## Real-Time Visualization and System Modeling



## A PowerWorld Retriever Update NASPI Work Group June 2008



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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**



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## **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**



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## 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

		Case: G:\ScottWarketing\Retriever\WECC Phasors\tmp2010Summer.pwb Display: PMU WECC	
		Grand Coulee 27.6	A deg
buses		Keeler -0.0 de	eg
om kV	Angle (De A PU Volt		
230	-71.6 0.99273	John Day	dea
230	-67.2 1.00000	Colstrip	
500	-60.8 1.03285	20.0 5	
230	-60.7 1.01485	Summer Lake	
500	-53.4 1.04286	3.1 Midmint	
230	-47.8 1.01480	Malin 4.6 Mittpoint 25.7 50.7	
500	-45.8 1.06056		
500	-45.5 1.05223		
500	-43.0 1.07000	Bridger	
500	-40.7 1.06480		
500	-32.3 1.05949		
500	-23.8 1.02545		
500	-23.7 1.06133		
500	-20.6 1.07120	han	
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Bus Records (Filter:PMU buses)					
	Number	Cust String 1	Nom kV	Angle (Dei 🛦 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

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## **Southern California Detail**







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### **ISO-NE: Wide-Area Monitor**





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### **ISO-NE: Internal Interfaces**





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## **ISO-NE: Neighboring Interfaces**

Courtesy: ISO New England Inc.

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**Retriever Add-ons** 

- Topology Processing: solve a power flow case from a real-time, full-topology, busbreaker 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 nodebreaker 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 postmortem analysis

### **ISO-NE: PowerWorld EMS Integration**

EMS Layer Da

Data Retrieval Layer

Analysis & Visualization Layer

Courtesy: ISO New

England Inc.





- 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



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## **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

<u>7</u> 2 F	🛿 Retriever Dataware Bridge 🛛 💷 🖂 🖂					
	Point ID filename	c:\temp\pointids.txt	Browse			
	Output filename	c:\temp\dwout.txt	Browse			
r						
	Update every	5 seconds. Start Stop				
		Messages				



## **Image Exporter**

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

Retriever Control Panel					
	Use this display to configure how others may access data displays from outside the local area network.				
Main	Remote Access         Image Export           Exports         Add Export         Remove Export         Modify Export				
Data Sources	BT52.pwd (BT52_Export_1)				
Aliases					
Exports	Export Uptions Note: Files are exported in the format YYYYMMDDHHMMSS_BT52_Export_1.bmp. The time is based on the 24 hour clock.				
Options	Description     BT52_Export_1     Protocol       Hostname     C     FTP       Username     Password     © HTTP				
	Directory Export every 5 🚖 retrieval(s).				



## 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**



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