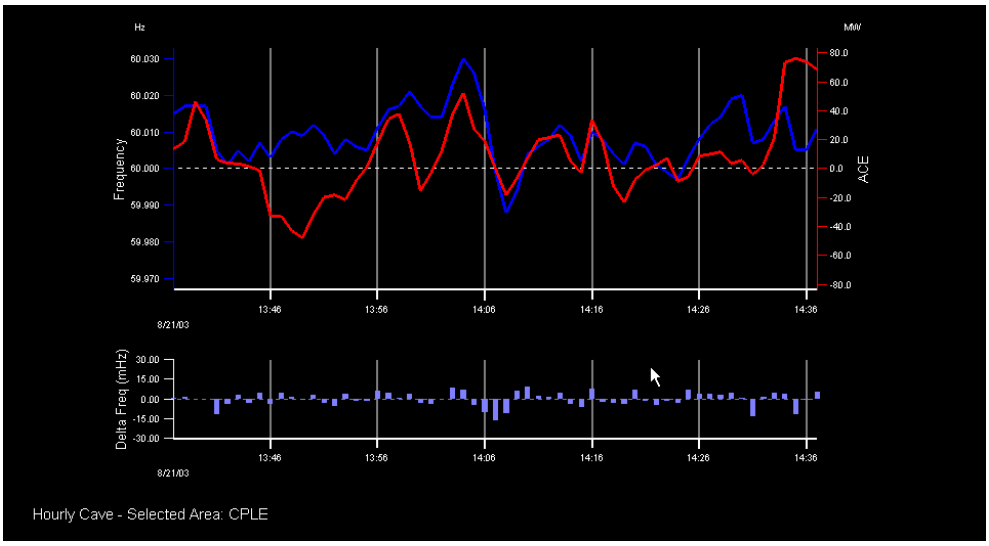

Figure 58 – Hourly Cave Maximized – Selected Hour – Frequency & ACE – CPLE

The Hourly Cave graph demonstrates Frequency in Blue (bottom) over the last hour and the ACE in Red (top) over the same hour.

To view the "10-Minute ACE/Frequency – Local," select the "CPLE" again, Adjacent Area 0, and "10-Minute ACE/Frequency." The three-panel diagram will appear as seen in Figure 59.

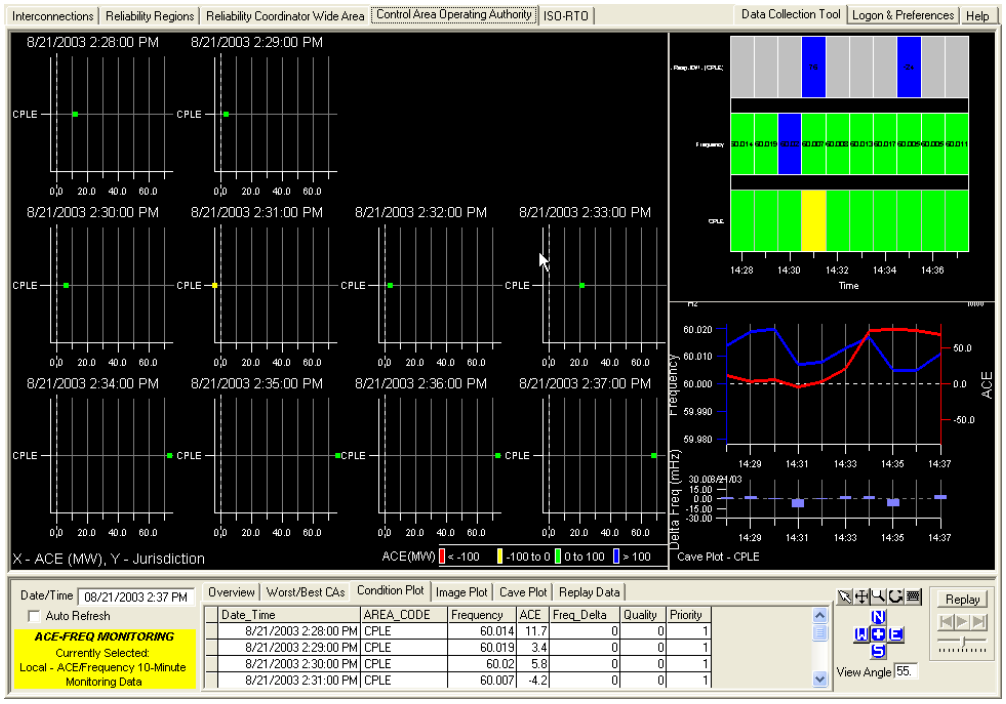

Figure 59 – Control Area – Local - 10-Minute ACE/Frequency Plot

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Replay Function

From the hourly three-panel screen, a replay of the last 24 hours can be viewed by clicking the "Replay" button. When this button is clicked the replay display will appear as seen in Figure 60.

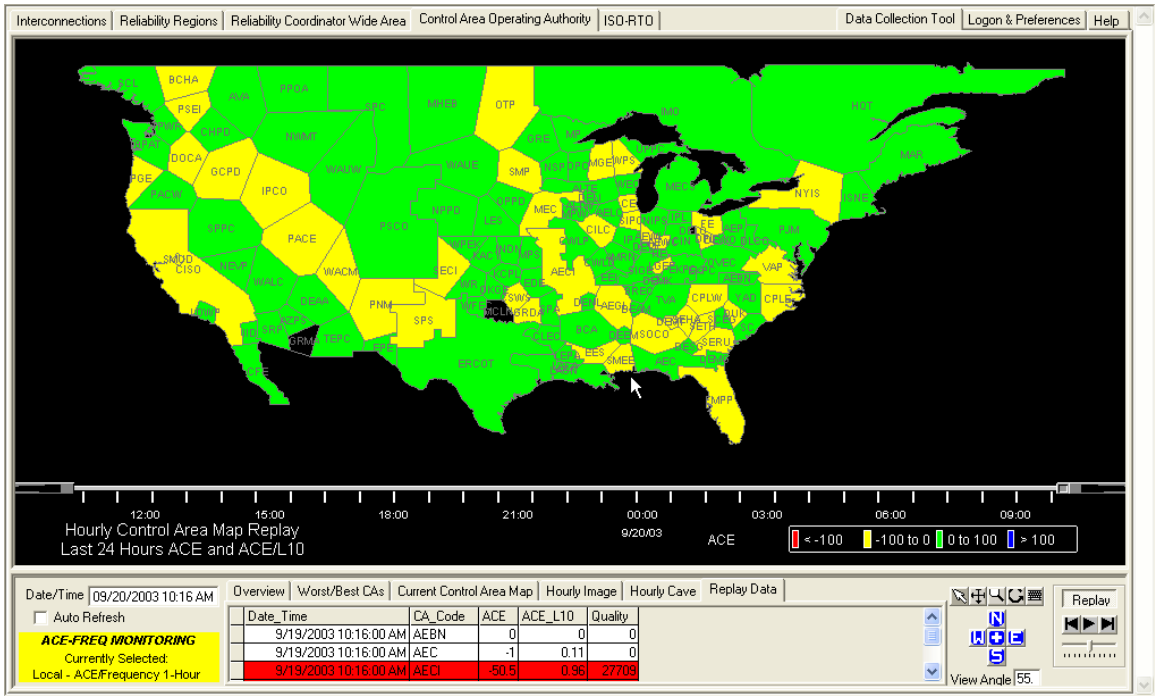

Figure 60 – Hourly Control Area Map Replay – Last 24 Hours ACE and ACE/L_{10}

To replay the last 24 hours, click the rerun button and the time indicator will return to the far left, the beginning of the sequence. The replay controls are shown in Figure 61.

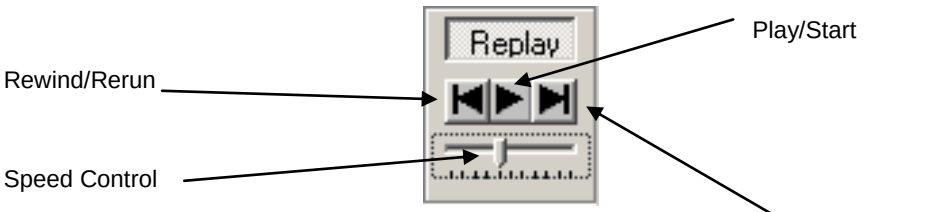

Figure 61 – Replay Controls

The "Speed Control" lever controls the speed of the replay. Move the lever left for quicker viewing; move it right for a slower view of the last 24 hours. Click the Play/Start button to begin viewing the last 24 hours.

To return to the orginal display without the time line click on the "Replay" button and the timeline will be removed and the display can be minimized.

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5. Wide-Area ACE-Frequency Real-Time Monitoring System– Global Epsilon

5.1 6-Hour Monitoring Visuals

After Right clicking on the Main Panel, the pop-up menu in Figure 62 reappears. By selecting "Epsilon-Global" the user will be taken to the Global Interconnection Map. In this view the user sees the Interconnection – "Epsilon1 for the Most Recent Hour."

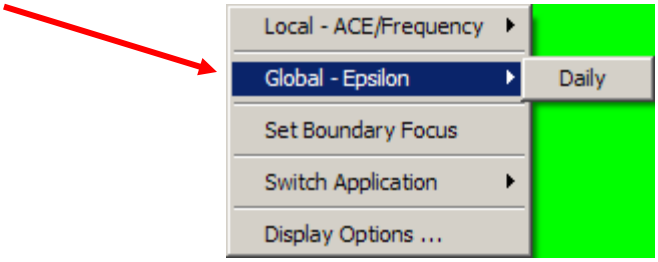

Figure 62 – Functions

The Global view is for the *Epsilon of the Interconnection (Figure 63).

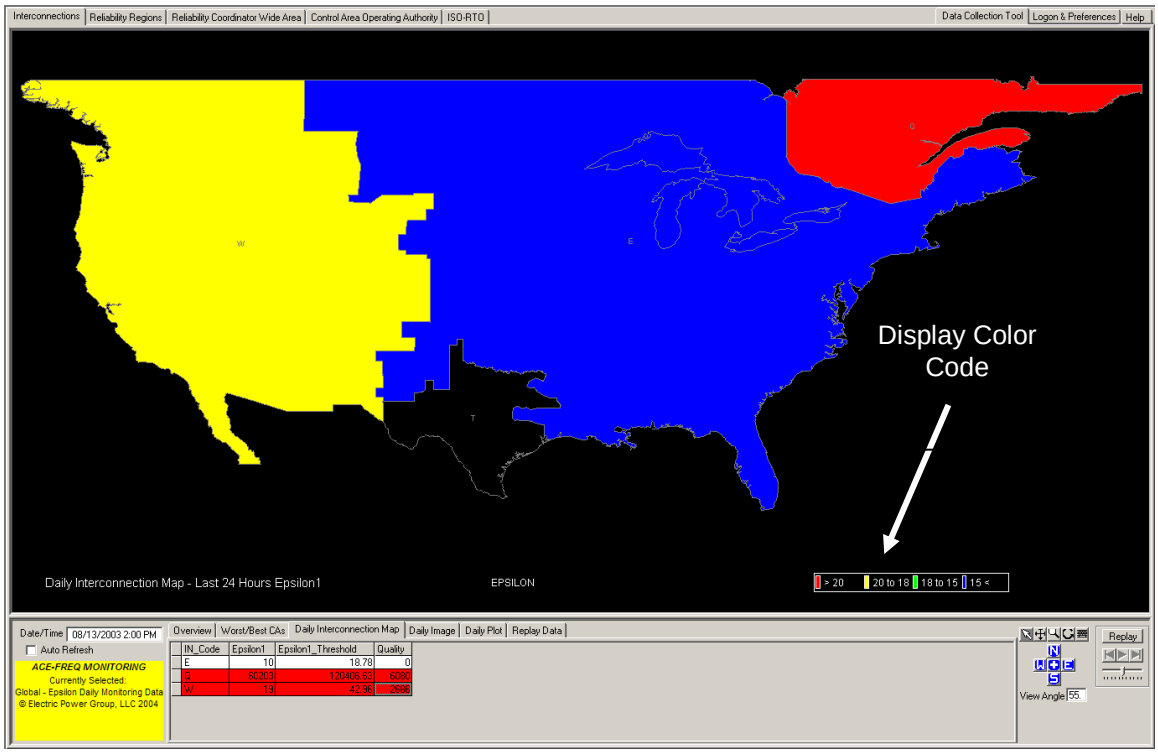

Figure 63 – Interconnection – Epsilon Daily - Maximized

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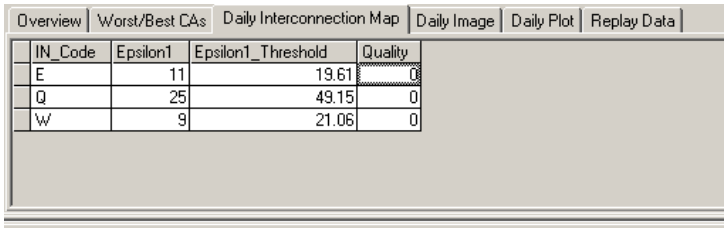
The Global Interconnection Data for the “Interconnection Map Epsilon1 Most Recent Hour” is shown to the right of the Time text box (Figure 64).



IN_Code	Epsilon1	Epsilon1_Threshold	Quality
E	11	19.61	0
Q	25	49.15	0
W	9	21.06	0

Figure 64 – Interconnection Map Epsilon1 Most Recent Hour Data Table

The seven columns in the data tables are:

1. ITC Code – Interconnection Code
2. Epsilon1 – Constant derived yearly from the targeted Interconnection frequency deviations found from the prior year
3. Epsilon Threshold – That threshold where the last hour frequency performance is compared to the Epsilon constant
4. Frequency – Frequency for each Interconnection Area
5. DCS Event – Number of DCS Events for the Interconnection Area for this time frame
6. Priority – Within the Interconnection, a specified CA is assigned the responsibility of providing the Frequency for CMS. Should this preferred CA not be able to supply the required frequency then the CMS program goes to the next on the list. This selection continues until the frequency is received at the CMS computer.
7. Quality – Number of minutes data has not been received from a Control Area

Interconnection Map Color Code

The display colors of the map are coded. This color code, which appears as shown in Figure 65, is displayed in the lower right corner of the main panel.

Figure 65 – Interconnection Map Code

Red Epsilon of >20

Yellow Epsilon of 18-20

Green Epsilon of 15-17

Blue Epsilon of 0-14

***Epsilon (ε)** is a function of the Frequency. It is a constant derived yearly from the targeted Interconnection frequency deviations found the prior year. This constant is used to compare the last hour frequency performance against this constant. It is used to assist the Regional Coordinator on knowing how the Interconnection control has performed.

Example: When the Constant and measured value equal a number between 0-14 our map is colored in blue for that Interconnection. Should the comparison of the Epsilon be greater than 14, but less than 18 then that Interconnection appears Green on the Interconnection Map

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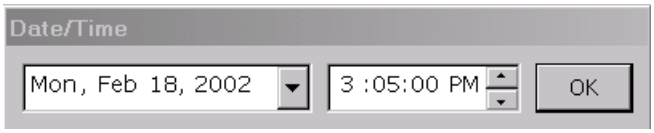

Figure 66 – Date/Time Pop-up menu

When the Date and Time are correct, click "OK." This brings up the Three Panel View.

Three-Panel Display

Select "Global Epsilon - Daily" to go directly to the three panel as seen in Figure 67. This is the same three panel for all five tabs. Each of the panels can be maximized. Panel 1 can be converted to a 3D view.

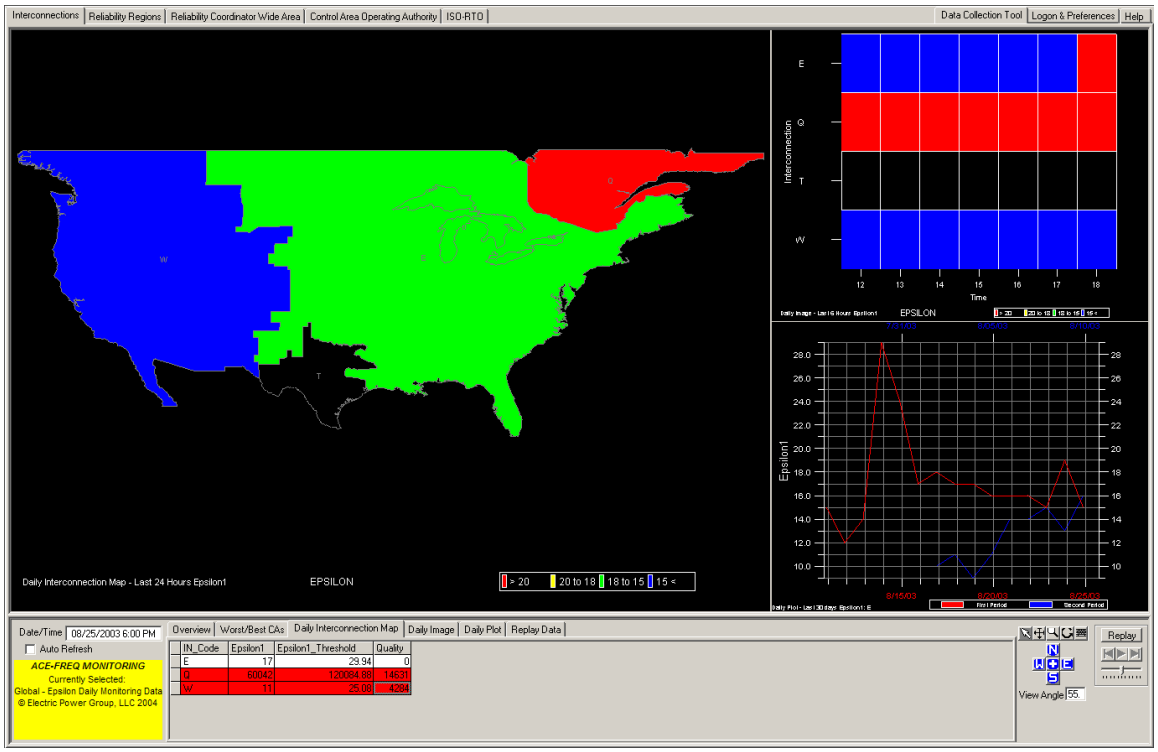

Figure 67 – Three-Panel Epsilon Display

The "Daily Interconnection Map – Last 24 Hours Epsilon" occupies the first panel, The "Daily Image Panel" is in the upper right hand corner. The "Daily Plot Panel" is located in the lower right hand corner of the display.

To view any one of the panels as a full screen, right click on the desired panel and a pop-up menu appears. Select "Maximize" and the panel will be shown as a full screen. The Daily Image Panel will expand to the full-screen size as shown in Figure 68.

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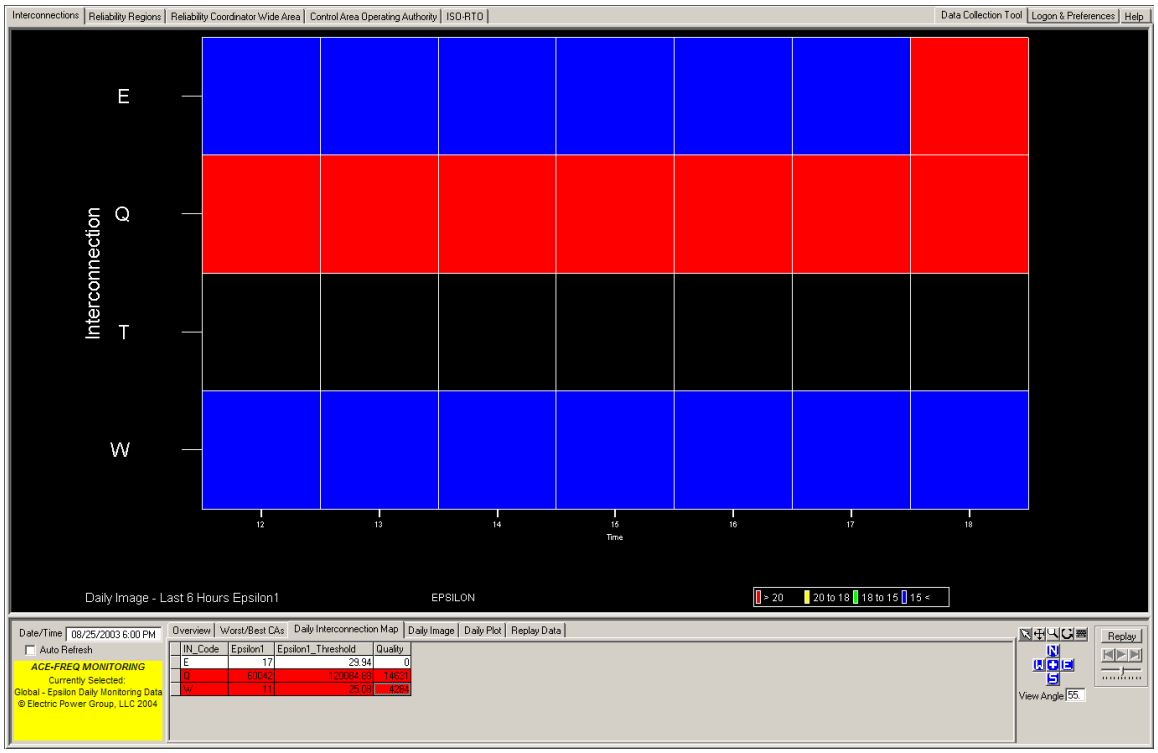

Figure 68 – Daily Image Last 6 Hours Epsilon1

This panel displays Epsilon1 for the last six hours. The Date/Time selected is represented on the far right of the display. The previous five hours are shown to the left of the time selected. The Epsilon color code is displayed in the bottom right hand corner of the panel.

5.2 30-Day Monitoring Visuals

The "Daily Plot Panel" can be selected from the three-panel display previously shown in Figure 67. To view the "Daily Plot Panel" right click over the panel. Click "Maximize" on the pop-up menu and the chart shown in Figure 69 appears.

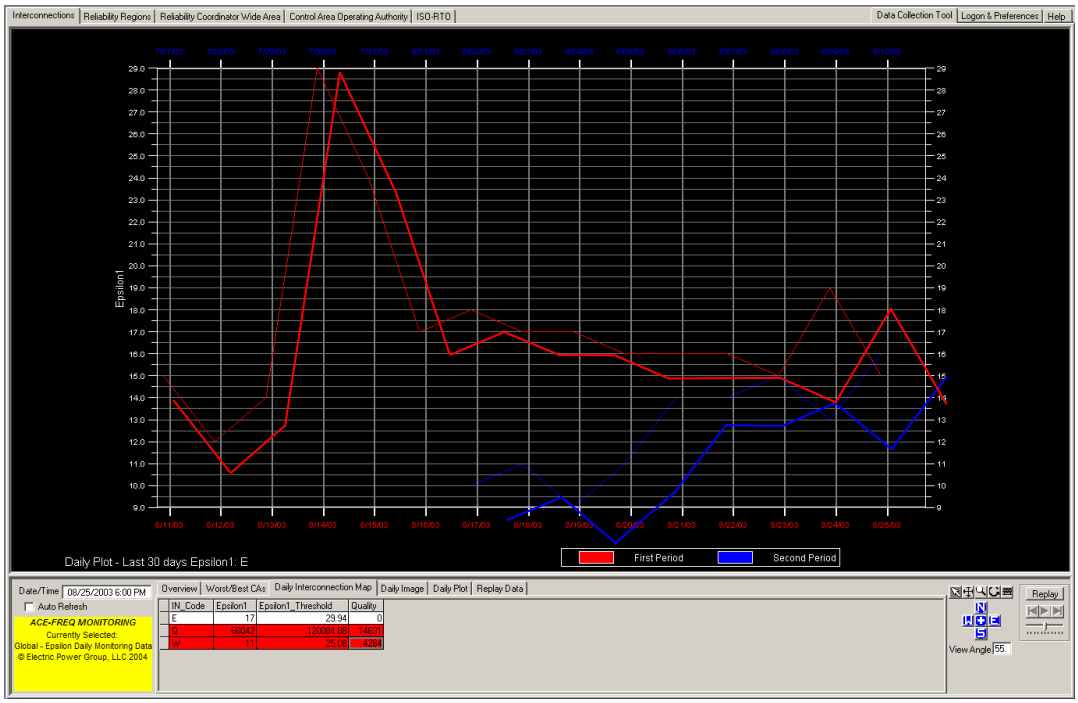

Figure 69 – Daily Plot Panel

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The “Daily Plot Graph” displays the last 30 days for Epsilon1. The Red plot displays the first period listed on the bottom of the graph. The Blue plot displays the second period listed on the top of the graph.

The “Interconnection” Map can be maximized as seen in Figure 70.

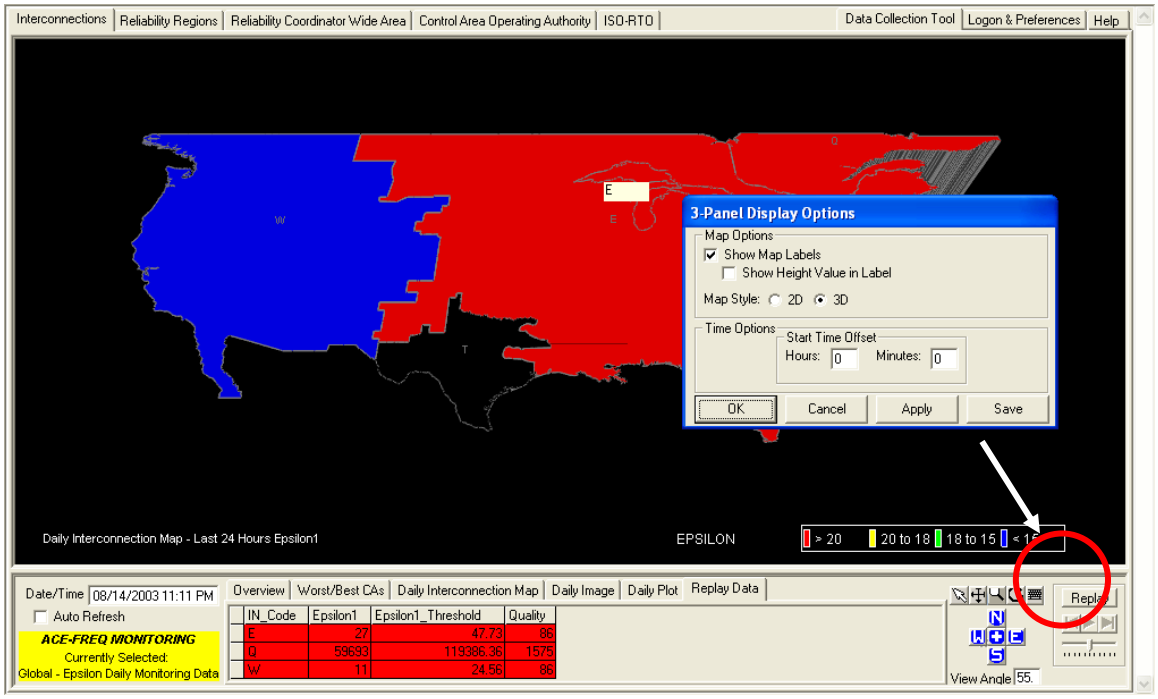

Figure 70 – Interconnection 3D Map

A second option appears in the pop-up menu. That selection is an “Option” function. Selecting this will cause the pop-up menu “3-Panel Display Options,” displayed in the center of Figure 70, to appear. The user has three options: “Show Map Label”, “Show Height Value in Label”, and “Map Style, 2D or 3D.” Clicking “OK” activates the new selections. This Option pop-up menu is only available for the Interconnection Map.

Replay Function

From this screen a replay for the last 7 days can be viewed by clicking on the “Replay” button. When this button is clicked, the replay display will appear as seen in Figure 71.

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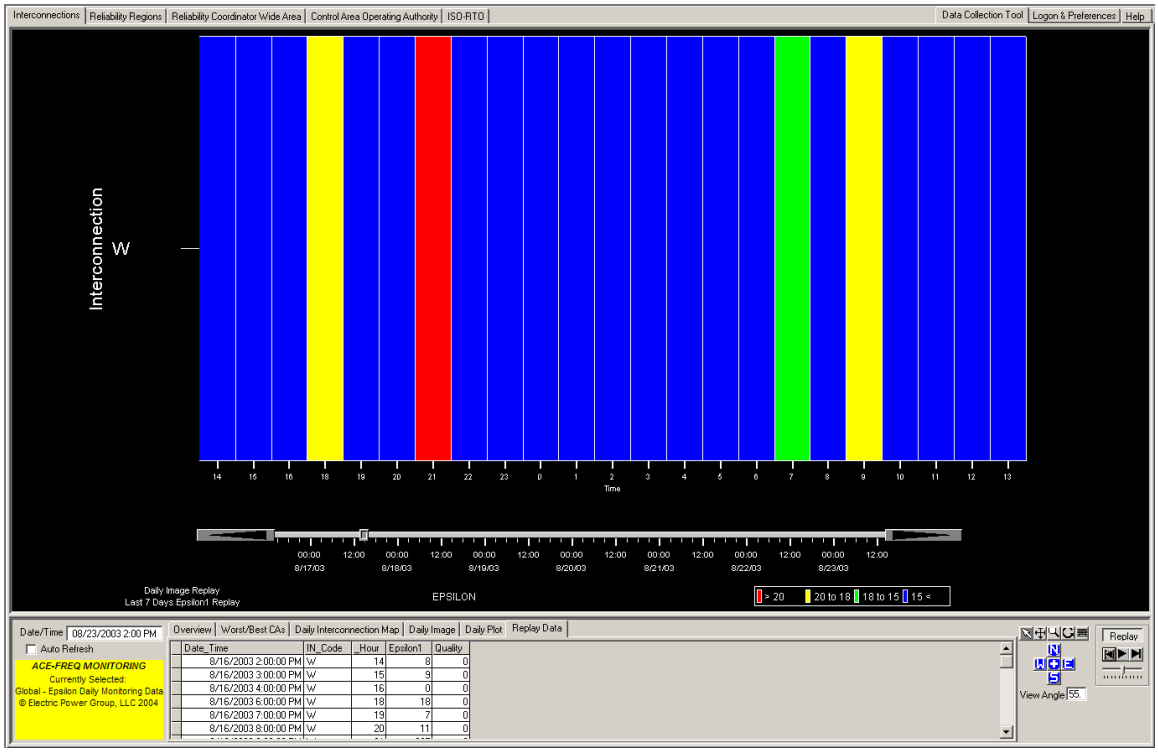

Figure 71 – Daily Image Replay – Last 7 Days Epsilon1 Replay

The replay controls are shown in Figure 72. To replay the last 7 days click on the rerun button and the time indicator will return to the far left, the beginning of the sequence.

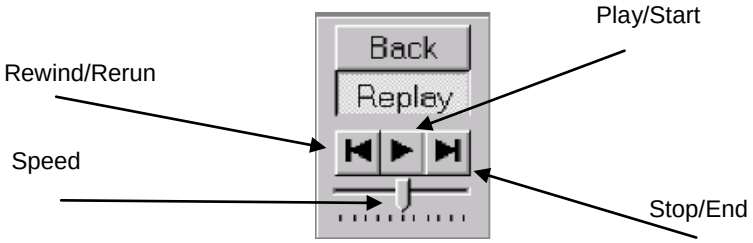

Figure 72 – Replay Controls

The "Speed Control" lever controls the speed of the replay. Move the lever left for quicker viewing; move it right for a slower view of the last 7 days. Click the Play/Start button to begin viewing the last 7 days. The "Back" button will return the user to the original (starting) Map

To return to the three-panel view, click the right-hand mouse button and then minimize display to return to the original panel. Click the Jurisdiction to bring up the selected Map. Click the "Back" arrow on the Toolbar to go back to the Web Home Page.

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6. Wide-Area ACE-Frequency Complementary Functions

6.1 Abnormal Frequency Notification (AFN)

The Real Time Interconnections Abnormal Frequency Notification (AFN) is a real time monitoring tool, part of the NERC/CERTS Frequency-ACE Monitoring System. The AFN is designed for real-time monitoring of abnormal interconnection frequencies, and to automatically issue emails to different stakeholders when certain performance criteria are met. The input data is provided by Control Areas to NERC over a secure connection using NERCnet, XML, and SOAP technologies.

6.1.1 Types of Email Notifications

Figure 73 is a summary describing the seven types of email messages generated by the AFN as well as the default parameters used as triggers to issue the Email Notifications.

Frequency Short Term Deviation

For each interconnection, the AFN checks to see if in the last minute the frequency changed by more than 28 millihertz (Note: This number is configurable). Caps are placed at 60.01Hz and 59.99Hz to prevent the AFN from generating a message under normal frequency conditions. If the frequency changed by more than 28 millihertz in the last minute and the current frequency has a value outside the Cap Area (greater than 60.01Hz or less than 59.99Hz), then the AFN records the frequency prior to the 28 millihertz change as a reference and issues an email (See Figure 74).

An example of the email is shown here:

Subject: SHORT TERM FREQUENCY DEVIATION QUEBEC, 0.028

SHORT-TERM: QUEBEC 8/12/2002 11:25:17 AM(EST) - Frequency Absolute value of two most recent 1-Minutes: ABS (60.020-59.991=0.029Hz>=0.028Hz.

Frequency Prolonged Deviation

Once an interconnection has had an occurrence of a Short Term Deviation, the AFN continues to monitor the frequency to see if it comes back to the previous value stored as a reference. If within 20 minutes (again, this number is configurable) the frequency does not return, emails are issued indicating that the interconnection still is under an abnormal frequency excursion.

An example of the email is shown here:

Subject: PROLONGED FREQUENCY DEVIATION QUEBEC

PROLONGED: QUEBEC 8/12/2002 11:36:49 AM(EST) – More than 20 minutes under Short-Term Deviation.

Frequency Long Term Deviation

The Abnormal Frequency Notification also tracks the average one-hour of frequency deviation from 60 Hertz. If the average deviation is greater than the threshold shown in table 2.1, (configurable in the system) emails are sent.

An example of the email is shown here:

Subject: LONG TERM FREQUENCY DEVIATION QUEBEC

LONG-TERM: QUEBEC 8/12/2002 9:32:40 AM(EST) - Rolling Hourly Frequency Average for last 61 minutes was 0.033Hz >= 0.030Hz.

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Frequency Deviation Alarms

Email Type	Time Window	Threshold	Caps
Frequency Short Term Deviation	1 Min	0.028Hz	0.01
			-0.01
Frequency Prolonged Deviation	20 Min	0.030Hz	0.01
			-0.02
Frequency Long Term Deviation	60 Min	0.016Hz	Rolling Average

Data Quality Alarms

Email Type	Criteria 1	Criteria 2
Frequency Quality Data Problem	Messages not sent until measurement has been down for at least 15 minutes	Message is not resent for same conditions for 1440 minutes
ACE Quality Data Problem	Messages not sent until measurement has been down for at least 30 minutes	Message is not resent for same conditions for 1440 minutes

Server Availability Alarms

Email Type	Criteria 1	Criteria 2
NERC Data Servers Down	Messages not sent until servers are unavailable down for at least 15 minutes	Messages not sent until server is unavailable down for at least 120 minutes

Time Error Correction Alarms

Email Type	Criteria
TEC Started	Messages sent when a TEC ACTIVE alert is received
TEC Ended	Messages sent when a TEC ENDING alert is received

Figure 73– Email Messages Summary and Criteria

Frequency Quality Data Problem

NERC has identified certain Control Areas as primary and secondary providers of frequency. These Control Areas are to send the frequency data every minute. In the event that the frequency is not sent for a configurable number of minutes, the AFN will issue an email.

An example of the email is shown here:

Subject: FREQUENCY QUALITY DATA PROBLEM WEST

FREQUENCY-QUALITY: WEST 7/16/2002 6:46:33 PM (PST) "Bonneville Power Administration Transmission" - Frequency source data has not been transferred for more than 15 Minutes

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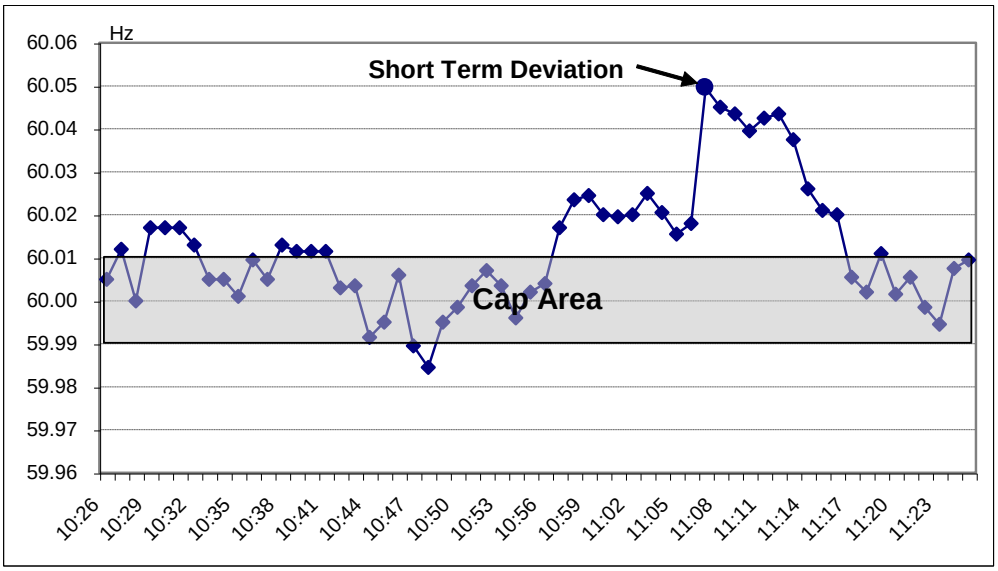

Figure 74– Example of Frequency Short Term Deviation

ACE Quality Data Problem

In addition to checking for frequency, the AFN also checks for the availability of ACE data from Control Areas. If the data has not been sent to NERC for a configurable number of minutes, then AFN will issue emails accordingly.

An example of the email is shown here:

Subject: ACE QUALITY DATA PROBLEM WEST

ACE-QUALITY: WEST 7/17/2002 3:35:37 AM (PST) "Nevada Power Company" - ACE has not been transferred for more than 30 minutes

NERC Data Servers Down

In the event that the NERC Data Servers are unavailable for a configurable number of minutes, the AFN will send notification emails.

Subject NERC DATA SERVERS DOWN

NERC DATA SERVERS DOWN: 7/24/2002 7:37:25 AM (PST) - NERC Data servers have been unavailable for the last 30 minutes. NERC Data servers have been unavailable 67% of the time today.

TEC Started

When a Time Error Correction (TEC) START notification is issued by one of the Reliability Coordinator Desks, the AFN issues email announcing the date and time that the TEC is expected to start as well as the new target frequency the system is expected to stabilize. During a TEC, the Frequency Deviation Alarms Cap Area (see Figure 2.1) moves accordingly around the TEC target frequency.

Example of a Start Time Error Correction Email

Subject: TEC EAST STARTED, 59.98

TEC ACTIVE, START=8/10/2002 4:02:42 PM (EST), Sched Freq=59.98

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TEC Ended

When a Time Error Correction (TEC) END notification is issued by one of the Reliability Coordinator Desks, the AFN issues email announcing the date and time that the TEC is ending. After a TEC ENDING email, the Frequency Deviation Alarms Cap Area (see Figure 2.1) returns to the normal bandwidth around the normal operating frequency (60.00Hz).

Example of a Stop Time Error Correction Email

Subject: TEC EAST ENDED TEC, START=8/10/2002 12:03:37 PM (EST), End=8/11/2002 11:52:36 AM (EST)

Email Address List Structure

The Abnormal Frequency Notification is designed such that a different list of email addresses may exists per Interconnection per Email Type. For example, with the Eastern Interconnection, there could be five different email address lists, one per Email Notification Type.

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6.1.2 Interconnection Priority for Data Quality

Tables below list the Control Area(s) that have been selected as the Primary and Alternate source of both frequency for NERC. The ACE and frequency data are collected from each of the 138 participating Control Areas.

Eastern Interconnection

Priority	Control Area Code	Control Area
1	EES	Entergy Electric System
2	AES	American Electric Power Company
3	WEC	Wisconsin Electric Power Company
4	FRCC	Florida Reliability Coordinating Council
5	ISNE	ISO New England Inc.
6	NYIS	New York ISO

Western Interconnection

Priority	Control Area Code	Control Area
1	AZPS	Arizona Public Service Company
2	BPAT	Bonneville Power Administration Transmission
3	CISO	California ISO
4	WALC	WAPA-Lower Colorado

Quebec Interconnection

Priority	Control Area Code	Control Area
1	HQ	Hydro-Quebec Trans Energie

6.1.3 Root-Cause Assessment Process

Once an email message from the AFN is received, recipients may wish to identify possible root causes to better assess the interconnection frequency performance. The current released version of the NERC_CERTS ACE Monitoring System is the complementary tool to facilitate the assessment task. The following is a recommendation on how to proceed for a detailed assessment:

Step One: Start the ACE Monitoring application (if not running)

Step two Launch the ACE function (AKA: Area Control Error Monitoring)

Step Three Click on the interconnect tab or the Reliability Region tab in the top left-hand side of the screen, depending on how many CA's to assess.

Step Four Change the time:

There is a time stamp in the body of the email message that indicates when the disturbance occurred. If this time stamp is older than 10 minutes, you'll need to change the time in the ACE Monitoring application as published in the email.

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Step Five Click on the "Pick" tool located on the bottom right –hand side and then select the interconnection you wish to analyze. Note Figure 74

Step Six Right-Click and select the menu option "Local – ACE/Frequency" to get the 3-panel display. Note Arrow in Figure 74 and resulting display in Figure 75.

Step Seven Identify CA's with abnormal ACE's from the Image Plot to (Top Right Panel)

Step Eight Click on the Control Area(s) with abnormal ACE on the Image Plot to get that CA's Hourly ACE-Frequency (Cave_2) and verify correlations between the CA's with abnormal ACE and Interconnection Frequency.

Step Nine Select the tab on the bottom marked Hourly Cave. Here you will find the actual, numerical ACE-Frequency values for the CA selected in the text format.

Step Ten Use the ACE Monitoring User Guide or the Tri-folded summary brochure to identify the steps to use the Frequency-ACE conditional plots to analyze root-causes.

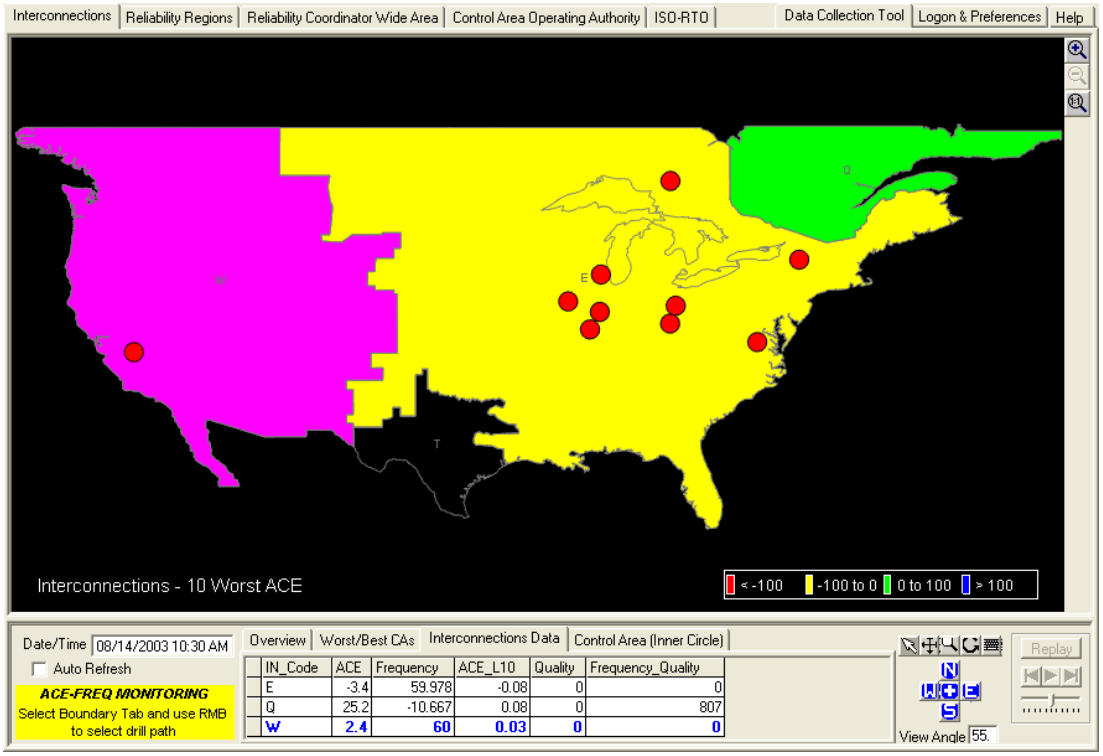

Figure 74 – West Interconnection Selected

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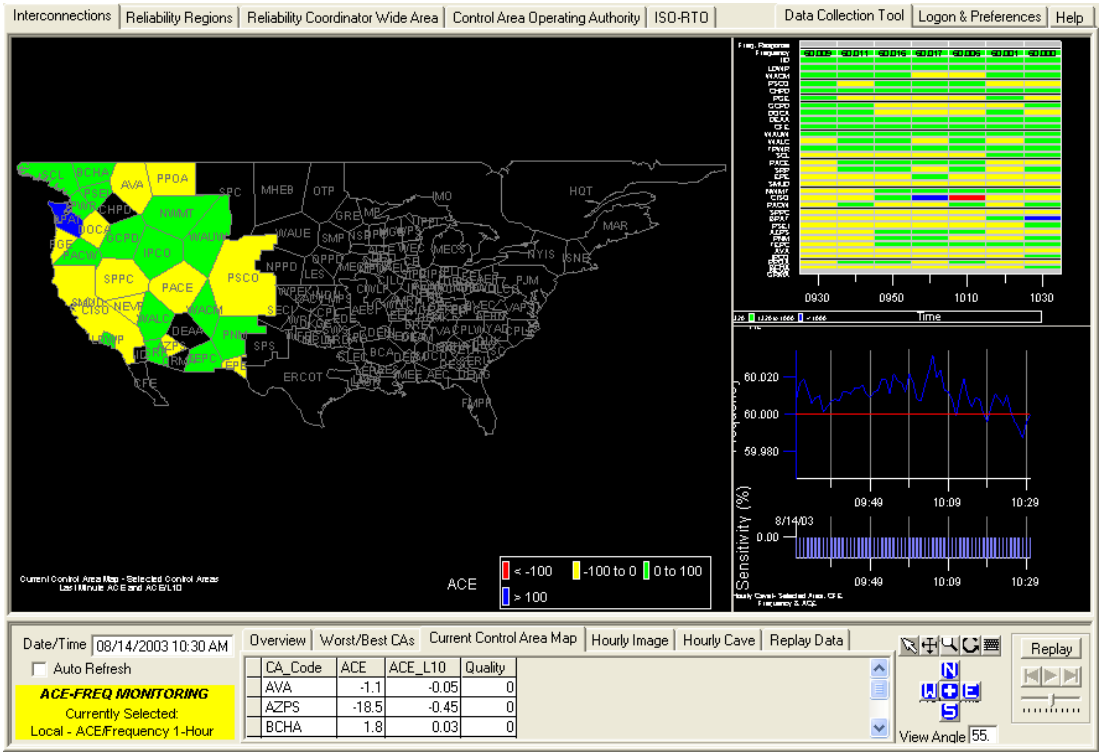

Figure 75 – Three Panels

Detailed Root Cause Analysis

To perform a detailed examination of the specific region initiating the email, click on the Reliability Coordinator tab at the top of the panel. Select the region desired. This will cause the region to appear in Magenta. Right click the mouse and the pop up menu will appear as seen in Figure 76.

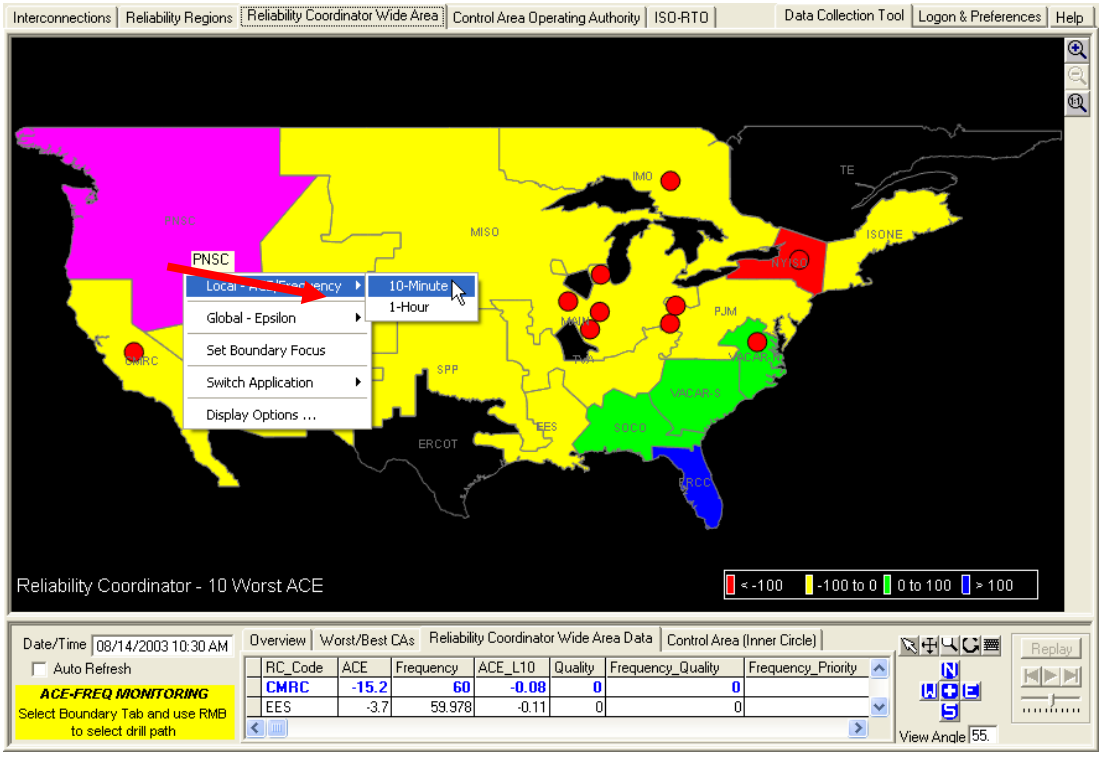

Figure 76 – 10-Minute Freq/ACE

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Clicking on the “10 minute Freq/ACE” in the Pop up Menu box will bring up Figure 77. This view demonstrates Frequency values for the entire Reliability Coordinator selected for the last 10 minutes. Noting that there are only nine displays indicates that one frequency was present for two scans. This does not mean that the same frequency was held for two consecutive minutes, just that the same frequency was present twice when scanned. To further analyze this data right click in the graph area. Another pop up box will appear as seen in Figure 78.

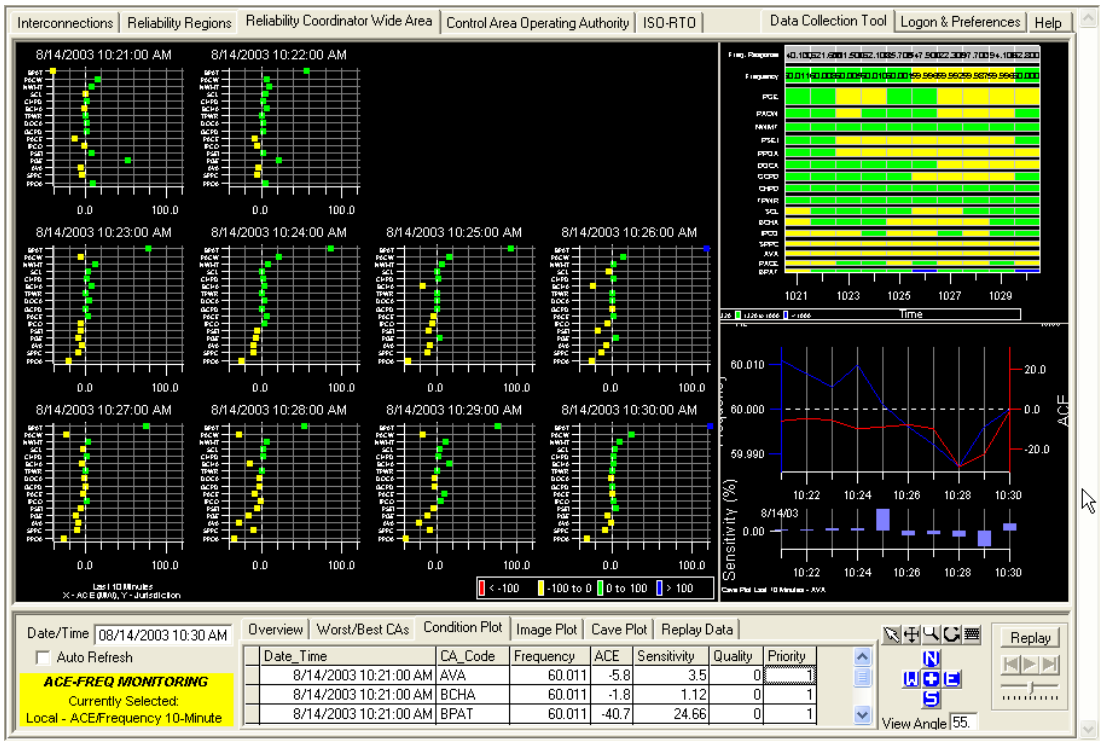

Figure 77 – Three-Panel Display – 10 Minute Freq/ACE

Click on “Unique Time Value (X-ACE, Y Jurisdiction)” in Figure 77 to reconfigure the data and graphs. The three options appear to the right of “Scatter Plot Grouping”. This data is displayed minute by minute with the date and shows the ACE for each Jurisdiction. Examining each minute allows the user to see the ACE values. The color code is presented at the bottom of the graphic view for determining the variations of the ACE for each jurisdiction. The graphic view can be maximized for easier readability by right clicking in the graphic area. The pop up box as seen in Figure 78 will appear. Click on Maximize and the graphic view will be expanded to the entire screen. To Minimize (return) right click in the graphic view and the “Minimize Display” pop up menu appears. Click on “Minimize Display” and the three (3) Panel graphic will return. It should be noted that while in the expanded graphic view the operator can change to the full screen data view by moving the mouse to “Scatter Plot Grouping” arrow and selecting the desired view.

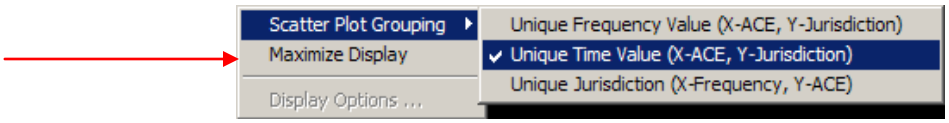

Figure 78 – Scatter Plot Grouping

The cave diagram can be changed from the selected ACE/Freq Image Plot diagram by clicking on any one of the colored boxes for the Control Area shown. Clicking on anyone of the (11) boxes shown in Figure 79 will change the “ACE/Freq Cave Plot”. The jurisdiction Cave diagram being viewed is stated in the bottom right hand corner of the cave diagram. This will allow the user to analyze the cause of the email notice.

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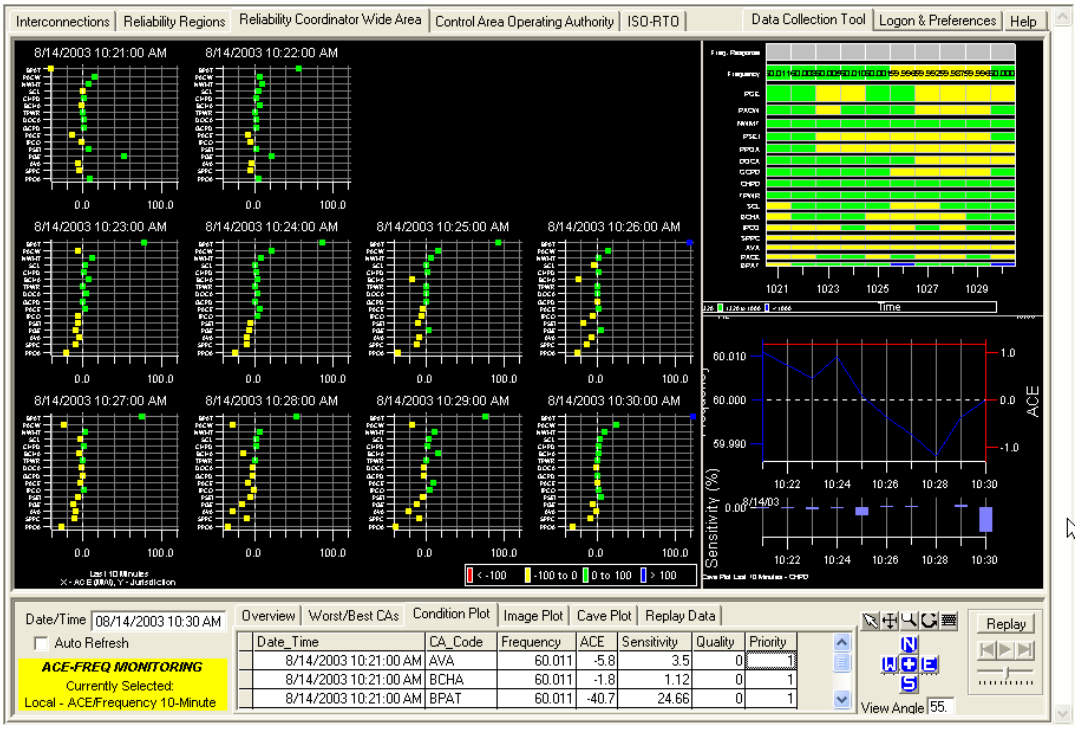

Figure 79 – Select different Cave Diagram from Three (3) Panel Graphic

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6.1.4 Recommended Email Management – Microsoft Outlook

If you use Microsoft Outlook as your email program and you are on one of the lists for the Abnormal Frequency Notification, one of the first things you may want to do is configure Outlook to manage and group your emails by the type of message received. Here is an example of how to set up Outlook.

Create A Folder

Bring up your "Inbox" folder and then click "File" from the above menu and choose "Folder" and then "New Folder." Give the new folder a name; a suggestion is AFN.

Store The Email Address

Once a message is received from the Abnormal Frequency Notification, store the email address in your personal address book. This will allow Outlook to track your messages.

Create A Rule

Microsoft Outlook allows you to create rules that govern what to do with certain messages once you receive them. Click on the menu option "tool" and then "Rules Wizard." The rule you'll want to create is to "Move new messages from someone;" the someone being the email address of the AFN you stored earlier and the specified folder to move to will be the AFN folder you created.

Group Messages In The AFN Folder

Bring up the "AFN" folder you created earlier and click the "Tools" menu option and then "Organize." A new Screen will be shown giving you four different ways of organizing your emails. Select the "Using Views" option and in the list menu, scroll down and highlight the option "By Conversation Topic." This will categorize all emails sent to you by AFN in to one of five groups (each type of AFN email possible).

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6.2 Interactive Data Collection (IDC)

The CERTS Data Collection Tool is an easy way for engineers and/or other support personnel to view/extract the raw data from the NERC Database that has been collected for the user to analyze. Click the "Data Collection Tool" tab in the upper right hand corner, as shown in Figure 80, to access this tool.

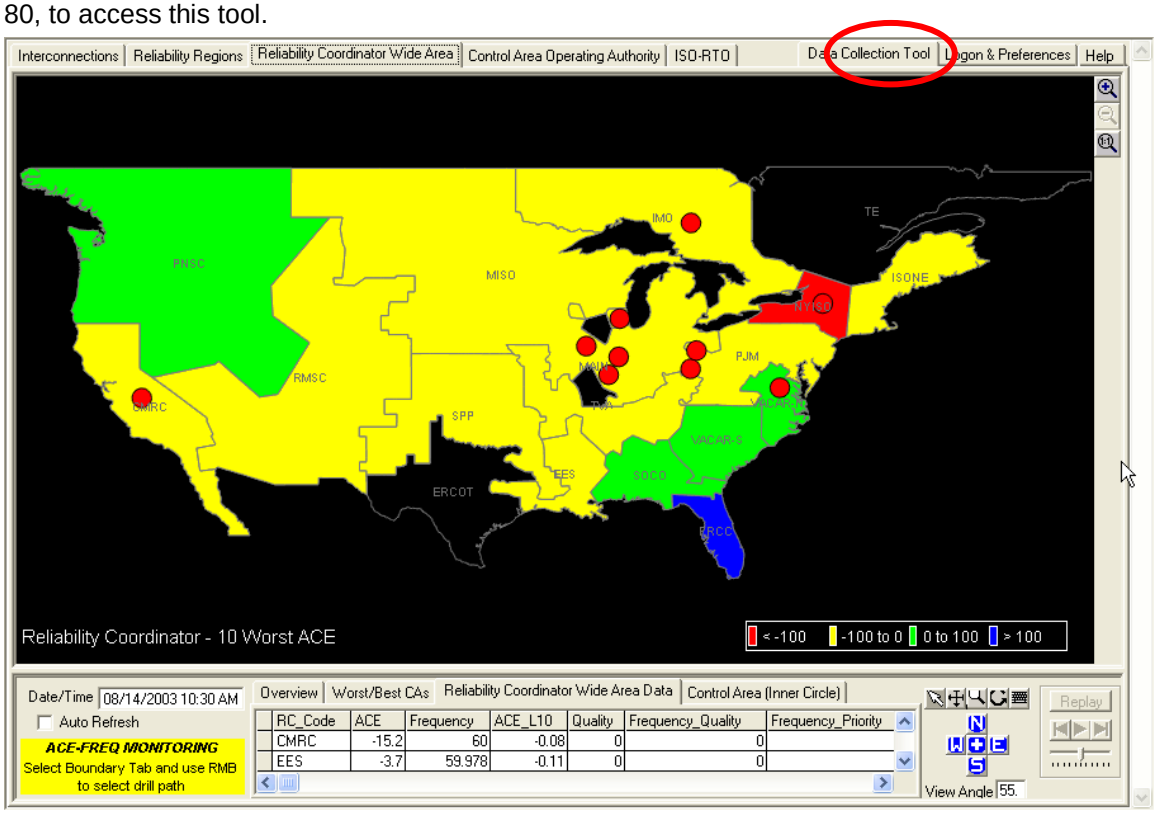

Figure 80 – ACE (Map)

The "CERTS Data Collection Tool" panel will appear. The buttons in the upper left hand corner of the screen, as seen in Figure 81, provide data collection options.

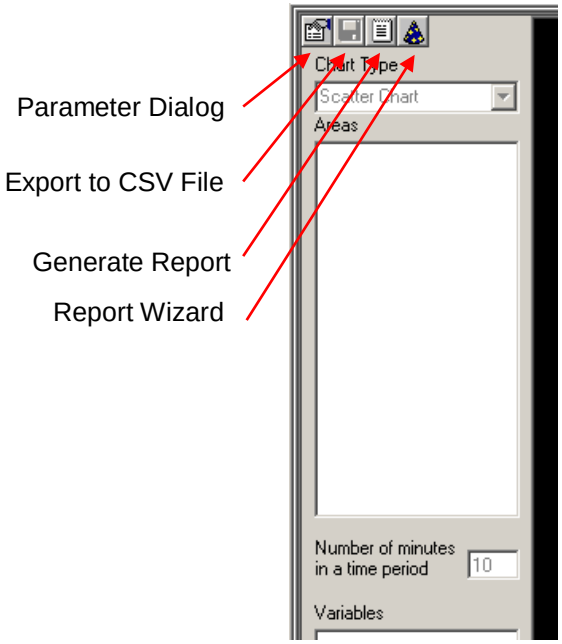

Figure 81 – CERTS Data Collection Tool

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Parameter Dialog and Report Wizard

The "Parameter Dialog" window, shown in Figure 82, enables viewing a specific Date and Time. Clicking the down arrow adjacent to the "Start Date/Time" Text Box will provide a calendar as seen in Figure 16. When a specific Start Date has been selected from this "Start Date" calendar, a corresponding default End Date appears in the "End Date/Time" text box. This default date will be the next calendar day. This date and time will be 24 hours from the start date. By using the down arrow on the "End Date/Time" window a different date can be chosen. The time can be adjusted by clicking the down arrow. This operation is the same as described at Figure 17.

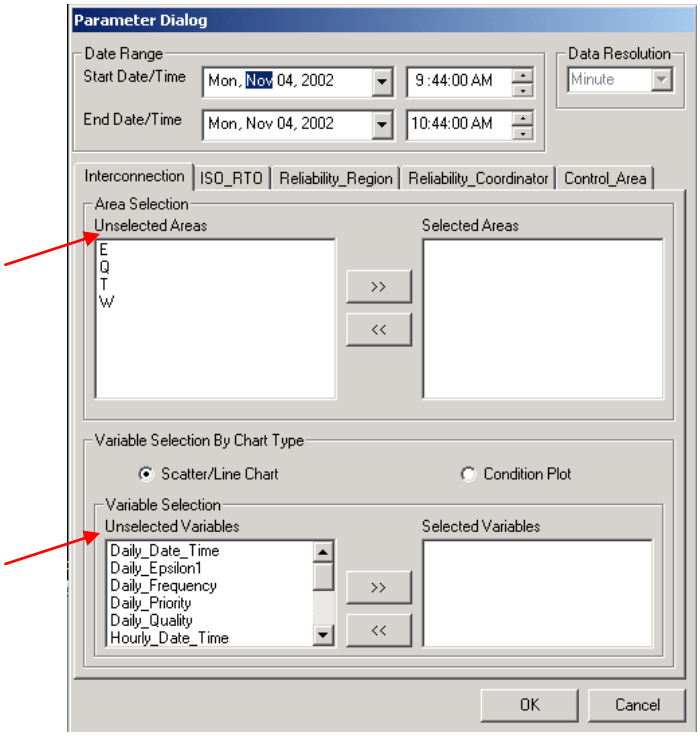

Figure 82 – Parameter Dialog Menu

The five Jurisdiction tabs below the Date/Time windows are the same as those from the Master Monitoring Display (Figure 9). After one of the five tabs is selected, choose the area(s) to be viewed from the "Unselected Areas" text box. Click on the desired area and that selection will be highlighted. Then the ">>" button must be clicked to move the selection to the "Selected Area" text box. Chart Type selection consists of the default "Scatter/Line Chart" and the "Condition Plot." The "Condition Plot" will only display the last ten minutes of data. Variables can then be selected from the "Unselected Variables" text box. These selected variables must be moved to the "Selected Variable" text box by clicking the ">>" button. Should one of the areas or variables selected not be needed, it can be returned to the Unselected Area or Unselected Variable text box by highlighting the undesired element and clicking the "<<" button. Once the selections are finalized, click "OK" to return to the "CERTS Data Collection Tool."

The *Report Wizard* walks you through the process described above on a step by step basis: first it allows you to select the date/time range, then the jurisdictional level of the report and then it gives you a list of available variables for the selected jurisdictional tab.

Warning: Both the *Parameter Dialog* and the *Report Wizard* allows downloading of flexible time periods. However, when selecting a large number of control areas and short time resolution (1-minute or 10-minute data), it is recommended to set a time frame not to exceed 24 hours. When selecting hourly, daily or monthly variables, the time frame should not exceed 30 days. A shorter

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period of time should be considered if a slow connection to the internet (i.e., dial-up) is used. The reason for this is that the application will time-out if any request to the database server is not completed within a certain period of time. This is done to prevent *permanent idle connections* to the database that can slow the server performance.

In the "CERTS Data Collection Tool" window, the selected Areas and Variables appear on the left side of the screen. For the Scatter Chart option, only two of the three variables are shown in the Variable text window; the third variable has been placed in the X Axis text box. Clicking the down arrow of the "X Axis" opens the window to reveal the variables shown above. Clicking the down arrow for "Scatter Chart" allows the user to select a "Line Chart." The data in tabular form appears in the bottom left corner. This is the data that will be used to construct the charts. To construct the charts highlight the area(s) that are to be charted. When more than one area is to be selected: highlight the first area. While holding down the "Shift" key, click on the number of the area to be viewed. Follow the same process for the "Variables." As each Area and Variable is selected, it will appear in the black chart area. With both areas and all three variables selected, the chart will be displayed as in Figure 83.

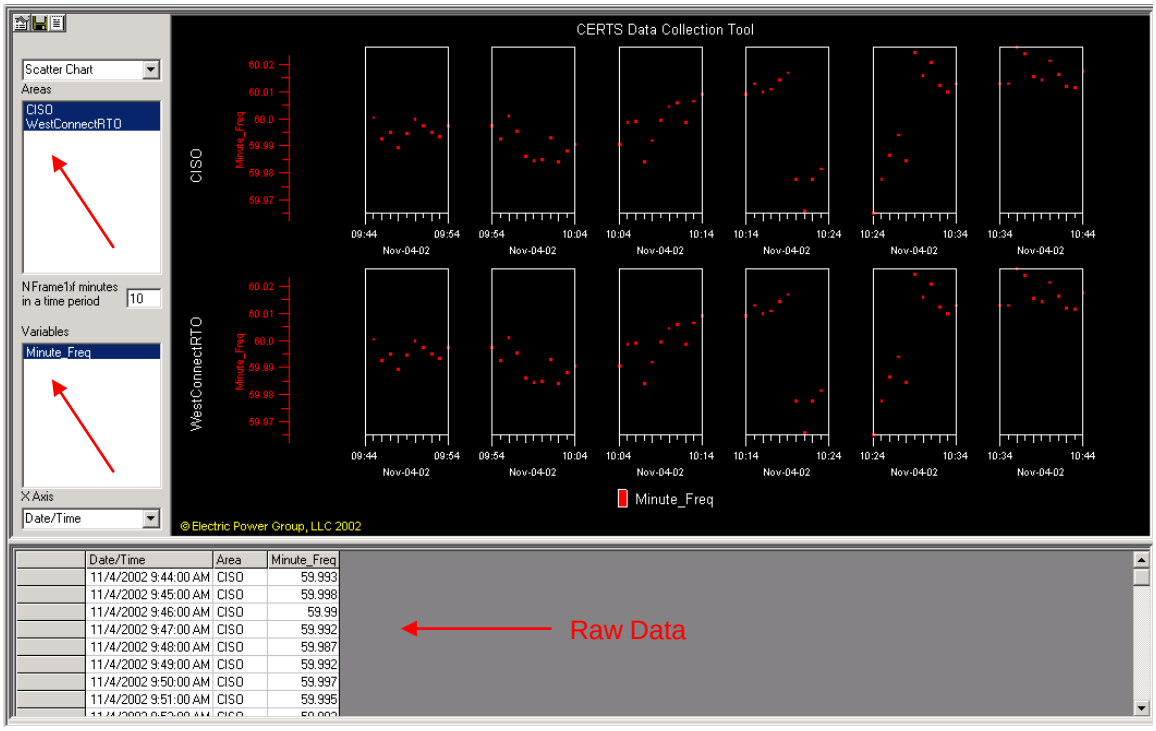

Figure 83 – CERTS Data Collection Tool – Scatter Chart

The time graduation can be changed by highlighting the number in the "Number of minutes in a time period" as viewed in Figure 83. This tool can be minimized and placed on the taskbar for review later. This tool must be manually closed.

6.3 Unavailable Data Reporter (UDR)

The Data Unavailability Report Generator is a reporting tool intended for those interested in tracking the reliability of the ACE data sent from Control Areas via the ICCP network. The Data Unavailability Report Generator is a web-based application that displays bar charts and tables representing the reliability of data from the Control Area over a given period of time. The Data Unavailability Report Generator displays the amount of time ACE data was not received for each Control Area selected.

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6.3.1 Getting Started

When the NERC/CERTS Frequency-ACE Monitoring System is installed for the first time, the Data Unavailability Report Generator is disabled. It can be enabled by calling NERC directly and speaking to one of the IT members.

Once enabled, the Data Unavailability Report Generator can be launched from the Data Collection Tool using the following steps in Figure 84.

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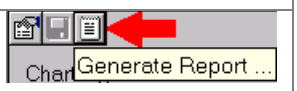
1. Start the NERC/CERTS ACE- Frequency Monitoring System. *(Note: There should be a short-cut such as this on the desktop.)*	
2. Launch the Area Control Error Monitoring function.	
3. Select the Data Collection Tool tab along the top-right side.	
4. Select the "*Generate Reports*" icon. *(Note: A "Tool Tip" will appear when the mouse hovers over the icon.)*	

Figure 84 – Starting the Data Unavailability Report Generator

6.3.2 Generating Reports

When the Data Unavailability Report Generator is launched a "Report Dialog" is displayed which allows the user to set the criteria for generating a report (see Figure 85 below). Four parameters must be selected in order to properly generate a report.

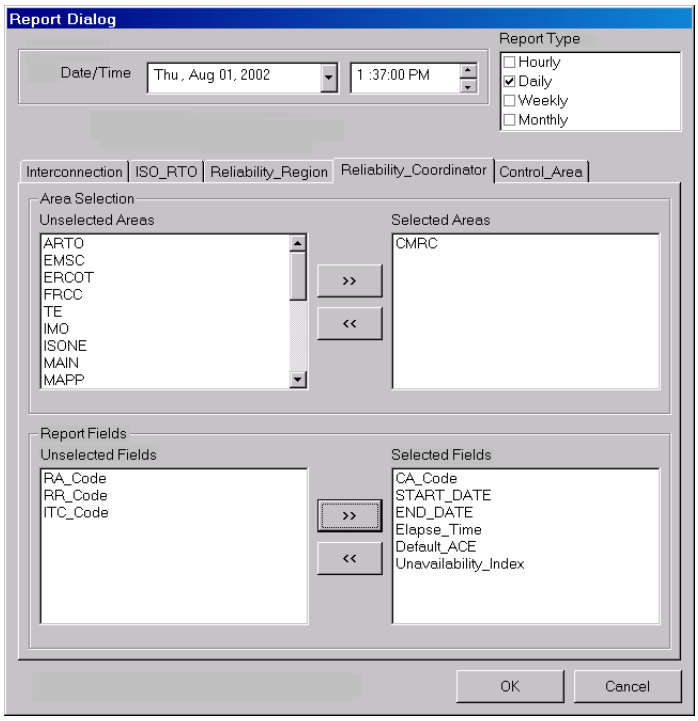


Figure 85 – The Report Dialog

The Date/Time Parameter

The Date/Time Parameter is used to mark the last date/time value in the query. It is the "end" date/time where the Report Type will indicate the beginning. For example, if the date/time parameter is set to August 1, 2002 1:37 PM and the Report Type "Daily" is selected, the data returned will be from July 31, 2002 1:37 to August 1, 2002 1:36.

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The Report Type Parameter
Each report type represents a "rolling" window of time where the date/time parameter indicates the "End Time". Figure 86 contains a description of each window of time.

Report	Start	End	Time Window
Hourly	End Time – 60 Minutes	End Time – 1 minute	60 Minutes
Daily	End Time – 24 Hours	End Time – 1 minute	24 Hours
Weekly	End Time – 7 Days	End Time – 1 minute	7 Days
Monthly	End Time – 30 Days	End Time – 1 minute	30 Days

Figure 86 – Report Type Rolling Window of Time

The Area Selection Parameter
Each Control Area is assigned to four unique jurisdictions (Reliability Coordinator, Reliability Region, ISO_RTO, and Interconnection). These jurisdictions can be used to report on all of the Control Areas therein thus eliminating the need to select the Control Areas manually. For example, if the Reliability Coordinator CMRC is selected, the resulting report would show the status of the four Control Areas assigned to CMRC (CISO, LDWP, IID, and SMUD).

The Field Selection Parameter
The Field Selection Parameter allows the user to control the amount of data returned. At least one field must be selected. Figure 87 has a description of the type of data contained in each field.

Field Name	Description
CA_Code	The Control Area's abbreviated name.
RC_Code	The Reliability Coordinator's abbreviated name.
RR_Code	The Reliability Region's abbreviated name.
IN_Code	The Interconnection's abbreviated name.
START_DATE	The beginning date/time of the report
END_DATE	The ending date/time of the report
Elapse_Time	The amount of time (in minutes) the Control Area's data was not available via the ICCP.
Default_ACE	The default ACE value used while no other data was available.
Unavailability_Index	The percentage of time the data was unavailable.

Figure 87 – Field Code Definitions

6.3.3 Sample Report
Embedded in this document is a sample of a report consisting of all the report types, all the report fields, and one Reliability Coordinator, CMRC (which contains four Control Areas).

Bar Charts
A bar chart is created for each report type selected. The Control Areas displayed within the bar charts are only those whose ACE data was not received by the ICCP for at least one minute of the requested time window. If more than one report type is requested then a summation bar chart appears at the bottom grouping all the reports into one bar chart.

Tabular Data
Below the bar chart section of the report is the actual data returned. Again, there is one table of data for each report type requested. Most of the report types will return one record of data for each Control Area. The Hourly report type is the exception to this as it will report all of the time gaps in the data. For example, in the sample report below, CFE data was only received once by the ICCP for the requested hour. Thus two records are displayed in the Hourly table for CFE quantifying the amount of time the ACE data was unavailable for CFE via the ICCP.

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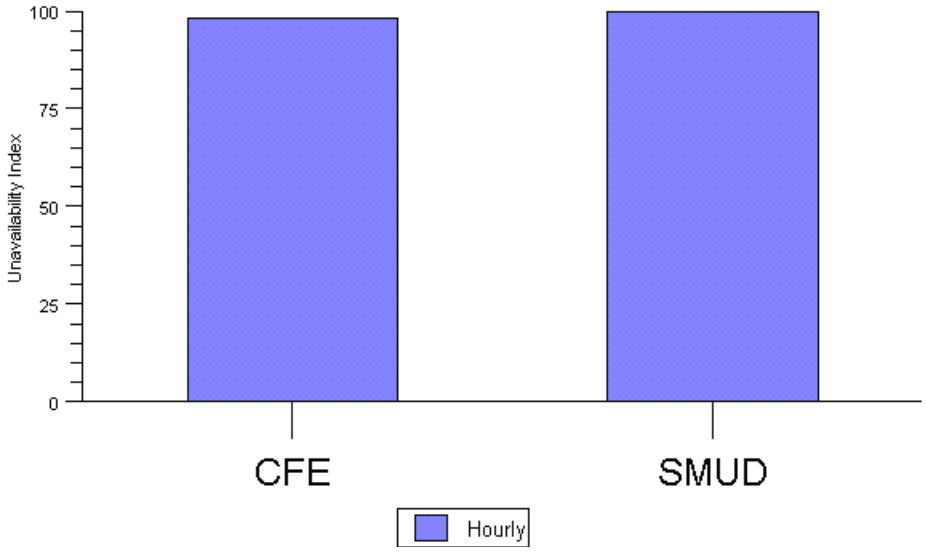
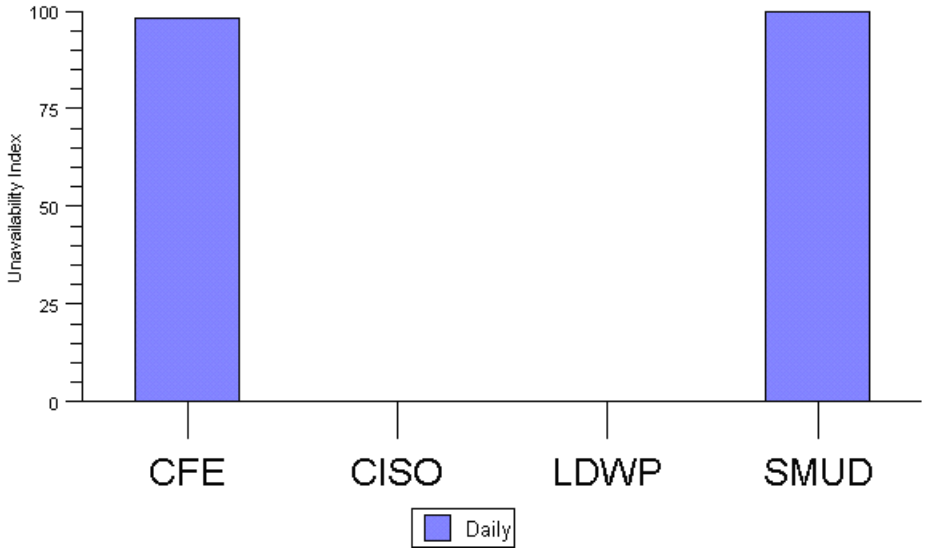
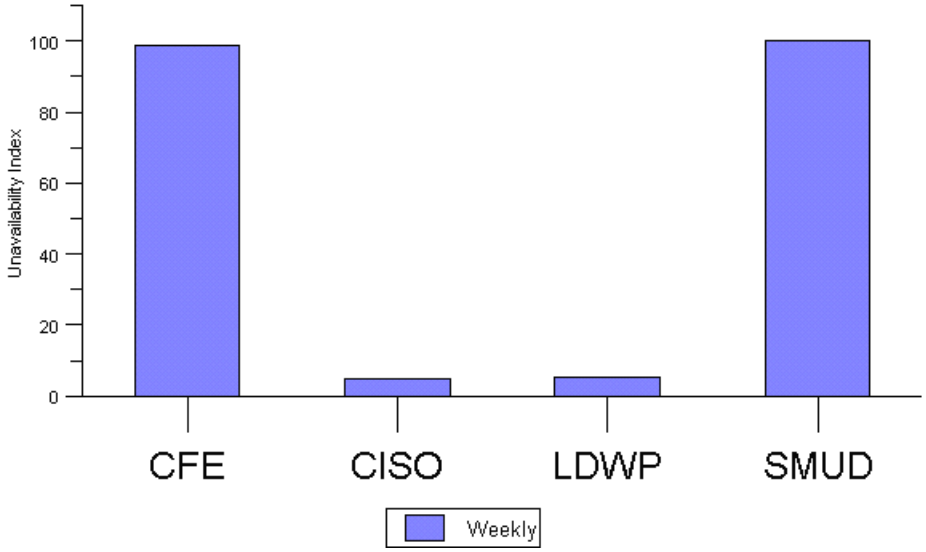
Sample Report
Data Unavailability Report
Wednesday, October 30, 2002 05:00 PM PST, Region(s): CMRC







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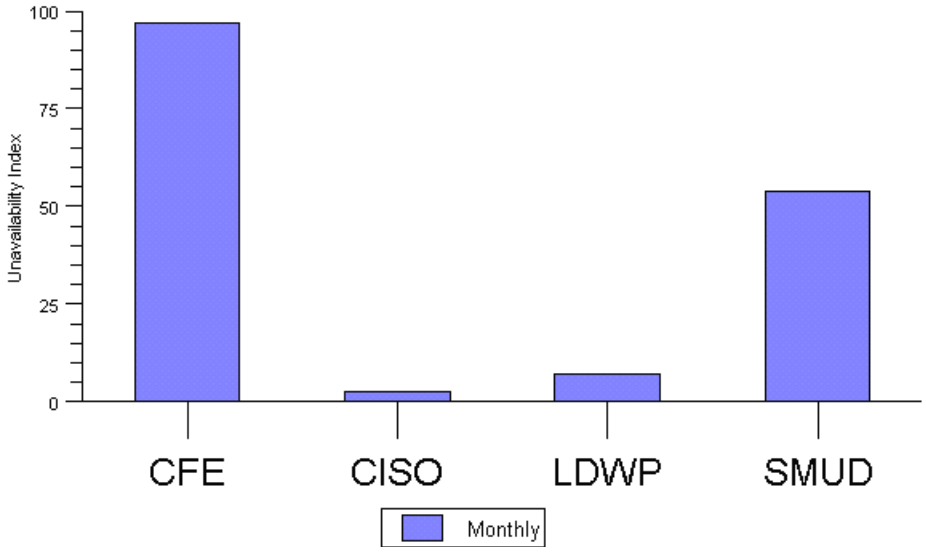

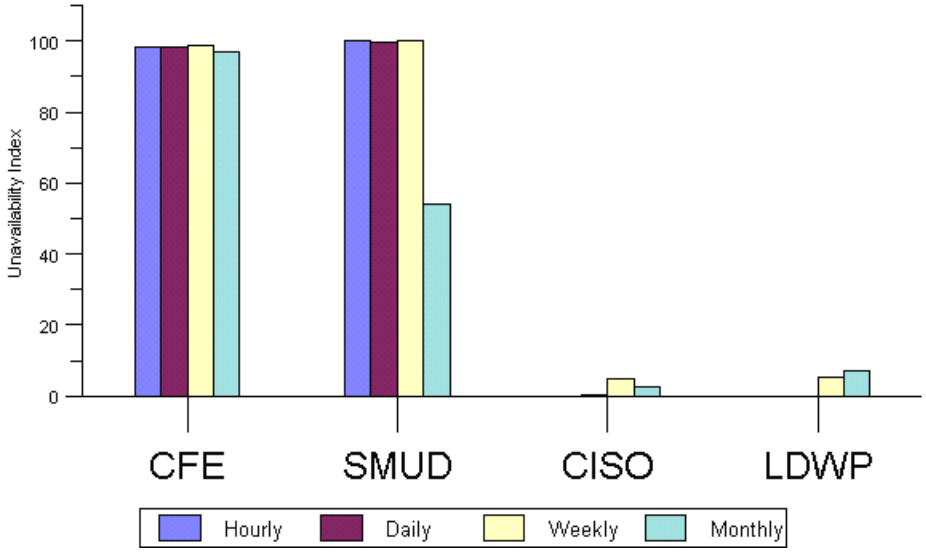

Hourly Data Unavailability Report

Wednesday, October 30, 2002 05:00 PM PST, Region(s): CMRC

CA Code	RC Code	RR Code	ITC Code	START DATE	END DATE	Elapse Time	Default ACE	Unavailability Index
CFE	CMRC	WECC	W	10/30/2002 3:14:00 PM	10/30/2002 4:14:00 PM	61	0	98.33
CFE	CMRC	WECC	W	*10/30/2002 4:16:00 PM*	10/30/2002 4:59:00 PM	44	0	98.33
SMUD	CMRC	WECC	W	10/14/2002 11:28:00 AM	10/30/2002 4:59:00 PM	23372	0	100

Daily Data Unavailability Report

Wednesday, October 30, 2002 05:00 PM PST, Region(s): CMRC

CA Code	RC Code	RR Code	ITC Code	START DATE	END DATE	Elapse Time	Default ACE	Unavailability Index
CFE	CMRC	WECC	W	10/29/2002 5:00:00 PM	10/30/2002 4:59:00 PM	47751	N/A	98.26
CISO	CMRC	WECC	W	10/29/2002 5:00:00 PM	10/30/2002 4:59:00 PM	2	N/A	0.14
LDWP	CMRC	WECC	W	10/29/2002 5:00:00 PM	10/30/2002 4:59:00 PM	1	N/A	0.07
SMUD	CMRC	WECC	W	10/29/2002 5:00:00 PM	10/30/2002 4:59:00 PM	32553798	N/A	99.79

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Weekly Data Unavailability Report

Wednesday, October 30, 2002 05:00 PM PST, Region(s): CMRC

CA Code	RC Code	RR Code	ITC Code	START DATE	END DATE	Elapse Time	Default ACE	Unavailability Index
CFE	CMRC	WECC	W	10/23/2002 5:00:00 PM	10/30/2002 4:59:00 PM	387606	N/A	98.74
CISO	CMRC	WECC	W	10/23/2002 5:00:00 PM	10/30/2002 4:59:00 PM	50322	N/A	4.79
LDWP	CMRC	WECC	W	10/23/2002 5:00:00 PM	10/30/2002 4:59:00 PM	51834	N/A	5.36
SMUD	CMRC	WECC	W	10/23/2002 5:00:00 PM	10/30/2002 4:59:00 PM	185123610	N/A	100.28

Monthly Data Unavailability Report

Wednesday, October 30, 2002 05:00 PM PST, Region(s): CMRC

CA Code	RC Code	RR Code	ITC Code	START DATE	END DATE	Elapse Time	Default ACE	Unavailability Index
CFE	CMRC	WECC	W	9/30/2002 5:00:00 PM	10/30/2002 4:59:00 PM	1461765	N/A	96.93
CISO	CMRC	WECC	W	9/30/2002 5:00:00 PM	10/30/2002 4:59:00 PM	83580	N/A	2.55
LDWP	CMRC	WECC	W	9/30/2002 5:00:00 PM	10/30/2002 4:59:00 PM	134491	N/A	6.94
SMUD	CMRC	WECC	W	9/30/2002 5:00:00 PM	10/30/2002 4:59:00 PM	272601741	N/A	54

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7. Three Typical ACE Utilization Scenarios

The Real-Time Interconnection Abnormal Frequency Notification (AFN) is designed for real-time monitoring interconnection frequencies. The AFN will automatically notify Resource Coordinators, NERC Resource subcommittee members, and the NERC Staff when applicable. The email recipients can use the ACE-Monitoring system capabilities to assess the root cause for the abnormal frequency. Listed are three scenarios from history.

<u>Scenario No. 1</u>

Date: 3-8-04

Time: 1824 (PST)

Short Term Frequency Deviation email transmitted to:

CISO Reliability Coordinator

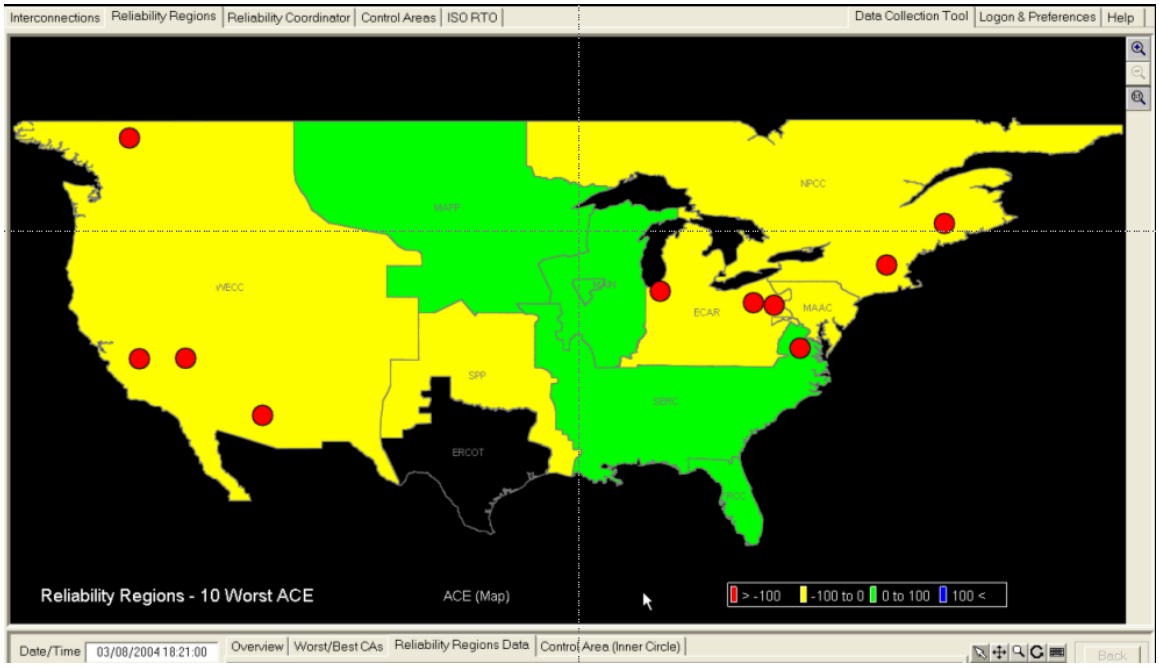
NERC Resource subcommittee members

NERC Staff

Message reads:

Short-Term: CISO 03/8/04 5:01 PM(PST) – Frequency Absolute value of two most recent 1-minute: ABS (*60.030-60.040=0xxxxxxxxxxxxx.*

Short-Term: CISO 03/8/04 6:10 PM(PST) – Frequency Absolute value of two most recent 1-minute: ABS (*59.59-=0xxxxxxxxxxxxxxx).*



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Summary

- ***Two frequency abnormal periods on 3/8/04***
  - ***5:01 to 5:12 PM – 60.04 Hz highest***
  - ***6:10 to 6:32 PM - 59.95 Hz lowest***
- ***Frequency-ACE tool alarmed users for both abnormalities for 12 and 32 minutes***
- ***Zooming in into WECC Reliability Coordinator and Control Areas ACE, Frequency-ACE tool identified and alarmed CAISO ACE as the only root cause for frequency abnormalities***
- ***Frequency-ACE did not identify other Control Areas ACE helping interconnection frequency***

Scenario No. 2

Date: 4-30-02

Time: 14:38 (EST)

Short Term Frequency Deviation email transmitted to:

TVA Reliability Coordinator

NERC Resource subcommittee members

NERC Staff

Message reads:

Short-Term: TVA 04/30/02 2:38 PM(EST) – Frequency Absolute value of two most recent 1-minute: ABS (59.969-59.967) = 0.033Hz>=0.028Hz.

- To review the root cause of this message start the ACE Monitoring application (if it is not running)
- Launch the ACE function (AKA: Area Control Error Monitoring)
- Click on either the Interconnection, Reliability Region or Reliability Coordinator tab. In this scenario the Reliability Coordinator tab will be selected.
- Change the time listed to the time given in the email.
- With the “Pick” tool selected (arrow) click on the TVA designated area on the map. The TVA area will turn magenta.
- Left click the mouse and select “10 minute frequency/ACE” in the pop up box.
- The three panel screen will appear.
- From this view it is seen that TVA is out of compliance for the time designated.
- Selecting the “Cave Plot” in the data table and locating the time with the scroll bar the time and frequency of the notice is presented.

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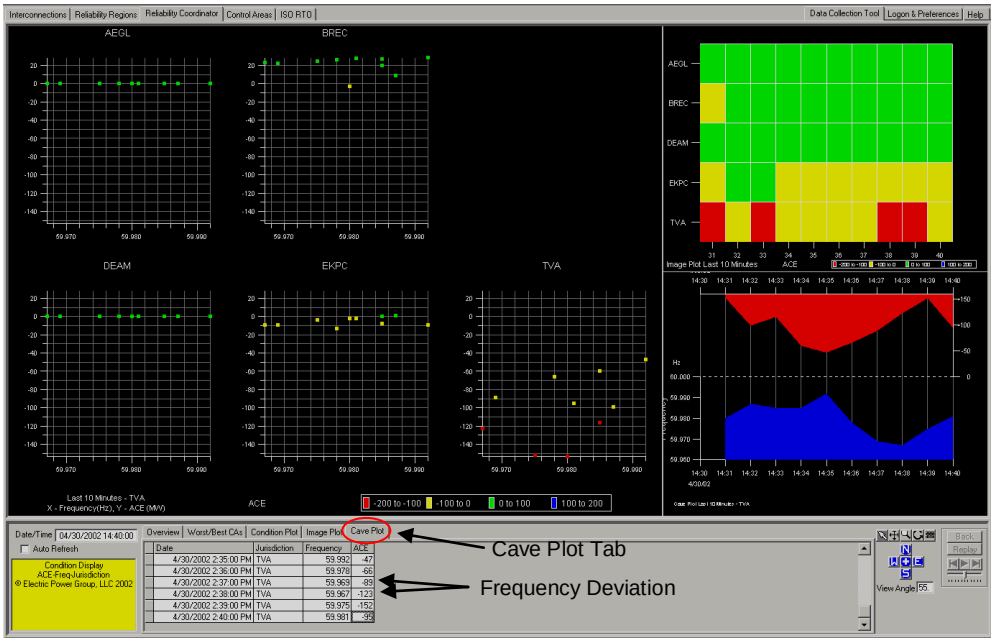

Figure 88 - Scenario # 1 Three Panel

<u>Scenario No. 3</u>

Date: 4-30-02

Time: 14:22 (EST)

Short Term Frequency Deviation email transmitted to:

MISO Reliability Coordinator

NERC Resource subcommittee members

NERC Staff

Message reads:

Short-Term: MISO 04/30/02 2:23 PM(EST) – Frequency Absolute value of two most recent 1-minute: ABS (59.969-59.967) = 0.033Hz>=0.028Hz.

- Change the time to the time indicated in the message.
- In the first scenario the “Reliability Coordinator Tab” was selected. In this scenario we will click on the “Control Area Tab”.
- The “CSWS” Control Area is red and the DCS is flashing.
- Select “CSWS” with the pick function. (CSWS will turn magenta)
- Right click the mouse and select “Local-ACE/Frequency”
- The date and time pop-up box will appear. Check to see that the time of the message is correct and click “OK”.
- The Three Panel display will appear for your viewing.
- In the data tables select the “Hourly Cave Tab”.
- Locate the time and the frequency excursion will be presented for your analysis.

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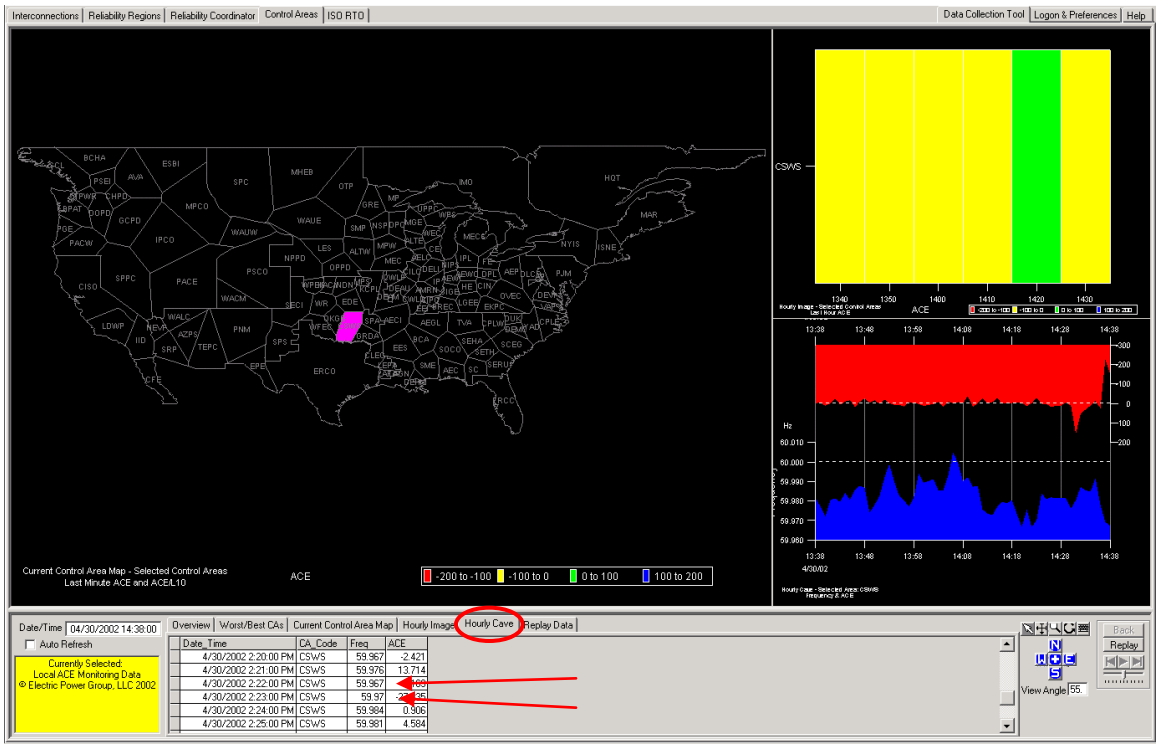

Figure 89 - Scenario # 2 Three Panel

<u>Scenario No. 4</u>

Date: 2-28-02

Time: 03:12 (EST)

Short Term Frequency Deviation email transmitted to:

PJM Reliability Coordinator

NERC Resource subcommittee members

NERC Staff

Message reads:

Short-Term: PJM 02/28/02 3:12 AM(EST) – Frequency Absolute value of two most recent 1-minute: ABS (59.972-59.969) = 0.031Hz>=0.028Hz.

- Change the time to the time indicated in the message.
- Select the “Reliability Region Tab”.
- The “MAAC Region” is displayed in Red.
- Select “MAAC Region” with the pick function. (MAAS will turn magenta)
- Right click the mouse and select “10 Minute Frequency/ACE” function in the pop up box.
- The Three Panel display will appear for viewing.
- The last ten minute graphs display the frequency for each control area.

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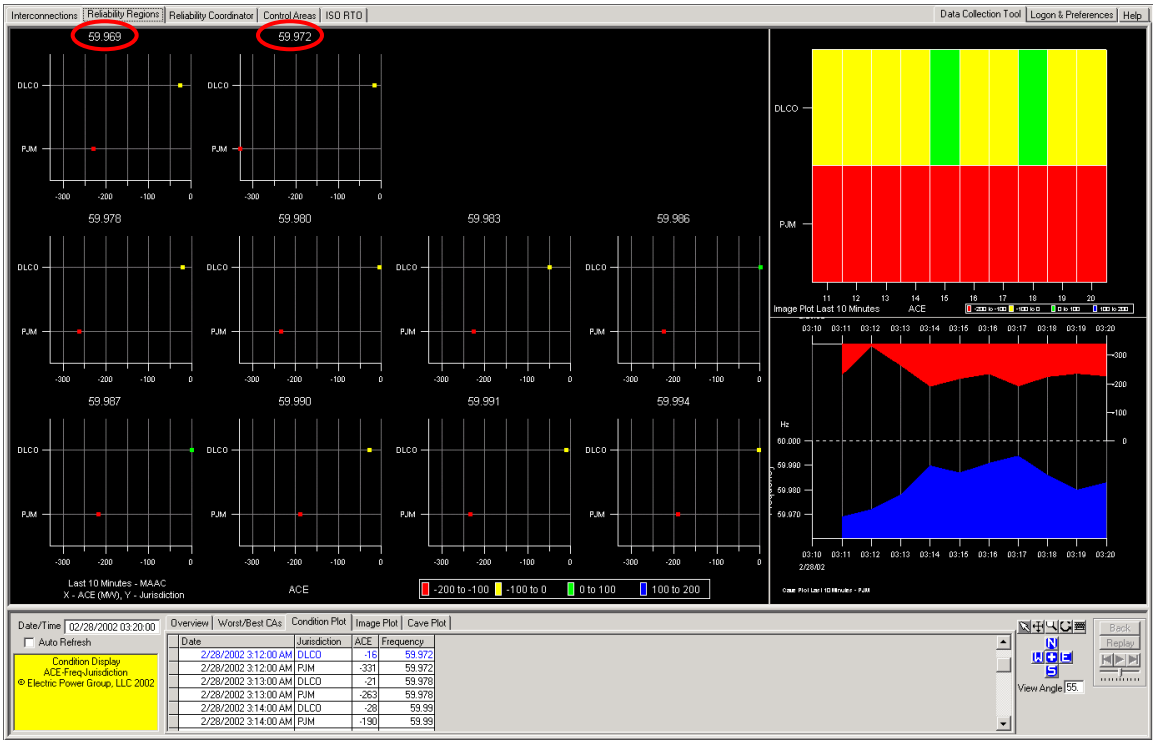

Figure 90 - Scenario #3 Three Panel

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8. ACE-Frequency Logon and Preferences

Click the “Logon & Preferences” tab and the window in Figure 91 appears.

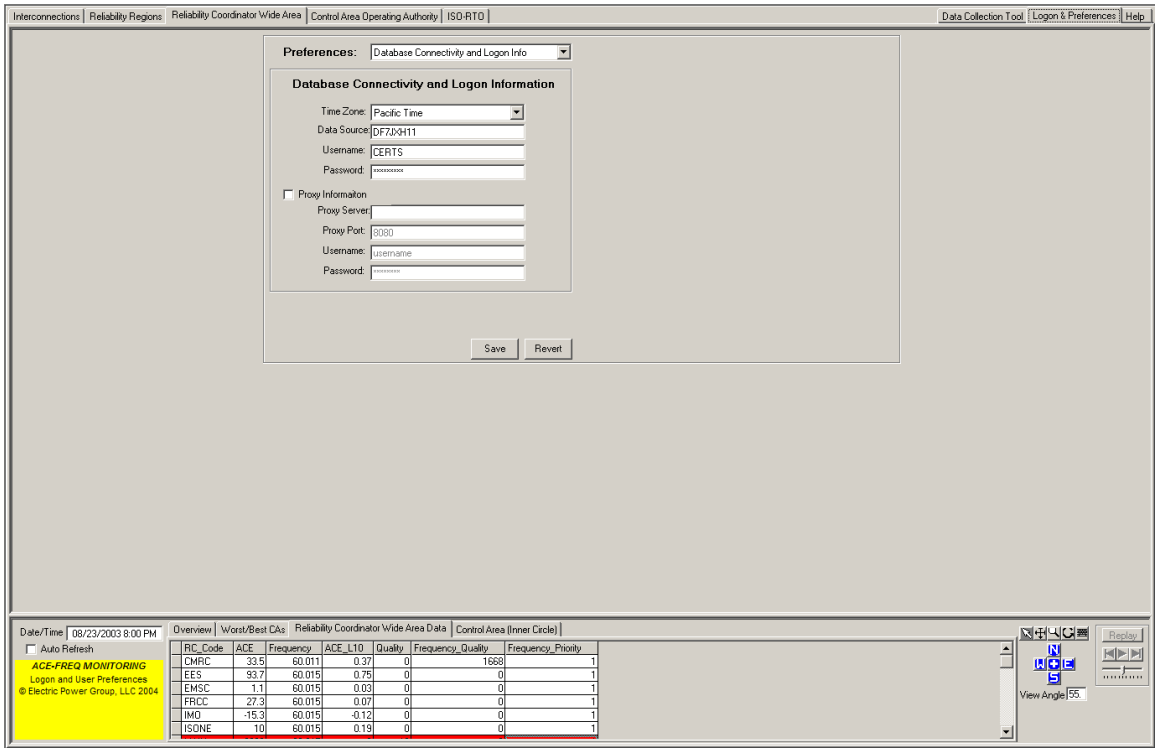

Figure 91 – Logon and Preferences

The default for “Preferences” is “Database Connectivity and Logon Info,” as seen in Figure 92.

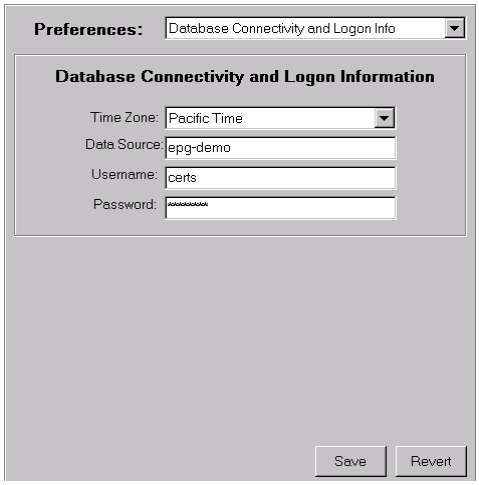

Figure 92 –Preference – Database Connectivity and Logon Information Menu

*Proxy Informatio*n: If your database/web server requires a proxy, connectivity information can be entered in this area. Please consult with your network administrator for the proper proxy settings.

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Clicking the down arrow will reveal the five Preferences available:

1. Database Connectivity and Logon Info – Menu for default logon settings. “Time Zone” arrow allows selection of time zone. Contact NERC for Username and Password information.
2. Definition of Jurisdiction Maps – Menu enables user to update map changes.
3. Area Control Error Monitoring – Option to change map titles to user preferences.
4. FREQ/ACE Display – Option to change titles for conditional plots to user preferences.
5. Abnormal Frequency Notification System – Currently being implemented in select sites. For more information, contact NERC.

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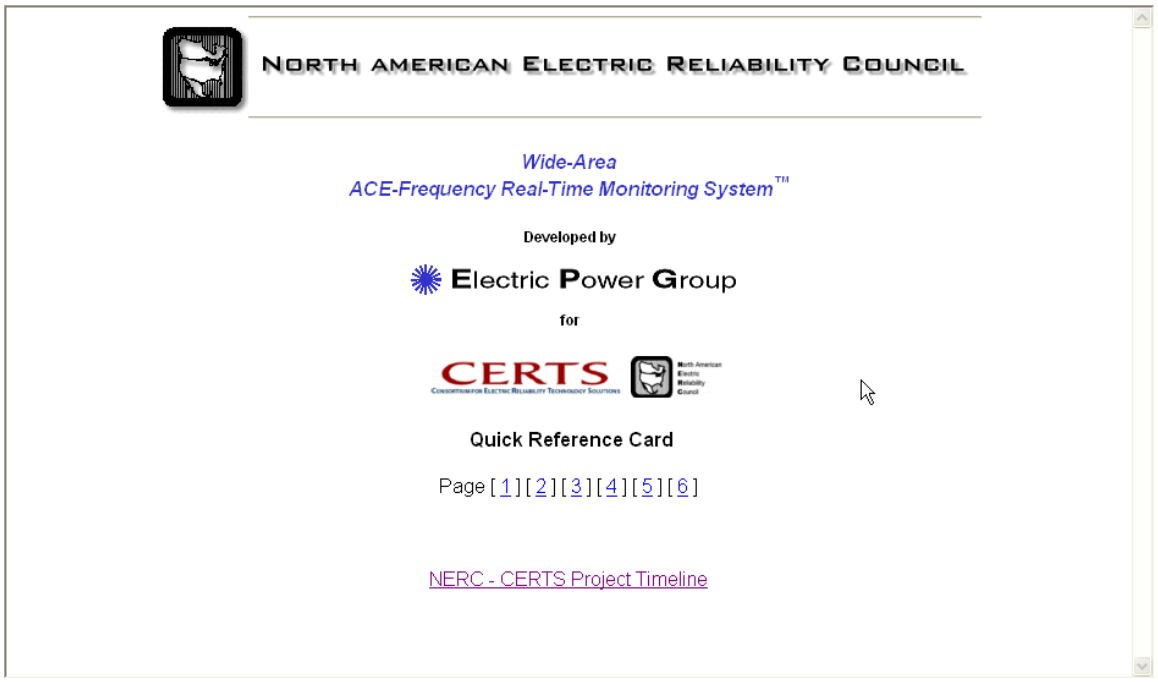
9. Wide-Area ACE-Frequency Real-Time Monitoring Help

This tab brings up the NERC Wide-Area ACE-Frequency Real-Time Monitoring System Quick Reference Card.



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Appendix A: Terms and Definitions

ACTUAL INTERCHANGE. The metered interchange over a specific INTERCONNECTION between two PHYSICALLY ADJACENT CONTROL AREAS.

ADJACENT CONTROL AREAS. Two CONTROL AREAS that are interconnected:

- Directly to each other, or
- Via a multi-party agreement or transmission tariff. (Examples include Independent System Operator and Power Pool agreements.)

AREA CONTROL ERROR (ACE). The instantaneous difference between net actual and scheduled interchange, taking into account the effects of frequency bias including a correction for meter error.

AREA CONTROL ERROR/L_{10} (ACE/L_{10}).

AREA INTERCHANGE ERROR. Area Interchange Error survey to determine the Control Areas' Interchange Error(s) due to equipment failures or improper Scheduling operations or improper AGC performance.

AUTOMATIC GENERATION CONTROL (AGC). Equipment that automatically adjusts a CONTROL AREA'S generation from a central location to maintain its interchange schedule plus frequency bias.

CLOCK HOUR. The 60-minute period ending at :00. All surveys, measurements, and reports are based on clock hour periods unless specifically noted.

COMMONLY OR JOINTLY OWNED UNITS (COU/JOU). These terms may be used interchangeably to refer to a unit in which two or more CONTROL AREAS share ownership.

CONTRACT INTERMEDIARY CONTROL AREA. A NERC CONTROL AREA that has connecting facilities in the scheduling path between the SENDING CONTROL AREA and RECEIVING CONTROL AREAS and operating agreements that establish the conditions for the use of such facilities.

CONTROL AREA. An electrical system bounded by interconnection (tie-line) metering and telemetry. It controls generation directly to maintain its INTERCHANGE SCHEDULE with other CONTROL AREAS and contributes to frequency regulation of the INTERCONNECTION.

CONTROL AREA FREQUENCY BIAS.

CPS. Control Performance Standard

CONTROL PERFORMANCE STANDARD (CPS2). The average ACE for each of the six ten-minute periods during the hour (i.e., for the ten-minute periods ending at 10, 20, 30, 40, 50, and 60 minutes past the hour) must be within specific limits, referred to as L_{10}.

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DISTURBANCE CONTROL STANDARD (DCS). The ACE must return either to zero or to its pre-disturbance level within 15 minutes following the start of the disturbance.

DISTURBANCE. 1. Any perturbation to the electric system. 2. The unexpected change in ACE that is caused by the sudden loss of generation or interruption of load.

EPSILON (ε). A constant derived from the targeted frequency found. It is the targeted Root Means Square (RMS) of one-minute average frequency error from a schedule based on frequency performance over a given year.

FREQUENCY BIAS SETTING. A value, in MW/0.1 Hz, set into a CONTROL AREA's AGC equipment to represent a CA's response to a frequency deviation.

HOURLY VALUE. Data measured on a clock-hour basis.

INADVERTENT INTERCHANGE. The difference between the CONTROL AREA's NET ACTUAL INTERCHANGE and NET SCHEDULED INTERCHANGE.

INTERCHANGE. Energy transfers that cross CONTROL AREA Jurisdictions.

INTERCONNECTION. When capitalized, any one of the three bulk electric system networks in North America: Eastern, Western, and ERCOT. When *not* capitalized, the facilities that connect two systems or CONTROL AREAS.

L_{10}. See Control Performance Standard (CPS2)

OPERATING RESERVE. That capability above firm system demand required to provide for regulation; load-forecasting error, equipment forced and scheduled outages and local area protection. It consists of spinning and non-spinning reserve.

OPERATING SECURITY. The ability of a power system to withstand or limit the adverse effects of any credible contingency to the system including overloads beyond emergency ratings, excessive or inadequate voltage, loss of stability or abnormal frequency deviations.

OPERATING SECURITY LIMIT. The value of a system operating parameter (e.g. total power transfer across an interface) that satisfies the most limiting of prescribed pre- and post-contingency operating criteria as determined by equipment loading capability and acceptable stability and voltage conditions.

PHYSICALLY ADJACENT CONTROL AREAS. Two CONTROL AREAS that are directly interconnected with each other.

REGION. One of the NERC Reliability Councils.

SCHEDULE (*verb*). To set up a plan or arrangement for an INTERCHANGE TRANSACTION.

SCHEDULE (*noun*). An INTERCHANGE SCHEDULE.

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SCHEDULING PATH. The TRANSMISSION SERVICE arrangements reserved by the PURCHASING-SELLING ENTITY for a TRANSACTION.

SCHEDULED TOTAL INTERCHANGE. The net of all INTERCHANGE SCHEDULES with all ADJACENT CONTROL AREAS. It is, in essence, the scheduled interchange with the INTERCONNECTION.

SECURITY AREA. The group of CONTROL AREAS under the purview of a RELIABILITY COORDINATOR.

RELIABILITY COORDINATOR. An entity that provides the security assessment and emergency operations coordination for a group of CONTROL AREAS. RELIABILITY COORDINATORS must not participate in the wholesale or retail merchant functions.

RELIABILITY COORDINATOR FUNCTION. The process of maintaining bulk transmission security for a CONTROL AREA, group of CONTROL AREAS, sub region, etc.

RELIABILITY COORDINATOR INFORMATION SYSTEM (SCIS). A generic reference to the communication system in the Eastern Interconnection, the WSCCnet (Western Interconnection), and the ERCOT Communication System as applicable.

SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA). A system of remote control and telemetry used to monitor and control the transmission system.

SPINNING RESERVE. Unloaded generation that is synchronized and ready to serve additional demand.

TOTAL ACTUAL INTERCHANGE. The algebraic sum of all INTERCHANGE metered with all PHYSICALLY ADJACENT CONTROL AREAS. It is, in essence, the actual interchange with the Interconnection.

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