Technology Innovation Project *Project Brief*

TIP 250: Control Room and Advanced PMU Visualizations Using PowerWorld Retriever

Context

BPA's control room display increases situational awareness and maximizes system safety, availability and reliability margins**.** It has wide-area overviews of graphical data presentation, but needs more effective display technology to accommodate the advent of heightened-precision real-time data. What is already recognized as a high-stress situation, especially during outages and high-risk conditions, cannot be further accentuated by an insufficient visual data stream. To date, BPA has not taken full advantage of recent advancements in power system visualization in the control center. This project advances that effort. For the first time, BPA dispatchers/transmission operations engineers could use the same tools, visualization, and model as BPA planners, promoting ultimate situational awareness.

Description

This project will use a previously created full-topology power system model to implement a new series of power system visualizations in PowerWorld Simulator and Retriever for use in the BPA control center. These visualizations will be for use on BPA's large video wallboard and smaller desktop displays, and scripts will be written to automatically update the displays following system maintenance. Automated building of substation diagrams will also be added to the PowerWorld products. In addition, new tools will be added to PowerWorld's visualization environment to handle phase measurement unit (PMU) data, including trending and real-time contouring of this data. These new tools will be available to both the planning and operations staff of BPA for off line or real time analysis.

Emphasis for this project will be placed on developing a software framework that is user friendly. The ability to quickly and easily display real-time results and generate plots of transient data in a real-time environment will be the primary concern. All new tools will be seamlessly integrated with PowerWorld Simulator and Retriever tools.

Why It Matters

1. The off-line tools, such as contingency analysis and DSA, can be directly used in the real-time production environment without requiring changes to the EMS modeling.
2. Seamless exchange of cases between the real-time and planning environments facilitates comparing the actual operating outcome with the planned operation and correcting model discrepancies. This also allows for developing a centralized model for the power system.
3. The project will greatly simplify maintenance and operation, allowing data managers and engineers to deal with a single format. There is no need to understand multiple models with diverse data structures that should represent the same physical system.
4. A unified set of applications and interfaces can be presented to operators, operation engineers, and planners that make learning and usage easier, faster and cheaper.
5. Powerful visualization tools available in the offline environment can be used within the real-time environment, enhancing situational awareness.
6. Unification of power system models will help enhance operating practices, increasing the capability to predict insecure conditions in the system and making better tools available to identify economic opportunities in the electricity market.
7. Unification of control center technologies will result in savings in time and cost of personnel training.
8. The addition of new PMU visualization techniques will allow a more complete analysis of the stability characteristics of the system.

Goals and Objectives

This project proposes building on the successes of the previous model by closing technology gaps in the transmission services area of the BPA technology RoadMaps. The first project goal is to use the previously created full-topology model to create a new series of real-time visualization displays for use within the BPA control center. These real-time displays will be designed and implemented by PowerWorld in conjunction with BPA operations staff with an emphasis on providing visualizations that meet their needs. Because the detailed full-topology model will be used, there will be no effort required by the operator to maintain a separate underlying data model.

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The second goal will be to greatly reduce maintenance tasks for BPA operators on the new control center displays. This will be accomplished by implementing scripts to automatically create PowerWorld display files from EMS model data. These scripts will run whenever the EMS model is updated and similarly update the displays as needed. In addition, PowerWorld will create a tool that automatically lays out substation displays so that operators may click on a substation visualization and see a display of the connections inside that station, and its real-time data, with little or no effort needed to draw or update the displays.

The third goal will be to link the full-topology model and PowerWorld Retriever visualizations to Phase Measurement Unit (PMU) data. This will involve modifications to the existing PowerWorld Retriever functionality to enable real-time graphing (strip charts) of PMU data and other modifications that will greatly enhance Retriever's ability to visualize and present PMU data. This portion of the project will deliver a state of the art PMU visualization system that is fully integrated into the visualization of all BPA data and includes a very accurate geographic mapping of all PMU data. Mapping the PMU data directly to the full-topology model will enable future projects to take advantage of the integrated topology processing tool, opening up the possibility of advanced analysis tools using PMU data directly in their analysis algorithms.

Deliverables

1. A series of new displays for use in the BPA control center including displays for both the large video wallboard and local workstations.
2. Scripts that will automate the editing of control center displays so that changes to the system model are reflected on the displays. Automation of changes to the system model itself based on EMS model changes is already complete.
3. A new tool in the visualization that allows the operator to click on a substation display and see an automatically constructed nodal diagram including all generators, loads, shunts, breakers, etc. in the substation.
4. A new tool that allows the operator to click on a PMU data point and view a real time, near real time, and long-term trace of the PMU data.
5. A new tool that allows the operator to create a PMU contour map that shows the movement of angle data in real time, and play a movie of the recent events.
6. Assurance that those who will be using the tool are trained on it and have an understanding of the modeling and software issues.

Project Start Date: December 2011

Project End Date: September 2012

Participating Organizations:

PowerWorld

Funding

Total Project Cost:	$702,500
BPA Share:	$352,500
External Share:	$350,000
BPA FY2012 Budget:	$352,500

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