



PowerWorld Retriever is an exciting application of advanced visualization techniques to real-time power system operations. With its popular Simulator product line, PowerWorld Corporation has been an innovator in utilizing new, effective approaches to clarifying the often complicated trends and relationships that characterize electric power systems. With Retriever, PowerWorld extended these techniques to the control room, giving system operators the tools they need to make quick, informed, and appropriate decisions.

Real-Time Visualization to Enhance Situational Awareness

The same innovative visualization techniques PowerWorld developed for the popular Simulator analysis package have been implemented in Retriever, along with several others especially suited for real-time monitoring.

- Contouring technology to depict the spatial variation of virtually any power system quantity over a region, including bus voltages and angles, bus marginal prices, loads, generation, and branch flows;
- Gauges to illustrate numerical quantities such as bus voltage or generator output; may be used in conjunction with contouring to simultaneously show related quantities, such as voltage magnitude and angle;
- Dynamic object formatting to allow comprehensive alarming by changing the display characteristics of any object or its related text, such as transmission lines, substations, generators, or loads, according to any specification;

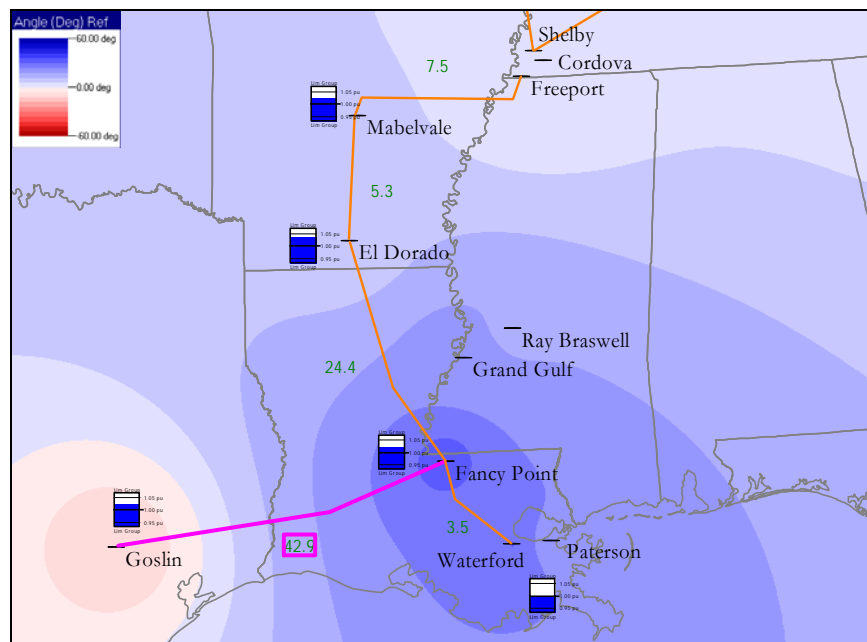


Figure 1 - Gauges depict voltage magnitude; contouring depicts phase angle, with numeric readings for angle differences across path and dynamic emphasis showing alarm condition (in pink)



- Animated branch flows show unequivocally the magnitude and direction of transmission line flows;
- Alarm indicators such as pie charts to indicate the magnitude of branch flow relative to equipment rating and that change in size and color as warning and overload conditions are reached;

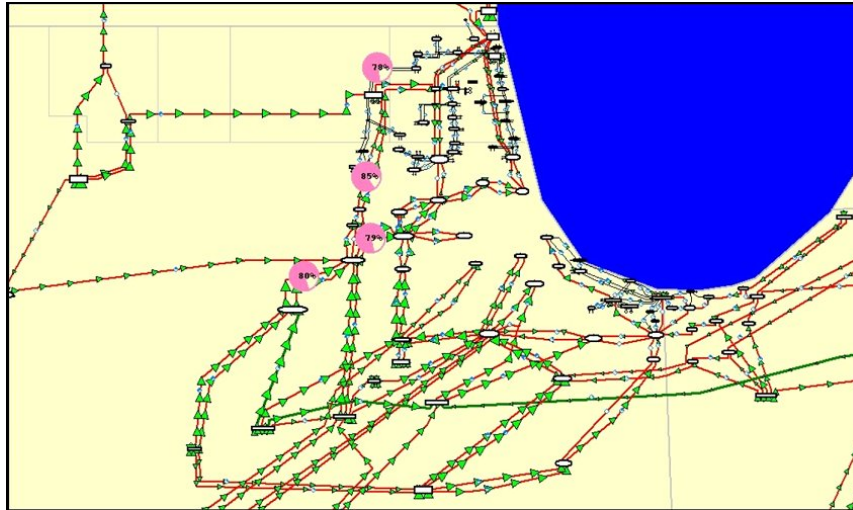


Figure 2 - Arrows to show direction and magnitude of flow, with enlarged pie charts to show heavily loaded transmission facilities

- Geographic views with dynamic viewports that support zooming and panning, thus allowing a very large geographic region to be displayed;
- Automatically generated node views to summarize all relevant information concerning a node, including its current measurements, connected equipment, and neighboring nodes;
- Component status highlighting to quickly draw attention to off-line generators and open transmission elements.
- GIS integration to incorporate other features into the display of the power system, such as terrain topology or weather; and
- Strip charts to record changes in parameters over time.

Data Formats and Protocols

What distinguishes Retriever from its planning-mode cousin is the ease with which it connects to external, real-time data sources. Retriever can import real-time data from:

- DatAWare, a data aggregation and archival tool developed by TVA. Retriever access is through a server-side bridge;
- PI System, a data aggregation and archival tool developed and marketed by OSISoft.



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- eDNA, a data aggregation and archival tool developed and marketed by Instep;
- Flat-text data sources having a very flexible, user-defined format and residing on both LANs and WANs; and
- ODBC data sources using SQL.

Retriever can simultaneously import the most current data from one or more sources. The data retrieval may be initiated manually or set to occur at specified intervals. It then maps the retrieved data to the appropriate fields in an underlying topology model, where Retriever's visualization engine can depict the data in the clear, dramatic, and colorful way PowerWorld customers have come to expect. Supported communication protocols include ftp, http, and secure shell.

For PI, eDNA, and DatAWare data sources, Retriever can display the evolution of a system over time by accessing archived historical data over a prescribed period. This feature allows the user to produce a movie of system events, which may be particularly useful for operator training and for post-mortem analysis. The PI and eDNA interfaces enable the retrieval of real-time or historical streams.

Retriever data interfaces have been continuously improved and optimized to reduce access times. For example, the PI interface has recently been upgraded to allow the simultaneous retrieval of large arrays of data with a single call.



Solve a Power Flow Case with Real-Time Data

Retriever includes a topology processing module which allows the automated population and conversion to a bus/branch from the underlying full-topology node-breaker model.

A real-time power flow solution can be obtained and results mapped to the full-topology model for analysis or visualization. This feature generally requires high-quality state estimator inputs with good coverage of the modeled system to ensure convergence of the resulting power flow case.

The bus/branch model can be used for off-line analysis of contingencies, available transfer capability, security-constrained optimal dispatch, and much more, using PowerWorld analysis tools.

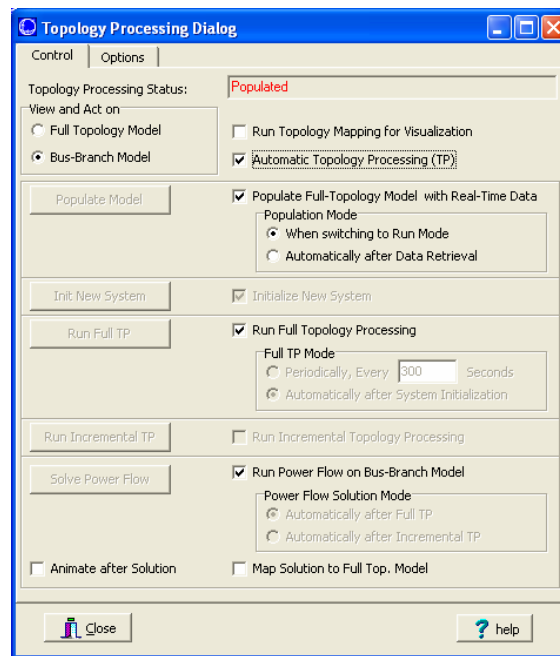


Figure 3 - Topology Processing Options

Real-time analysis features are being continuously enhanced and will soon include:

- Dynamic topology processing, which will allow a faster translation to a bus-branch model by merging or splitting buses when the system topology changes; and
- Contingency screening and contingency analysis, which will incorporate the splitting of buses and dynamic breaker configurations under contingencies.



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Status of Deployment for EIPP

PowerWorld Retriever is currently being used by several EIPP participants, including TVA, Entergy, AEP, and Southern Company.

Entergy has demonstrated the viability of reading real-time PMU data from their PI system into PowerWorld Retriever, but deployment in the control room is pending the development of measures to differentiate between normal and abnormal operating characteristics.

TVA, AEP, and Southern Company have deployed and are using Retriever in their control rooms to visualize transmission line flows and system voltages.

ISO-New England, though not currently an EIPP participant, has developed an automated power flow model creation interface and has deployed PowerWorld Retriever's topology processing in the production environment in conjunction with their state estimator.