FERC Technical Conference

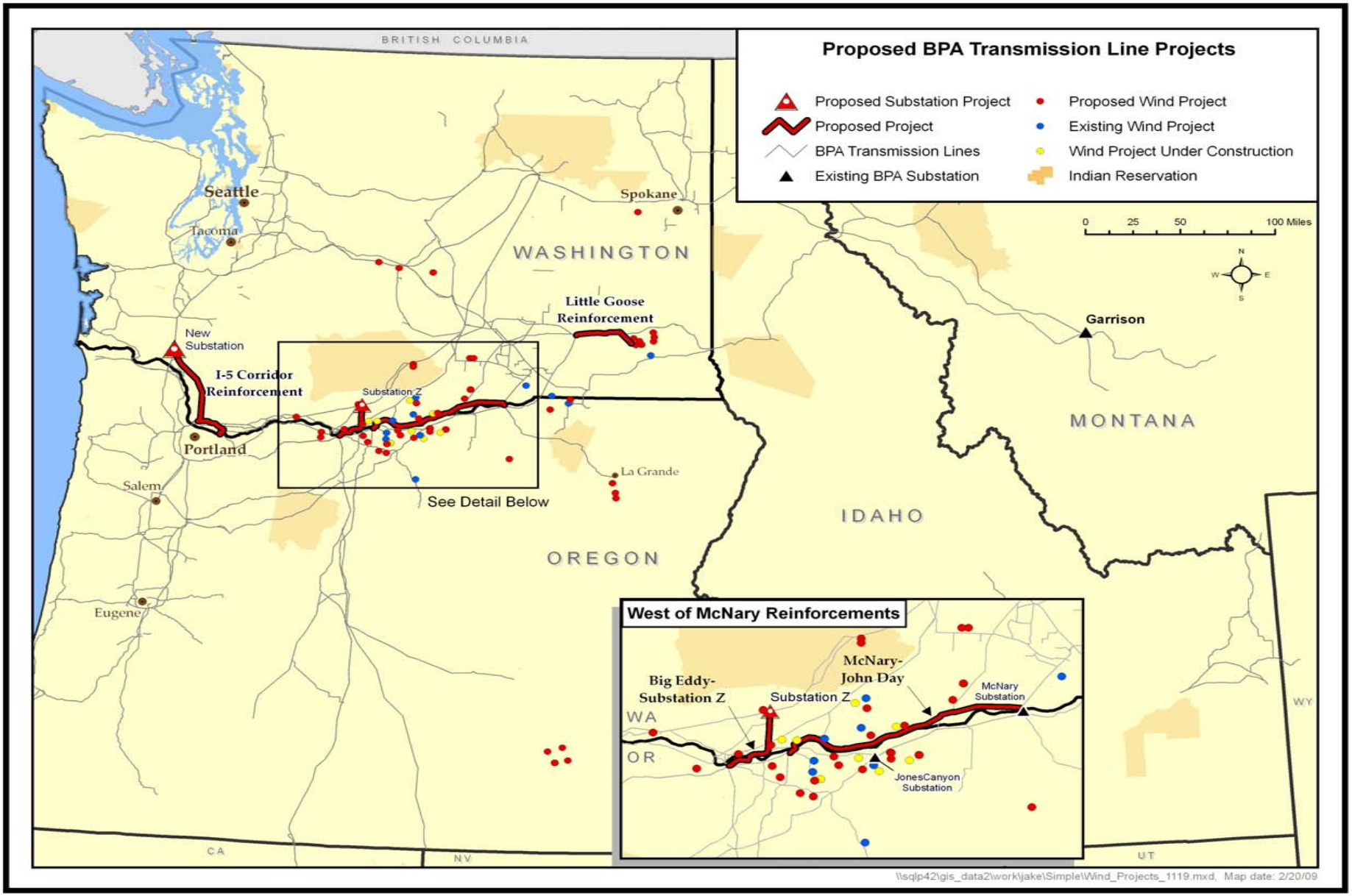
Integrating Renewable Resources Into the Electric Grid

Brian Silverstein, SVP Transmission

March 2, 2009

BPA's Substantial Wind Energy Experience

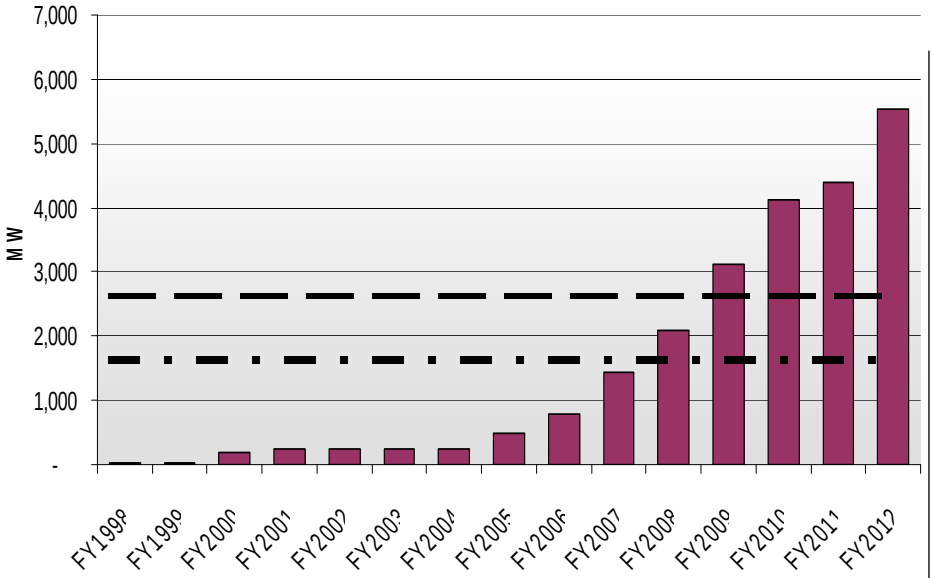
- BPA has over 2,000 MW of wind interconnected to its 10,500 MW peak load balancing area. This quantity is expected to double within the next 2-3 years, placing BPA among the utilities with the highest concentration of wind energy in the United States.
- BPA has interconnected 19 wind farms as of fall 2008 with more than 1,000 wind turbines on line.
- BPA has built five new substations and six tap lines for wind farms.
- Approximately 75% of the wind generation in the BPA balancing area serves load outside of the BPA balancing area.
- 4,716 MW, (74 percent) of committed requests for grid expansion under BPA's 2008 Network Open Season were for wind generation.


Proposed BPA Transmission Line Projects
Proposed Substation Project
Proposed Project
BPA Transmission Lines
Existing BPA Substation
Proposed Wind Project
Existing Wind Project
Wind Project Under Construction
Indian Reservation
0 25 50 100 Miles
BRITISH COLUMBIA
WASHINGTON
OREGON
IDAHO
MONTANA
WY
UT
NV
CA
Seattle
Tacoma
Spokane
Portland
Salem
Eugene
La Grande
Garrison
New Substation
I-5 Corridor Reinforcement
Little Goose Reinforcement
Substation Z
See Detail Below
West of McNary Reinforcements
Big Eddy-Substation Z
McNary-John Day
Substation Z
McNary Substation
JonesCanyon Substation
WA
OR
\\sqlp42\gis_data2\work\jake\Simple\Wind_Projects_1119.mxd, Map date: 2/20/09

BPA is experiencing the highest wind penetration in a Balancing Authority

Utility	(A) Installed Wind	(B) Peak Load	Wind Penetration (A/B)
PacifiCorp East	858	5,689	15%
PacifiCorp West	251	3,555	7%
PNM	204	2,500	8%
Northwestern Energy	146	1,724	8%
CAISO	2,800	49,071	6%
ERCOT	5,812	62,400	9%
BPA 2009	3,130	10,500	30%
BPA 2010	4,130	10,500	39%

Historical and Forecasted Wind Totals
in BPA's Balancing Authority



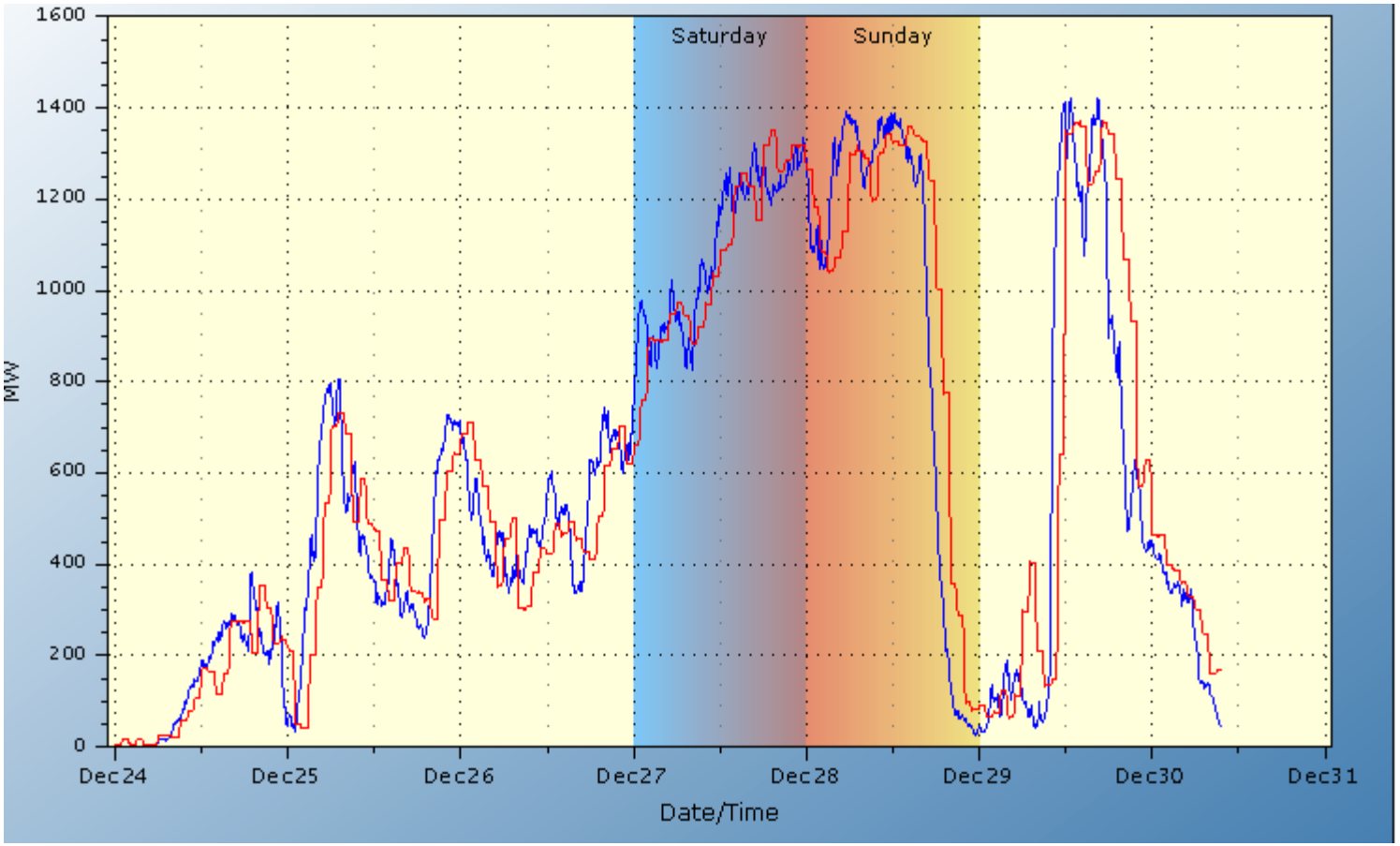
= 15% penetration (1575 MW, reached in 2008)
= 25% penetration (2625 MW, will reach in 2009)

Understanding Wind Energy

- Like others across the country, BPA views wind primarily as an *energy*, rather than a *capacity* resource for system operations.
- The primary value of wind energy lies in its ability to displace fossil fuel consumption, reduce carbon emissions, and limit exposure to volatile natural gas prices.
- The natural variability and uncertainty of wind energy increases the demand for balancing reserves. This increased demand for balancing reserves requires changes in system operations with corresponding integration costs and consequences for balancing resource availability.
- While it is important to acknowledge the operational characteristics of wind energy, BPA, along with wind developers and operators, is exploring many innovative approaches to reliably integrating wind into the grid.

BPA Balancing Authority Total Wind Generation and Wind Basepoint

24 Dec 2008 – 31 Dec 2008 (Last updated 30 Dec 2008 09:36:35)



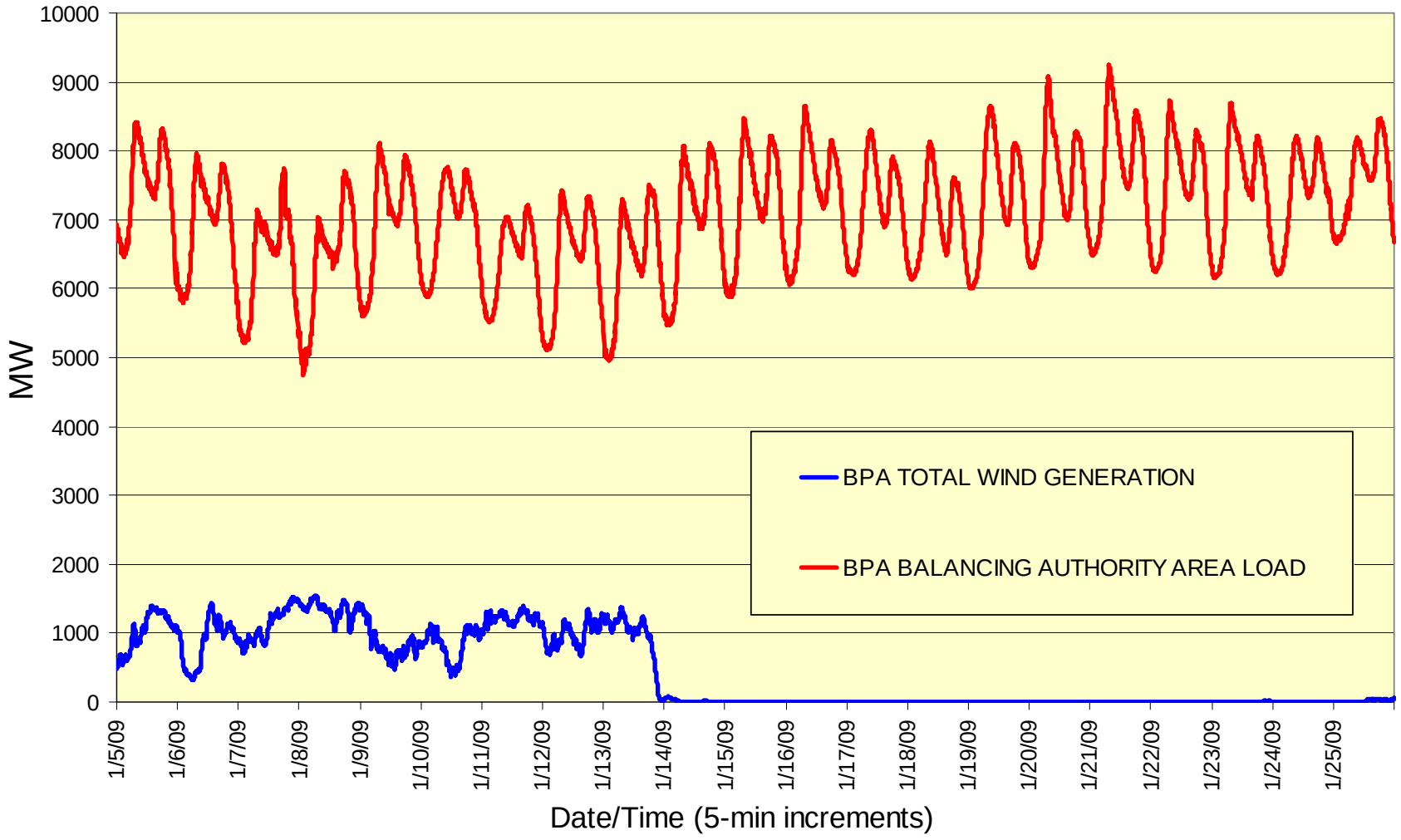
Based on 5-min. readings from the BPA SCADA system for points 79687, 103349

Balancing Authority Wind Generation in **Blue**, Wind Basepoint in **Red**; Installed Wind Capacity = 1592 MW

BPA Technical Operations: Roy Ellis (rcellis@bpa.gov)

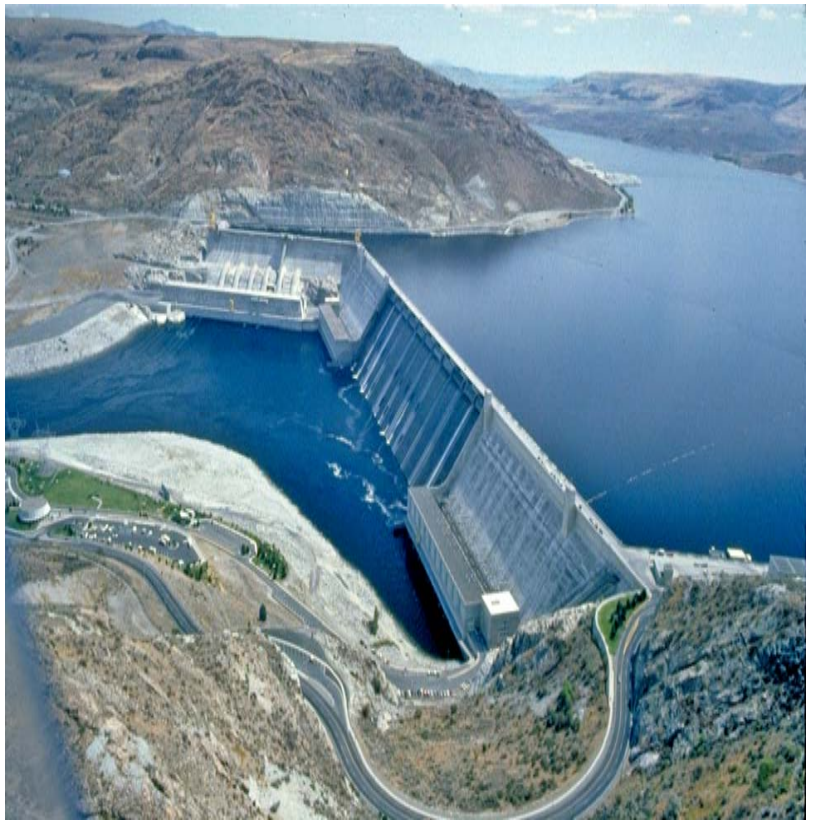
BPA Balancing Authority Area Load & Total Wind Generation

Jan. 5-25, 2009



More than hydro alone can handle

- With the expected growth of wind in the BPA balancing area, there may not always be enough water or flexibility in the FCRPS to provide sufficient balancing reserves while also meeting power loads and non-power obligations.
- Under current wind generation forecasting and scheduling practices and accuracy, we think we are able to provide balancing reserves for approximately 3,000 – 3,500 MW of installed wind generation.
- Beyond this level of wind, we will need additional tools in our operational tool box to reliably integrate wind and meet our power and non-power obligations.



New operational protocols to manage reserve limitations

A two part approach:

- BPA will determine its balancing reserve capability through system planning studies and then establish a quantity of reserves (incremental and decremental) to be made available for wind integration in its rate case processes. And,
- BPA has established protocols in Dispatch Standing Orders to limit variable generators to stay within established balancing reserve limits.
  - Variable generators that have substantially over-generated relative to schedule will be instructed to reduce generation to specified levels when BPA reaches 90% of its decremental reserve capability.
  - Transmission Schedules (E-tags) for variable generators that have substantially under-generated relative to schedule will be curtailed down to actuals when BPA reaches 90% of its incremental reserve capability.

Operational Protocols will allow BPA to sign additional LGIAs

- BPA has already signed Large Generation Interconnection Agreements (LGIAs) with 2,700 MW of wind.
- Another 2,000 MW have requested LGIAs to be signed in the next six months, with more in line beyond that.
- The protocols described above will give BPA the assurance that it can continue to sign LGIAs for additional wind power while maintaining reliability and meeting its environmental and other obligations.

Additional solutions, short-term

- Improving wind generation forecast accuracy. BPA and wind operators are working to improve the accuracy of generation forecasts used for scheduling.
- Third-party supply. BPA received 18 responses to a Request for Information on additional sources of generation and load for balancing reserves. BPA is evaluating implementation of a pilot project on use of these sources in FY 2010 and 2011 time frame.
- Dynamic scheduling. BPA is working to address the technical barriers to increased dynamic scheduling of wind energy to other balancing areas from its system. BPA is also working with members of ColumbiaGrid and NTTG to examine the grid impacts of greater use of dynamic scheduling in the northwest region.
- ACE diversity interchange. BPA is participating with other regional utilities in an initiative that allows multiple balancing authorities to share their Area Control Error and net out variations in load resource balance. The Steering Committee of the NW Wind Integration Action Plan has acknowledged that we expect it to be cheaper from a societal perspective to address wind integration across a larger geographic footprint.

Short-term solutions, cont.

- **Self-supply of reserves by large wind operators** could substantially reduce the reserve requirements BPA now faces. The systems required to enable self-supply are the same as those required for third party supply and dynamic scheduling.
- **Conditional Firm Service** is being offered by BPA to maximize utilization of the transmission system and facilitate additional wind interconnection.

Long-term solutions

- **New Transmission Scheduling Practices and Procedures:** A Joint Initiative of ColumbiaGrid, NTTG and WestConnect is exploring changes in generation schedules within the hour to help reduce the size of generation imbalances and support bilateral markets for flexibility services.
- **Transmission Additions:** BPA has completed its 1st Network Open Season and will continue to work with other regional entities on ways to add additional transmission infrastructure to promote a more geographically diverse wind fleet.
- **Improving Automatic Generation Control.** BPA is adding new tools to its AGC system to see whether it can anticipate changes in wind generation, reducing reserve needs.
- **Flywheels, pumped storage, compressed air and demand-side management** are potential sources of wind integration services that are being explored by BPA and others.

Conclusion

- The federal hydro power system currently provides wind integration services for the bulk of the Northwest's wind fleet.
- The cost of integrating wind with hydropower is rising, and the federal hydro system is reaching the limits of the wind integration services it can supply.
- BPA is working closely with wind power operators and owners, Northwest and Western utilities and others to develop solutions to the challenges created by the rapid growth of wind energy and to help develop a reliable, cost-effective wind fleet for regional consumers.