

***Consortium for
Electricity
Reliability
Technology
Solutions***

Reliability
Compliance
Monitoring System
for Area Control
and Area
Interchange Errors

Graphic-Geographic Visualization Package

Prepared By

Consortium for Electricity Reliability Technology Solutions (CERTS)

For Review By

**North America Reliability Council (NERC)
Resources Subcommittee**

June, 2001

Release: 06.01.2001



CERTS

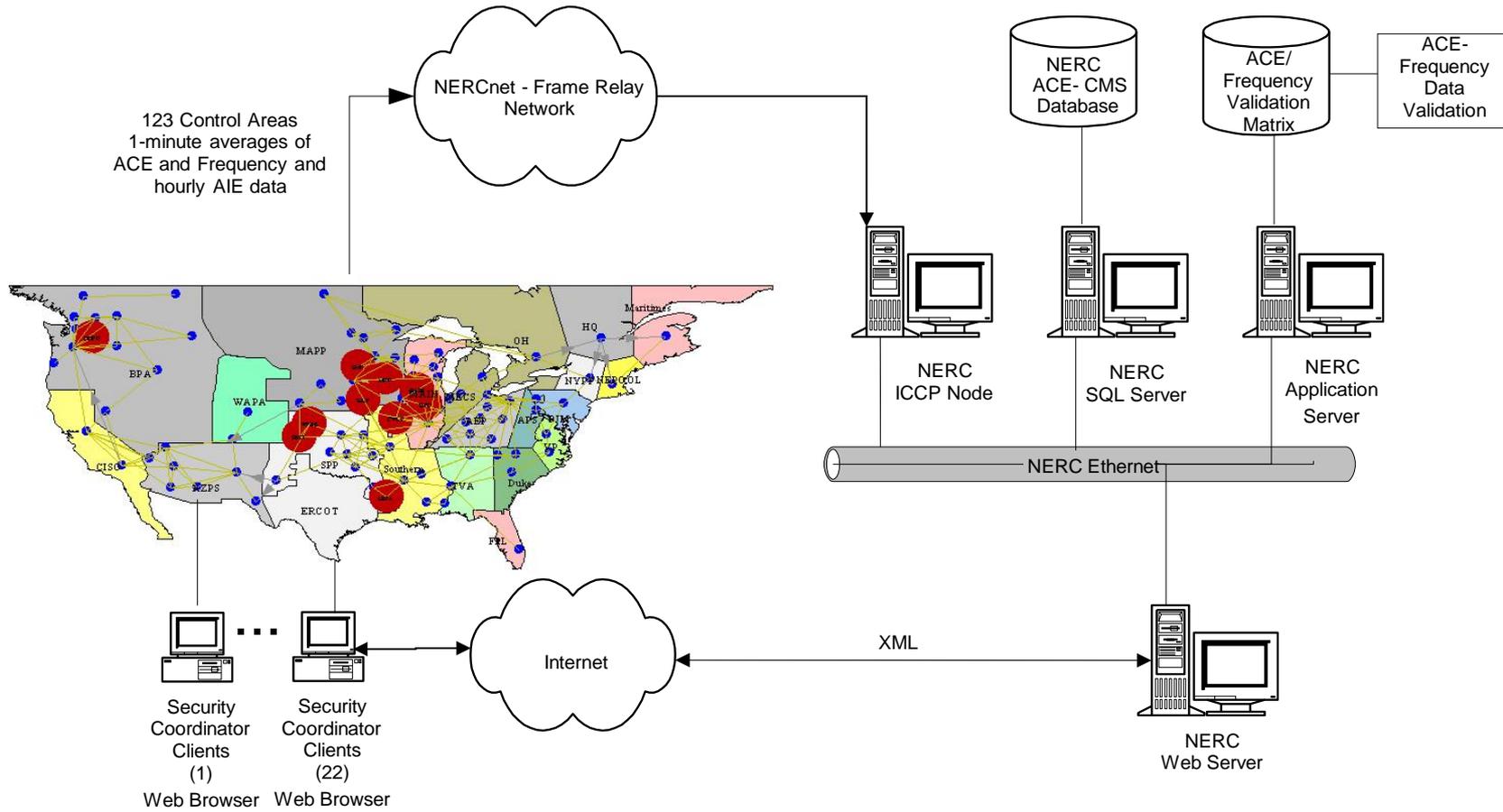
 **Electric Power Group**

INTRODUCTION

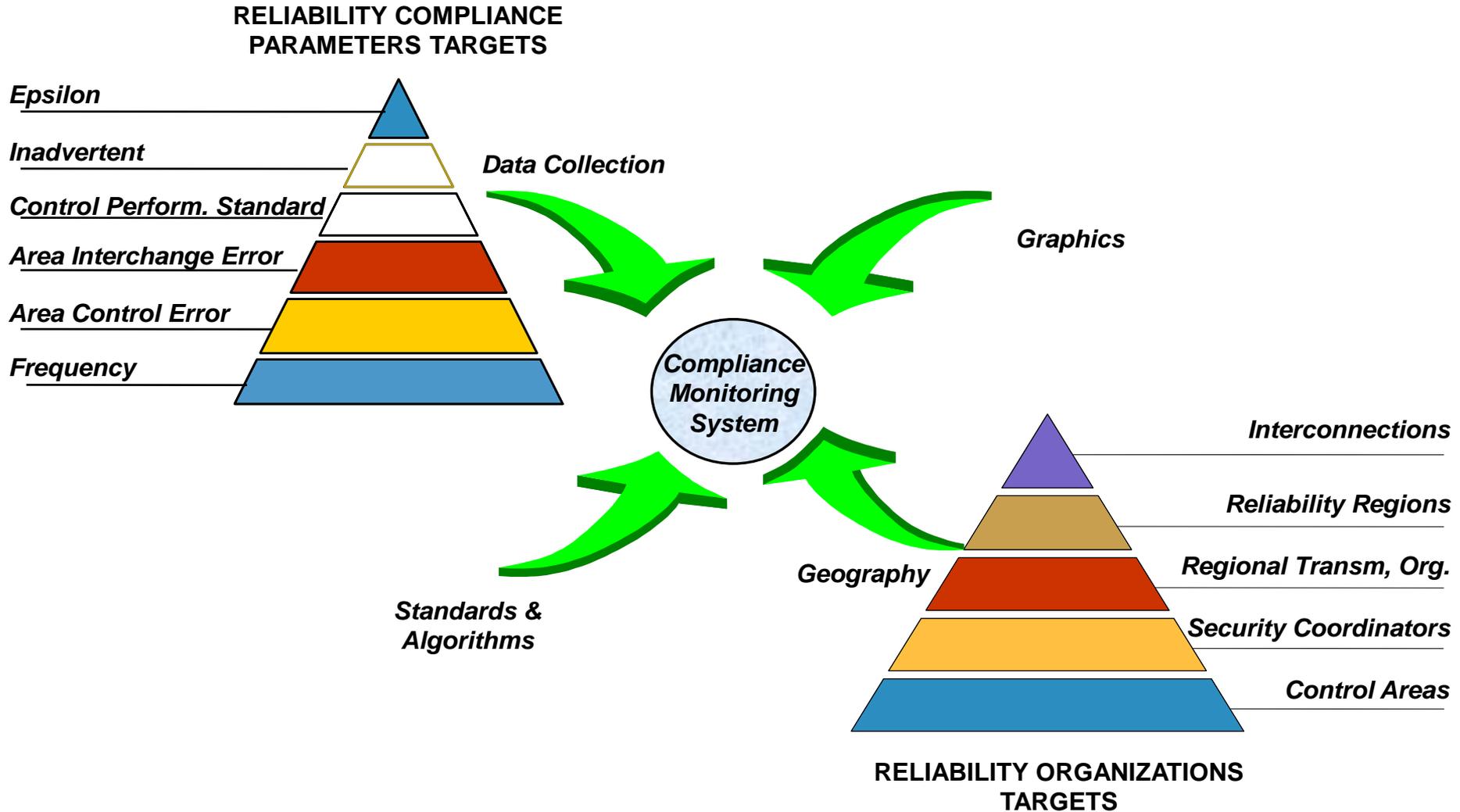
NERC is in the process of developing mandatory compliance standards. An important aspect of a standard is the measurement associated with the standard, so as to determine if the appropriate entities are in compliance. The Security Coordinator will be asked to have a more active role in compliance monitoring. Therefore, they will require the necessary support systems in place to effectively monitor and track current and historical performance, plus the important aspect of looking at the near term behavior. When completed, the ACE and AIE Monitoring System applications will deliver wide-area graphic-geographic performance monitoring capabilities for NERC Security Coordinators.

The ACE and AIE Monitoring Systems, using CERTS' graphic geographic visualization methodology, will assist to meet the NERC Operating Committee and NERC Resources (old performance) Subcommittee's need for identifying Control Areas that cause large or long-term frequency deviations in each NERC interconnection. These applications will also allow Security Coordinators to monitor ACE and AIE performance and compliance for each of their jurisdictions using the proposed wide-control-area visualization.

CERTS/NERC - ACE Compliance Monitoring System Architecture and Data Flow Overview

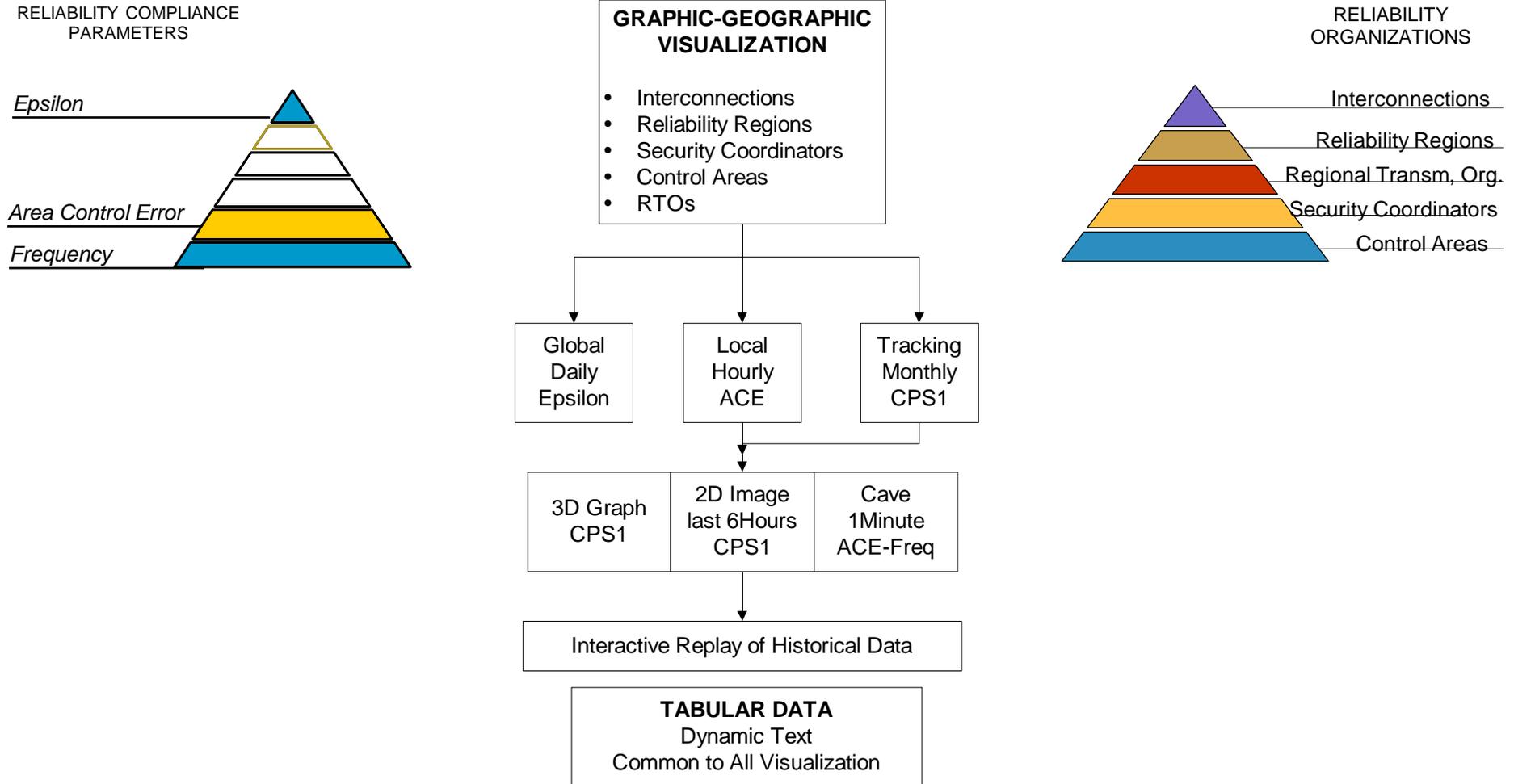


NERC Compliance Monitoring Systems Functional Overview



CERTS/NERC ACE Compliance Monitoring System

Functionality and Web-Base Visualization Very High Level Overview



CERTS COMPLIANCE MONITORING SYSTEM (CMS) VISUALIZATION INFRASTRUCTURE

Home Web Page

Introduction | Preferences

ACE
AIE
CPS
INAD

NORTH AMERICAN ELECTRIC RELIABILITY COUNCIL
Reliability Compliance Monitoring System

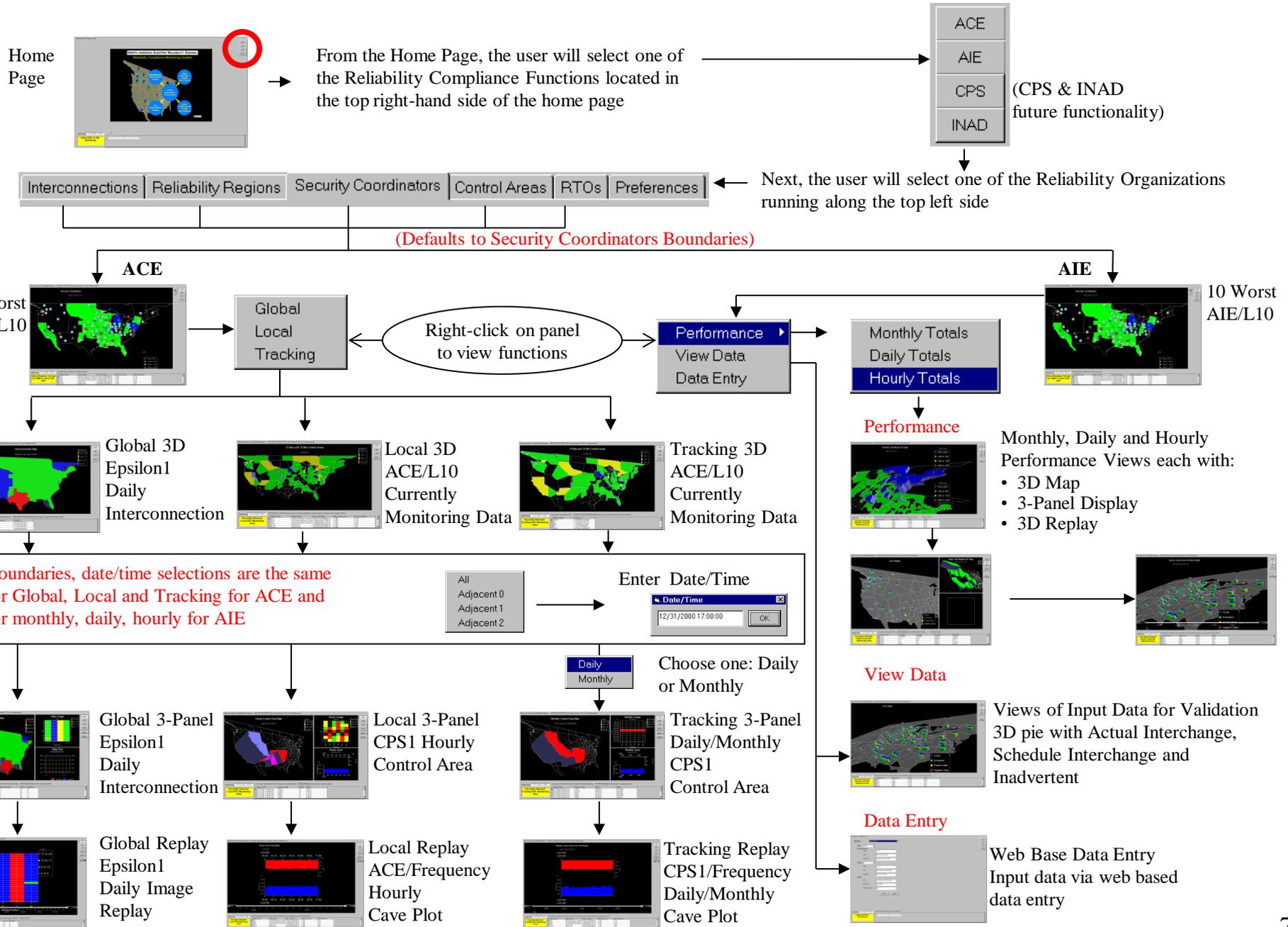
INADVERTENT MONITORING (Future)
AREA CONTROL ERROR MONITORING
CERTS Information Visualization
AREA INTERCHANGE ERROR MONITORING
CPS MONITORING (Future)
CERTS

Date/Time 12/31/2000 17:00:00

PURPOSE
Monitor Reliability Compliance Parameters and identify root reasons for non-compliance

Select ACE or AIE Monitoring

NERC Compliance Monitoring System Visualization Overview -Rev. 06.14.2K1



ACE COMPLIANCE MONITORING VISUALIZATION

Master Monitoring Display Components and Keyboard Usability



Components

- Execution Buttons**
Main Functions
- Zoom Buttons**
Allows user to zoom in to read CA's Name.
- Preferences**
allows the user to customize the application to their liking.
- Boundary Tabs**
The Boundary Tabs represent the Reliability Organizations Entry Points
- Control Areas**
- Main Panel**
- Dynamic Window**
Displays Raw Data in Real-Time

The screenshot shows the 'Security Coordinators' tab of the Master Monitoring Display. The main panel displays a map of the United States with various control areas (CAs) represented by colored bubbles. A legend on the right indicates ACE values: 100 to 500 (Blue), -100 to 100 (Green), -200 to -100 (Yellow), and -500 to -200 (Red). The bottom panel shows a table of data for selected CAs.

| CArea_Code | Entity Name | ACE_L10_Ratio | ACE_10min_avg | ACE_Prediction |
|------------|----------------------------|-----------------------|---------------|----------------|
| AEC | Alabama Electric Cooperat | -4.67027715833068E-02 | -1.466 | 21.34 |
| AECI | Associated Electric Coope | -2.53882352941176E-02 | -1.079 | 21.74 |
| AEP | American Electric Power Ci | -1.88020439061317E-02 | -1.987 | -0.38 |
| ALTE | Alliant East | -3.39958875942426E-02 | -1.488 | 24.02 |
| ALTW | Alliant West | -9.86448784376246E-03 | -0.495 | 1.08 |

Action Window

- Global
- Local
- Tracking

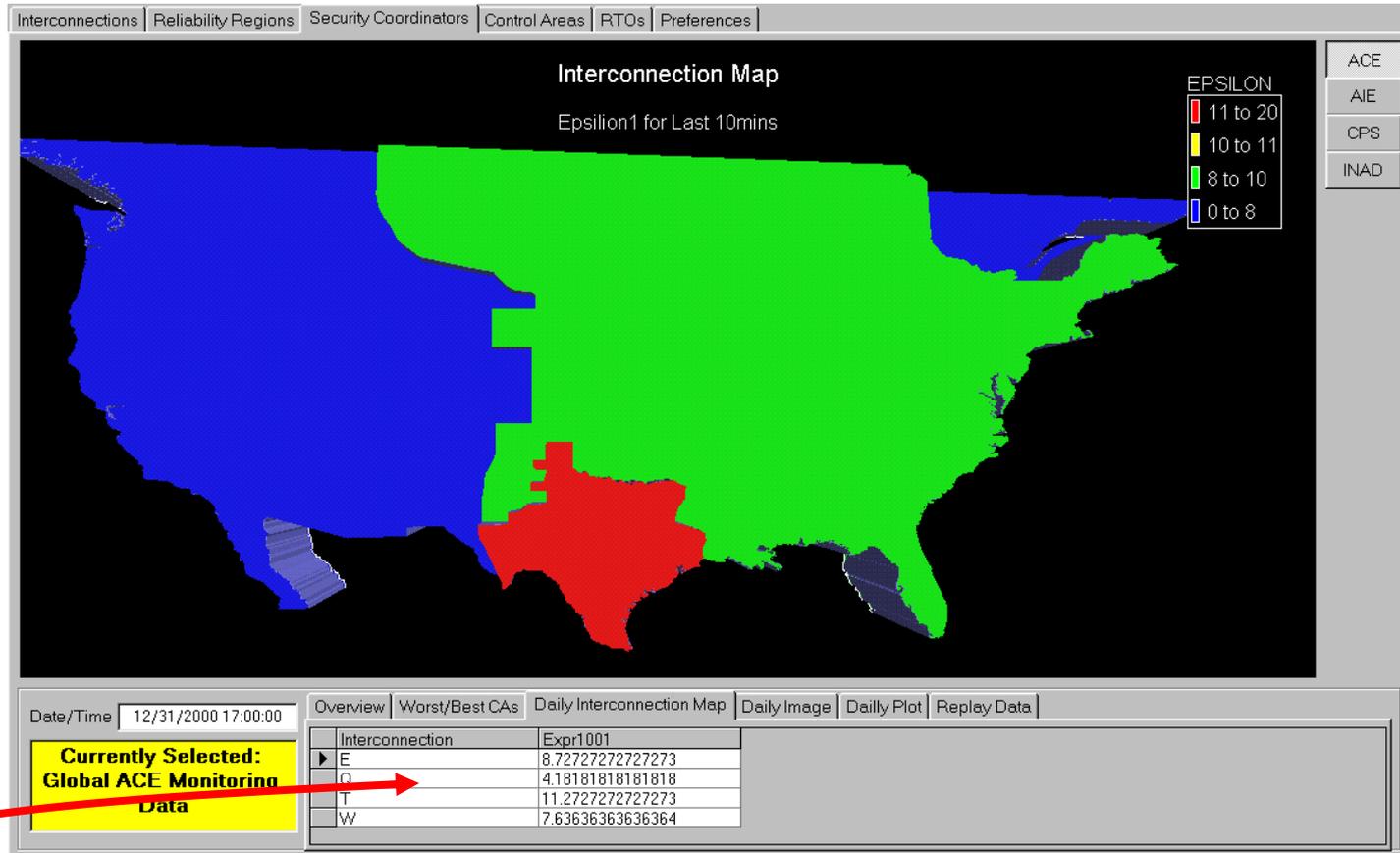
Keyboard

- TILT**
Hold down the <Alt> button, click and move the mouse to better view the heights of the regions on the 3D maps.
- SELECT**
Hold down the <Ctrl> button and click on one or more areas on the map to view their particular set of data.
- ZOOM**
Hold down the <Shift> button, click and move the mouse to zoom in and out.
- FUNCTIONS**
Right-Click on the Main Panel to view a menu of the relevant functions.

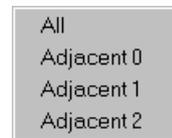


- Each bubble represents a Control Area. The Inner most color is the ACE. The outermost is the ratio ACE/L10 where ACE / L10 > 1 Red, ACE / L10 < 1 Blue, and anything else = White.
- The Security Coordinators tab is the default display.

3D - Interconnections - Epsilon1 - Global

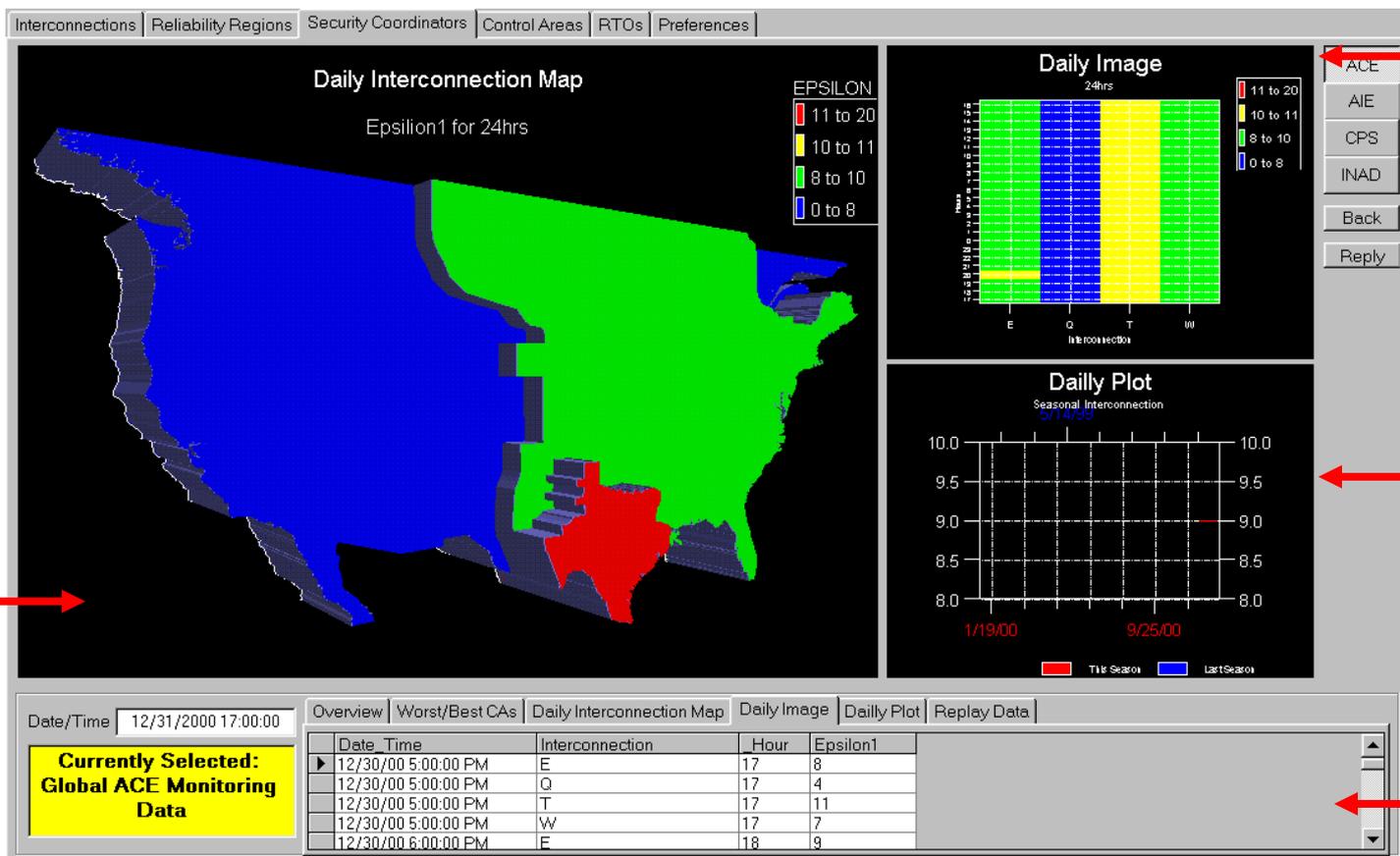


- The height of the map represents the Epsilon1 for each Interconnection within the last 10 minutes.
- The Data Tab marked “Daily Interconnection Map” displays each of the Interconnections with its corresponding Epsilon1
- Select one of different Interconnections to inspect.
- Right-click on the map and select from the pop-up menu All or one of the selected Adjacent options



Epsilon1 - Interconnections - Global Monitoring

Daily Interconnection Map (Epsilon1 for 24hrs)



Daily Image Panel

Daily Plot Panel

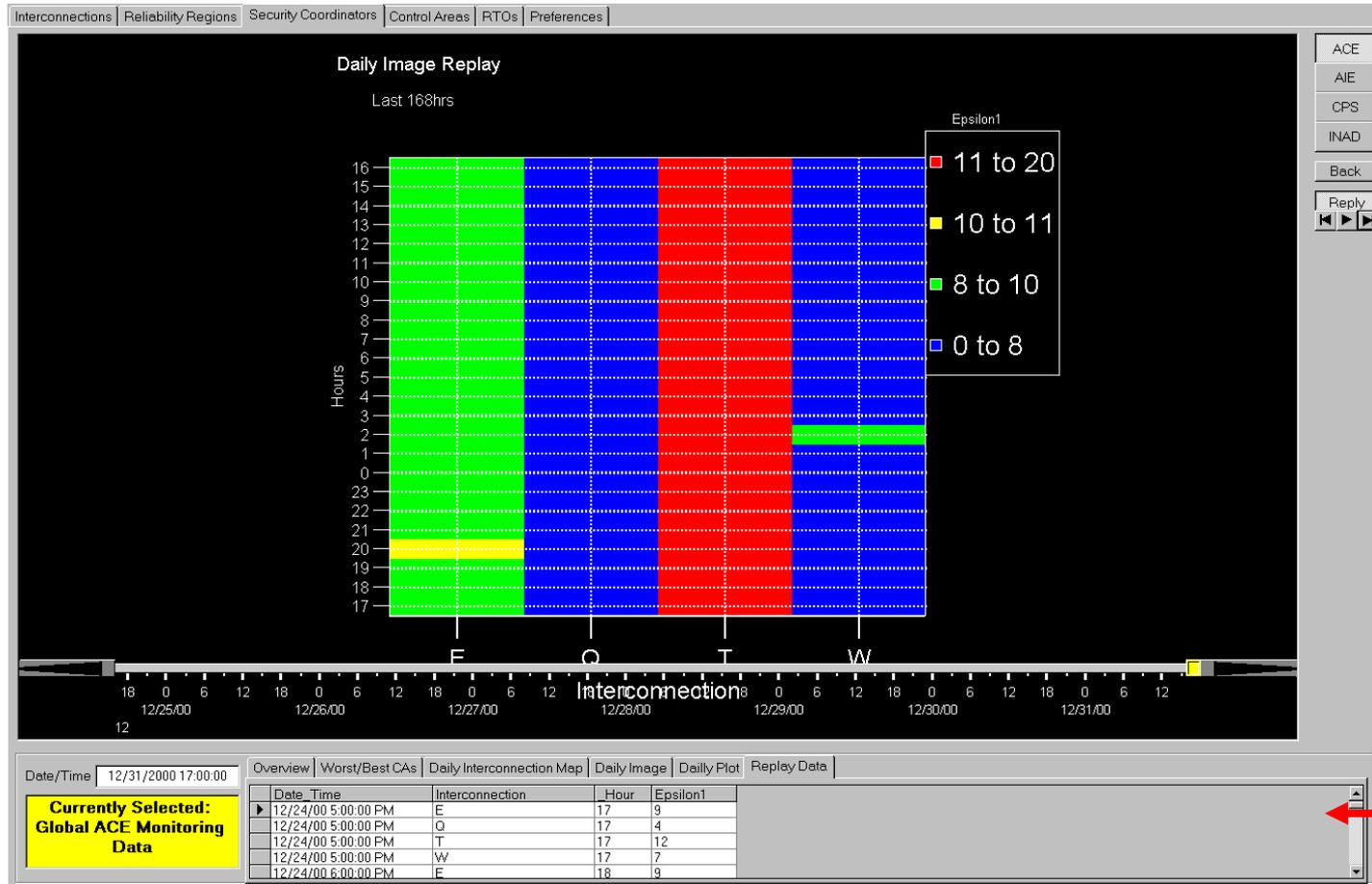
Daily Image Data

Daily 3D Map

- Three Panels to choose from (right-click on any one to display in full screen)
- Daily 3D Map for Interconnections Epsilon1 (RMS value of 1-minute average for last 24hrs of frequency)
- Daily Image displays Interconnections (x), Hourly rolling averages for each of last 24hrs (y), and Epsilon1(color)
- Daily plot displays One Interconnection daily Epsilon (y1) and Interconnection daily Epsilon1 for this and last year - seasonal (y2)
- The Daily Plot Tab of the data window displays the dynamic data used to generate the Daily Plot Graph.
- User can select an Interconnection for a given Hour from the Daily Image panel (by holding down the <Ctrl> button) and the data for that Interconnection will be displayed in the Daily Plot Panel

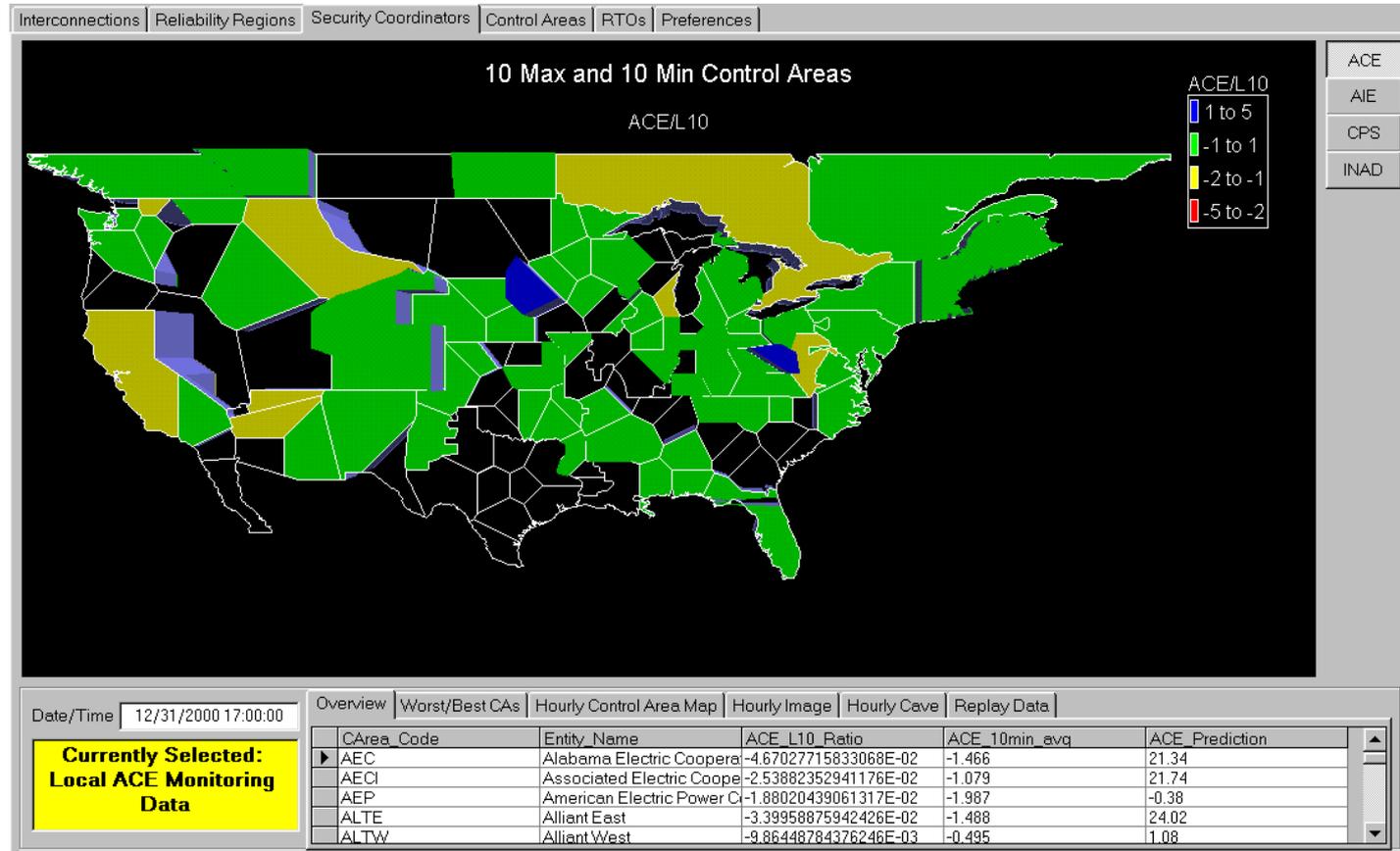
Epsilon1 - Interconnections - Global Monitoring

Daily Image Replay (Last 168hrs)



- The Replay feature displays the dynamic data graphically as it progresses through time.
- This Replay feature is available for any of the three panels (3D Map, Image, Plot) on the previous screen
- Default Replay is for the 3D Map
- For Global Monitoring, the replay feature is set for 168 hour span, 1-hour increments
- The Daily Image will change to show the status of the Interconnections for the given hour
- Click the Replay Button to begin.
- Select the Rewind button first followed by the Play button to start the Replay

ACE - Control Areas - Local Monitoring



- This is a 3D Map where the Height of each area is proportional to the Ranking (daily cumulative ACE/L10)
- Here, the user is able to select some or all of the control areas and a time boundary for the data.
- Right-Click on the map and choose from the menu All or one of the Selected Adjacent options.
- When prompted, enter a Date/Time Boundary for the Data.

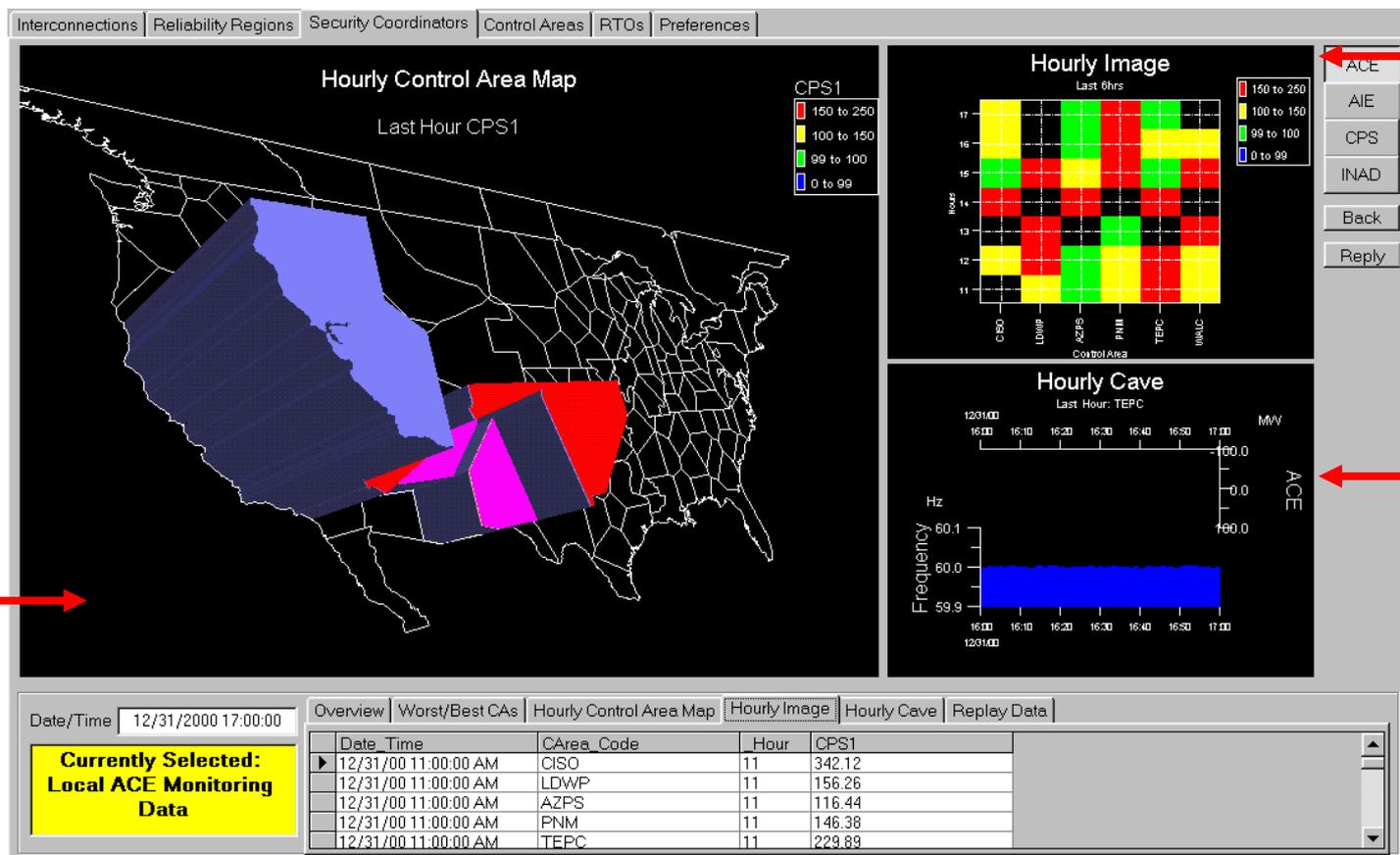


ACE - Control Areas - Local Monitoring

Hourly Control Area Map (Last Hour CPS1)



Hourly 3D Map



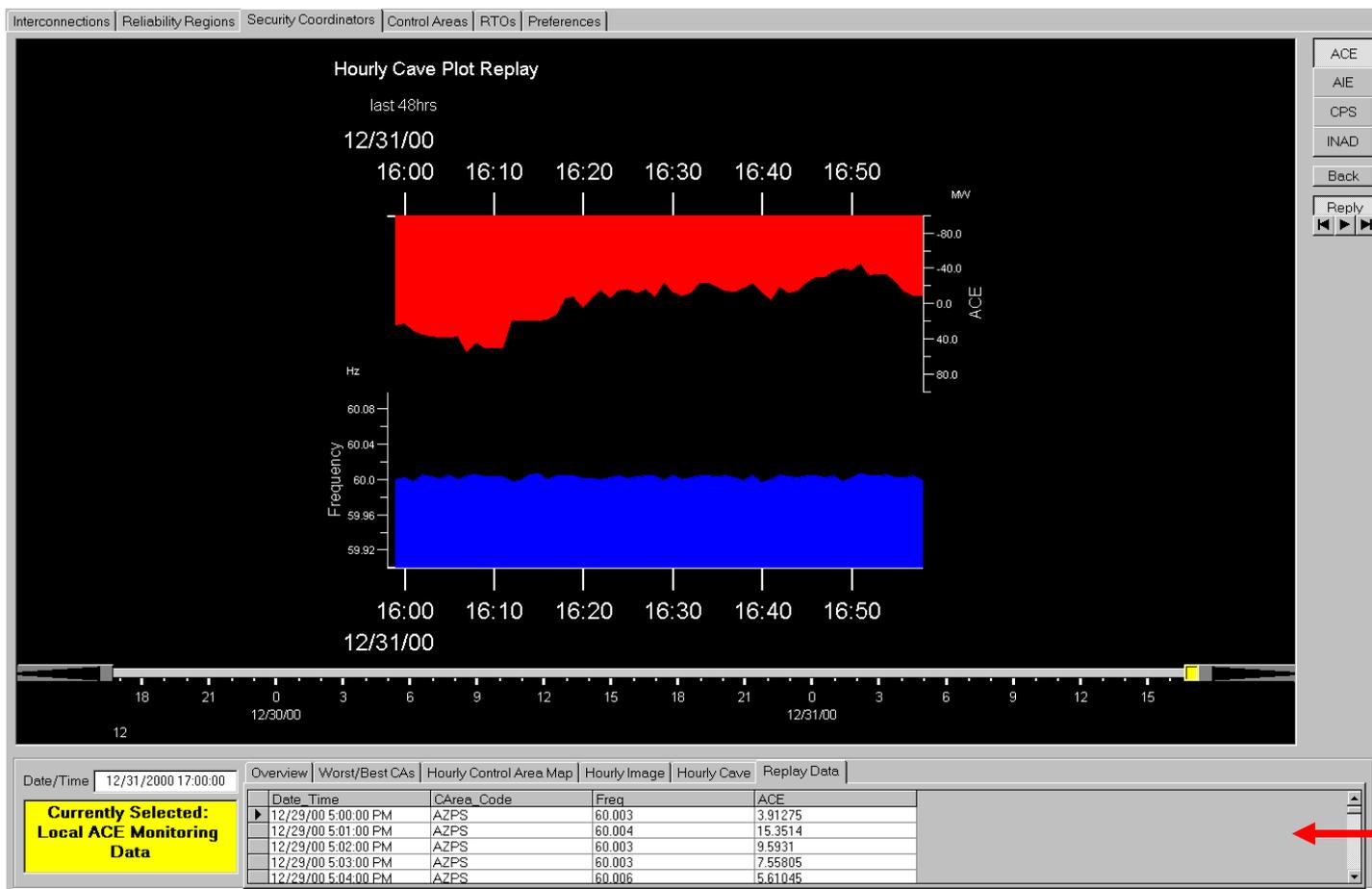
Hourly Image Panel

Hourly Cave Panel

- Three Panels to choose from (right-click on any one to display in full screen)
- Hourly 3D Map for the last hour average of CPS1 for selected Control Areas, alarming those that are part of the 10 worst CAs
- Hourly Image displays the worst 10 Control Areas (x), the last 6 hours (y), and the hourly average of CPS1 (color)
- Hourly Cave displays Last Hour for selected CA-ACE (y1) and Frequency Deviation (1 Minute Resolution) (y2)
- User can select a Control Area for a given Hour from the Hourly Image panel (by holding down the <Ctrl> button) and the data for that Control Area will be displayed in the Hourly Cave Panel

ACE - Control Areas - Local Monitoring

Hourly Control Area Cave Plot Replay



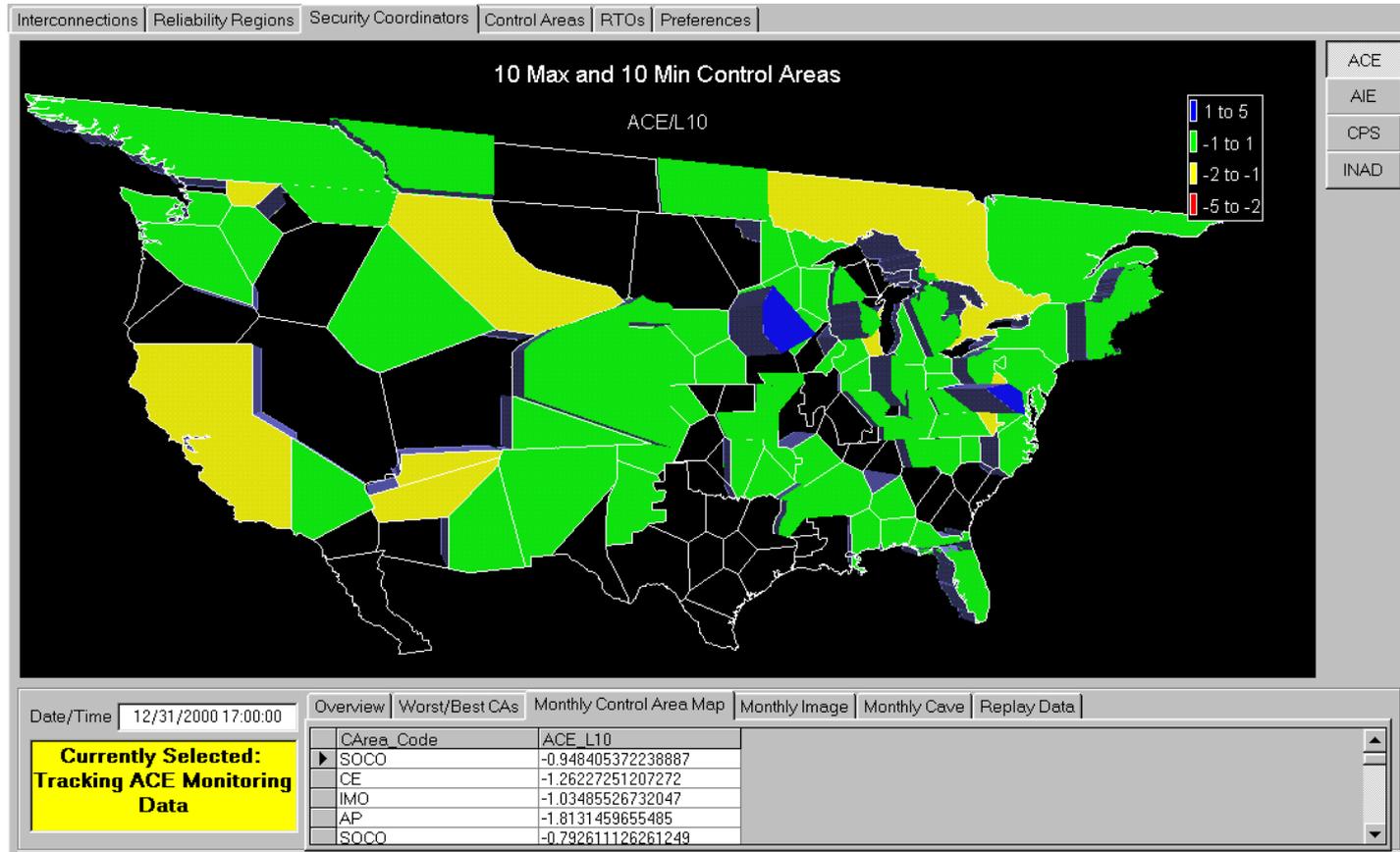
Replay Controls

Time Line

Replay Cave Data

- This Replay feature is available for any of the three panels (3D Map, Image, Cave) on the previous screen by right-clicking on any of the panels and then clicking on the Replay button.
- Default Replay is for the 3D Map
- For Local Monitoring, the replay feature is set for 48 hour span, 1-minute increments
- The Hourly Image will change to show the CPS1 of the Control Areas for the last 48 hours
- Click the Replay Button to begin.
- Select the Rewind button  first followed by the Play button  to start the Replay

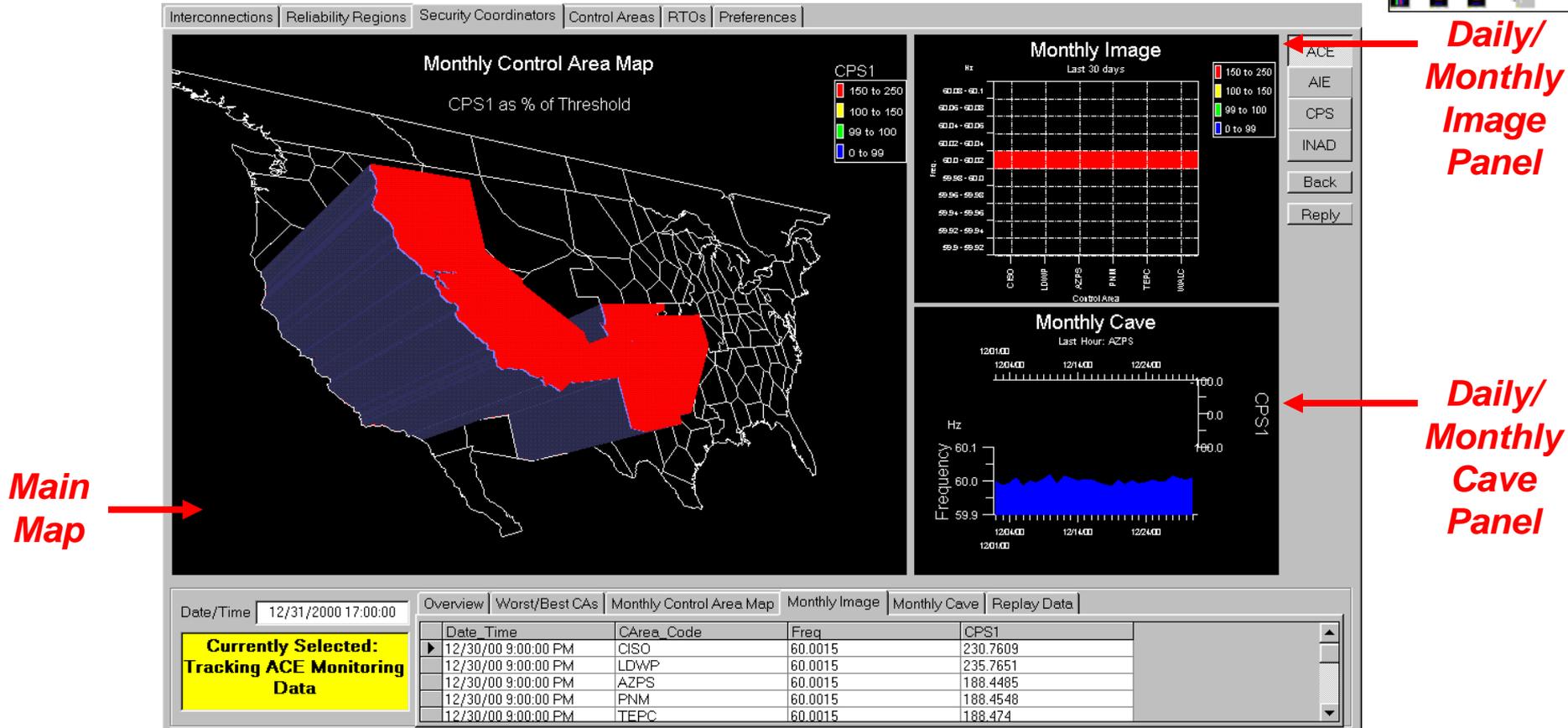
ACE - Control Areas - Tracking



- This is a 3D Map where the Height of each area is proportional to the Ranking (daily cumulative CPS1 as % of threshold)
- Here, the user is able to select some or all of the control areas and a time boundary for the data.
- Right-Click on the map and choose from the menu All or one of the Selected Adjacent options.
- When prompted, enter a Date/Time Boundary for the Data.

ACE - Control Areas - Tracking

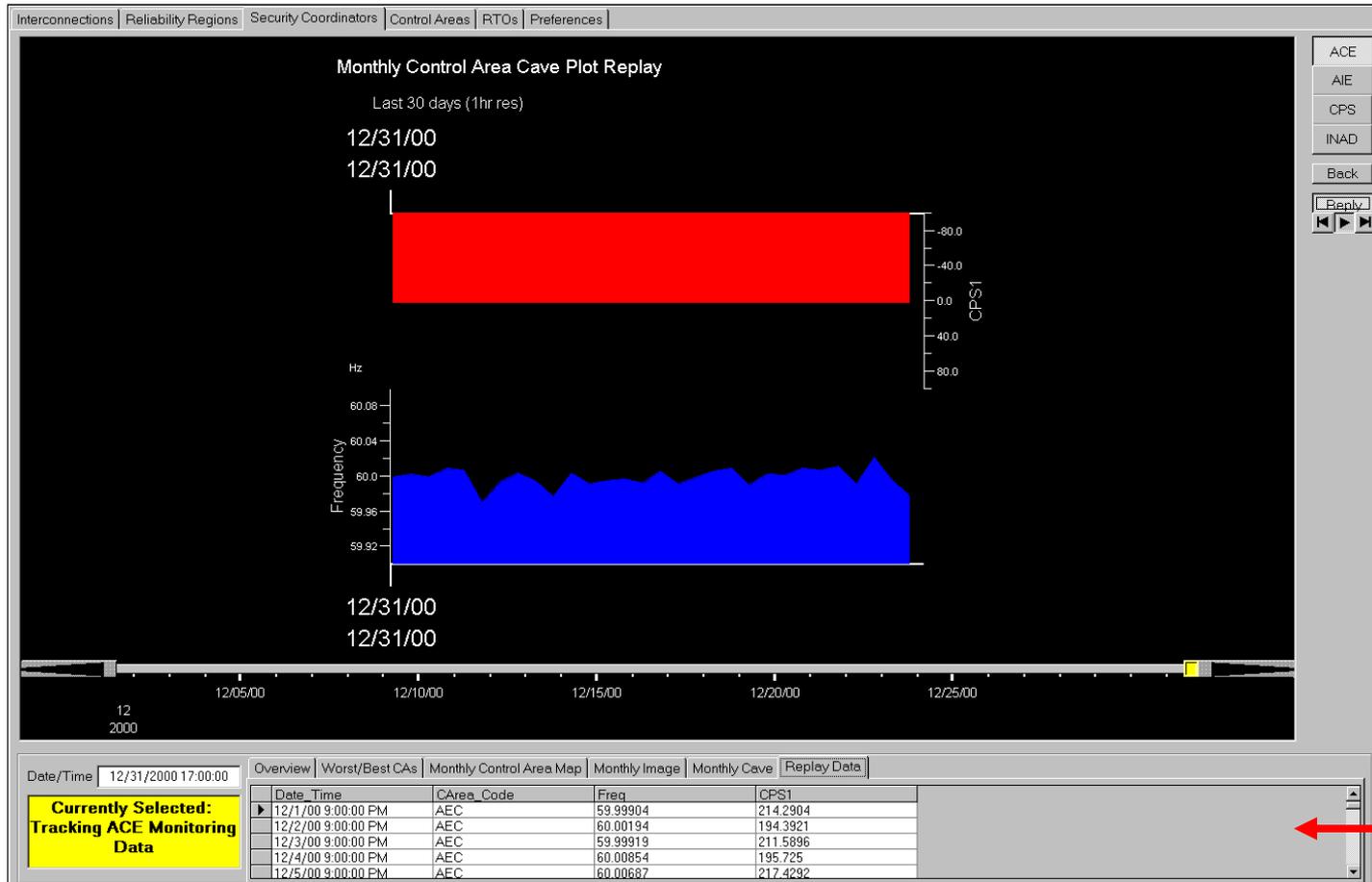
Daily/Monthly Control Area Map (CPS1 as % of Threshold)



- Three Panels to choose from (right-click on any one to display in full screen)
- Daily/Monthly CA 3D Map displays the Height proportional to Ranking (daily cumulative CPS1 as % of threshold)
- Daily/Monthly Image displays Control Area(s) (x), Frequency Deviation (y) and CPS1 (color)
- Daily/Monthly Cave displays one Control Area's daily Frequency Deviation (y1) and CPS1 (y2) for the given month (x)
- User can select a CA from the Monthly Image panel (by holding down the <Ctrl> button) and the data for that Control Area will be displayed in the Monthly Cave

ACE - Control Areas - Tracking

Daily/Monthly Control Area Cave Plot Replay



← **Replay Controls**

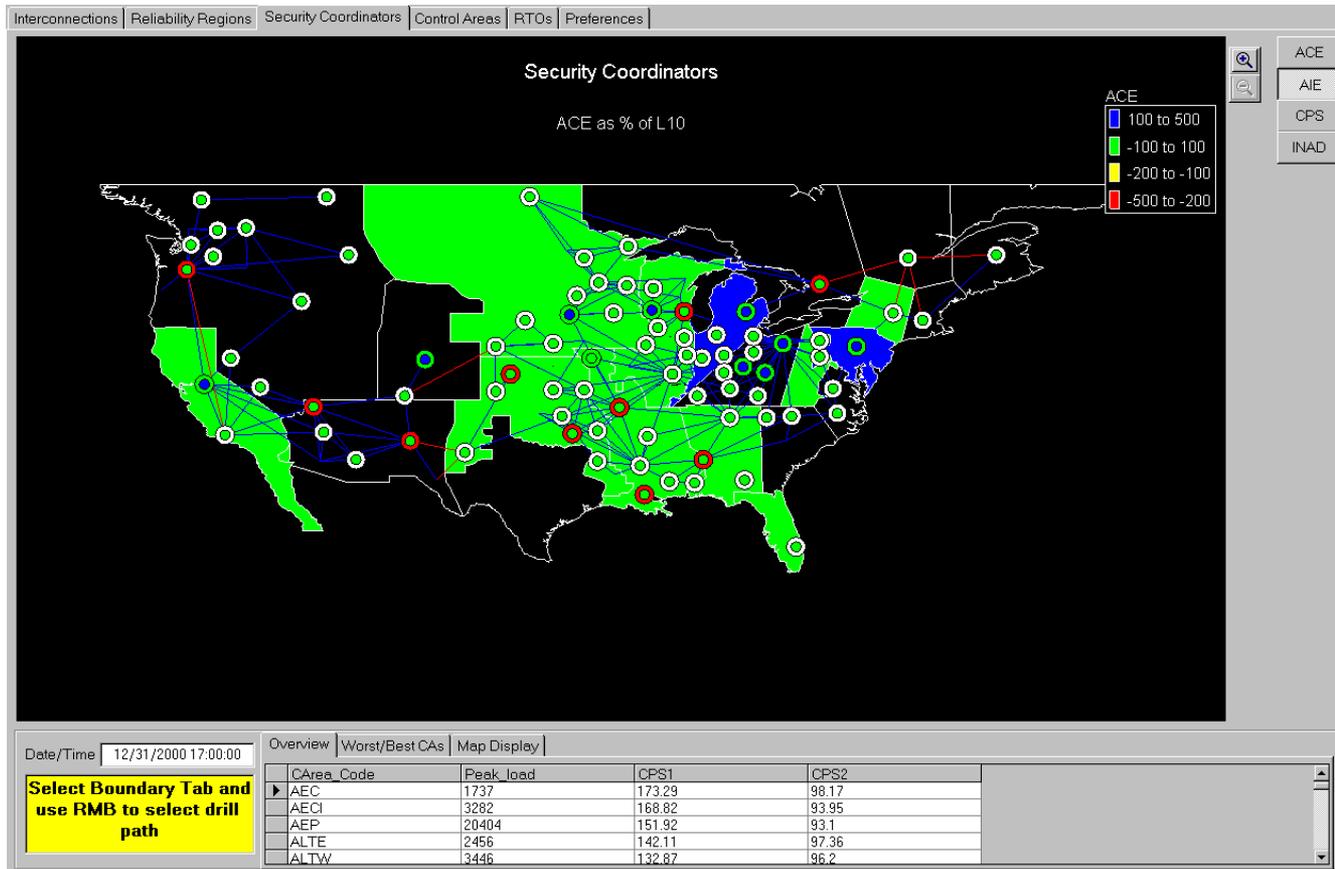
← **Replay Cave Data**

Time Line

- This Replay feature is available for any of the three panels (3D Map, Image, Cave) on the previous screen by right-clicking on any of the panels and then clicking on the Replay button.
- Default Replay is for the 3D Map
- For Local Monitoring, the replay feature is set for 48 hour span, 1-minute increments
- The Hourly Image will change to show the CPS1 of the Control Areas for the last 48 hours
- Click the Replay Button to begin.
- Select the Rewind button  first **followed** by the Play button  to start the Replay

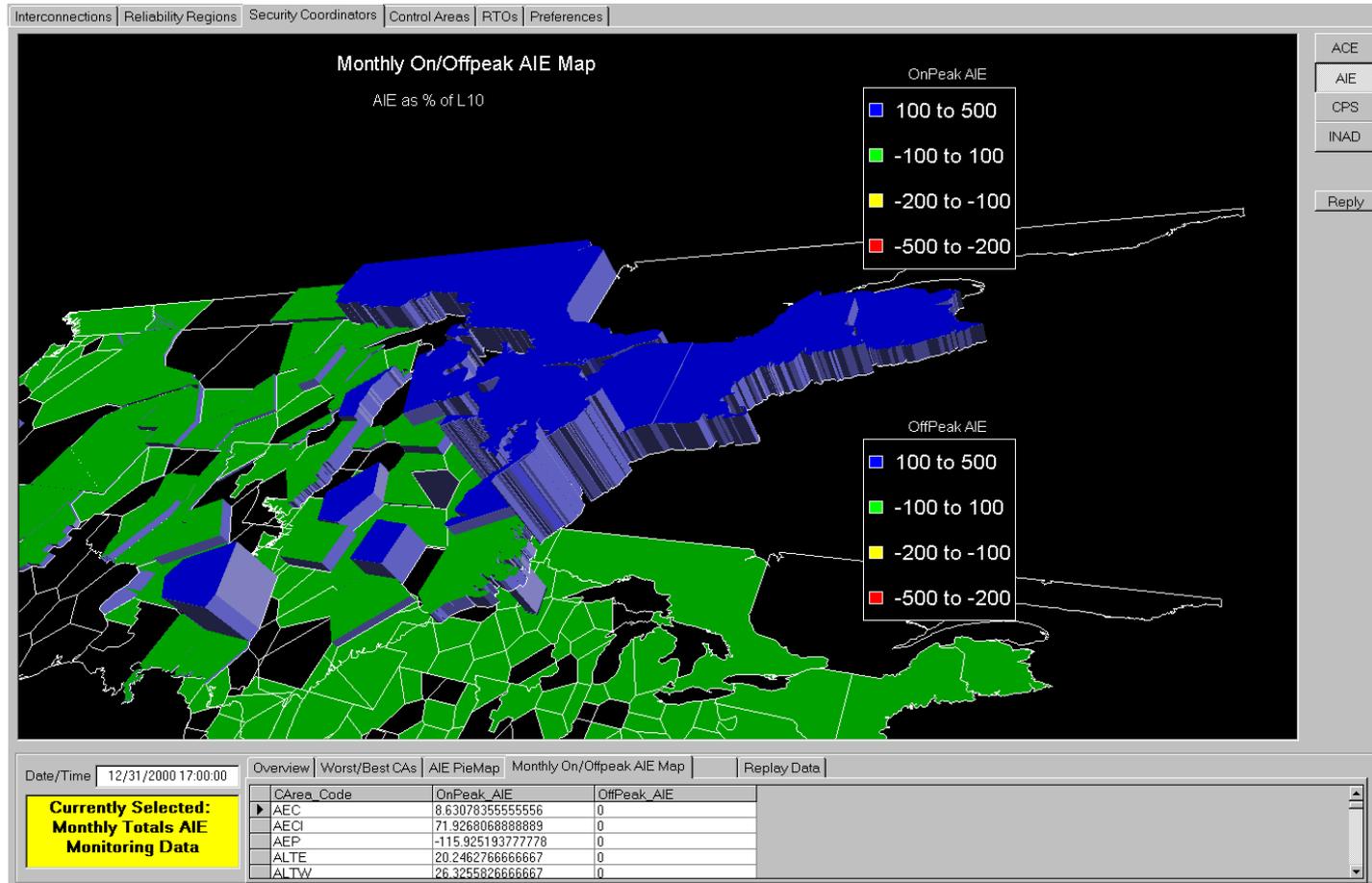
PRELIMINARY AIE COMPLIANCE MONITORING VISUALIZATION

AIE Default Display



- Each bubble  represents a Control Area. The Inner most color is the AIE. The outermost is the ratio AIE/L10 where $AIE / L10 > 1$ Red, $AIE / L10 < 1$ Blue, and anything else = White.
- The Security Coordinators tab is the default display.

AIE - Performance Views Monthly, Daily, Hourly



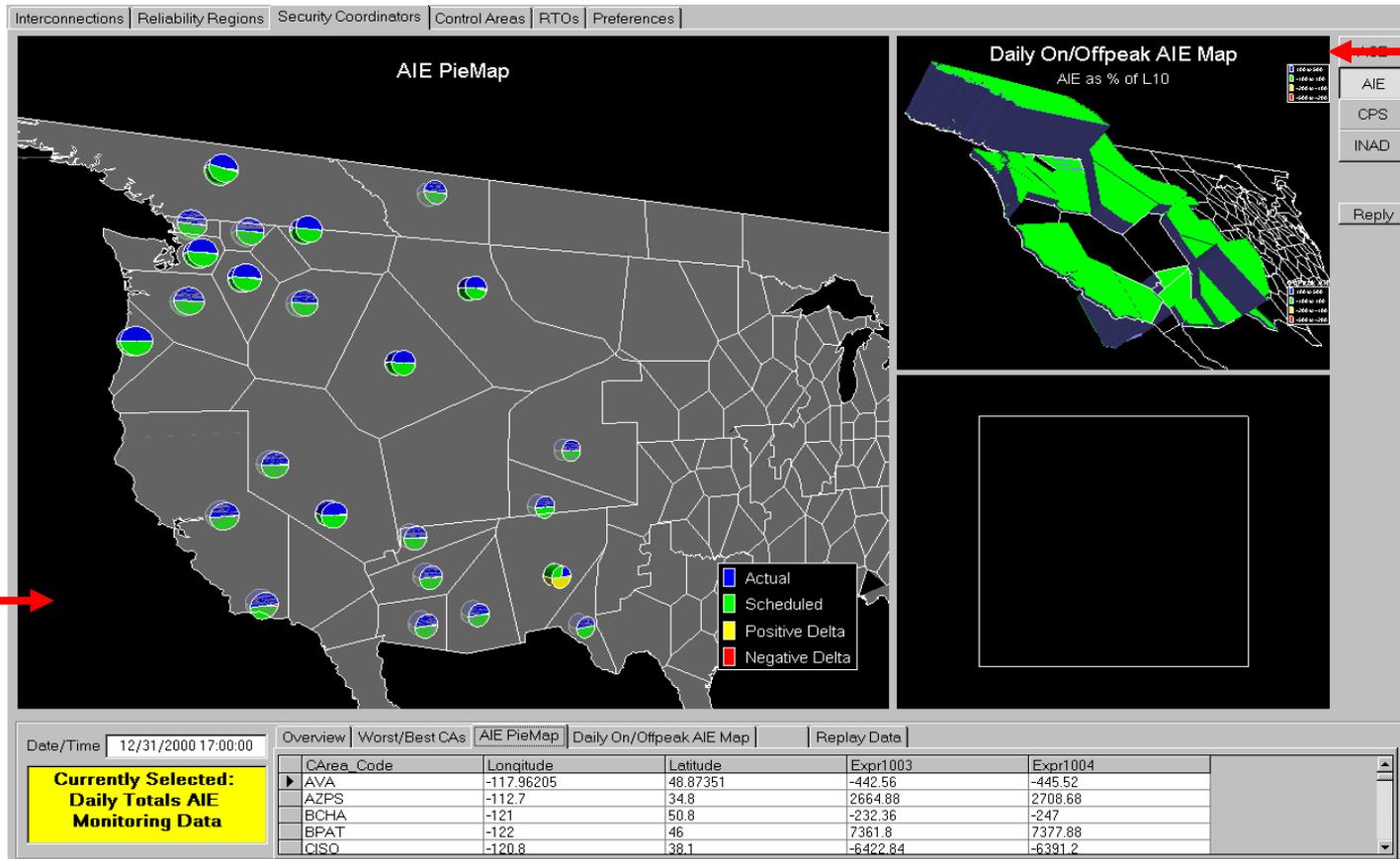
- This is a 3D Map where the Height of each area is proportional to the Ranking (AIE(s) as % of L10 at On/Off Periods)
- This map is available in three different time variations: Monthly, Daily and Hourly.
- The user can get view these maps by clicking on the AIE button in the top right hand side, clicking on Performance, then selecting from Monthly, Daily or Hourly.

AIE - Monitoring Data



On/Off Peak

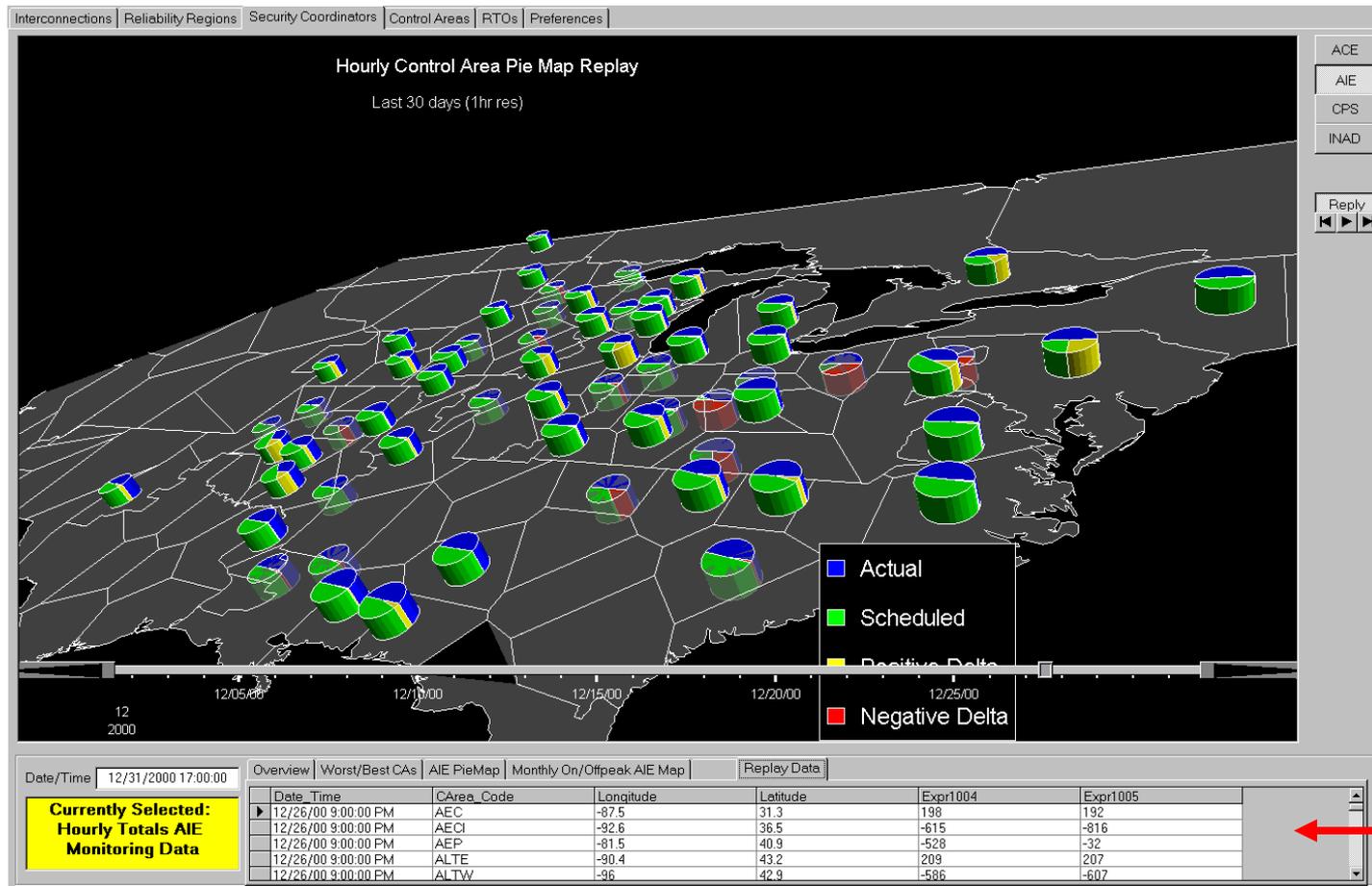
Main Map



- Two Panels to choose from (right-click on any one to display in full screen)
- Main Map is a 3D Map with Actual Interchange, Schedule Interchange and Inadvertent.
- Daily On/Off peak AIE Map displays AIE as % of L10

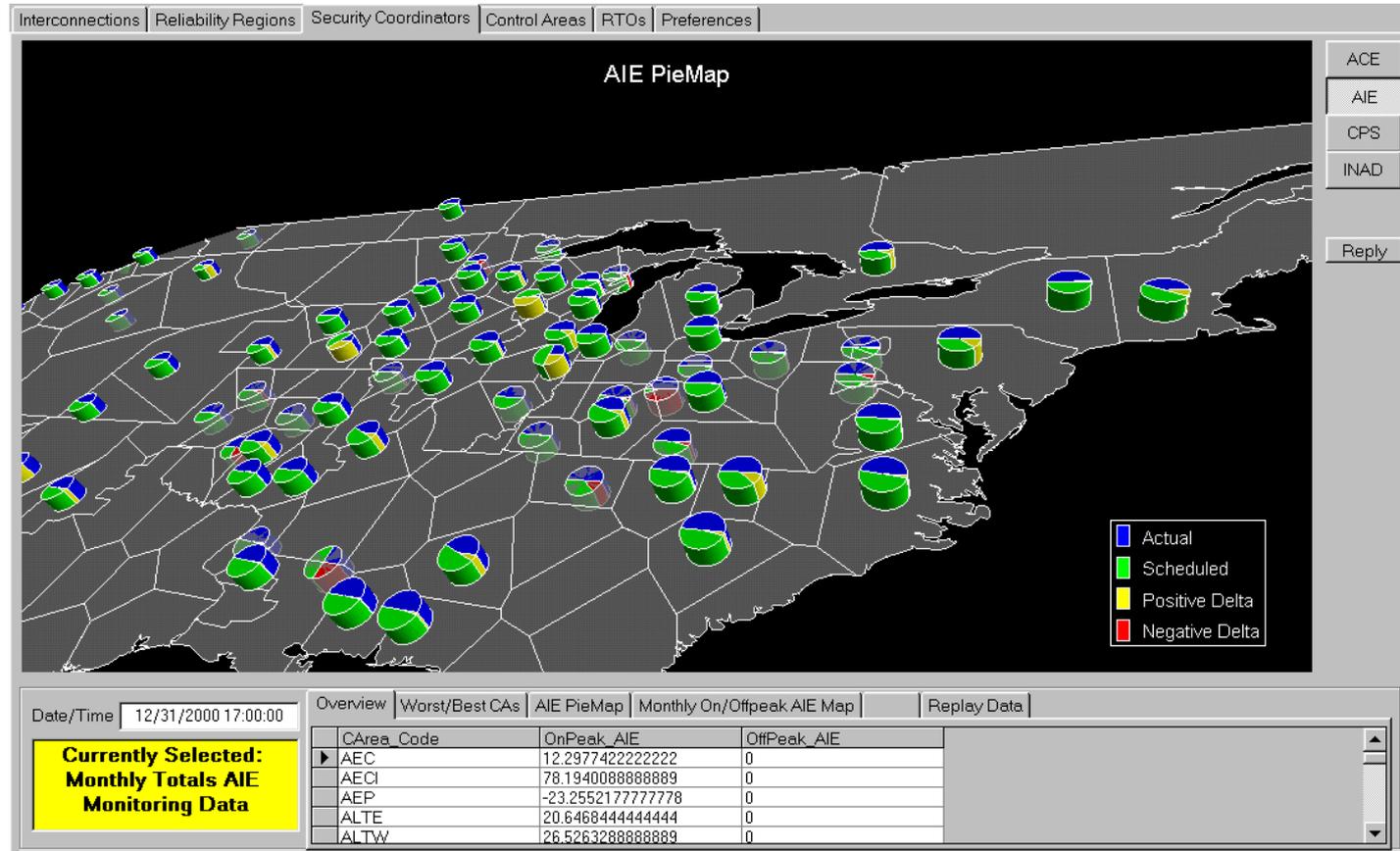
AIE - Replay

Available for Performance & Data Views



- This Replay feature is available for both of the main AIE Functions, Performance and View Data by clicking on the Replay button.
- For Hourly 3D Pie, the replay feature is set for 30 day span, 1- day increments
- Click the Replay Button to begin.
- Select the Rewind button  first followed by the Play button  to start the Replay

AIE - Views of Input Data For Validation Daily, Hourly



- This is a 3D Map with Actual Interchange, Schedule Interchange and Inadvertent.
- This map is available in two different time variations: Daily and Hourly.
- The user can view these maps by clicking on the AIE button in the top right hand side, clicking on View Data, then selecting from Daily or Hourly.

AIE - Web Base Data Entry



AIE Web Base Data Entry

Select a Control Area ▼

Date_Time

Actual_Interch

Sched_Interch

BIP

UIP

Unknown

Hourly_Avg_Freq_Error

- This is a mock-up of the AIE Web Entry Form. The final version will vary.
- From here, the user will be able to re-submit their raw data into the system.
- There will also be a Web Form to handle Noncompliance issues as well as Disputes.