

Real-Time Visualization and System Modeling



A PowerWorld Retriever Update
NASPI Work Group
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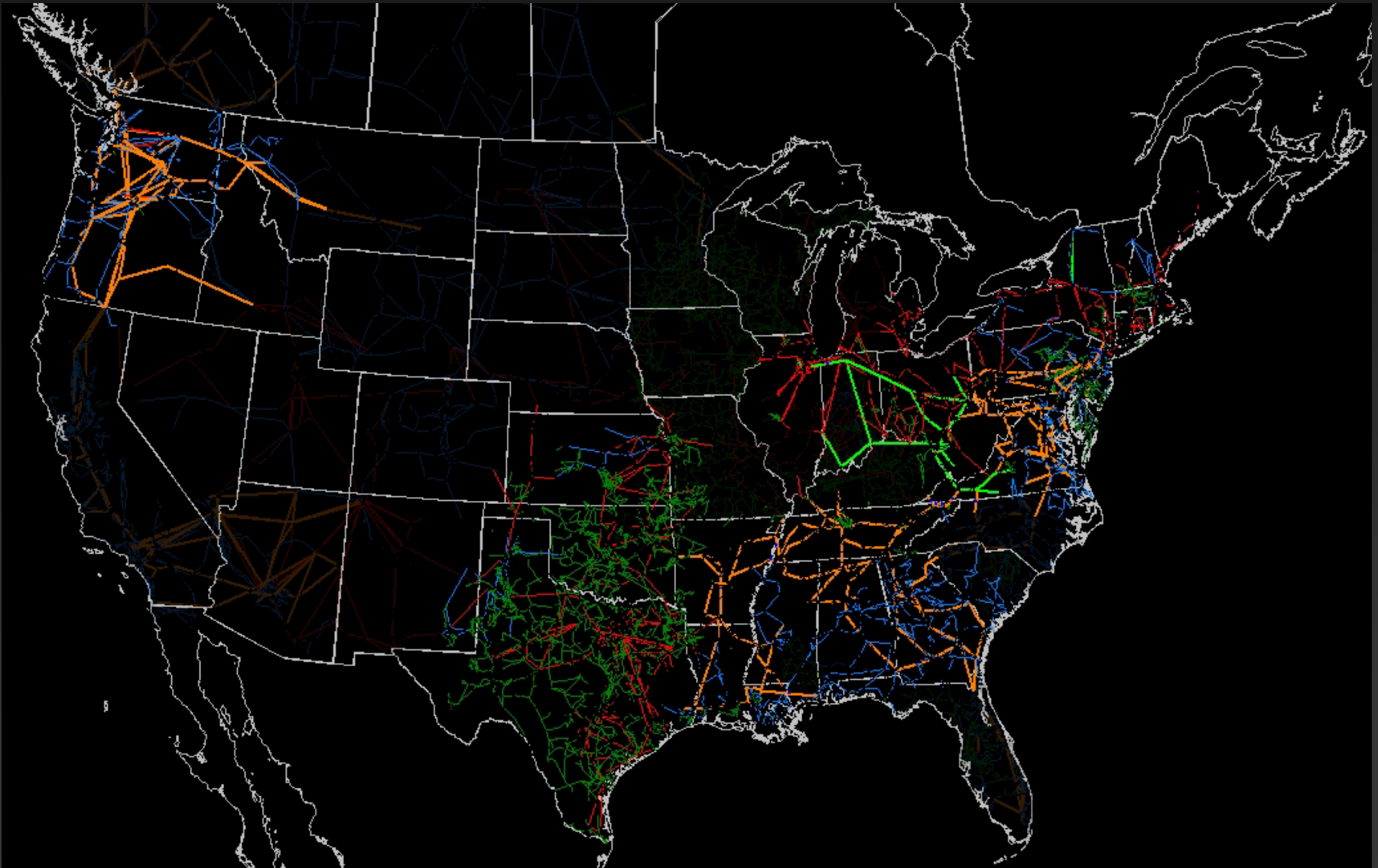


PowerWorld Retriever

- Real-time visualization
- Provides overview of system health to enhance situational awareness
- Easy to develop wide-area, regional, and local system diagrams
- Independent of EMS platform
- Remote and LAN access
- Internal Topology Processing allows ready analysis of real-time models in PowerWorld environment



Retriever Deployment



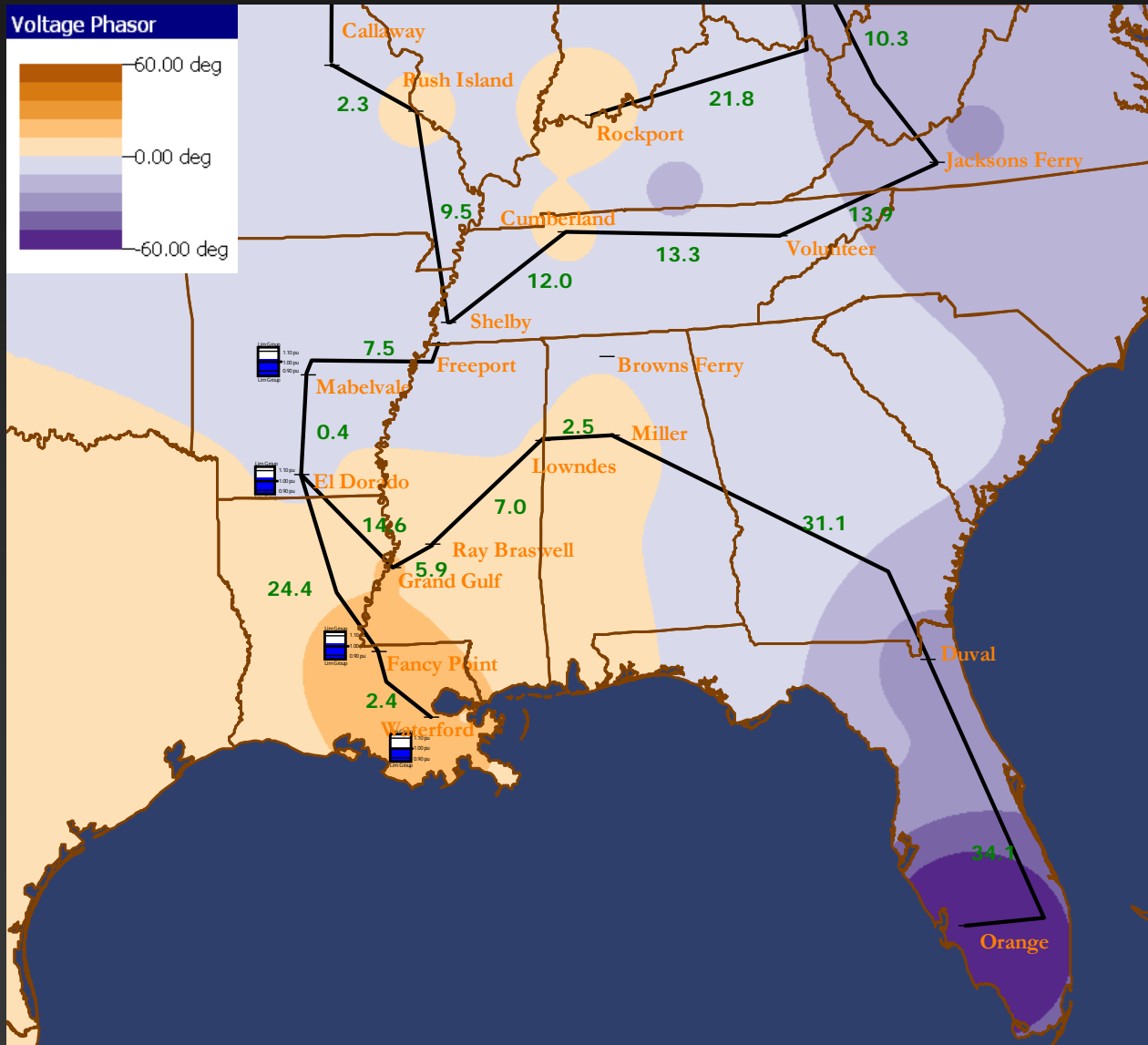


Retriever Deployment

- Covers roughly 60% of load in Eastern Interconnect, 100% of ERCOT, BPA in Western Interconnect, and TransGrid in Australia
- Independent System Operators
 - PJM, ISO New England, New York ISO, Southwest Power Pool, ERCOT ISO
- Utilities
 - AEP, BPA, TVA, Southern Company (Alabama Power, Mississippi Power, Georgia Power), ITC, Texas Utilities, Entergy, Exelon (ComEd), SCANA, Springfield (IL) City Water Light and Power



Angle Contour





Path Angle Differences

Change of color, line weight, flashing, or other characteristics may be used to indicate alarm condition

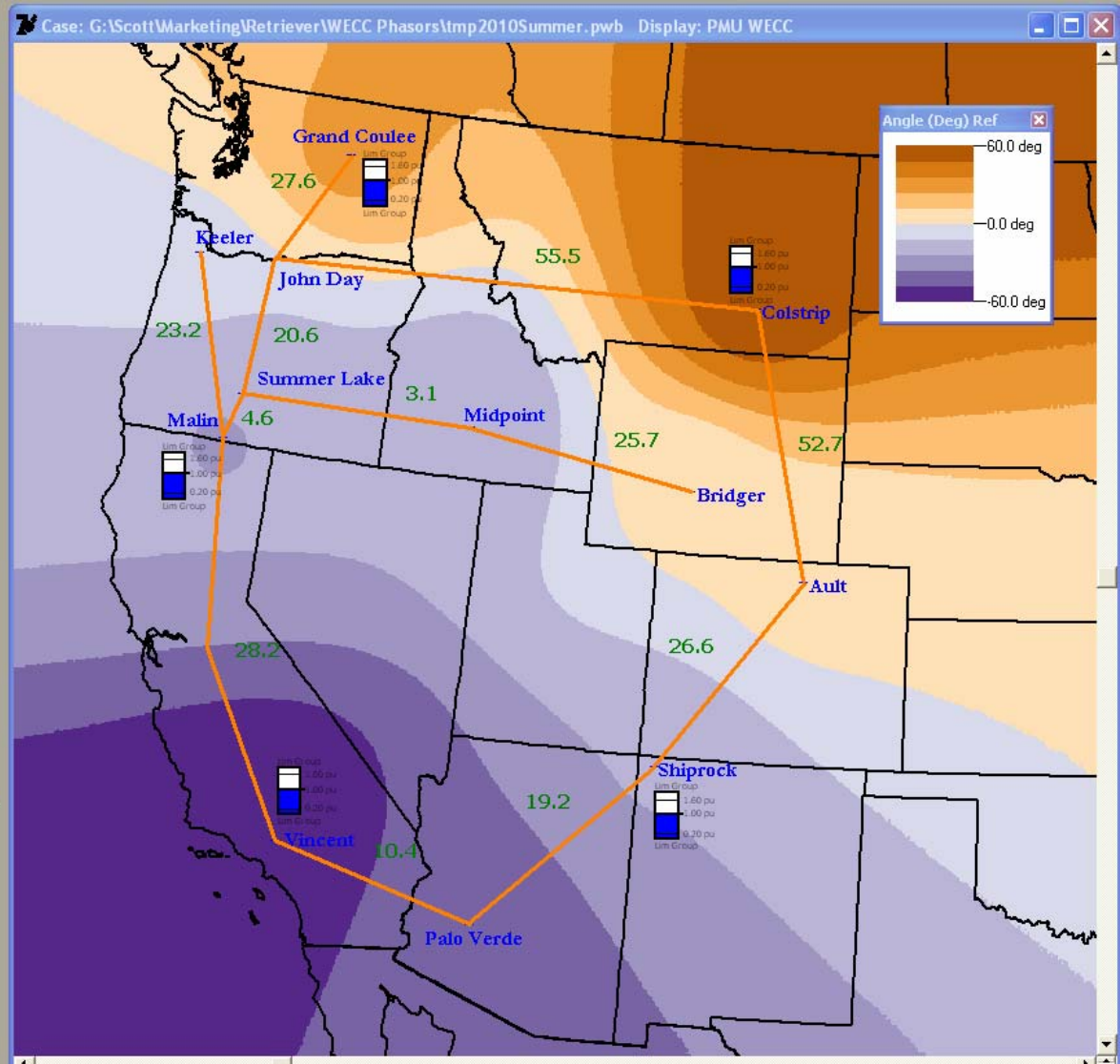




Multi-Mode: Text, Contour, and Gauges

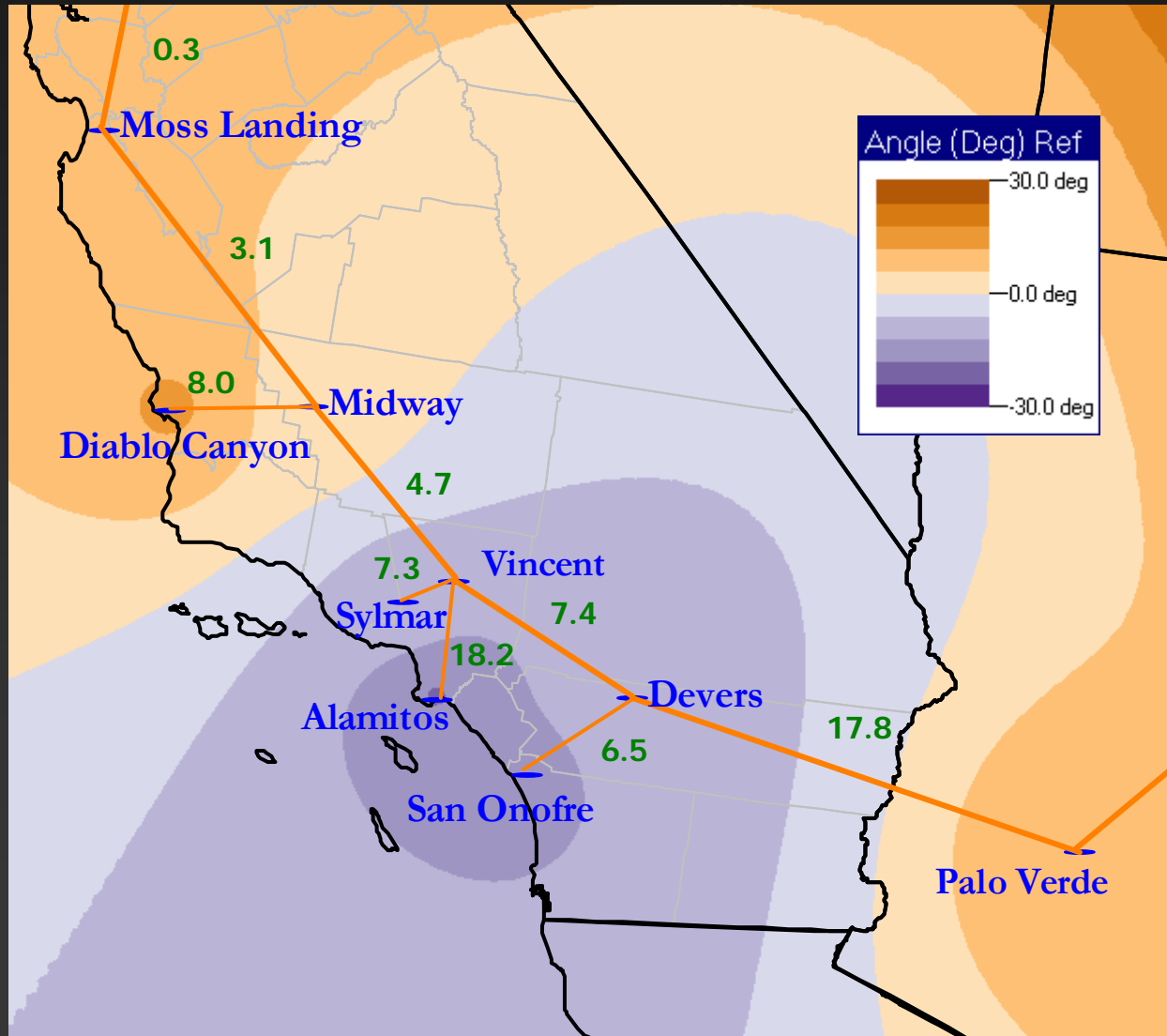
Bus Records (Filter: PMU buses)

	Number	Cust String 1	Nom kV	Angle (Deg) Ref	PU Volt
1	24006	Alamitos	230	-71.6	0.99273
2	24131	San Onofre	230	-67.2	1.00000
3	24801	Devers	500	-60.8	1.03285
4	26094	Sylmar	230	-60.7	1.01485
5	24156	Vincent	500	-53.4	1.04286
6	30060	Midway	500	-48.6	1.06372
7	30526	Pittsburg	230	-47.8	1.01480
8	30035	Tracy	500	-45.8	1.06056
9	30045	Moss Landing	500	-45.5	1.05223
10	15021	Palo Verde	500	-43.0	1.07000
11	30057	Diablo Canyon	500	-40.7	1.06480
12	30005	Round Mountain	500	-32.3	1.05949
13	40687	Malin	500	-25.1	1.06409
14	79095	Shiprock	500	-23.8	1.02545
15	60240	Midpoint	500	-23.7	1.06133
16	41043	Summer Lake	500	-20.6	1.07120
17	40601	Keeler	500	-1.9	1.06161
18	40585	John Day	500	0.0	1.08000
19	60085	Bridger	345	2.0	1.05000
20	73012	Ault	345	2.8	1.02395
21	40287	Grand Coulee	500	27.6	1.08000
22	62057	Colstrip	500	55.5	1.08000



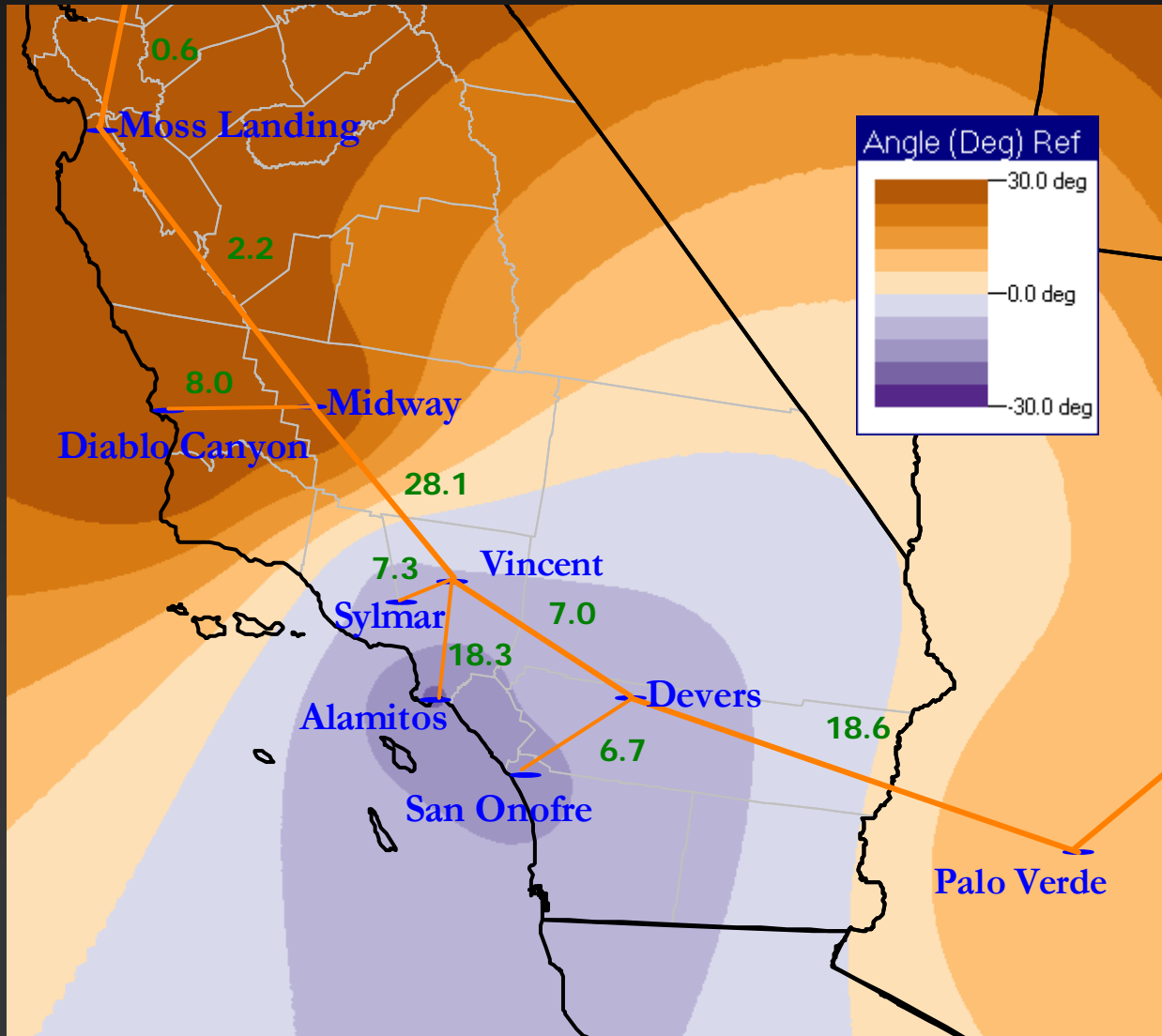


Southern California Detail





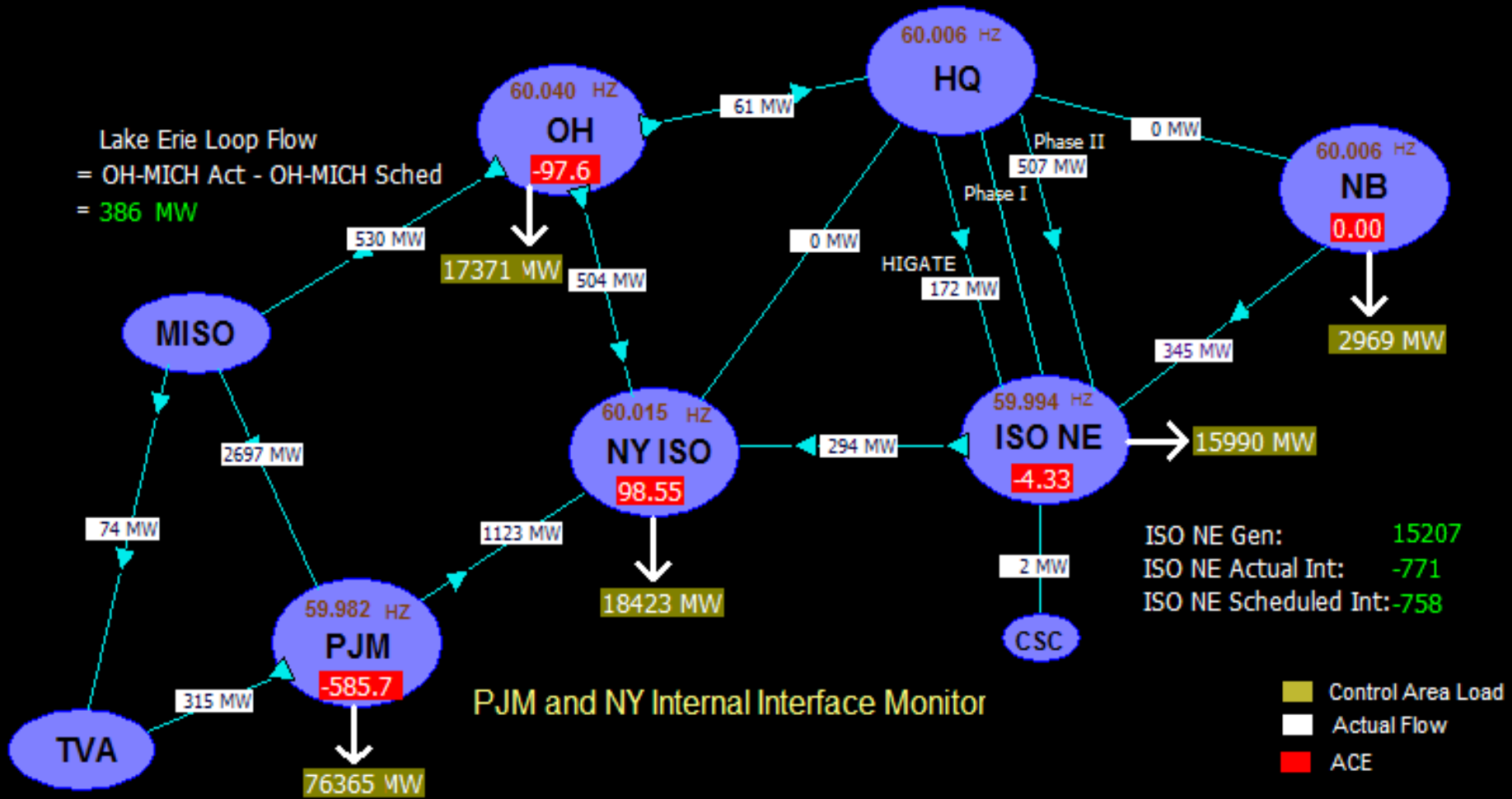
Contingency: Loss of Midway-Vincent 500kV



ISO-NE: Wide-Area Monitor

Courtesy: ISO New England Inc.

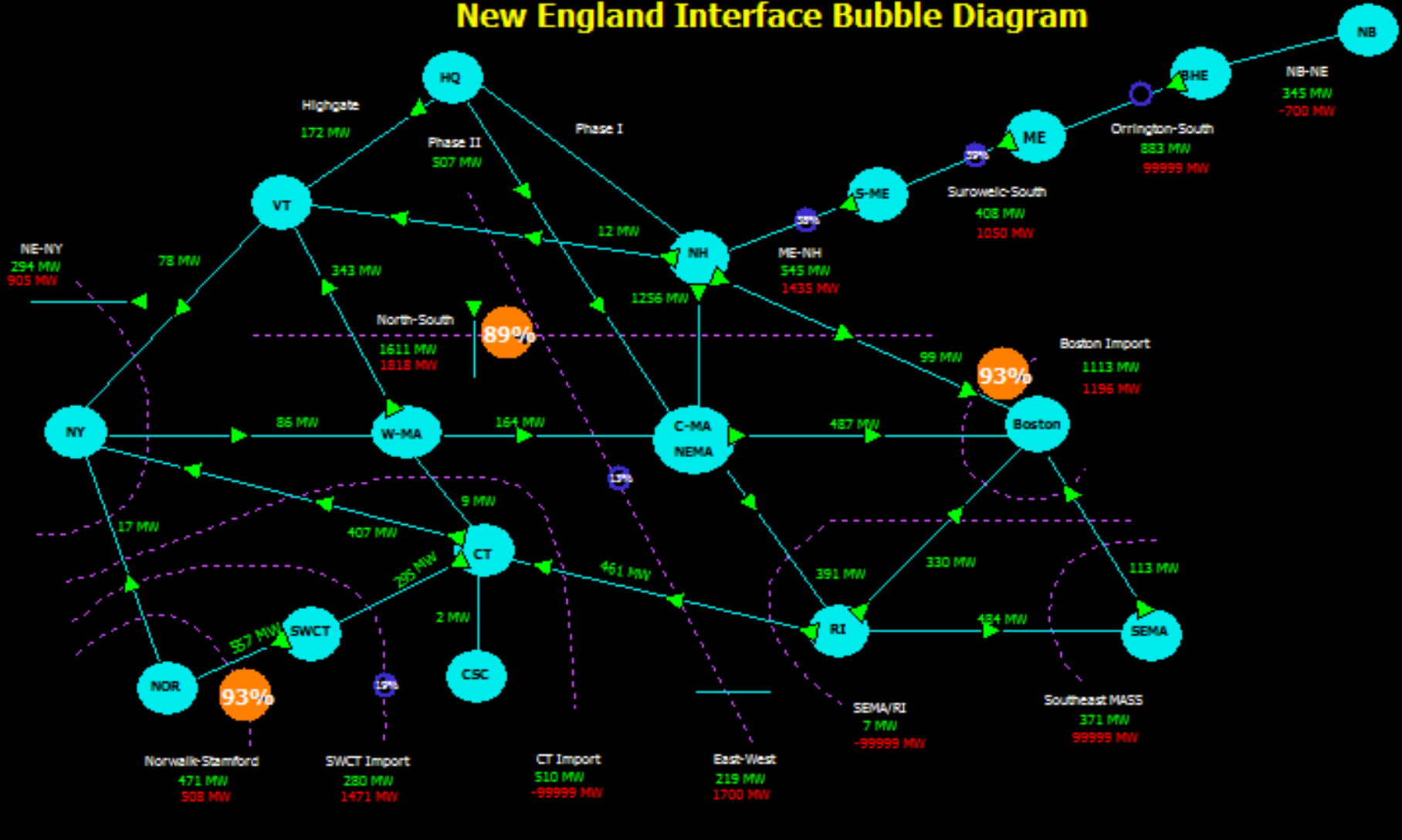
Wide Area Monitor



ISO-NE: Internal Interfaces

Courtesy: ISO New England Inc.

New England Interface Bubble Diagram

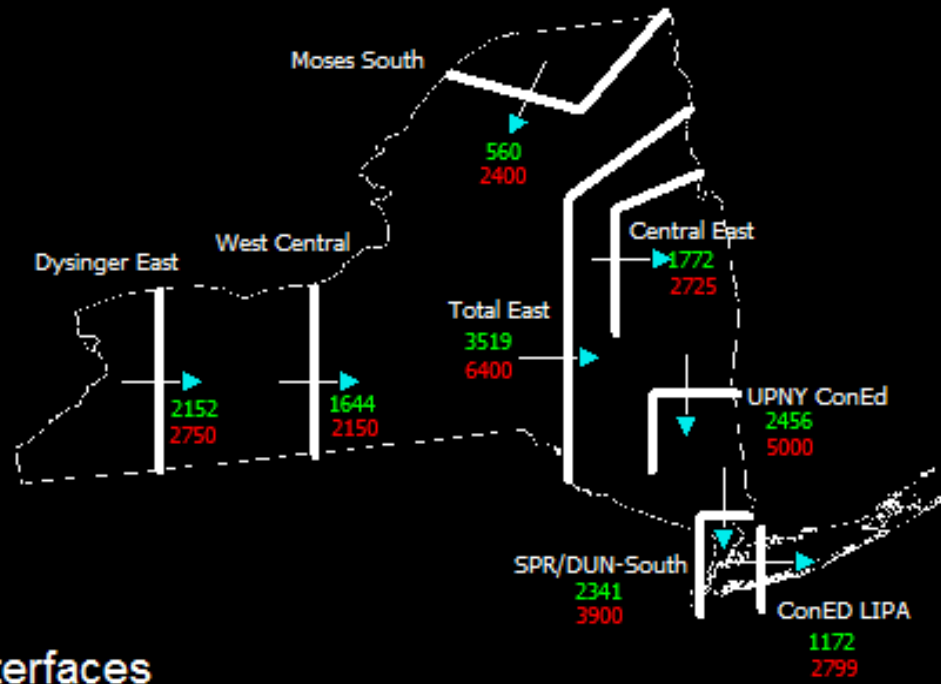


ISO-NE: Neighboring Interfaces

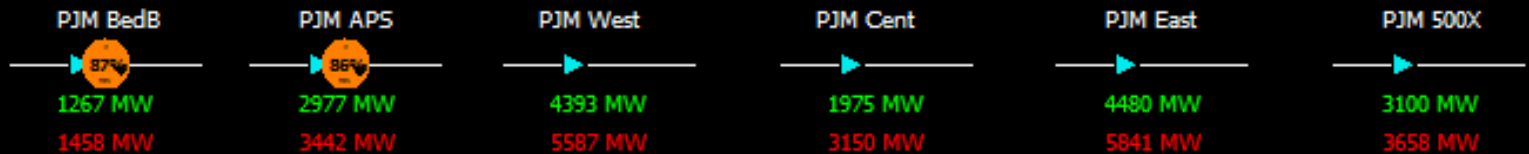
Courtesy: ISO New England Inc.

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PJM and New York Internal Interface Monitor



PJM Reactive Interfaces





Retriever Add-ons

- Topology Processing: solve a power flow case from a real-time, full-topology, bus-breaker model
- Plug-in Data Source: customize interface between Retriever and real-time data stream
- Shapefile Data Source: retrieve GIS images in ESRI shapefile format
- Image Exporter: automatically post Retriever displays to the web



Topology Processing

- Create a power flow case from real-time state estimator data
- Bridge the real-time, full-topology, EMS node-breaker model and reduced bus-branch model – automatically within PowerWorld Simulator
- Bring planning tools to real-time environment
 - Contingency, available transfer capability, voltage stability analysis - based on actual system conditions
 - Evaluate operational transfer limits for interface ratings
 - Operator training for emergency operation or post-mortem analysis



Topology Processing: Which Model?

- The full Node-Breaker model does not change between EMS updates
- Bus-Branch model may change each time it is created from EMS, depending on breaker states
- One-line diagram and integrated study tools such as Interface and Contingency Definitions must be linked to a CONSTANT model
 - Node-Breaker is a better fit
 - PowerWorld Topology Processing automatically handles model reduction for speed and numerical stability



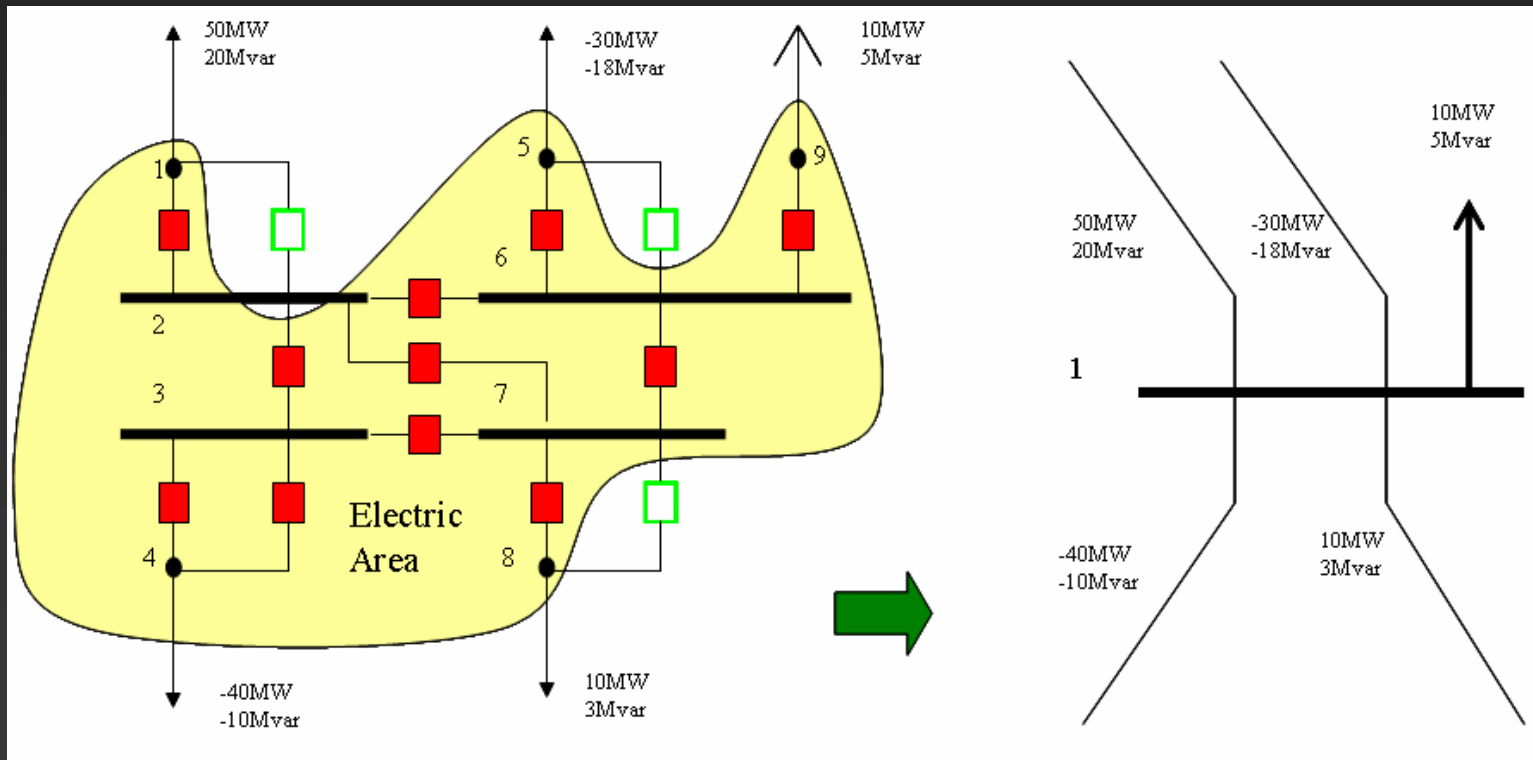
Real-Time and Planning Models

- Real-Time Model

- Node/breaker
- Full topology

- Planning Model

- bus/branch
- Consolidated





TVA DatAWare Connection

- Server-side DatAWare-Retriever bridge
 - Periodically queries the server for new data
 - Publishes the newly retrieved data to a flat file
 - Retriever can access the flat file over ftp, http, or local/LAN

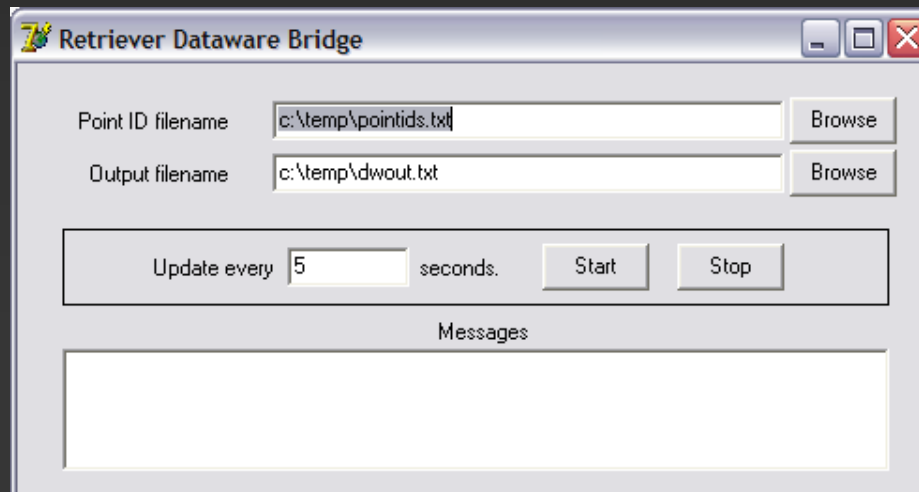
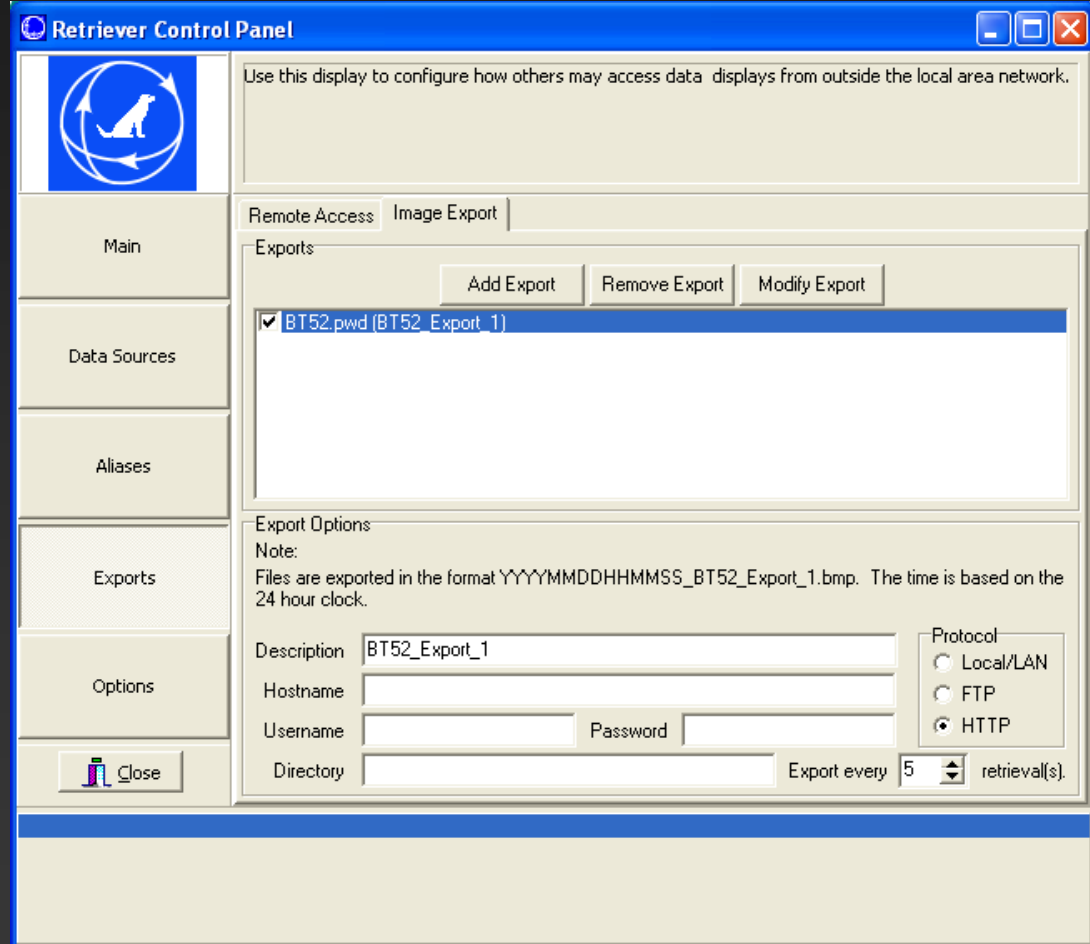




Image Exporter

- Configure Retriever to automatically dump a display to a graphic file at specified interval
- Post a contour for remote or web-based viewing





Summary

- Retriever brings PowerWorld's industry-leading visualization techniques to the real-time environment
- Advantages
 - Flexibility in data and display format
 - Ability to communicate complex data and trends quickly, in a manner that is easily understood
 - Visualization platform developed over several years and guided by hundreds of customers and research
 - Widespread usage in North America
 - Integration of real-time models and planning analysis
 - Ongoing development of cutting-edge tools



Eastern Phasor Visualization

