Action Items from BPA Voltage Control Technical Conference held on August 23, 2011

Current State	What we heard at the Conference	Action Items
A. Primary Voltage Control • BPA already requires wind power plants to operate in voltage control with reactive droop. • BPA requires 0.95 power factor dynamic reactive capability at 34.5-kV collector station plus switched shunts to compensate for reactive losses in the collector system • BPA developed typical designs that would meet the requirements	• Reactive droop is needed for stable reactive power sharing among the multiple plants • Wind power plants are capable of very fast voltage control • Manufacturer's would like to see consistent "dynamic performance" requirements, UK example was mentioned	• BPA may need to update the voltage control "dynamic performance" requirements based on the manufacturer's feedback received at the meeting: o Review international practices, particularly UK o Seek collaboration with others, particularly California ISO, ERCOT, Midwest ISO, and PJM Interconnection, UWIG o Engage manufacturer's participation to ensure that the requirements are feasible o Provide examples of control settings that would meet the "dynamic performance" requirements o Instruct wind power plant operators on capacitor switching coordination • BPA may develop certification tests that new and existing projects must perform to demonstrate its voltage control capabilities – make the tests reasonable, not too onerous • Response validation by observation o Review of first month operational data from PMUs and SCADA o Develop tools for continual validation of voltage control • Develop a handbook on voltage controls for wind power plant operators
B. Retrofit Existing Plants • Several existing wind power plants struggle with setting voltage controls to operate correctly in droop mode • BPA need to be able to adjust a power plant voltage schedule either by sending a voltage reference or voltage lower/raise commands.	• It sounds like most plants in BPA control area should have droop capabilities or can be easily upgraded	• BPA work with WTG manufacturers and power plant operators to retrofit and tune up their existing voltage controls. • Addition of the voltage schedule adjustment controls could be included to the retrofit.

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C. Secondary Voltage Controls • A coordinated secondary voltage controller is required at a wind hub to coordinate the reactive output of wind power plants with BPA shunt capacitors • BPA designed the first such controller for Jones Canyon	• Wind plants need to be in droop control for stable reactive power sharing • BPA Jones Canyon design is in agreement with the coordination work done by GE in other parts of WECC	• Initiate a project to design and install secondary voltage controllers at John Day and Rock Creek • Planning will complete the development of Time Sequence Simulator • Planning will complete secondary voltage control studies for John Day and Rock Creek • Design a system-wide coordinated voltage controller (Northwest-wide)
D. Payment for Reactive Power • BPA attempted to pay for reactive power and voltage support in the past, but had overall bad experience	• Reactive power payments received significant interest at the conference	• Should BPA look around to see whether there are any large grid operators similar to BPA where the reactive power payments worked well?
E. Frequency Controls • BPA will require new wind power plants to have a frequency control module	• Wind power plants are capable of very impressive frequency response o Spilling wind is needed for sustained response o Inertial-like response can be provided as well • Utilities need to specify the frequency response requirements, UK was cited as a good example • Need to explore payment for frequency Response	• BPA needs to develop the frequency control "dynamic performance" requirements: o Review international practices, particularly UK o Conduct system studies o Seek collaboration with others, particularly California ISO, ERCOT, Midwest ISO, and PJM Interconnection, UWIG, NREL o Engage manufacturer's participation to ensure that the requirements are feasible • Develop certification tests that a new project must perform during the commissioning to demonstrate its frequency control capabilities • Frequency response validation by observation o Review of operational data from PMUs and SCADA o Develop tools for continual validation of plant frequency response • Develop a handbook on frequency controls for wind power plant developers

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F. Handbook • BPA has voltage control requirements in its interconnection standards	• There were many comments about having a handbook for all developers and plant operators that provides detail on the interconnection and operational requirements, as well as clarity on the compliance measures with applicable NERC Standards	• BPA needs to work with other utilities, plant operators and manufacturers to develop a handbook that provides technical details on the interconnection, modeling and operational requirements for wind power plant developers and operators
G. Operational Data • BPA needs WPP dynamic reactive reserve calculated for the COI and PDCI operations. The calculation will be done by WPP and the reserves will be telemetered to BPA	• Wind power plant management systems appear to have the data for calculating the plant dynamic reactive reserves	• BPA to work with the manufacturers on how to calculate reactive reserves at wind power plants • BPA to work with the manufacturers to implement the reactive reserve calculations in their plant controller that consider the operational point of each wind turbine • Implement reactive reserve calculators at the new and existing wind power plants • WPP operators to provide Reactive Reserve data to BPA
H. WPP Model Data • WECC developed guidelines for wind power plant modeling, including model data forms • BPA has made significant progress in collecting "as-build" model data for wind power plants • Phase 1 of generic dynamic models is available, more work is planned for Phase 2, sounds like the work in progress.	• Many presenters and participants emphasized the importance of having good models and using "as-build" model data • Many presenters emphasized the need for WPP model validation • Validation of plant models will be required by MOD-026 and 027 NERC Standards, and model validation by observation is an acceptable method.	• The effort is on-going • Collaborate with WECC Renewable Energy Modeling Task Force, UWIG / EnerNex, NREL, EPRI, IEEE and CIGRE
G. State Estimator Models • Wind power plant representation in BPA and WECC State Estimators is very deficient	Was not discussed at the meeting	• BPA TP to provide the most recent WPP models to TOS to implement in the state estimator • Programming needs to be done to extrapolate the model from the metered data • Validate state estimator WPP models

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I. PMU program • BPA requires PMUs to be installed at new power plants connected at 230-kV and above • BPA has a project to install PMUs at many existing wind power plants • BPA also has a main grid PMU project which will install PMUs at wind hubs and at many large conventional generators • BPA developed a Power Plant Model Validation (PPMV) application that uses PMU data for model validation of conventional power plants	• Several presenters and participants emphasized the importance of PMU data for performance monitoring and model validation	• BPA needs to establish a PMU program: o Ensure that the new projects have PMUs o Retrofit existing projects with PMUs • BPA needs to extend the PMU-based power plant model validation application to wind power plants • BPA needs to use PMUs to study any possible control interactions related to wind generation
J. Situational Awareness • BPA has very little real-time situational awareness of wind power plant dynamic performance	• PMU-based situational awareness tools were viewed as a high priority	• BPA will research applications for using PMU data for real-time situational awareness of dynamic performance of wind power plants
K. Industry Collaboration • BPA has extensive operating experiences with wind generation	• The conference validated that BPA is on the right track with respect to voltage control, frequency control and modeling • There were many comments on strengthening the voltage control standards at NERC and WECC level, keeping them technology neutral	• BPA needs to be more actively involved in the industry efforts to share their expertise and to influence policy and standard processes at the national level • BPA needs to monitor the policy and standard developments world-wide to adopt the best practices at BPA • BPA needs to look for opportunities to link with others working on wind integration issues – utilities, grid operators, manufacturers, plant operators, RTOs, NERC, WECC, IEEE, EPRI and DOE National Labs