

**Consortium for
Electric
Reliability
Technology
Solutions**

Release 4.0

**Wide-Area
Real-Time
Resources Adequacy
Monitoring System
(ACE-Frequency)**

RELEASE 4.0
Version 0.91

FUNCTIONAL SPECIFICATION

By

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

For

NORTH AMERICAN ELECTRICAL RELIABILITY COUNCIL (NERC)

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EXECUTIVE SUMMARY

This document describes enhancements and additional functionality to be incorporated in NERC Resources Adequacy Monitoring Release 3.5. This project will complement and enhance Release 3.5 Wide-Area Real Time ACE-Frequency Monitoring System™ developed and deployed by Consortium for Electric Reliability Technology Solutions-Electric Power Group (CERTS-EPG) and currently installed at NERC, DOE, FERC (alarms), and Reliability Coordinators' sites. Additional features complying with requirements coming from NERC Staff, Resources Subcommittee and Reliability Coordinators will be implemented in Release 4.0. The enhancements and additional functionality have been grouped in the following functional categories:

- New functional enhancements - Sub-categorized as follows:
 - Alarm, monitoring and analysis functions
 - Metrics, Analysis, and Assessment functions
 - System Hardware-Software Infrastructure changes
- Disturbance and alarm archiving capabilities
- Situational awareness capabilities
- Load-transmission resource adequacy capabilities

New Functional Enhancements Requirements

Section -3 of this specification describes the details for the following requirements categories:

- Alarm, monitoring and analysis functions
- Metrics, Analysis, and Assessment functions
- System Hardware-Software Infrastructure changes

Disturbance, Alarm, Response, and Archiving (DARA) Functional Requirements

Section -4 of this specification describes the details for the following DARA major functional capabilities:

- Disturbance identification, data collection and data archival;
- Alarm broadcasting and alarm data archival;
- 1-panel, 2-panel and 4-panel multi-view geographic visualization of Frequency Response and other data parameters in the ACE-Frequency application;
- Enhancements to the existing DCT to import, visualize and export (to CSV) archived alarm and disturbance data.

Some of the DARA functionality has already being developed by AVS but requires integration in R 4.0. Other DARA functionality needs to be designed, developed, and integrated in R3.5.

Situational Awareness Load-Generation Functional Requirements

Section-5 of this specification describes the details for the Situational Awareness application, which is designed to help provide users situational awareness information for load-generation resources adequacy and imbalances and help answer high level policy type situational awareness questions such as:

- What is the current status of the four interconnections, reliability regions and reliability coordinators in terms of generation adequacy – normal, alert, emergency, and automatic load shed?
- What is the magnitude and geographic location of load-generation imbalances?
- What is the current trace and near-term trend of the four interconnections load-generation imbalance abnormalities – stable, improving, worsening?
- What does the load generation unbalance translate into in terms of customer loads, number of customers, and location of customer?

Situational Awareness Load-Transmission Requirements Using Transmission Load Relief (TLR)

Section-6 of this specification describes the details for the integration of TLR data. The fundamental objective for the integration of TLR data is to add load-transmission resource adequacy capability to the load-generation resource adequacy.

NERC TLR data will be collected, used and visualized by overlapping key TLR variables on the ACE-Frequency multi-view geographic displays.

Functionality Overview:

Following is a summary of the different Resource Adequacy functionality from Release 2.5 to Release 4.0, the target of this specification.

Alarming, Monitoring, Analysis, and Assessment Functional Categories	Application Functional Evolution				Base Application
	NERC 4.0	NERC 3.5	DOE 3.0	NERC 3.0	NERC 2.5
<i>Alarming and Monitoring Functional Categories</i>					
New, Enhanced, and Generic Functionalities	X				
DARA Functionality – Integration of AVS-DARA components and new DARA functions	X				
New operational Jurisdictional boundaries requested by NERC-Staff (Reliability First, IESO to ONT, etc.)		X			
10 worst-ACE circles segmented to indicate alarm ranking		X			
New automatic notification alarm for out of BAAL-violation alarm condition		X			
Capability to use set boundary focus for any single jurisdiction i.e. interconnection, regions, etc		X			

Enhanced options-display with capability to modify frequency alarm thresholds and calculation types		X			
Display and track interconnections primary/secondary frequency sources		X			
Enhanced user interactive on-line help based on application functionality		X			
Capability for user to print any graphical panel		X			
Capability for user to rearrange and tailor the graphic display panels		X			
Data Viewing Restriction up to Reliability Coordinator Jurisdiction Level			X		
ACE-Cumulative Bars and Frequency Line Plot				X	
On Display Alarms and Reports (Missing or Bad ACE Data)				X	
Enterable Frequency Alarm Thresholds (for Flashing Circle Alarms)				X	
User Adjustable Monitoring Time-Window				X	
New BAAL Frequency Alarms and Updated Alarm Thresholds				X	
30-Min CPS1 and BAAL Monitoring Under Field-Trial				X	
Capabilities to monitor and track in real-time Wide-Area Resources Adequacy using Balancing Authorities ACE and Interconnection frequency, and to identify root causes via multi-panel zoom-in graphic visuals					X
Monitoring and tracking visualization solutions using the Grid-3P Geographic, Multi-View Visualization structure					X
Automatic Abnormal Frequency Notification Alarms (by E-mail, Pager, etc.)					X
Interactive Data Collection and Analysis Visuals					X
Interactive Data Unavailability Reports					X
Analysis and Assessment Functional Categories					
Data quality and performance reports, user-selectable for last 1-hour, 24-hours, 7-days, 30-days		X			
CPS-BAAL-Epsilon tracking displays for last 24-hours, and last 30-days for analysis and tracking Resources Adequacy compliance		X			
Graphic displays for new Resources Adequacy performance metrics, BAAL-violations, BAAL-events and minutes under BAAL events		X			
New multi-variable circular plot for simultaneous analysis and tracking of Resource Adequacy or any performance metric		X			
Situational Awareness (SA) Functional Category					
Load-Transmission Resources Adequacy	X				
High-Level probabilistic Alarms and Displays	X				
Weather Overlap of DOE Weather Maps on ACE-Frequency visuals	X				
State/County Overlap Capability on ACE-Frequency graphic visuals	X				
Capability to Notify Actions and post assessment Reporting	X				
System Hardware-Software Infrastructure					
New NERC dedicated computer-hardware for monitoring applications		X			
Improve user response time by using a new Web-Service		X			
Removed password for online help displays		X			
Online Application News and Help				X	

1. INTRODUCTION

This functional specification summarizes enhancements, expansions, additions of new metrics and hardware-software infrastructure changes for this release. In addition, this specification describes requirements for disturbance and alarm archiving capabilities, situational awareness capabilities, and load-transmission resource adequacy capabilities. Section 2 describes the background of ACE-Frequency application leading to release 3.5; section 3 summarizes requirements for release 4.0 new functional enhancements; section 4 describes disturbance, alarm, response, and archiving requirements; section 5 describes situational awareness requirements; and section 6 describes transmission-load relief requirements. Data requirements are listed in section 7.

The enhancements and additional functionality have been grouped in the following categories:

- New functional enhancements - Sub-categorized as follows:
 - Alarm, monitoring and analysis functions
 - Metrics, Analysis, and Assessment functions
 - System Hardware-Software Infrastructure changes
- Disturbance and alarm archiving capabilities
- Situational awareness capabilities
- Load-transmission resource adequacy capabilities

2. BACKGROUND

The Wide Area Real Time ACE-Frequency Monitoring System developed by CERTS-EPG for NERC Release 2.5 was the first release which has monitoring and tracking visualization, automatic abnormal frequency notification and interactive data collection visuals.

Release 3.0 followed 2.5 and in addition to functionalities of 2.5 it was enhanced for: ACE-Cumulative Bars and Frequency Line Plot, On Display Alarms and Reports (Missing or Bad ACE Data), Enterable Frequency Alarm Thresholds (for Flashing Circle Alarms), 30-Min CPS1 and BAAL Monitoring (Under Field-Trial), New BAAL Frequency Alarms and Updated Alarm Thresholds and User Adjustable Monitoring Time-Window.

Additional feature were added to release 3.0 complying with requirements coming from NERC Staff, Resources Subcommittee and Reliability Coordinators in release 3.5 and these are listed as follows:

Alarming and Monitoring:

- New Jurisdictional boundaries requested by NERC-Staff (Reliability First, IESO to ONT, etc.)
- 10 worst-ACE circle segments to indicate alarm ranking
- New automatic notification alarm for out of BAAL-violation alarm condition
- Capability to use set boundary focus for any single jurisdiction i.e. interconnection, regions, etc
- Enhanced options-display with capability to modify frequency alarm thresholds and calculation types
- Enhanced user interactive on-line help based on application functionality
- Capability for user to print any graphical panel
- Capability for user to rearrange and tailor the graphic display panels

Analysis and Post Assessment:

- User selectable data quality and performance daily, weekly and monthly reports
- Analysis capability using CPS-BAAL-Epsilon displays for last 24-hours, and last 30-days
- Graphic displays for new metrics, BAAL-violations, BAAL-events and minutes under BAAL events
- New multi-variable circular plot for simultaneous analysis and tracking of performance metrics

System Hardware-Software Infrastructure:

- New NERC dedicated computer-hardware for monitoring applications
- Improve user response time by using a new Web-Service
- Removed password for online help displays

3. RELEASE 4.0 FUNCTIONAL ENHANCEMENTS REQUIREMENTS - OVERVIEW

This section summarizes the new requirements for alarming and monitoring capabilities, analysis and assessment capabilities, and hardware – software infrastructure changes. Sections 3.1 through 3.36 will describe the details of the following requirements:

Alarming, Monitoring and Analysis Functions:

- Enhance “Set Jurisdictional Boundary Focus” by resolving the problem in release 3.5 with incomplete coloring of discontinuous boundaries such as PJM.
- Enhance jurisdiction selection by providing a rubber banding capability. This feature will enable a user to select jurisdictions which are either partly or fully inside the rubber band. The rubber band should also have all the features of the “Set Jurisdictional Boundary Focus” option.
- Add Jurisdictions such as EDBA, Constellation, Entergy etc requested by NERC
- Expand Canadian jurisdictional map by adding all Border States and Maritime Provinces as requested by Ontario and Hydro Quebec
- Enhance panel 2 of CPS-BAAL 30 minute monitoring display by providing the tool tip capability (placing cursor on a rectangle shows its value) similar to ACE-Frequency bar chart panel 2 display.
- Enhance visibility of “Jurisdictional ACE-Frequency- bar chart” displays by avoiding use of dark Colors
- Enhance frequency response (FR) calculation for panel 2, 30 minute’s ACE monitoring display, by using 6 second frequency samples for each interconnection. Store samples in the data base, calculate FR for the first BA and show it in the image display in all jurisdictional displays. Also include FR in the data collection tools
- Enhance data integrity of the current “User Enterable Parameters - Defined /Authorized by NERC-RS Enterable by Support Team Only” by user name and password protection
- Enhance “User Enterable Options” display by categorizing it by applications- NERC-ACE Frequency and Situational Awareness
- Enhance “Print Current Panel” option to print all 4 panels to-gather as shown in any 4-panel display.
- Enhance “Print Current Panel” option by adding date and time information on the right bottom corner of the page
- Enhance “data quality and performance reports- export to CSV” so that they look the same as the web based reports. This requires changing fonts of three main titles and titles of 4 reports, and removing abbreviations from all column headings of all four reports
- Enhance “Frequency Sources Data Quality Report” by adding a new column, “Total Minutes Unavailable”, in the end for the total minute’s data was unavailable from the source”.

- Enhance “Last 30-minutes CPS-BAAL” panel 2 display by sorting values based on the normalized CPS1 (CPS1/L10) similar to ACE normalization in ACE-Frequency bar chart panel 2 display.
- Enhance user interface by providing capability to locate a BA in a geographical map by clicking on the BA in panel 4 tabular displays.
- Integrate all functionalities of DARA as described in ACE-Frequency Application Enhancements and DARA Functionality, prepared for CERTS by Advanced Visual Systems
- Remove duplicate information from data quality and performance reports and alarms.
- Improve help files access time and data security by directly connecting to the EPG server and user name /password protection respectively. India has already done it for DOE Release 4.0; integrate it in NERC R4.0.
- Extend the online help menu and add NERC tutorials for an easy user access. A block will be added to right of the “Case Scenarios” in the help menu to provide a link to the NERC created tutorials
- Enhance the capability to update online help files independently without an application release in order to provide users the current and upgraded help files.
- Enhance ACE bar chart display by providing an option to show only the top five offending (ACE not helping frequency) balancing authorities. If frequency is below 60 Hz, the top offending balancing authorities’ are with worst negative ACE’s and if frequency is above 60 Hz then the top offending balancing authorities’ are with best positive ACE’s

Metrics, Analysis, and Assessment Functions:

- Enhance monitoring and analysis capability by providing an option to include Net-ACE of an interconnection in panel 2 of all “Jurisdictional ACE-Frequency” 4 Panel displays; this value is shown below the interconnection frequency row.
- Enhance all resource adequacy monitoring and analysis displays by providing an option so that a user can select: either Composite ACE or the Frequency component or the interchange component
- Integrate all functionalities of DOE-Situational Awareness described in DOE-Situational Awareness functional specification version 1.4_053106.
- Enhance monitoring and analysis capability by providing an option to show ACE or ACE/L10 in all “Jurisdictional ACE – Frequency displays”. The default color scales for ACE/L10 are: >5 Blue <-5 red. Also provide options to change thresholds for color scales of ACE and ACE/L10. The default color scales for ACE remain the same.
- Enhance monitoring and analysis capability by providing an option to show TLR (Transmission Load Relief) values in all geographic maps. Each value will be shown by changing the color and width (along with the direction of flow) of the existing tie-line between the two jurisdictions.
- Include the following CPS-BAAL values in Data Collection Tools and Report Creation: CPS1, CPS2, BAAL_Minutes, BAAL_ EventNo. And BAAL_ViolationNo.

- Enhance CPS-BAAL visuals so that any graph or plot can be displayed from any panel by expanding RMB “3-panel User Enterable Options”.
- Resolve the problem of “longest period unavailable” is greater than the “total minutes unavailable” in the data quality and performance reports.
- Enhance CPS-BAAL visuals so that last 30 minutes, 24 hours and 30 days options can be accessed from any panel 1 or 2 or 3 of CPS-BAAL displays by expanding RMB options.
- Enhance data collection tools by adding scheduled frequency of an interconnection obtained from TEC alarm message. Scheduled frequency value, its start and end time are read from the TEC alarm message.
- Enhance user date and time selection for data quality and performance reports creation by changing its format similar to data collection tools

System Hardware-Software Infrastructure Changes

- Enhance data security and block users from accessing files containing configuration and jurisdictional maps data by encrypting all Shape Files and ACE_Setup.cfg file.
- Enhance CSV report creation by using XSLT; it will enhance flexibility to add or delete items from the report.
- To improve the user-access add help file settings in Logon and Preferences block. This will avoid delays in accessing help files if user name and passwords are changed.
- Enhance visuals to provide timely updates for the following: updated jurisdictional maps, help files and reports by adding: a flashing message on the right hand upper corner of the default display to show that new updates are available and enable users to download the updates.

New Alarming and Monitoring Capabilities

3.1 Enhance “Set Jurisdictional Boundary Focus” by resolving the problem in release 3.5 with incomplete coloring of discontinuous boundaries such as PJM.

The incomplete coloring for segments of discontinuous boundaries in Releases 3.0 and 3.5 has been a problem, (e.g. Select PJM map and the small segments of RC PJM do not get selected and their colors do not change) and this problem needs to be fixed (See Figure-1)



Figure 1 - PJM Discontinuous Boundaries

3.2 Enhance jurisdiction selection by providing a rubber banding capability.

The ACE application provides a way for users to focus attention on one jurisdiction region in the map. This is achieved in the 1-panel display by highlighting the region using the left mouse button and then selecting the “Set Jurisdiction Boundary Focus” option from the right mouse button menu. The application replaces the current map display with a new map display containing the control areas that comprise the selected jurisdiction.

The ACE application will be enhanced to support the selection of multiple jurisdictions for boundary focus. The following is a listing of the high-level functional requirements for the new functionality.

3.2.1 The application will support the selection of multiple jurisdictions from any of the map displays (Interconnections, Reliability Regions, Reliability Coordinators, ISO/RTO or Control Areas) via the multiple selection feature of the application and the “Set Jurisdiction Boundary Focus” option from the right mouse button menu.

3.2.2 The application will replace the current map with jurisdiction focus maps containing the jurisdictions that comprise the selected jurisdictions.

3.2.3 The jurisdiction focus map will display the lowest level of jurisdictions allowed to be viewed by the user. The lowest jurisdiction level may be Reliability Regions, Reliability Coordinators or Control Areas.

3.2.4 The application will allow a set of selected jurisdictions to span multiple Interconnections, Reliability Regions, and Reliability Coordinators, ISO/RTO or Control Area regions.

3.2.5 The jurisdiction focus map will show the outline of each jurisdiction that was selected by the user, with jurisdictions colored according to the “parent” map coloring scheme.

3.2.6 The jurisdictions shown in the jurisdiction focus map will maintain their spatial geographic relationships

3.2.7 The 4-panel real-time data displays will not show data from regions that cross multiple interconnections. If the user attempts to drill-down from a jurisdiction boundary map that contains jurisdictions crossing multiple interconnections, an informational message will be displayed and the drill-down operation will be disallowed.

3.2.8 Drill-down to the 4-panel analysis charts will show data for the Control Areas, regardless of the user’s jurisdiction level access.

The following is a listing of the non-functional requirements for the new functionality.

- The installation package will install the shape files as hidden files so that they are, by default, invisible to users.
- The application will use the configuration files to define the disk location of “child” maps from “parent” maps.
- The application must generate the jurisdiction focus map from the jurisdiction master map without significant delay
- The database queries will be modified to support the collection of data for the jurisdictions in the jurisdiction focus map.

This feature will enable a user to select jurisdictions which are either partly or fully inside the rubber band. The rubber band should also have all the features of the “Set Jurisdictional Boundary Focus” option. In Figure-2 there are 3 rubber bands: 1 will select 2 RC’s PNSC and RMSC, 2 will select RC’s TVA, EES, SOCO, VACARS and FRCC, and 3 will select only MISO.

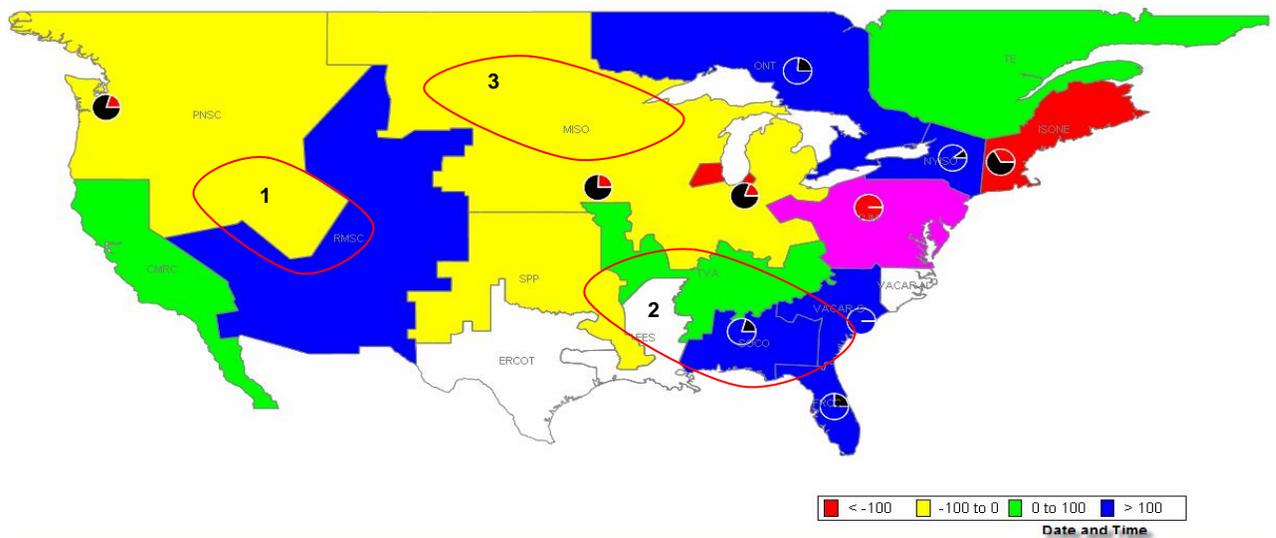


Figure 2 - Rubber Band Examples

3.3 Add Jurisdictions such as EDBA, Constellation energy etc provided by NERC-Staff.

Add shape files for the new jurisdictions

3.4 Expand Canadian jurisdictional map by adding all Border States and Maritime Provinces as requested by Ontario and Hydro Quebec

See Figure-3.

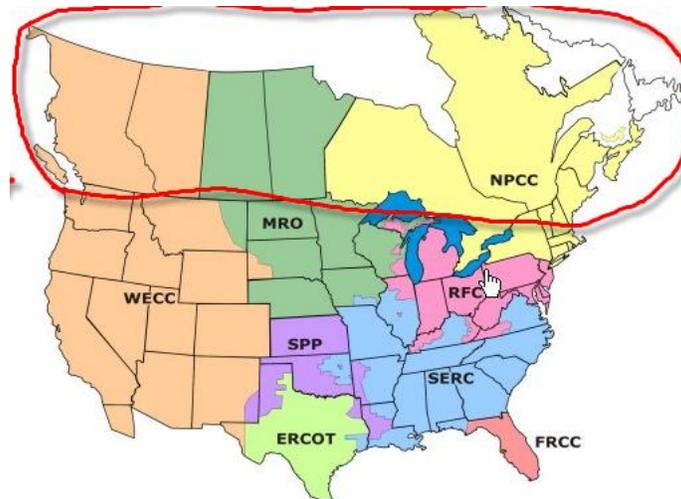


Figure 3 - Addition of Canadian Provinces

3.5 Enhance panel 2 of CPS-BAAL 30 minute monitoring display

Enhance panel 2 of CPS-BAAL 30 minute monitoring display by providing the tool tip capability (placing cursor on a rectangle shows its value) similar to ACE-Frequency bar chart panel 2 display.

3.6 Enhance visibility of “Jurisdictional ACE-Frequency bar chart” displays by avoiding use of dark Colors as shown in Figure-4.

Enhance visibility of “Jurisdictional ACE-Frequency bar chart” displays by avoiding use of dark Colors as shown in Figure-4.

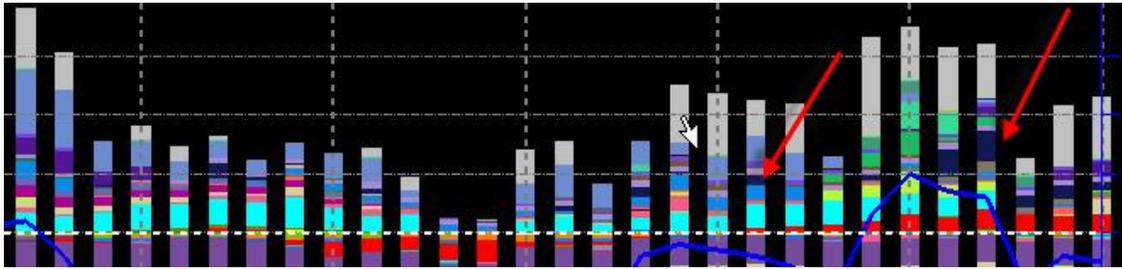


Figure 4 – Bar Chart Colors

3.7 Enhance frequency response (FR) calculation for panel 2, 30 minute’s ACE monitoring display.

Use 6 second frequency samples for each interconnection; store samples in the data base; calculate FR for the first BA and show it in the image plot in all jurisdictional displays. Also include FR in the data collection tools.

3.8 Enhance data integrity of the current “User Enterable Parameters - Defined /Authorized by NERC-RS Enterable by Support Team Only” by user name and password protection

Move NERC support team enterable AFN alarm parameters for ACE-Frequency and Situational Awareness from the client "User Enterable Options" to "Logon and Preferences" tab and make them password protected. See Figure-5 and Figure-6 below.

Preferences: ACE-Frequency Calculation and Alarm Options

ACE-Frequency Calculation and Alarm Options

Username:

Password:

Frequency Calculation Option Per Interconnection:

Interconnection: 1-Minute Min/Max 1-Minute Average

Frequency E-Mail Threshold Per Interconnection:

Interconnection: Threshold:

Local Display Alarm-Circle Frequency Threshold Per Interconnection:

Interconnection: Threshold:

Figure 5 – ACE-Frequency Calculation and Alarm Options

Preferences: Situational Awareness Frequency Alarm Options

Situational Awareness Frequency Alarm Options

Username:

Password:

Frequency Alert Threshold Per Interconnection: Low High

Interconnection: Threshold

Frequency Emergency Threshold Per Interconnection:

Interconnection: Threshold

Frequency Drop Load Threshold Per Interconnection:

Interconnection: Threshold

Figure 6– Situational Awareness Frequency Alarm Options

3.9 Enhance current “print panel option” to print all 4 panels as shown in R3.5 in the 4-panel display.

3.10 Enhance “Print Current Panel” option by adding date and time information on the right bottom corner of the page.

See Figure 7.

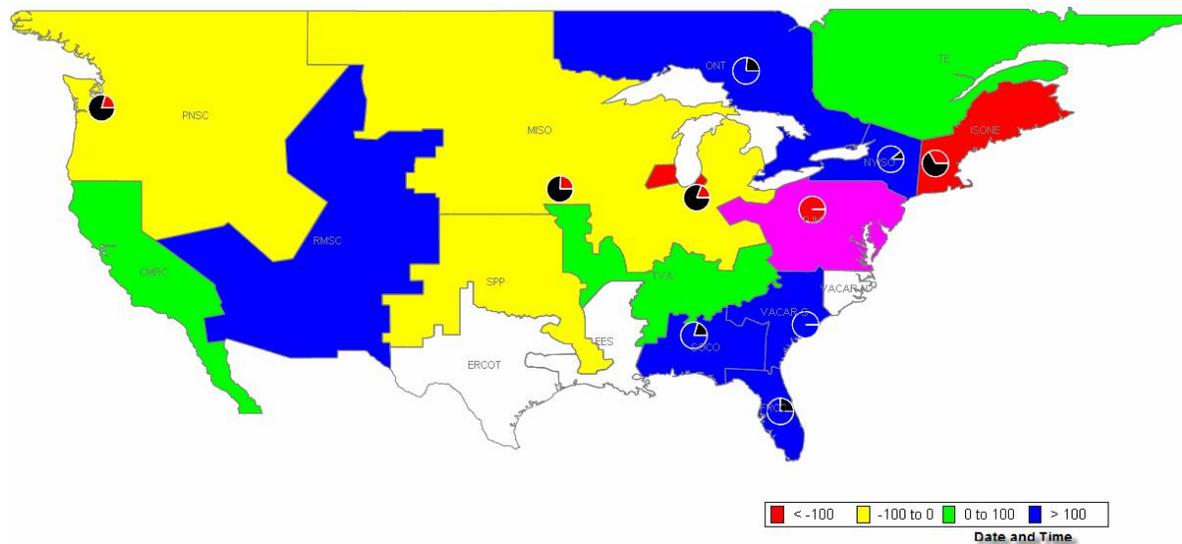


Figure 7- Print Date and Time

3.11 Enhance “data quality and performance reports-export to CSV”

Enhance “data quality and performance reports- export to CSV” so that they look the same as the web based reports. This requires changing fonts of three main titles and titles of 4 reports, and removing abbreviations from all column headings of all four reports as follows:

- Main Title-Arial 16 Bold
- Next title Arial 14 Bold
- Report title- Arial 12 bold and
- Column headings Arial 10 B title case (no abbreviations on any headings), see Figure-8

Eastern Interconnection										
+										
Last Hour Data Quality and Performance Reports										
ACE Data Quality - Unavailability Report										
RC Code	BA Code	Balancing Authority name	From Date/Time	To Date/Time	Total Minutes Unavailable	Percent Unavailable	Longest Period unavailable	Number Of Periods Unavailable	Total minutes Missing Data At NERC	Missing data Percent At NERC
MISO	DEVI	DECA. LL	4/24/2006 20:30	4/24/2006 21:29	59	100%	59	1	1	1.67%
	LGEE	LG&E Ene	4/24/2006 20:30	4/24/2006 21:29	59	100%	59	1	1	1.67%
	SPC	SaskPowe	4/24/2006 20:30	4/24/2006 21:29	59	100%	59	1	1	1.67%
	SMP	Southern M	4/24/2006 20:30	4/24/2006 21:29	47	79.66%	4	13	1	1.67%
	MPW	Muscatine	4/24/2006 20:30	4/24/2006 21:29	26	44.07%	3	23	1	1.67%

Figure 8- CSV Format Examples

3.12 Enhance “Frequency Sources Data Quality Report” by adding a new column

Enhance “Frequency Sources Data Quality Report” by adding a new column, “Total Minutes Data Was Not Received”, in the end for the total minute’s data was unavailable from the source beyond the time range selected. For example the selected time range may be an hour but data may not have been available for the last 7 days; report minutes in 7 days in this column as shown in Figure-9.

Frequency Sources Data Quality Report										
Priority	BA Code	Balancing Authority Name	From Date/Time	To Date/Time	Total Minutes Unavailable/Bad Quality at the source	Longest Period Unavailable/Bad Quality	Number of Periods Unavailable/Bad Quality	Total Minutes Missing Data at NERC	Total Minutes Data Was Not Received	
6	IP	Illinois Power Co.	6/2/2006 2:10:00 PM	6/2/2006 3:09:00 PM	2 (3.39%)	1	2	1 (1.67%)		
4	NYIS	New York Independent System Operator	6/2/2006 2:10:00 PM	6/2/2006 3:09:00 PM	1 (1.69%)	1	1	1 (1.67%)		

Figure 9- Frequency Source Data Quality Report Enhancement

3.13 Enhance “Last 30-minutes CPS-BAAL” panel-2 display

Enhance “Last 30-minutes CPS-BAAL” panel-2 display by sorting values based on the normalized CPS1 (CPS1/L10) similar to ACE normalization in ACE-Frequency bar chart panel-2 display.

3.14 Enhance user interface by providing capability to locate a BA in a geographical map

Enhance user interface by providing capability to locate a BA in a geographical map by clicking on the BA in panel 4 tabular displays. Example- on a 1-panel RC-view locate a BA MPW by clicking in the panel-4 list (See Figure-10).

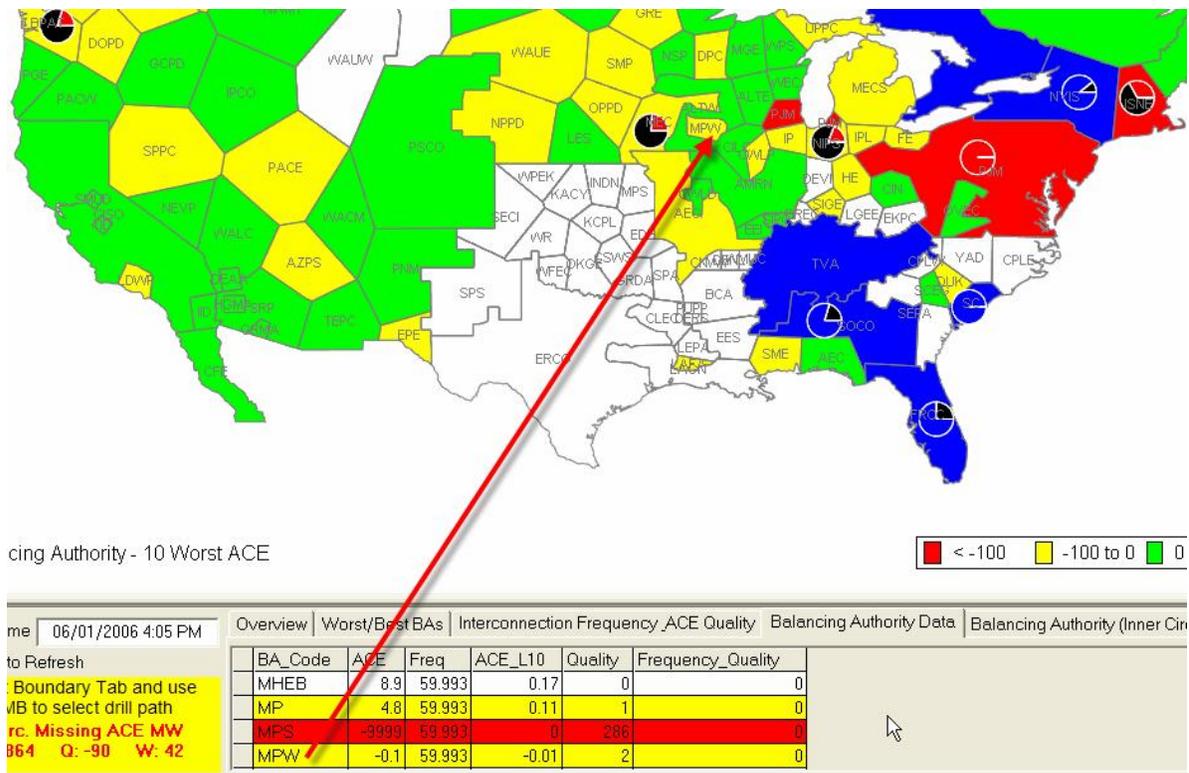


Figure 10 - Locating BA in the map

3.15 Integrate all functionalities of DARA

Integrate all functionalities of DARA as described in ACE-Frequency Application Enhancements and DARA Functionality, prepared for CERTS by Advanced Visual Systems.

3.16 Remove duplicate information from data quality and performance reports, and alarms.

(Provide information)

3.17 Improve help files access time and data security

Improve help files access time and data security by directly connecting to the EPG server and user name /password protection respectively. India has already done it for DOE-SA Release 3.8; integrate it in NERC R4.0.

3.18 Extend the online help menu to add NERC tutorials

Extend the online help menu to add NERC tutorials for an easy user access. A block will be added to the right of the “Case Scenarios” in the help menu to provide a link to the NERC created tutorials. (See Figure-11)

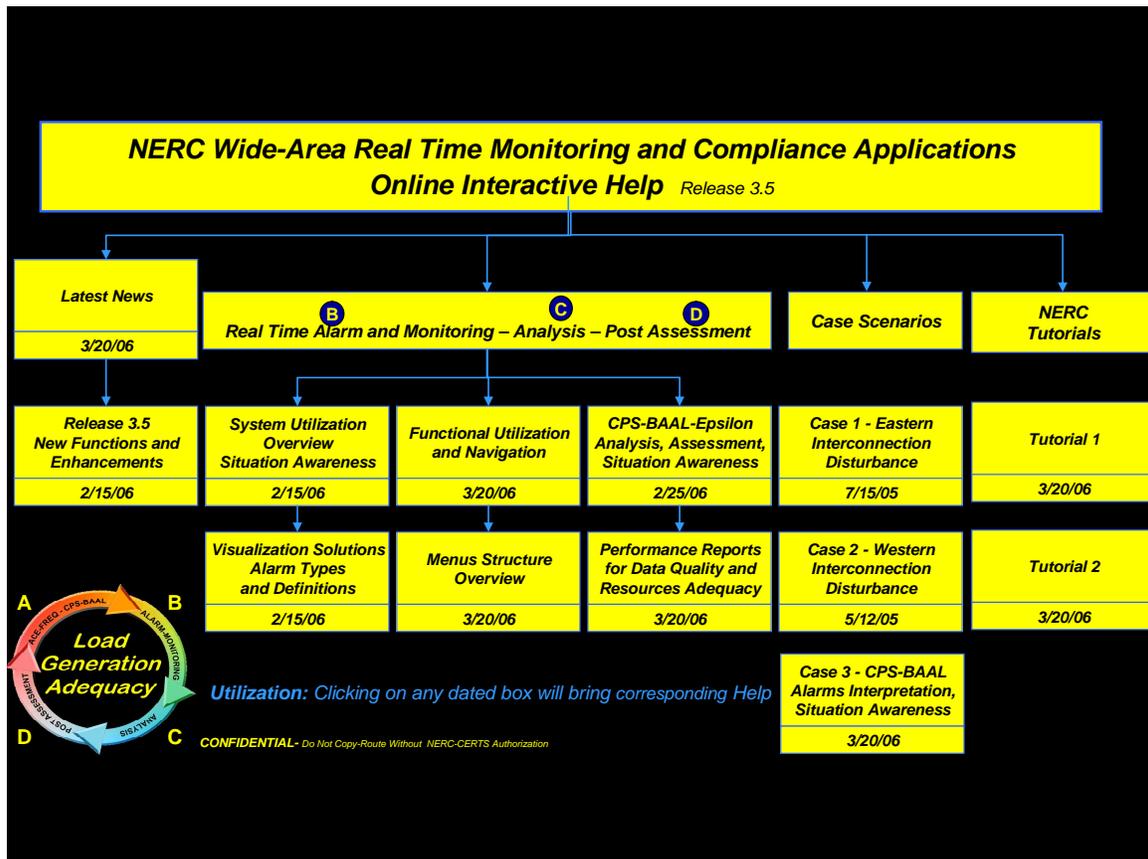


Figure 11 - Extended Help Menu

3.19 Enhance the capability to update online help files

This should be done independently without an application release in order to provide users the current and upgraded help files.

3.20 Enhance ACE bar chart display by providing an option to show only the five offending BA's or RC's

Enhance ACE bar chart display by providing an option to show only the five offending BA's or RC's as follows: If frequency is below 60 Hz, the top offending jurisdictions are with worst negative ACE's and if ACE is above 60 Hz then the top offending jurisdictions are with best positive ACE's. (Provide a graphical example).

New Metrics, Analysis, and Assessment Capabilities

3.21 Enhance monitoring and analysis capability by providing an option to include Net - ACE of an interconnection in panel-2

Enhance monitoring and analysis capability by providing an option to include Net - ACE of an interconnection in panel-2 of all "Jurisdictional ACE-Frequency" 4 Panel displays; this value is shown below the interconnection frequency row (See Figure-12)

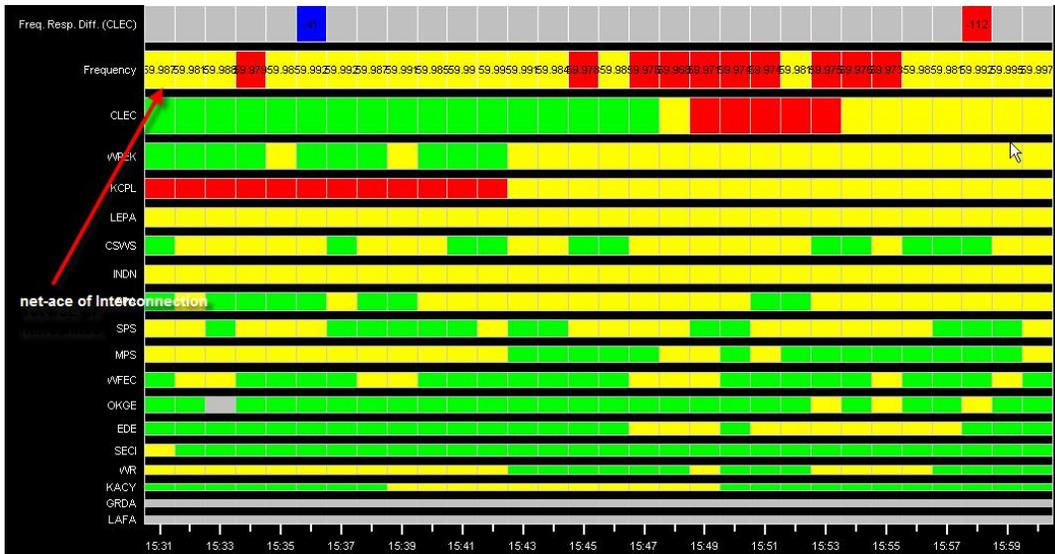


Figure 12- Net-ACE of an Interconnection

3.22 Enhance all resource adequacy monitoring and analysis displays

Enhance all resource adequacy monitoring and analysis displays by providing an option so that a user can select: either Composite ACE or the Frequency component or the interchange component as shown in Figure-13.



Figure 13– Net ACE and its Components

3.23 Integrate all functionalities of DOE-Situational Awareness

Integrate all functionalities of DOE-Situational Awareness described in DOE Situational Awareness functional specification version 1.3.6.

3.24 Enhance monitoring and analysis capability by providing an option to show ACE or ACE/L10

Enhance monitoring and analysis capability by providing an option to show ACE or ACE/L10 in all “Jurisdictional ACE – Frequency displays”. The default color scales for ACE/L10 are: >5 Blue <-5 red. Also provide options to change thresholds for color scales of ACE and ACE/L10. The default color scales for ACE remain the same.

3.25 Enhance monitoring and analysis capability by providing an option to show TLR (Transmission Load Relief) values in all geographic maps.

Each value will be shown by changing the color and width (along with the direction of flow) of the existing tie-line between the two jurisdictions. For example a TLR between SOCO and FRCC will be shown as in Figure-14.

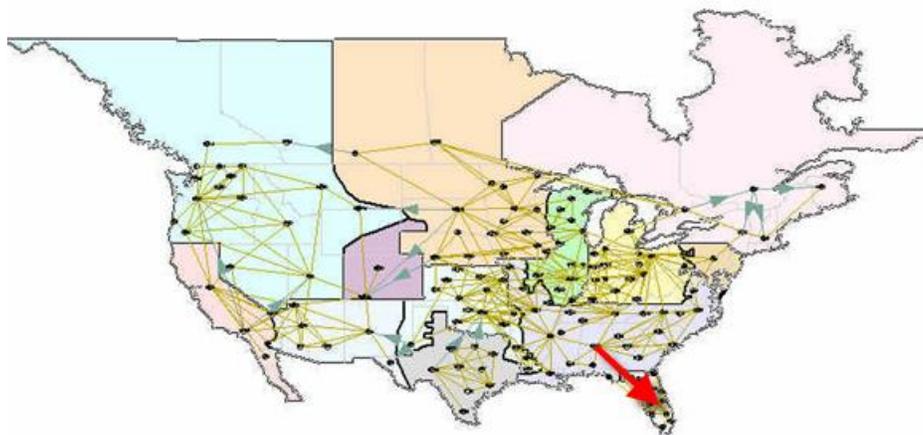


Figure 14 - TLR Data

3.26 Include CPS-BAAL values in Data Collection tools and report creation

Include the following CPS-BAAL values in Data Collection tools and report creation: CPS1, CPS2, BAAL_Minutes, BAAL_EventNo., and BAAL_ViolatioNo

3.27 Enhance CPS-BAAL visuals so that any graph or plot can be displayed from any panel by expanding RMB “3-panel User Enterable Options”.

Expand “3-Panel User Enterable Options” as shown in Figure-15 Item_30 in panel-2 and 3 of last 24 hour and last 30 days four panel CPS-BAAL displays. The purpose of this enhancement is to provide capability of viewing any two charts out of four in panel-2 and 3.

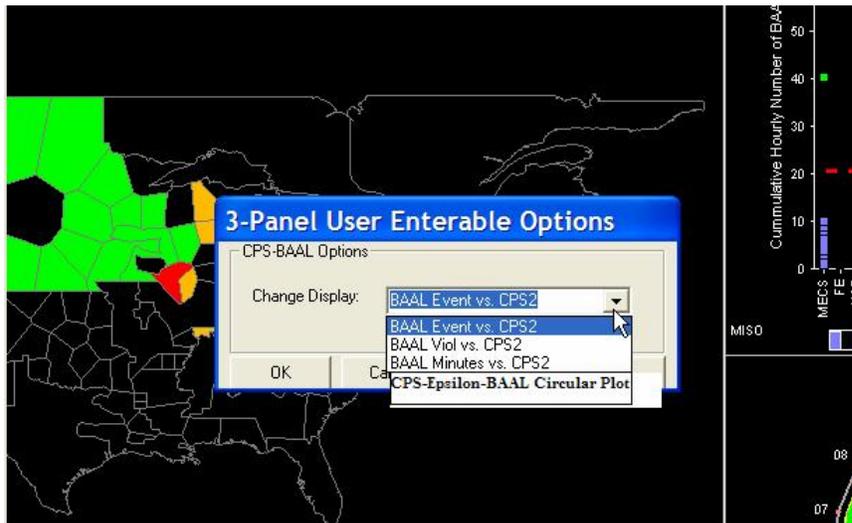


Figure 15 - CPS-BAAL Visuals Enhancement

3.28 Resolve the problem of “longest period unavailable” is greater than the “total minutes unavailable” in data quality and performance reports.

3.29 Enhance CPS-BAAL visuals

Enhance CPS-BAAL visuals so that last 30 minutes, 24 hours and 30 days options can be accessed from any panel 1or 2 or 3 of CPS-BAAL displays by expanding RMB options. Expand RMB “3-panel User Enterable Options” to include options shown in Figure-16. Also invoke this option in panel 3 of 24 hours and 30 days displays (circular plots).

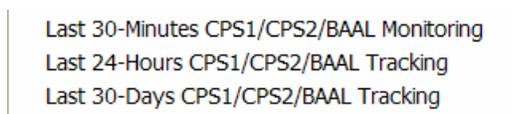


Figure 16- CPS-BAAL RMB Enhancement

3.30 Enhance data collection tools by adding scheduled frequency of an interconnection obtained from TEC alarm message.

Scheduled frequency value, its start and end time are read from the TEC alarm message.

3.31 Enhance user date and time selection for data quality and performance reports creation

Enhance user date and time selection for data quality and performance reports creation by changing its format similar to data collection tools

New System Hardware-Software Infrastructure Changes

3.32 Enhance data security and block users from accessing files containing configuration and jurisdictional maps data

Enhance data security and block users from accessing files containing configuration and jurisdictional maps data by encrypting all Shape Files and ACE_Setup.cfg file.

3.33 Enhance CSV report creation by using XSLT

This enhancement will provide flexibility to add or delete items from the reports.

3.34 Add help file settings in Login and Preferences block to improve the maintenance capability

This will avoid delays in accessing help files if user and passwords are changed (example certs3 to certs4)

3.35 Enhance visuals to provide timely updates

Enhance visuals to provide timely updates for the following updated jurisdictional maps help files and reports. Add a flashing message on the default display right hand upper corner to show that new updates are available and enable users to download the updates.

3.36 NERC dedicated computer hardware for monitoring applications

The ACE-Frequency Monitoring System utilizes standard Intel/Windows based workstations interconnected using NERC Local Area Network. This straightforward hardware configuration facilitates integration to NERC's current and future information

systems. Figure-17 shows the ACE-Frequency Monitoring System hardware overview. The application architecture uses XML to transfer the data from the client, delivered in conjunction with Microsoft's IIS, ASP and server side business logic.

NERC ICCP Data Collection and Management
 Current Hardware-Software Architecture, Data Flow Overview - Rev:03.02.2006

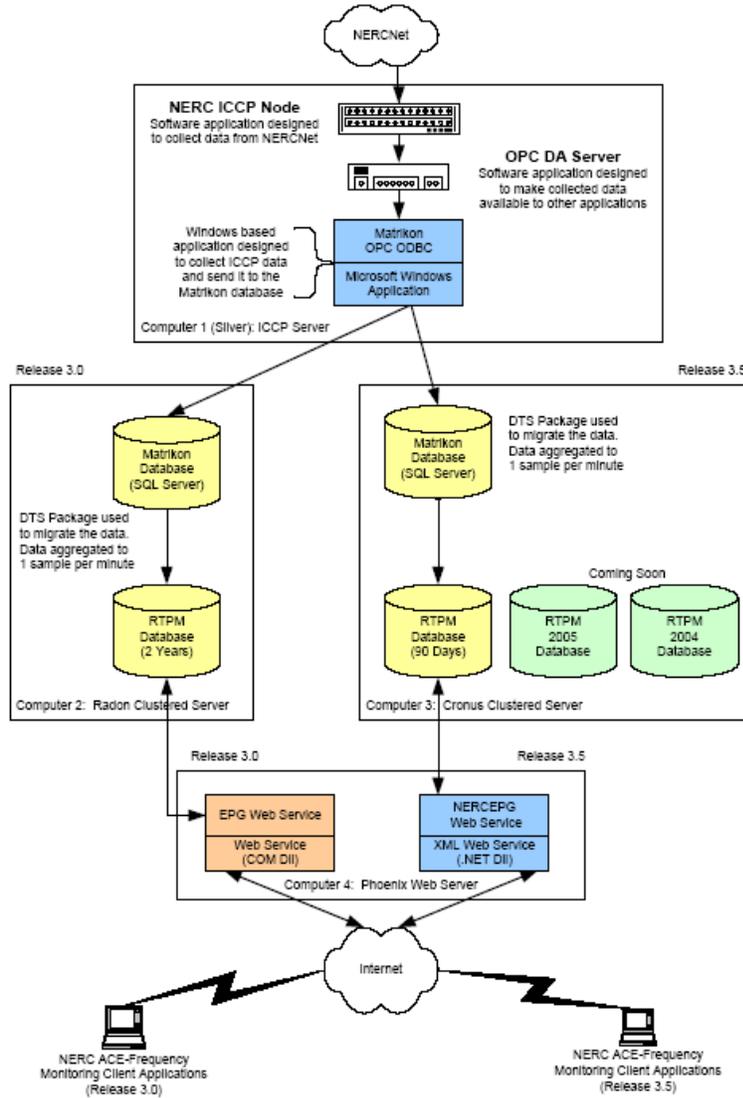


Figure 17 - ACE-Frequency Monitoring Systems Hardware Overview

4. DISTURBANCE, ALARM, RESPONSE AND ARCHIVING (DARA) FUNCTIONAL REQUIREMENTS

Release 4.0 will integrate the software that AVS already developed for the NERC DARA project for the A, B, C, D, E, and F functions shown in Figure-18. In addition, the functionality for G, H, and I will be developed and implemented as part of Release 4.0 enhancements.

The DARA major objectives are:

- Disturbance identification, data collection and data archival;
- Alarm broadcasting and alarm data archival;
- 1-panel, 2-panel and 4-panel multi-view geographic visualization of Frequency Response and other data parameters in the ACE-Frequency application;
- Enhancements to the existing DCT to import, visualize and export (to CSV) archived alarm and disturbance data.

The activities that define the requirements for this task are show in the overview Figure-18.

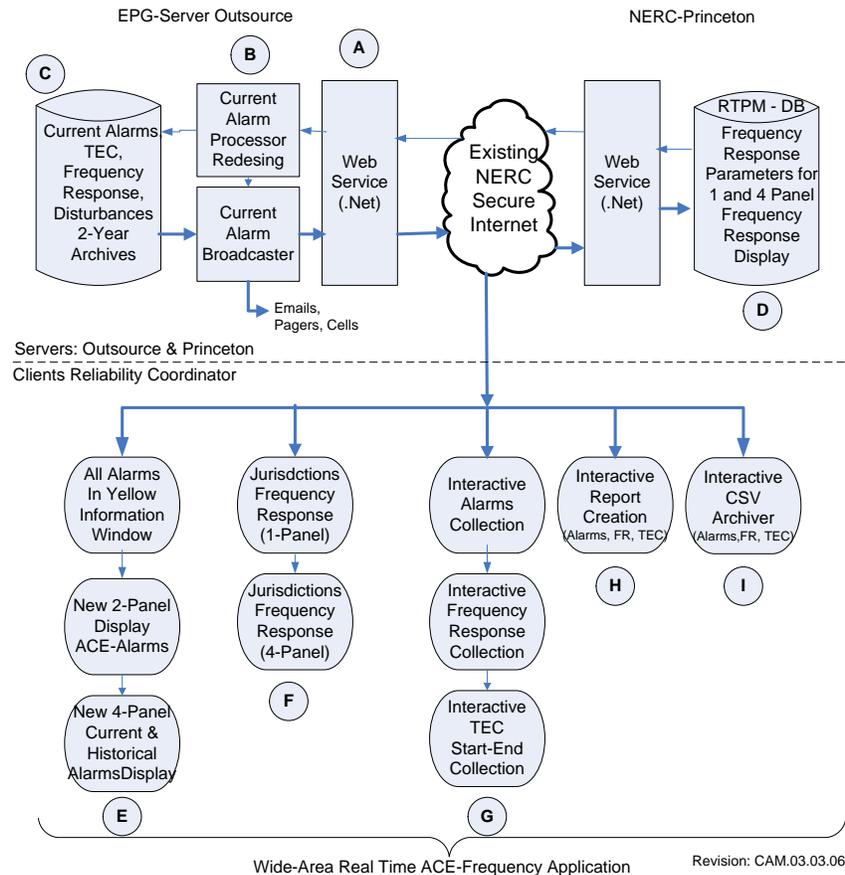


Figure 18 - The DARA Requirements for Release 4.0

Integration of AVS functional capabilities for A through F will give the users the capabilities described in sections 4.1, and 4.2.

DARA Functions to Migrate/Integrate from AVS-DARA

4.1 Activities A-C: Alarm and Disturbance Broadcasting and Archival

Activities A-C involve the Alarm Processor, the Alarm Broadcaster and the remote service.

The Alarm Processor currently monitors the acquired data for alarm conditions and notifies the Alarm Broadcaster when an alarm condition is met. The triggers for the alarms are defined in a configuration file. The Alarm Broadcaster currently sends alarm emails to a list of recipients when the alarms occur. Alarm recipient lists are currently defined in the configuration file.

A disturbance is defined as a specialized alarm in which the data (defined by the disturbance type) is archived for five minutes prior to and five minutes after the disturbance occurrence. The Alarm Processor and Broadcaster currently handle the computation, identification and broadcast of one disturbance, however, the disturbance data is not currently cached or archived.

AVS ProServ will evaluate the need for re-designing the current Alarm Broadcaster and Alarm Processor. The estimates presented here assume that the current Alarm Broadcaster and Alarm Processor can be enhanced to achieve the listed requirements. Should a re-design of the Alarm Broadcaster and Alarm Processor become necessary, the estimates for these requirements must be revisited. EPG prefers that the requirements listed here are designed and implemented with future expansion and simplistic maintenance in mind.

4.1.1 A remote service which supports archival of alarm and disturbance data to a SQL database will be implemented. If possible the current ACE-Frequency remote service will be enhanced to achieve this functionality.

4.1.2 The current Alarm Processor and Alarm Broadcaster will be enhanced to communicate with the remote service for alarm and disturbance archival.

4.1.3 The current Alarm Broadcaster will be enhanced to import the list of alarm recipients from a local Access database. The alarm recipients are currently defined in a configuration file. NOTE: Access database is not being used, the recipients are in the RTPM database.

4.1.4 The Alarm Broadcaster will be enhanced to notify the remote service when an alarm has occurred. The remote service will archive the alarm, with the alarm type,

alarm information and priority in the alarm archive database. The alarms and the data values to be archived for each alarm need to be defined.

4.1.5 Alarms will be archived and available in the database for 2 years.

4.1.6 Stored procedures to support the extraction of data necessary for DARA tasks D-I will be implemented in the archival databases.

4.1.7 Frequency Response data is currently being calculated via a stored procedure in the NERC database. Archival of this parameter has been completed by EPG. The data is archived for 90 days in the NERC database. The current Alarm Processor and Broadcaster already handle the computation and broadcast of the Frequency Response Alarm. The Alarm Processor will be enhanced to archive this alarm occurrence.

4.1.8 There is currently one disturbance defined. It is computed and broadcast by the Alarm Processor and Broadcaster. The Alarm Processor will be enhanced to allow the future definition of additional disturbances.

4.1.9 The Alarm Processor will be enhanced to cache five minutes of disturbance data at all times. When a disturbance occurs, the Alarm Processor will notify the remote service to archive the disturbance data for five minutes prior to and five minutes after the disturbance occurrence.

4.1.10 The ACE-Frequency client user interface currently allows users to set alarm thresholds and store the results in the database. Additional alarm threshold settings, as defined by EPG, will be added to the user interface and stored in the database. The list of alarm thresholds settable by the user must be defined.

4.2 Activities D-F: ACE-Frequency Enhancements for DARA Support

The ACE-Frequency Application will be enhanced to support Alarm & Disturbance-Event Visualization screens. The application will allow end users to monitor via the 1-panel and the 4-panel visuals specific parameters such as jurisdiction Frequency Response for those instances when a disturbance-event has been identified. In addition, the application will be enhanced to include a new 2-panel visual.

4.2.1 The yellow status window in the ACE-Frequency application will display descriptive text when an alarm occurs. The ACE-Frequency application will poll the database for new alarms when the data for the current view is updated.

4.2.2 The right mouse button (RMB) menu structure of the ACE-Frequency application will be enhanced to include options for visualizing the alarm & disturbance data. The RMB menu structure displayed in the 1-panel and 2-panel views is defined as follows:

- Jurisdiction ACE-Frequency (Existing menu with no changes. Visible only when the RMB occurs in the ACE map.)

- ½ Hour 1-min ACE/Freq Bar-Chart
- Hourly 10-min Avg ACE/Frequency
- 10 min with 1 minute Resolution ACE/FREQ
- Interconnection Epsilon Frequency (Existing menu with no changes)
 - Daily / Hourly Frequency Performance
- User Enterable Options (Existing menu with new options)
 - Current Chart Options – displays the current user enterable options dialog. The dialog displayed is dependent upon which map (ACE or Alarm) in which the RMB occurs.
 - Display – a new option allowing the user to switch between 1-panel and 2-panel views. If only one option is checked, the 1-panel view is used. Otherwise, the 2-panel view is shown.
 - § ACE – If checked, the ACE map is displayed in the 1-panel or 2-panel view
 - § Alarms – If checked the Alarm map is displayed in the 1-panel or 2-panel view
- Jurisdiction CPS1/BAAL Performance (Existing menu with no changes. Visible only when the RMB occurs in the ACE map.)
 - 30 Minutes
 - Last 24-Hours CPS1/CPS2/BAAL Tracking
 - Last 30-Days CPS1/CPS2/BAAL Tracking
- Frequency Response Display (Visible only when the RMB occurs in the Alarms map.)
 - RMB Options from Frequency Response Display
 - Time – selection of these menu items navigates the user to the 4-panel frequency response display. The data for the selected time period is downloaded and displayed in the 4-panel view.
 - 10 minutes
 - 1 hour
 - ...
 - 2 years
- Alarms Analysis (Visible only when the RMB occurs in the Alarms map.)
 - Categories – check menu items that allow the user to choose which alarms are displayed in the current Alarm map view. The alarm categories will be defined in the configuration file or a database table.
 - § Alarm 1 – if checked, alarm 1 is included in the display

§ ...

§ Alarm N – if checked, alarm N is included in the display

- Time – selection of these menu items navigates the user to the 4-panel alarm display. The data for the selected time period is downloaded and displayed in the 4-panel view.

§ 10 minutes

§ 1 hour

§ ...

§ 2 years

4.2.3 The ACE-Frequency Application default startup view will be defined in the configuration files. Default view choices are as follows:

- The existing ACE 1-panel display, showing the ACE map view (jurisdictions colored by ACE).
- The Alarm 1-panel display, showing the Alarm map view (see definition below in 0).
- A new 2-panel display, showing the ACE map view on the left and the Alarm map view or the Frequency Response view on the right.

4.2.4 A new map view, the Alarm map, will show the jurisdictions colored by the number of alarms in the jurisdiction. NOTE: the number of alarms over what period of time? NOTE: Alarms available are current for the interconnections, therefore only the interconnection map is shown with data.

4.2.5 A bar chart will be overlaid onto each jurisdiction in the Alarm map. The bar charts will show the frequency response value for the last “N” frequency response disturbances. The value “N” will be defined in the configuration file. The display options will support turning the overlaid bar charts on or off.

4.2.6 The Alarm map data will be updated automatically, as in the other 1-panel displays in the ACE application.

4.2.7 The Alarm map view will support single and multiple jurisdiction boundary setting as outlined in section 3.1.

4.2.8 The Alarm map view will allow the user to select one or more jurisdictions to focus on, and drill down to the 4-panel alarm display using the RMB menu options outlined in 4.2.2. The 4-panel alarm display is outlined below.

4.2.9 The Alarm 4-panel display will show the Alarm map for the selected jurisdictions in panel 1.

4.2.10 The Alarm 4-panel display panel 2 will show an image plot. The Y-axis will be the Control Areas for the selected jurisdictions. The X-axis will be time for the selected time period (from the RMB menu).

4.2.11 The color scheme used for the image plot will be the same as the color scheme for the Alarm map

4.2.12 The Alarm 4-panel display panel 3 will show a bar plot of the number of alarms for the control area selected in panel 2. The X-axis will be the last selected time period (from the RMB menu). The Y-axis will be the number of alarms over the time period.

4.2.13 The color scheme used for the bar plot will be the same as the color scheme for the Alarm map.

4.2.14 A new map view, the Frequency Response map, will show the jurisdictions colored Red or Blue as follows:

- Frequency Response – Frequency Bias ≥ 0 Blue
- Frequency Response – Frequency Bias < 0 Red

4.2.15 The Frequency Response map data will be updated automatically, as in the other 1-panel displays in the ACE application.

4.2.16 The Frequency Response map view will support single and multiple jurisdiction boundary setting as outlined in section 3.2.

4.2.17 The Frequency Response map view will allow the user to select one or more jurisdictions to focus on, and drill down to the 4-panel Frequency Response display using the RMB menu options outlined in 0. The 4-panel Frequency Response display is outlined below.

4.2.18 The Frequency Response 4-panel display will show the Frequency Response map for the selected jurisdictions in panel 1.

4.2.19 The Frequency Response 4-panel display panel 2 will show an image plot. The X-axis will be the last “N” Frequency Response disturbances, where “N” is defined in the configuration file. The Y-axis will be the Control Areas for the selected jurisdictions. .

4.2.20 The color scheme used for the image plot will be the same as the color scheme for the Frequency Response map.

4.2.21 The Frequency Response 4-panel display panel 3 will show a bar and line plot for the Control Area selected in Panel 2. The X-axis will be the last “N” Frequency Response disturbances, where “N” is the same as for Panel 2. The Y-axis will be

Frequency Response value at the time of the disturbance. A horizontal reference line will be shown on the chart to indicate the frequency bias for the Control Area.

4.2.22 The color scheme used for the bar and line plot will be the same as the color scheme for the image plot. .

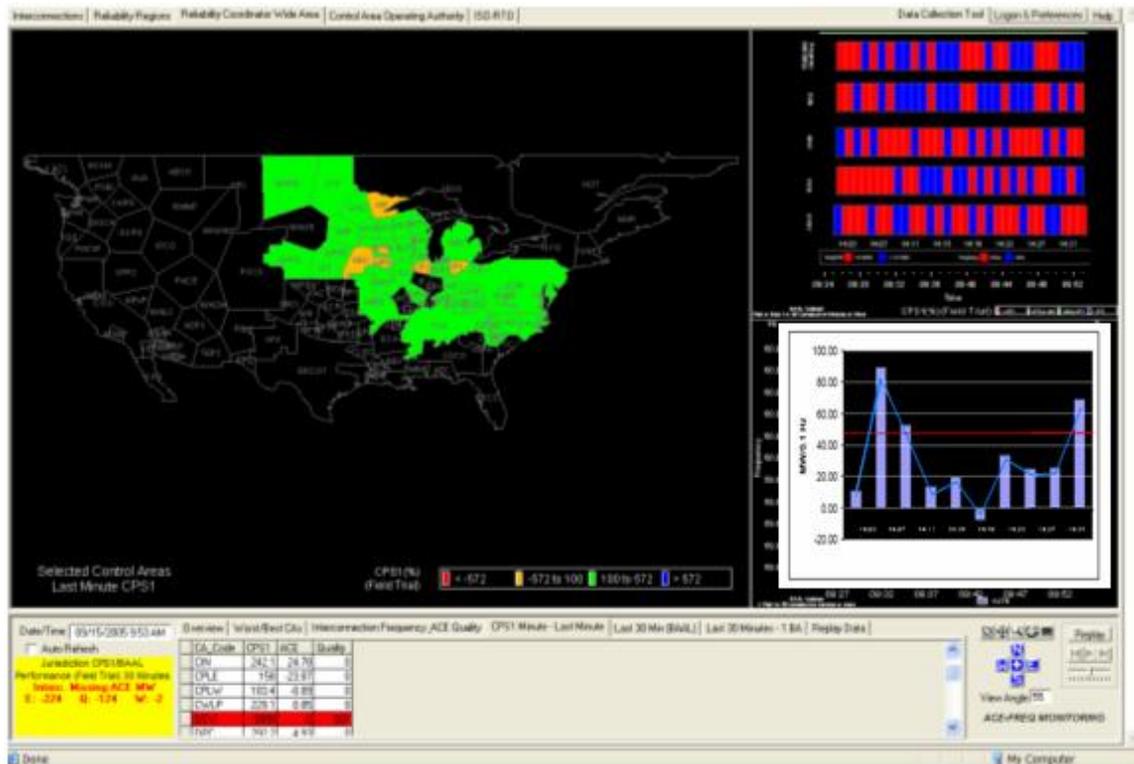


Figure 19 – 4-Panel Jurisdictions Frequency Response Visualization for Disturbances

New DARA Functions for Release 4.0

4.3 Activities G-I: Alarm Archive and Reports

4.3.1 CSV Output of Disturbance Data - Function G

Similar to the equivalent report and archiving sections of the ACE-Frequency

- The system must have the ability to save the system data for the displayed alarm, disturbance and events as CSV files on the local machine

4.3.2 AIE, Inadvertent, CPS/BAAL Reporting - Function H

- The same process used to identify, capture, display and report alarms, disturbances and events for the ACE will be used for the other applications (AIE, Inadvertent, CPS/BAAL).

4.3.3 Archivers - Function I

The following parameters will be collected and archived:

Alarms

- Frequency Deviation Alarms
- Data Quality Alarms
- Server Availability Alarms
- Time Error Correction Alarms

Time Error Correction

- Speed Time
- Slow Down Time

Frequency Response

- **Panel 1** shows the selected Jurisdiction color-coded, using the difference between jurisdiction Frequency Response and its frequency bias for the of the last frequency disturbance.
- **Panel 2** shows image plot of Frequency Response for selected Jurisdiction for the last 50 frequency disturbances;
- **Panel 3** shows bar/line (selectable) chart of Frequency Response of user selected jurisdiction from the image plot for the last 50 (enterable) frequency disturbances.
- **Panel 4** will display tabular data for the variables from each of panels 1, 2,

Disturbances

- Short Term
- Long Term

5. SITUATIONAL AWARENESS LOAD-GENERATION FUNCTIONAL REQUIREMENTS

Release 4.0 will integrate all the DOE-SA situational awareness functions and navigation. This section will also include the new situational awareness requirements for R4.0.

Figure-20 shows the required visualization solution overview for the DOE Situational Awareness application. Figure-20 shows the NERC Resources Adequacy Release 3.5 is being used as the base infrastructure for the Situational Awareness functions. To respond to the three fundamental functional requirements for an effective Situational Awareness system, detection, comprehension and trend, two basic dashboards have been researched and defined: Detection-Alarm Dashboard, and Adequacy Trace-Trend Dashboard.

Users will interact between the two dashboards. One of the dashboards should allow for identification of abnormal balance resource conditions, and the other will help to identify possible root causes for unbalances, its dimension and impact. As shown in Figure-20, two complementary functions are also required for helping the situational awareness process: Automatic Alarm Broadcasting and Archiving, and Performance Reports

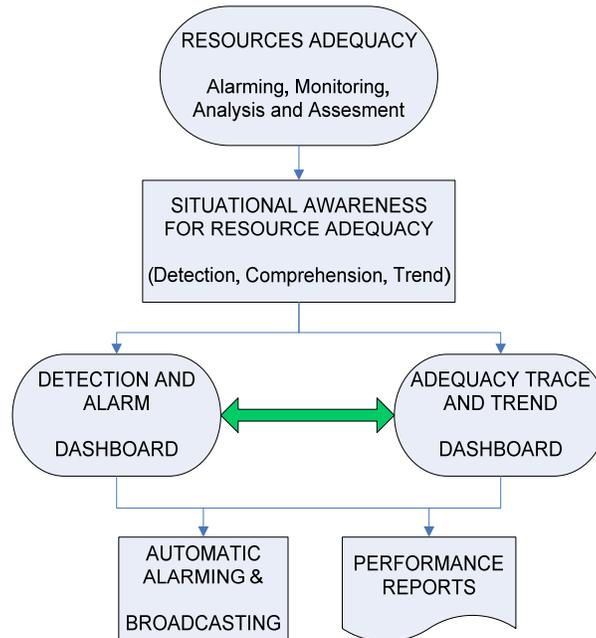


Figure 20 – Situational Awareness Visualization Solution Overview

5.1 Detection-Alarm Dashboard for Situational Awareness

The DOE-SA application only has alarm-dashboards for interconnections, reliability regions, and reliability coordinators. Release 4.0 will add a new alarm dashboard for Balancing Authorities using the G-3P image for visualization.

The definition and layout of the DOE-SA load-generation alarms for the detection-alarm dashboard follows very closely the current reliability coordinators local-area operating generation/capacity alert conditions shown at the top of Table-1 below. Coordinators will start operating with this local alerts starting in summer-2006. The DOE-SA wide-area situational awareness alarms are based in the theoretical-operational principles and frequency thresholds from NERC Balancing Authorities ACE limit (BAAL) definitions and results of its Field Trial. They follow very closely the format and nomenclature of its equivalent alerts at the local-area level shown in Table-1. Table-1 shows the four situational awareness alarm types and definitions categorized under the following four wide-area operational conditions:

- **Normal** - System can tolerate a generation or load contingency without abnormal load-generation unbalances and without violating any frequency limits.
- **Alert** - The risk and impact of a second contingency becomes greater than acceptable.
- **Emergency Manual Load Drop** - System is exposed to unacceptable level of risk. Customers load maybe be manually dropped, restoration procedures in place.
- **Automatic Load Shed** - Load has already being dropped by under-frequency relays, restoration procedures in place.

Table 1 – Local and Wide Area Alarm and Alert Conditions

OPERATING GENERATING/CAPACITY ALERT CONDITIONS AT THE BALANCING AUTHORITY, RESERVE SHARING GROUP AND LOAD SERVING ENTITY LEVELS				
Condition Level>>>>	Normal	Alert Level 1	Alert Level 2	Alert Level 3
Threat Level>>>>	Low	Elevated	High	Severe
Condition/Threat Color>>>>	Green	Yellow	Orange	Red
NERC Local-Area Balancing Authority Reserve Sharing Group, Load Serving Entity Resource Adequacy (Generating/Capacity)	No Energy Emergency Alert (EEA) In Effect	EEA 1-All Available Resources in Use	EEA 2 Load Management Procedures in Effect	EEA 3- Firm Load Interruption Imminent or In Progress
RESOURCES ADEQUACY LOAD-GENERATION ALARMS AT THE INTERCONNECTION, RELIABILITY REGIONS AND RELIABILITY COORDINATOR LEVELS				
Condition Level>>>>	Normal	Alert	Emergency	Load Shed
Threat Level>>>>	Low	Elevated	High	Severe
Condition/Threat Color>>>>	Green	Yellow	Orange	Red
CERTS-EPG Wide-Area Interconnection, Reliability Region, Reliability Coordinators Situational Awareness for Resource Adequacy (Load-Generation)	System can tolerate a generation or load contingency without violating any frequency limit. Load-generation unbalance does not force system frequency to violate any of the three BAAL frequency performance thresholds	The risk and impact of a second contingency becomes greater than acceptable. Reliability Coordinators required to take remedial action. Load-generation unbalance is violating the first BAAL frequency threshold (FTL)	System is exposed to unacceptable level of risk. Customers load maybe be manually dropped, restoration procedures in place. Load-generation unbalance is violating the second BAAL frequency threshold (FAL)	Load has already being dropped by underfrequency relays, restoration procedures in place. System frequency violated the third BAAL frequency threshold (FRL)

Figure 21, 22, and 23 show the required 3-panel detection-alarm dashboard for interconnections, reliability regions, and reliability coordinators with panel-1 showing alarm-conditions for each wide-area jurisdiction. Following are detail functional descriptions for this dashboard three panels.

5.1.1 Panel-1 Color-coded Alarms

Panel-1 on the left side shows color-coded the Normal, Alert, Manual Load Shedding required, and Automatic Load shedding alarms for all fourth North America interconnections which are the alarm default jurisdiction.

5.1.2 Panel-2 Geographical Boundaries of Jurisdiction Selected

Panel-2 on the right side shows the geographical boundaries for the jurisdiction selected together with the total MW that already were dropped. The state boundaries are shown in the background. Any map will have the capability to display state or county boundaries.

5.1.3 Panel-3 Alarm Timing and Trace Rate Tabular Text Tables

Panel-3 shows two tabs. The Alarms Condition and Duration Tab shows a table with the jurisdiction selected, the current interconnection frequency, and the time the system has been in a particular alarm mode. The Load-Shed Tab shows the interconnection frequency, the jurisdiction name, the estimate numbers of customers dropped, and the cumulative total of customers dropped.

Besides interconnections, users can select reliability regions and reliability coordinators jurisdictions via the tabs at the top-left. Both the alarms in panel-1 and the geographic maps in panel-2 will change accordingly to visualize the corresponding data for the selected jurisdiction.

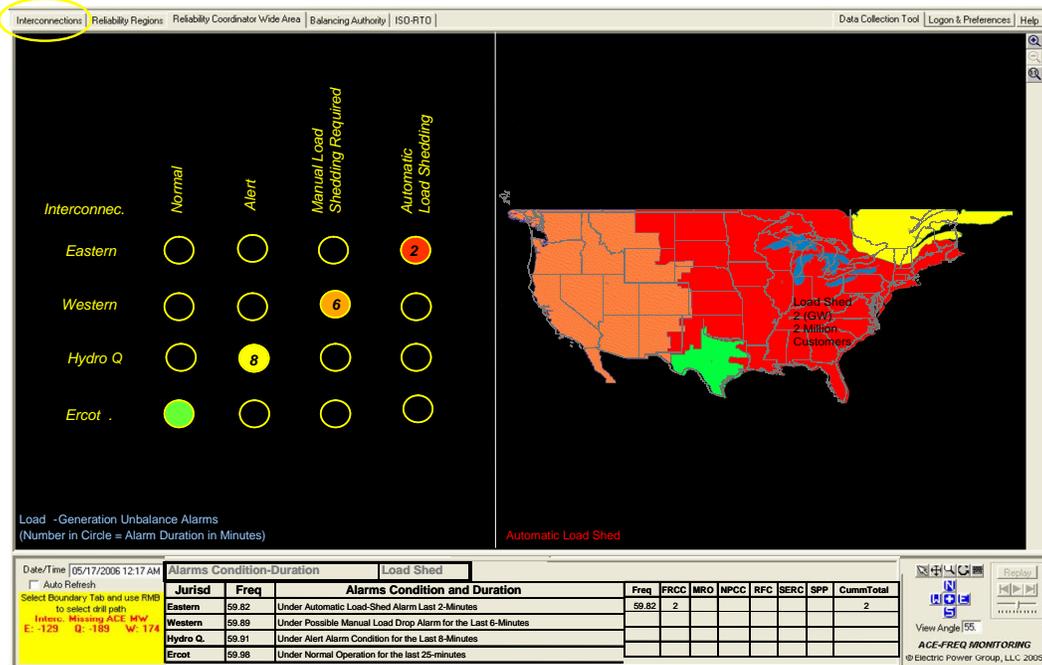


Figure 21 – Detection-Alarm Dashboard for Interconnection

The different formats, labels, names, and colors shown in figures 21, 22, and 23 are the ones required for DOE-SA detection-alarm dashboard.

5.1.4 User Options to Rearrange Graphs and Plots in Panels

Panel-1 of the detection-alarm dashboard is required to display the four interconnections, all reliability regions and all reliability coordinators for all interconnections grouped together by the major jurisdiction the user has selected. Also the detection-alarm dashboard needs to have the user option to display in panel-2 the default map or the reliability regions load-shed bar-graph shown in panel-2 from Figure-20. By default, the states boundaries need to overlap the jurisdictions boundaries as shown in panel-2 from Figure-21 and Figure-23.

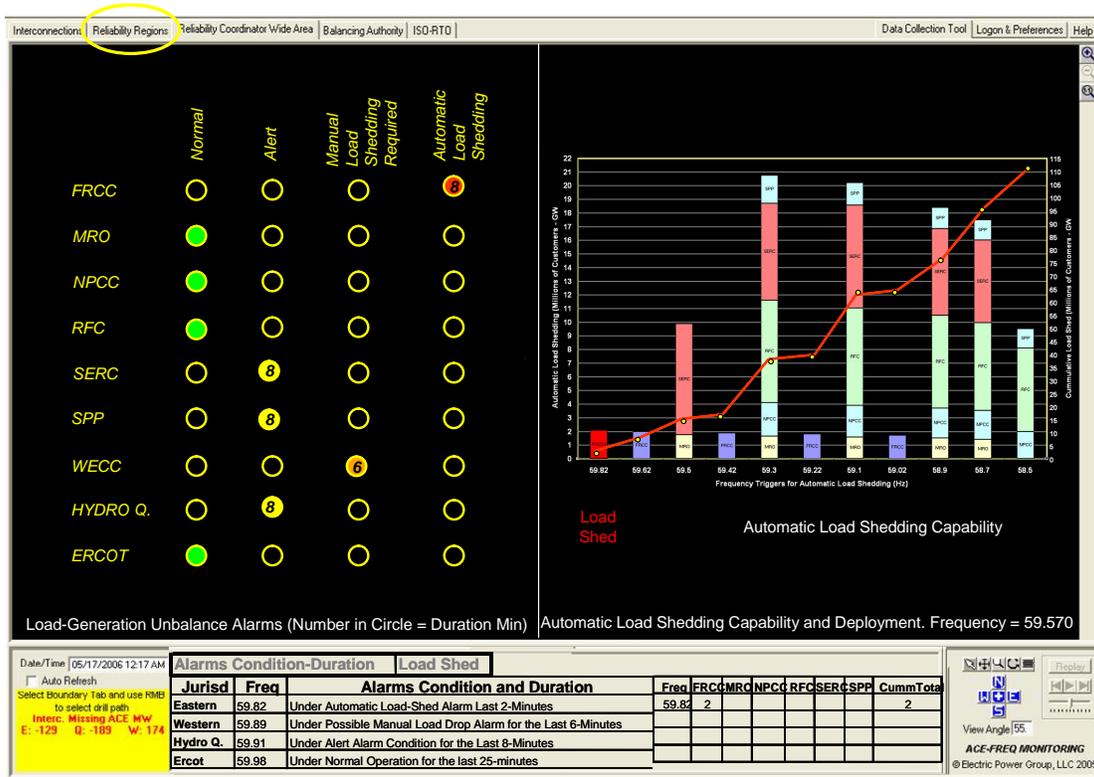


Figure 22 - Detection-Alarm Dashboard for Reliability Regions

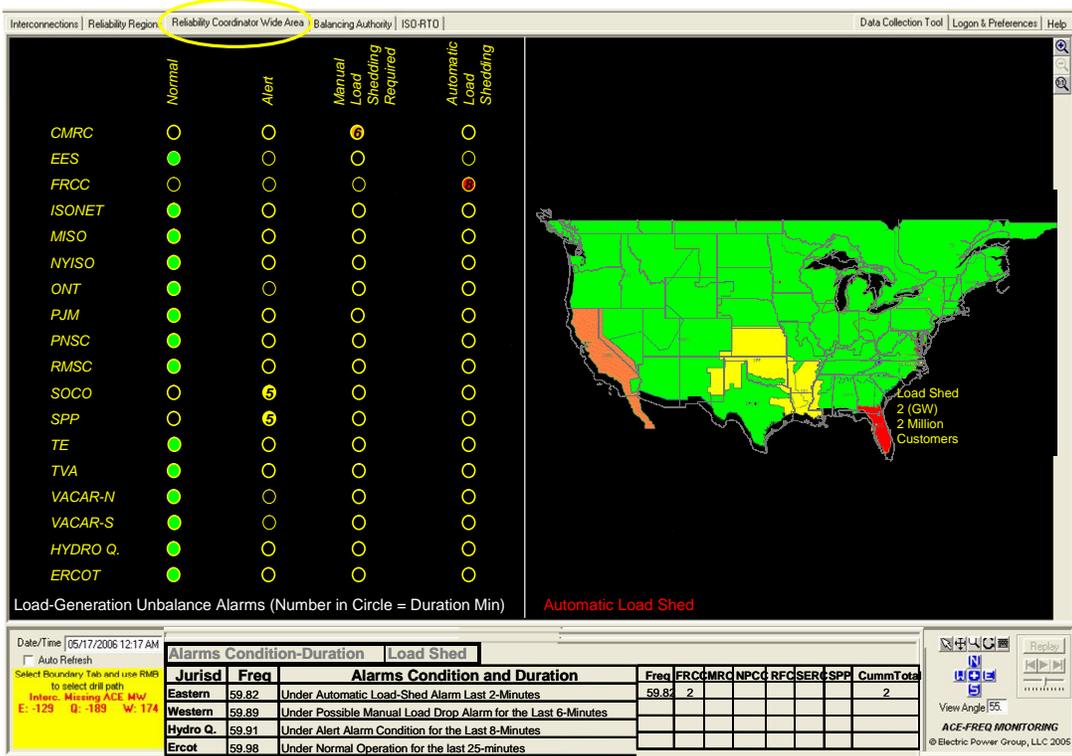


Figure 23 - Detection-Alarm Dashboard for Reliability Coordinators

5.2 Adequacy Trace-Trend Dashboard for Situational Awareness

The DOE-SA application adequacy trace-trend dashboard panel-1 has only three references: the BAAL-curve, the frequency-bias line, and the historical data polygons. The release 4.0 will integrate a fourth reference, the CPS1-plot.

After users have been alarmed and notified of abnormal resource adequacy unbalances via the detection-alarm dashboard, they can navigate by clicking on the any of the alarm-circles to a second dashboard showing a 4 panel visual solution to allow investigation of possible root-causes and reasons for the resource abnormal unbalances. Figure-24 shows this multi-view visual containing four major functions: a trace for the resources adequacy status in panel-1, a color-coded reliability coordinators geographic view with its color-code ACE in panel-2, load-shed bars or alarm-map plots in panel-3, and in panel-4 the tabular text tables showing the magnitudes of the data corresponding to the plots or graphs showing in each of the other three panels. All four functions are presented as an integrated and coordinated trace-trend dashboard.

As shown in Figure-24, the text-labels for the trace and the two references data shown at the bottom-right corner of panel-1 and the red-coloring of the bars in panel-3 showing load already shed are visual requirements.

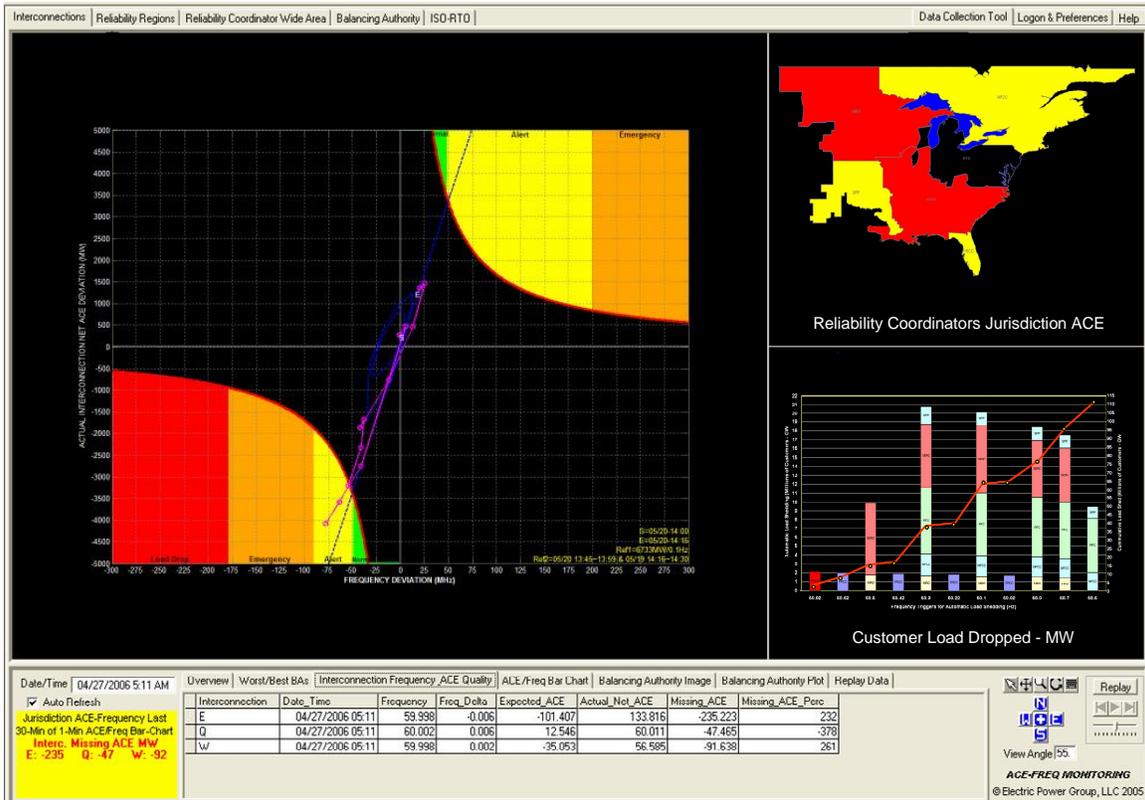


Figure 24 – Adequacy Trace-Trend Dashboard Visualization Solution

Following are brief descriptions of each panel of the trace-trend dashboard:

- Panel-1 shows for the interconnection the minute-by-minute resources adequacy trace for the last 10-minutes as a default, the trace-length in minutes can be selected by users. Three major operational references are also shown: the alarms BAAL boundaries, the frequency bias rate-line, and probabilistic grouped historical-data selected by user.
- Panel-2 shows the color-coded ACE magnitude and geographic location for those reliability coordinators having the most impact in the resources adequacy imbalances shown in panel-1. The visual and information in panel-2 complements panel-1 information by directing users to identify the root-causes, magnitude and geographic location of resources adequacy imbalances.
- Panel-3 gives user additional information by showing per reliability region the estimated number of customers whose load has been dropped and the equivalent GW already shed when the resources adequacy trace-trend in panel-1 is already in the automatic load-shed red-area.
- Panel-4 gives the parameters magnitudes in a tabular text format. There will be a tab for each of the three panels of the dashboard. The data table for each tab will contain all the data used for the corresponding plot in either of the panels.

5.3 DOE-SA Navigation and Extended Menu Structure

5.3.1 Navigation Overview for Situational Awareness

Figure-25 shows an overview of DOE Situational Awareness Navigation. The different arrows and RMB menus in the right-side of Figure-25 show the navigation from the top functions, starting with the application icon and ending on the adequacy trace-trend dashboard. The different arrows and RMB menus in the left-side of the figure show the navigation from the bottom functions starting at the trace dashboard and going back to alarming and monitoring functions on the 1-panel display.

Because DOE initial focus and utilization will be with the detection-alarm dashboard, the current top-left jurisdictional tabs will be used to obtain the detection- alarm dashboard for the interconnections, reliability regions and reliability coordinators. Any jurisdictional change required for the adequacy trace-trend dashboard will require the user to go back, via the RMB, to the detection-alarm dashboard and select the jurisdiction required from any of the alarms circles in panel-1.

To navigate between the two situational awareness dashboards and have access to the options window that will allow users to define parameters for the trace-trend and reference plots, a new RMB has being designed and is shown in Figure-26 with its different options.

5.3.2 New RMB Menu for Default View

Figure-26 shows the expanded and categorized RMB menu including the situational awareness alarm and trace dashboards options. When users select the “Detection-Alarm Dashboard” option, the DOE-SA Detection-Alarm Dashboard will be displayed. If the user selects “Adequacy Trace-Trend Dashboard”, the respective dashboard will be displayed.

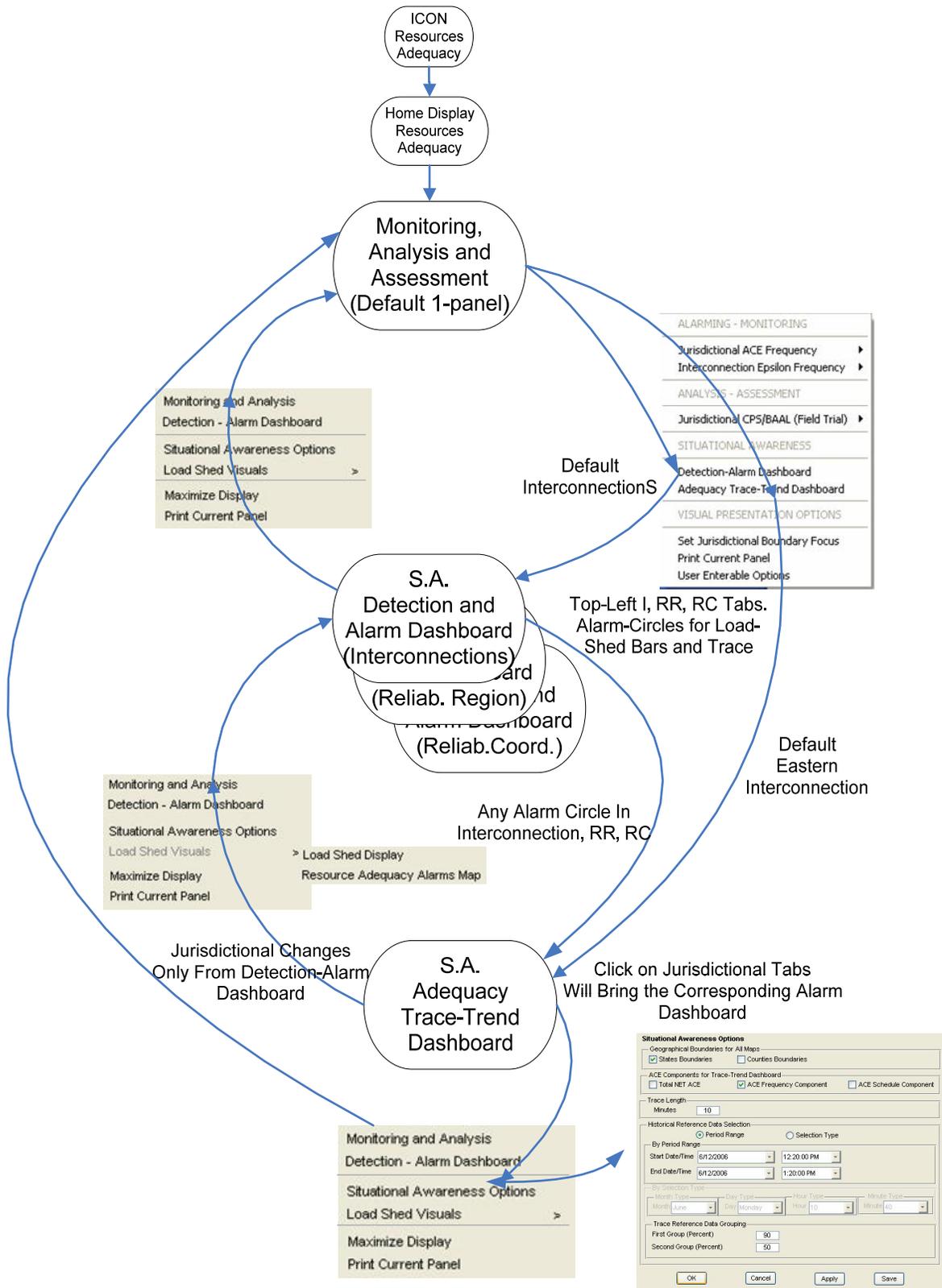


Figure 25 –Navigation Overview for Situational Awareness

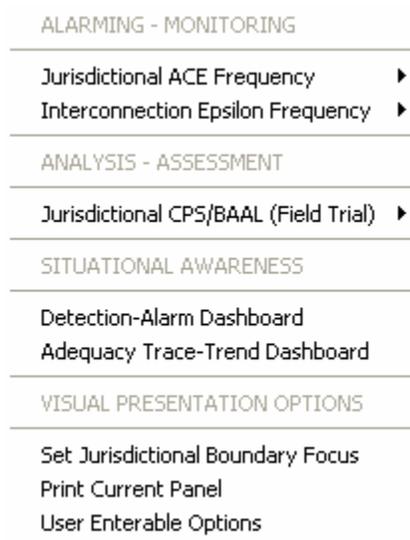


Figure 26 – Expanded RMB Menu to Include Situational Awareness

5.3.3 RMB Menu Options for Alarm and Trace-Trend Dashboards

Figure-27 shows the new RMB menu options for the detection-alarm and the adequacy trace-trend dashboards. Right clicks on any of the dashboards will bring the new RMB for situational awareness with its different options shown in Figure-27. Following is a brief description of each of the situational awareness RMB menu options

- Monitoring and Analysis – This option will display the Monitoring, Analysis, and Assessment default 1-Panel visual.
- Detection-Alarm Dashboard – This option will display the Detection-Alarm Dashboard
- Situational Awareness Options – This option will display the window shown in Figure-28 for users to enter trace and reference parameters.
- Load Shed Visuals – This option will bring a second menu for the user to select the plot they will like to show in panel-2 or panel-3 of the dashboards.
- Maximize Display
- Print Current Panel



Figure 27 – Situational Awareness Dashboards RMB Options

5.4 User Options for Trace Dashboard, Alarm Frequency Thresholds and Data Collection

5.4.1 User Selection of Adequacy Trace-Trend Dashboard Parameters

Same as DOE-SA capabilities. (Use DOE-SA functional specification version 1.3.6)

5.4.2 User Options for Alarm Frequency Thresholds

Same as DOE-SA capabilities, with the modifications described in section 3.8 and shown in Figure 5 and Figure-6 from that section. (Use DOE-SA functional specification version 1.3.6).

Other User Enterable Options (bottom part of window) for ACE-Frequency will remain the same as in DOE-SA.

5.4.3 User Options for Data Collection and Archive DOE-SA Data

The Data Collection Tool selection window will have two tabs. The ACE-Frequency tab will allow collecting and archiving Resources Adequacy Alarm and Monitoring data. The Situational Awareness tab will allow collection of DOE-SA data.

The Data Collection Tool for release 4.0 needs to use the same remote .Net service, as the DOE-SA application.

Figure-28 shows the data collection tool window. Table-2 shows the situational awareness data available for users to collect and archive.

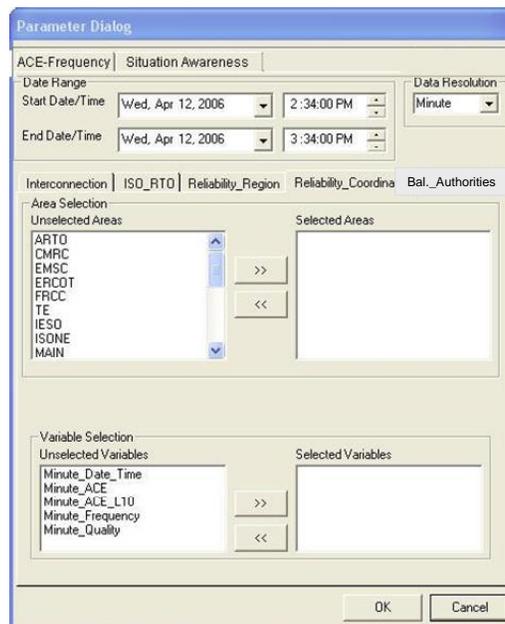


Figure 28 - Data Collection Tool Window

Table 2 – List of Data for Collection or Archiving as CSV files

Variables	Data Type	Description	Database Status	Unavailable Variable Create Method
Freq_Bias	Float	Jurisdiction Frequency Bias: Sum of Frequency Bias of ALL BAs in the Jurisdiction	Not Available	Stored Procedure
L10_Yealy	float	Jurisdiction Yearly L10: Sum of Frequency Bias of ALL BAs in the Jurisdiction	Not Available	Stored Procedure
Frequency	float	Interconnection Frequency	Available	
NetACE	float	Jurisdiction Net ACE: Sum of ACE of ALL BAs in the Jurisdiction	Not Available	Stored Procedure
Date_time	date_time	Date, Time Tag of the Jurisdiction Net ACE Data	Available	
Jurisdiction_ID	integer	Jurisdiction ID	Available	
NetACE	float	Jurisdiction Net ACE: Sum of ACE of ALL BAs in the Jurisdiction	Not Available	Stored Procedure
NetACE_Freq_Component	float	Jurisdiction Net ACE Frequency Component	Not Available	Stored Procedure
NetACE_Sched_Component	float	Jurisdiction Net ACE Scheduled Component	Not Available	Stored Procedure
Load Drop	float	Total Dropping MW of Jurisdiction When Frequency Under Frequency Relay Threshold	Not Available	Import into Database
Temperature	float	Temperature of the Balancing Authority	Not Available	Import into Database
Quality Code	integer	Quality Code of Temperature	Not Available	Import into Database

5.5 Situational Awareness Alarms Format and Route Criteria

The alarm description and format below should be use as the format template for the SA four alarm types described in Table-1. The SA alarms will be a new AFN category.

Actual Frequency Value

Subject Line
EMERGENCY LOAD-GENERATION UNBALANCE AT 59.944 Hz

Message

Interconnection Name *Time of Alarm Occurrence* *Threshold*

EMERGENCY: -EAST 8/23/2005 11:34:00 PM (EDT)
 Load-Generation unbalance has entered into the Emergency area and has been in there for more than 10 minutes. Possible Load Drop of xxxx MW at YYYY frequency

Load-Generation resources under inadequate balance.

Preventive Recommended Actions for Reliability Coordinators:
 1. RCs shall:

- Monitor the balancing authorities (BAs) within its RC area to identify if any BA(s) has an Area Control Error (ACE) greater than it's Balancing Authority ACE Limit (BAAL).
- Direct the corrective actions necessary to return the BA's ACE to an acceptable limit.
- Log event details and corrective actions on the Reliability Coordinator Information System (RCIS), in the Frequency section.

-----DISCLAIMER-----
 This notice reflects the most current information available from Control Areas. These notice results depend on the quality and completeness of the data supplied and, accordingly,

Figure 29 – Alarm Description and Format

Table-3 shows the alarms criteria and conditions for the Situational Awareness balance resources application. A un-alarm equivalent to Release 3.5 BAAL un-alarm is required for each of the SA alarms. The alarming heading should flash in the yellow information window each time an alarm is triggered. The Alarm criteria and conditions on Table-3 should apply to Reliability Regions and Reliability Coordinators. The system unavailable alarm and the system available un-alarm must be broadcasted when the DOE-SA application can not be accessed by DOE for more than 1 continuous hour. Unavailability alarm data should be archived for creating last 30-days system unavailability reports.

Table 3 – Alarms Criteria and Conditions for Situational Awareness

Criteria Alarm	Alarm Duration	Load Shed	Alarm Condition	Alarm Broadcasting Recipients
Normal	Not Alarm	N/A	N/A	DOE to Define
Alert	15 Minutes 30 Minutes	N/A	N/A	DOE to Define
Manual Load Shedding Required	5 Minutes	N/A	Steady	DOE to Define
	10 Minutes		Flash	
Automatic Load Shedding	1 Minute	> 1 MW	Flash	DOE to Define
System Unavailable	60 Minutes	N/A	Broadcast	DOE to Define

6. SITUATIONAL AWARENESS LOAD-TRANSMISSION REQUIREMENTS USING TRANSMISSION LOAD RELIEF (TLR) DATA

Figure-30 shows an overview of TLR process flow of data.

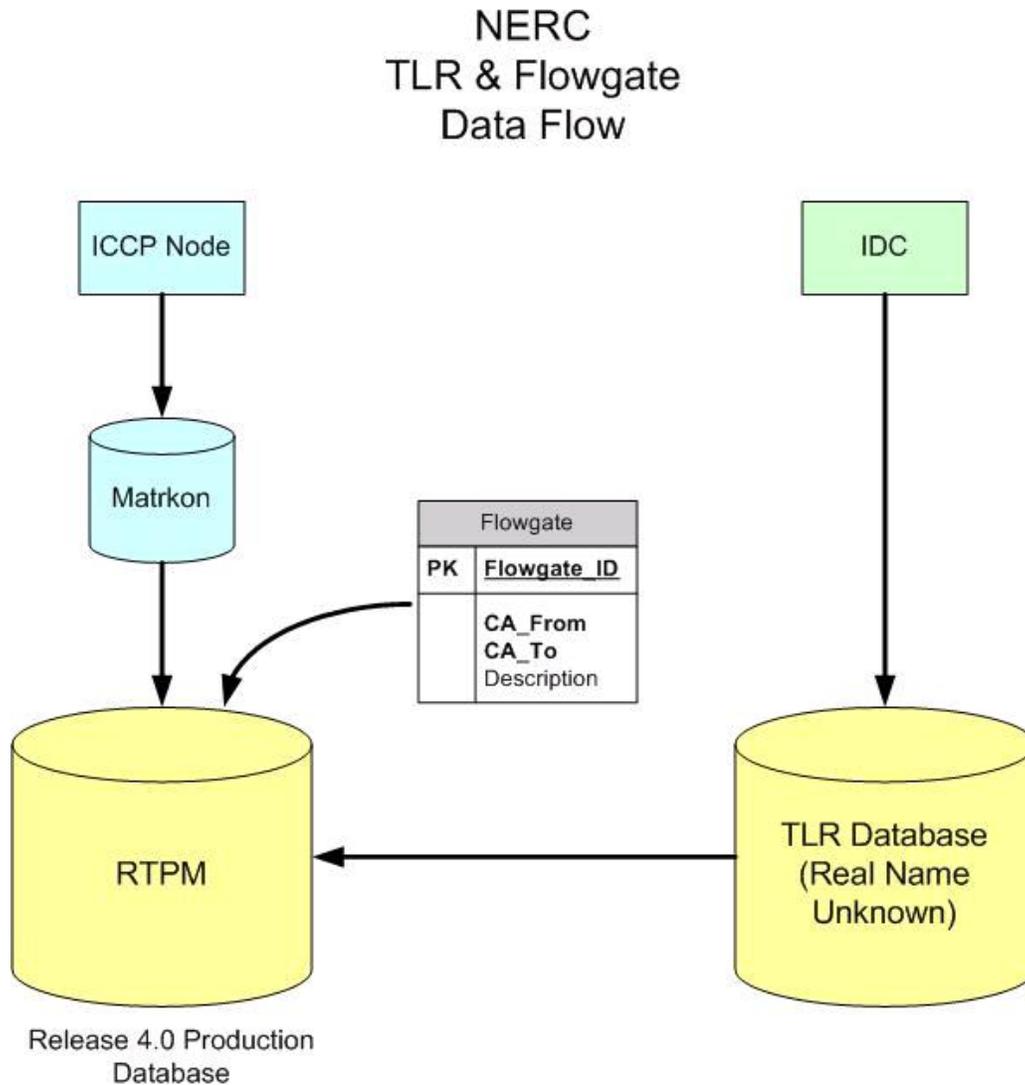


Figure 30 - Overview of TLR Process Flow of Data

7. DATA REQUIREMENTS

Figure 31 shows the Database Table Structure for Situational Awareness.

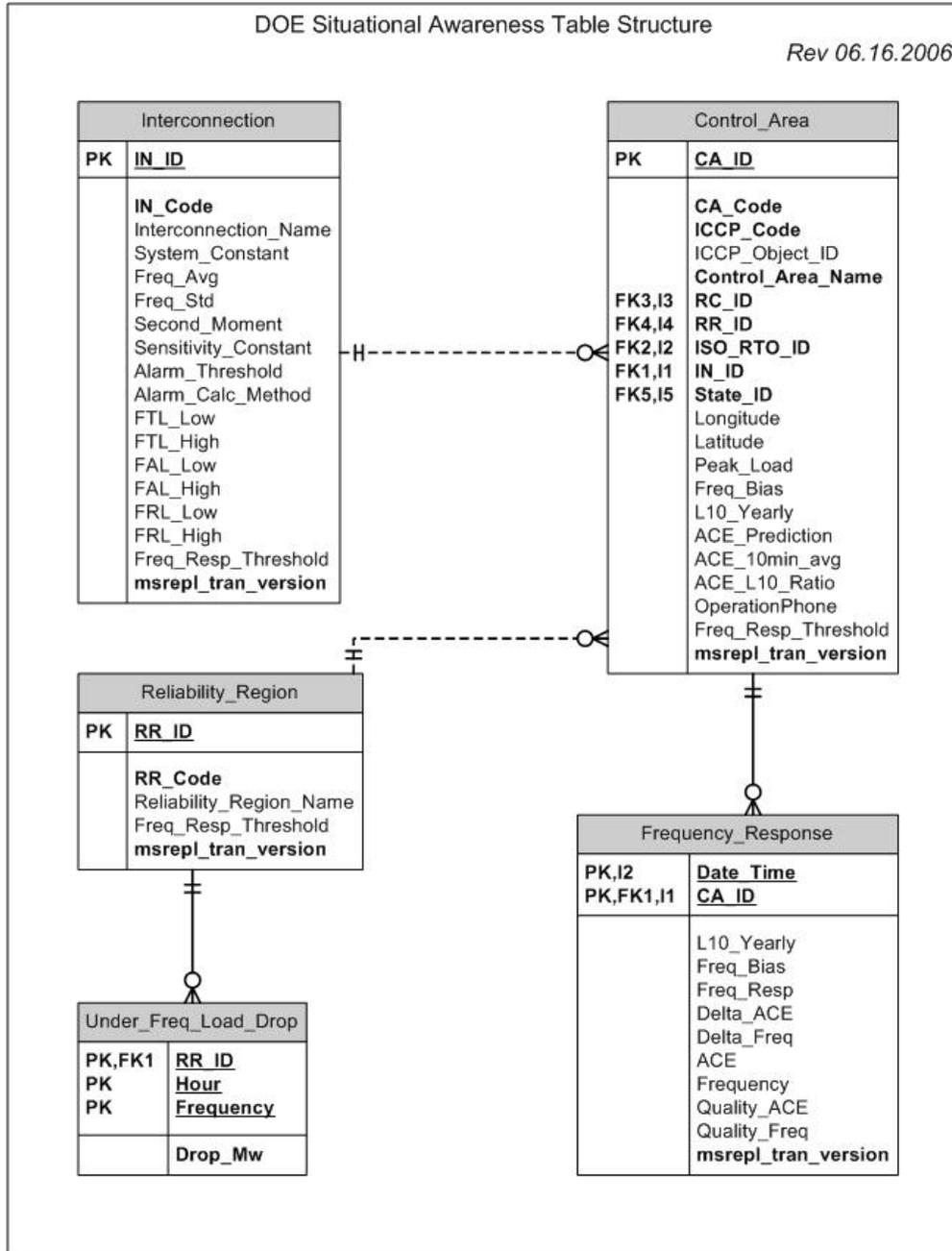


Figure 31 – Database Table Structure for Situational Awareness

Figure-32 shows the database disturbance and alarm (DARA) table structure.

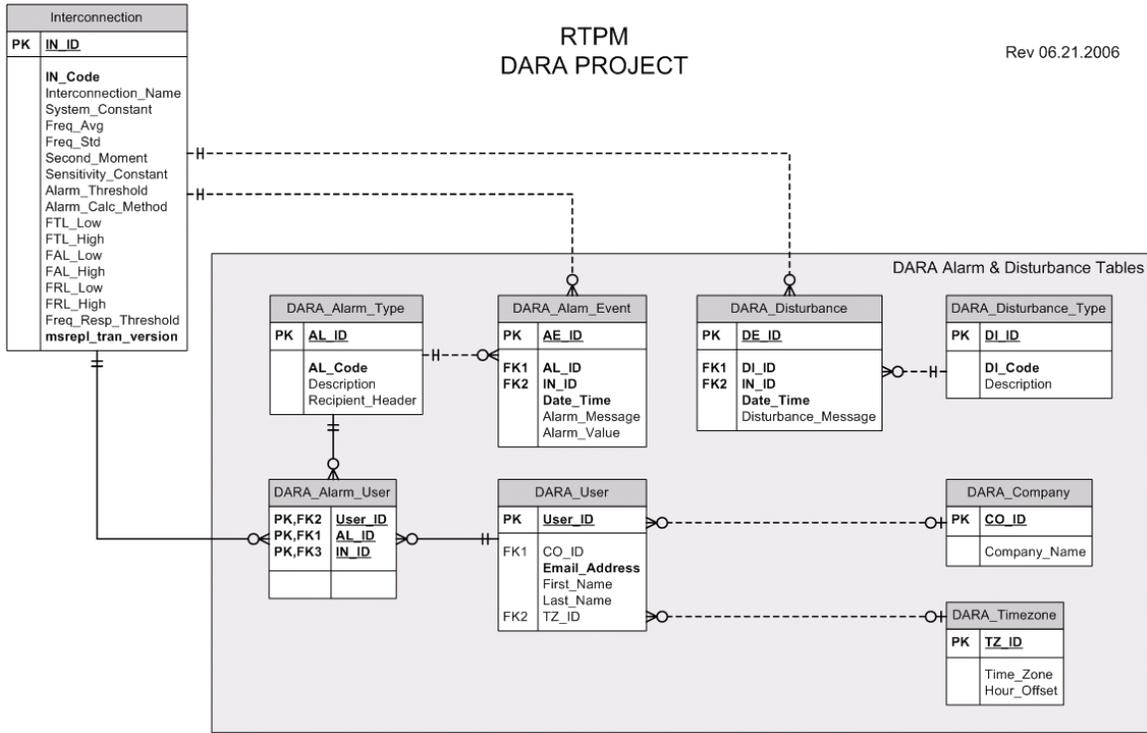


Figure 32 – DARA Database Table Structure

8. IMPLEMENTATION PLAN AND SCHEDULE

Table 4 shows the layout for the schedule for development of the project, testing and the final release.

Table 4 – ACE-Frequency Release 4.0 Tasks, Responsibilities, and Schedules

Task No.	Major Tasks and Sub-Tasks	Responsible	Completion Date	Progress
	New Functional Enhancements	EPG.B	Sep-06	
1	Prepare functional specification			
2	Define data requirements and implement database			
3	Define project design requirements			
4	Integrate Functional and Design Requirements into one Spec			
5	Software Development			
	DARA Capabilities	EPG.B	Sep-06	
6	Integration of Activities A thru F DARA capabilities			
7	Design, development, and integration of activities G thru I of DARA capabilities			
	Situational Awareness Capabilities	Ajay	Sep-06	
8	Integration of DOE-SA situational awareness capabilities			
	Load Transmission Resource Adequacy Capabilities	Ajay	Sep-06	
9	Design, development, and integration of load-transmission resources adequacy capabilities			