

factsheet

December 2008

Keeping up with the wind: BPA actions support increasing wind power in grid

The Bonneville Power Administration has more than 1,500 megawatts of wind power operating on its transmission system today, making it one of the nation's top wind power transmitters. Including this existing generation and projects under construction, the agency has signed Large Generator Interconnection Agreements that commit it to interconnect 2,700 MW of wind into its grid. Another 2,200 MW of requests are lined up to sign LGIAs in the next six months.

Rapid wind power additions to the BPA system are a result of actions by many regional parties. This successful infrastructure development is moving so quickly that it is outpacing the agency's ability to integrate variable wind power with the federal hydropower system.

Much of the wind on the BPA system has been developed in the Lower Columbia region, where projects tend to move up and down simultaneously.

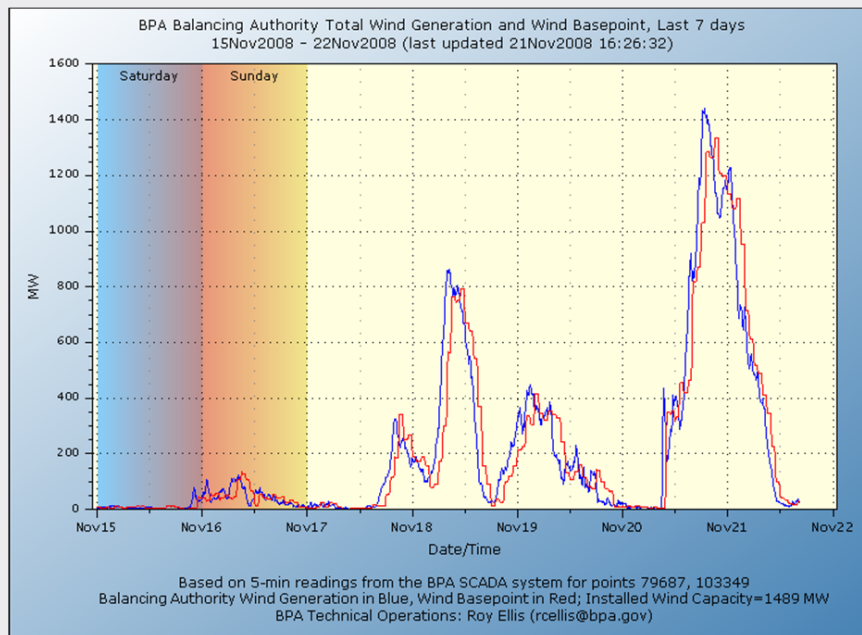
The result is large, unscheduled swings in wind generation of up to several hundred megawatts within a single hour. This is called generation imbalance.

When a power plant's output does not match its hourly generation schedule, BPA must increase or decrease federal generation in like amounts immediately to maintain the constant balance of generation and load needed to keep the system stable.

BPA now reserves significant amounts of water in federal reservoirs at all times so that it will

Wind fleet operation in BPA's balancing authority

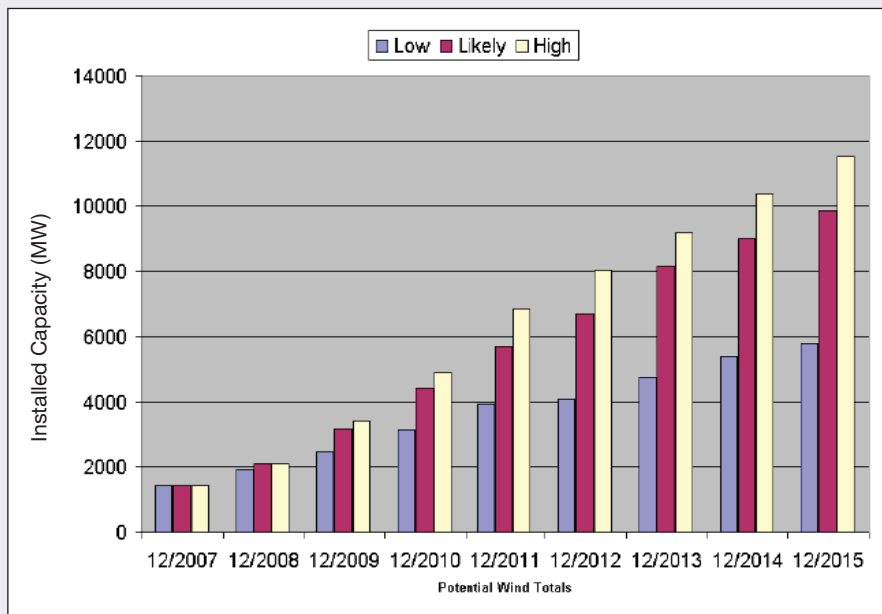
Nov. 15-22, 2008



BPA is seeing sudden, immense swings in wind output (blue) that often have not been scheduled. Adjustments in wind fleet generation schedules (red) tend to trail changes in wind fleet operation by about two hours. To maintain a reliable power system, BPA must set its balancing reserves at levels sufficient to address potential differences between scheduled and actual output.



Expected growth of the wind fleet in BPA's balancing authority



Wind power in the BPA system is growing extremely fast.

have enough capacity available to provide this balancing service when needed.

The hydro system's limits are being reached. Excessive wind generation imbalance is beginning to impose real consequences on power system operation that could affect both system reliability and protection of Columbia and Snake River salmon listed under the Endangered Species Act.

BPA is working aggressively with the wind and utility communities to develop new wind forecasting tools and market mechanisms to better manage wind and other variable resources in the transmission grid.

Until these tools are sufficiently mature, BPA will have to rely on the federal hydropower system. For the last several weeks, BPA has worked intensively on a way to allow BPA to continue to add wind farms to its existing system without jeopardizing system reliability or fulfillment of its hydro operation requirements under the Endangered Species Act and

Clean Water Act. We are sharing the resulting solution with the wind and utility communities and interested projects. If this approach works for all parties, we expect to resume signing interconnection agreements for additional wind farms by the end of this year.

We can only make commitments we are confident we can fulfill. Our challenge has been to define a solution that maintains reliability while providing enough flexibility to encompass new solutions to the generation imbalance problem that may emerge through time. We believe

we have found that solution, at least for the next 2,000 MW or so of wind entering the BPA system.

This solution may also help moderate what might otherwise have been very steep increases in the cost of providing wind integration services for the next rate period. BPA will establish costs of wind integration services for 2010-2011 in its 2010 rate case.

A three-part solution

The solution reflects BPA's existing system operation practices. The difference lies in making these practices automatic by adding computer software, memorializing the practices in contracts and forecasting balancing reserve needs in rate cases.

1) Protocols will limit wind operation to stay within balancing reserves. BPA will establish transmission operation protocols under which BPA's dispatch system would automatically instruct wind project operators to reduce their generation to

specified levels if necessary for reliability and ESA or Clean Water Act compliance. (Today, dispatchers deliver these instructions manually.) If a project does not comply within 10 minutes, BPA can disconnect that project from the grid. Any wind farm that failed to comply with dispatchers' orders three times over a 24-month period would be required to install Automatic Generation Control equipment that would give BPA the ability to directly control its output.

Because wind farms cannot increase power output on demand, a different approach is needed when wind generation is significantly below its schedules and BPA reserves are nearing depletion. In this case, BPA would curtail each wind project's transmission schedule or E-tag to the amount of power that project is actually generating plus that project's share of balancing reserves. This would stop further draw on the hydro system to supply power that wind projects are scheduled to produce but are not producing. It shifts the responsibility for balancing for under-generation of wind to the transmission contract holder and its balancing authority and to the wind power customer.

2) Contracts will memorialize protocols.

Large Generator Interconnection Agreements are contracts that define the responsibilities of BPA and each generator that connects to BPA's transmission system. They remain in effect for the life of the generator. BPA will add language to its LGIAs to memorialize the above protocols. Putting this language in the contract will ensure we can efficiently implement this practice with all wind generators.

3) Balancing reserves will be forecast in rates. BPA first forecast reserves for wind in its Wind Integration Rate for 2009. For the 2010-2011 rate period, BPA expects to establish a larger amount of balancing reserves to address wind fleet generation imbalance. BPA will continue to forecast the amount of balancing reserves in bi-annual rate cases. We will then control variable generation so that balancing reserves are not exceeded up or down.

Schedule

Dec. 8: BPA releases description of its proposed approach.

Dec. 10: Wind Integration Team public meeting on BPA approach.

January 2009: Begin signing new LGIAs.

Feb. 10, 2009: Prehearing conference launches discussions in 2010-2011 Rate Case.

February 2009: Automatic Generation Control and other modifications defined in technical specification.

July 17, 2009: Record of Decision on 2010-2011 Rate Case.

Oct. 1, 2009: Changes to AGC, scheduling and communications software complete. Dispatchers Standing Order in place.

Oct. 1, 2009: 2010-2011 rates in effect.

The limits on balancing reserves the Federal Columbia River Power System can provide reflect BPA's statutory responsibilities. For example, implementation of the Clean Water Act limits the level of nitrogen saturation permissible in the river when migrating salmon are present. Too much nitrogen in water can give fish gas bubble disease, similar to "the bends" in human divers. BPA cannot reduce hydro generation to compensate for wind over-generation if doing so would increase nitrogen saturation in the river above legal limits.

The amount of balancing reserves the federal hydropower system can supply may change over time. For example, the Biological Opinion on federal hydropower system operations establishes requirements for river flows and water spilled at dams for migrating fish. These requirements could change.

With accurate schedules, tools would be used rarely

Whether and how often BPA must limit wind farm output will depend on the accuracy of wind generation schedules, the sheer volume of wind requiring reserves in BPA's balancing authority and the availability of cost-effective reserves or other resource-balancing mechanisms or services. We will call for moderation of wind output only to maintain reliability and comply with our statutory obligations.

Wind farm operators have already suggested promising ways to improve the accuracy of wind generation scheduling. We are actively exploring these options with them. Also, the limits on wind farm output will apply individually to each project.

Those farthest from their scheduled output would be limited most often. Those whose output most nearly matches their schedules likely would see minimal impact.

A high priority issue

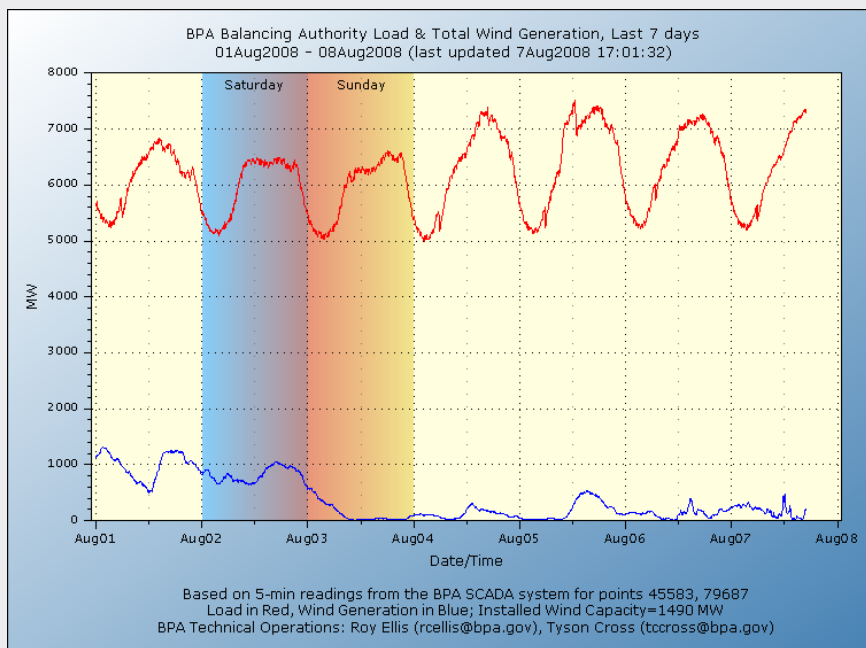
This is an extremely high priority for BPA. We expect to begin offering LGIAs with the new language in the next few weeks and will add it to existing LGIAs at the same time. Balancing reserves for fiscal years 2010-2011 will be forecast in the 2010 rate case, which will be completed in July 2009. Installation of Automatic Generation Control on wind plants will be complete by October 2009, when the FY 2010 rates go into effect.

Next up: Cost issues

BPA's proposal is only the first step. It will allow the agency to interconnect additional wind projects. But much further work is needed to develop more cost-effective solutions for large-scale wind integration.

On Dec. 2, leaders of Northwest utilities, the wind community and public interest groups met at the Steering Committee for the Northwest Wind Integration Forum. They called for renewed regional commitment to collaborative action on wind integration solutions. The Northwest Wind Integration Action Plan, completed in 2007, called for 16 regional actions to cost-effectively integrate large amounts of wind in the Northwest. Subcommittees

What's the big deal about balance?



Electricity is used the moment it is produced, and the amount of electricity entering a transmission system must match the amount being consumed, moment to moment. If these two amounts get out of balance, the system could become unstable and an outage could occur. The balancing authority for a transmission area, such as BPA, receives schedules for the hour-to-hour output of generators and then adjusts generation in real time to follow within-hour changes in load (red line). Unpredicted changes in wind generation – up or down – increase the adjustments other generators must make to keep net amount of generation and loads in constant balance.

are now being assigned to work on a region-wide basis to tackle the most promising actions.

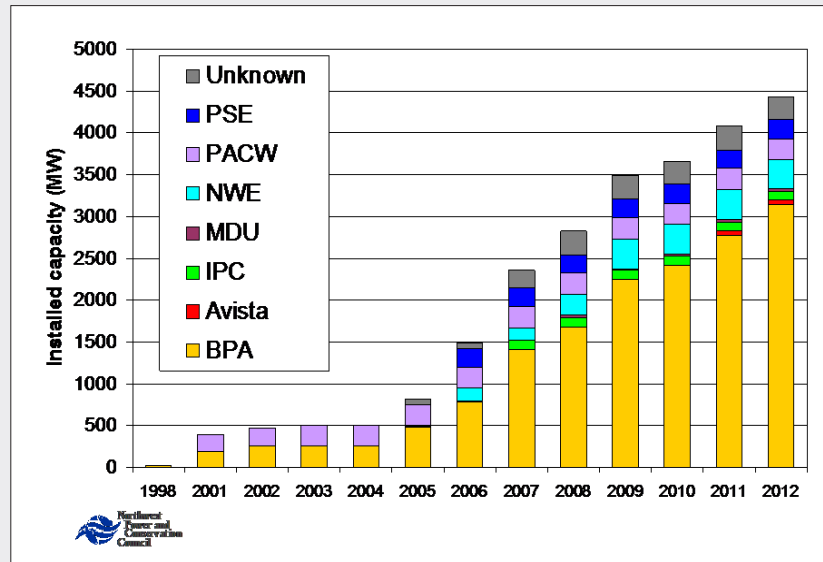
BPA is actively exploring ways to augment federal hydropower with other cost-effective capacity reserves. We are working quickly and closely with the wind power and utility requirements to blend these reserve sources with BPA's existing reserves and expect to develop techniques that increase the accuracy of wind generation schedules, increase availability of balancing reserves and otherwise reduce the potential need to exercise controls.

The BPA Wind Integration Team established by the 2009 Wind Integration Rate is working on a long list of technical solution. For example, BPA is working with wind plant operators to develop more accurate wind generation scheduling practices.

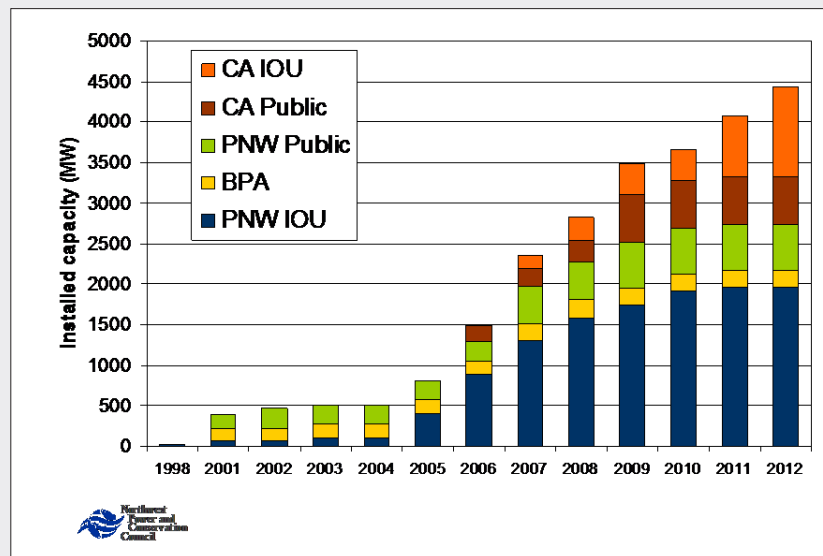
BPA has received 18 responses to a recent Request for Information on third-party within-hour wind integration services and their costs. Responses include natural gas, coal, demand-side management and construction of pumped storage. BPA expects to conduct a pilot project making use of the best of these proposals.

We are also exploring dynamically scheduling wind generation to other balancing authorities and a host of other technical concepts. Our customers, both utilities

Wind capacity by balancing authority



Customers for Northwest wind power



Most Northwest wind power is locating in BPA's balancing authority, which primarily serves publicly owned utilities in Oregon and Washington. However, the customers buying this wind power are predominantly Northwest investor-owned utilities and, increasingly, California utilities.

Graphs courtesy of Jeff King, Northwest Power and Conservation Council.

and wind project owners, are working closely with us to develop these concepts.

The steps we are taking today will help keep the wind resource growing while we develop these new solutions, so that wind and other variable renewable resources can become an even more important part of the Northwest's power system.

Leading edge of a national curve

BPA's percentage of wind to peak load is already substantially higher than that of other wind power growth areas such as California and Texas.

Eventually, all balancing authorities with substantial wind power resources will need to address large-scale wind integration issues. Because of the high and increasing penetration rate of wind in the BPA balancing authority, we must address them now.

Balancing authorities in the eastern United States are beginning to institute variable generation controls

along the lines BPA is proposing. Other regions with large amounts of wind tend to have much larger balancing authorities in which wind power can be balanced with a much larger load base. BPA is actively seeking to learn from these experiences.

Solutions BPA develops in concert with other Northwest utilities, wind developers and others will be available to apply to wind development in other regions, so that the nation can make the best possible use of this domestic, clean renewable resource.

For more information:

For more information, see BPA's wind Web page at www.bpa.gov/corporate/About_BPA/wind/index.cfm.

To participate in Wind Integration Team activities, contact Eric King at (503) 230-5236.

Or, contact your BPA Customer or Constituent Account Executive.