BONNEVILLE POWER ADMINISTRATION

Customer Comments Regarding "Regulation, Load Following and Generation/Load Imbalance"

Presented at the September 10, 2008, 2010 BPA Rate Case Workshop

The following are customer comments received from Renewable Northwest Project on September 24, 2008

RNP Comments on Pre-Decisional:
Regulation, Load Following and Generation/Load Imbalance
Preliminary Report

General Comments

The report generally follows Renewable Northwest Project (RNP) recommendations regarding how the quantity of total needed reserves should be calculated. While this is a very positive step forward in our view, there are important shortcomings with the current analysis that lead to very significant overstatement of integration costs. The most important issues remaining are:

- The "scaling methodology" used to represent the output of wind projects that have yet to be built.
- The assumption that current wind scheduling behavior is a reasonable foundation from which to estimate future reserve requirements.
- The proposed method of allocating reserve requirements.
- The character and treatment of the hour-long imbalance reserve requirements.
- RNP disputes the Report's assertion (p.8) that BPA has sought or received as much information as possible. We urge BPA to view stakeholders as partners in achieving the best result for BPA, its customers, and the region.

These issues are explained more thoroughly below. In addition to the specific issues, and editorial comments, RNP would like to underscore the importance of approaching wind integration from the broadest of perspectives—how does the region move forward toward a future with a large and growing portion of the energy production based on wind power? The first step is of course to appropriately characterize the wind resource and needed reserves. RNP's comments are provided in the spirit of reaching an accurate understanding of the wind resource and needed reserve requirements.

Wind integration studies of very high penetration levels (greater than 20% of energy demand) on constrained systems suggest that there is no hard upper limit to the amount of wind that can be integrated without adversely affecting reliability—wind can be spilled as necessary to maintain system control. However, spilling wind may well be the least cost effective means of accomplishing integration. RNP invites BPA and the other regional stakeholders to consider a future in which all available flexibility: hydro, thermal, loads, adjacent balancing authority loads and resources, and the wind projects themselves; are made available on an economic basis to maintain system adequacy and reliability.

To be sure, there are institutional barriers to be overcome, but even larger barriers were overcome to efficiently and economically exploit the value of another variable renewable resource: the Northwest hydro power system. Very long distance high voltage transmission lines were built, huge storage reservoirs financed and constructed to store floodwaters, diverse project owners came together under the Pacific Northwest Coordination Agreement to make the whole greater than the sum of the parts, and an international treaty with Canada negotiated and signed to make all of that happen.

By the end of this year, the Northwest will likely be generating more wind energy than nuclear energy. As BPA's report suggests, the wind industry has not stopped growing. Both Presidential candidates nominally support further growth of the renewable energy industry to combat the planet-scale threat of climate change and to reduce the country's dependence on foreign energy. In the words of the 1980 Power Act, BPA and the region need to map out an economic, efficient, and reliable way forward. We hope these comments and BPA's improved participation in true partnership, will help pave the way.

Scaling Methodology

BPA's proposed methodology is not common among other wind integration studies. For example, other recent Northwest studies such as Portland General Electric and Idaho Power Company's relied on mesoscale (weather) models to produce projected wind speed patterns at proposed sites. Wind speeds are then converted to generation. The meso-scale approach has its own challenges and issues. It is unclear whether BPA's proposed methodology is either superior or inferior to the meso-scale modeling approach.

In fact, obtaining data sets of wind generation for wind projects that have not yet been constructed presents a general problem for wind integration studies. Unfortunately, the problem is both challenging and vitally important to get at least approximately correct. What it means to be "correct" is also important and sometimes has not been well understood by analysts. Of greatest importance, is that the overall variability of the wind output, and its correlation with other wind projects be reasonably accurate. Both variability and correlation can be measured at different time scales, and must be accurate on all the relevant time scales. Reserve requirements are set on the extremes (or "tails") of the variability distribution, making the reserve levels especially sensitive to relatively small errors in the methodology.

BPA's methodology assumes that the output of a wind project is completely determined by knowing the output of nearby projects and inserting an appropriate time shift that represents the distance between projects at the prevailing wind speeds (and direction). As proposed, the BPA methodology fails to capture the natural diversity that exists among wind projects. Even adjacent wind turbines exhibit some amount of diversity. BPA's methodology excludes any and all such diversity from their analysis. This effect is well documented and can be found in the IEA Wind Task 25, "Design and Operation of Power Systems with Large Amounts of Wind Power". Figure 1 below illustrates the behavior of correlations among wind projects on various time scales with distance. While it is clear that the Northwest's peculiar geography likely results in different values, the general relationships should hold, namely: correlation at shorter time scales is lower than at longer time scales, and correlations decrease roughly with distance.

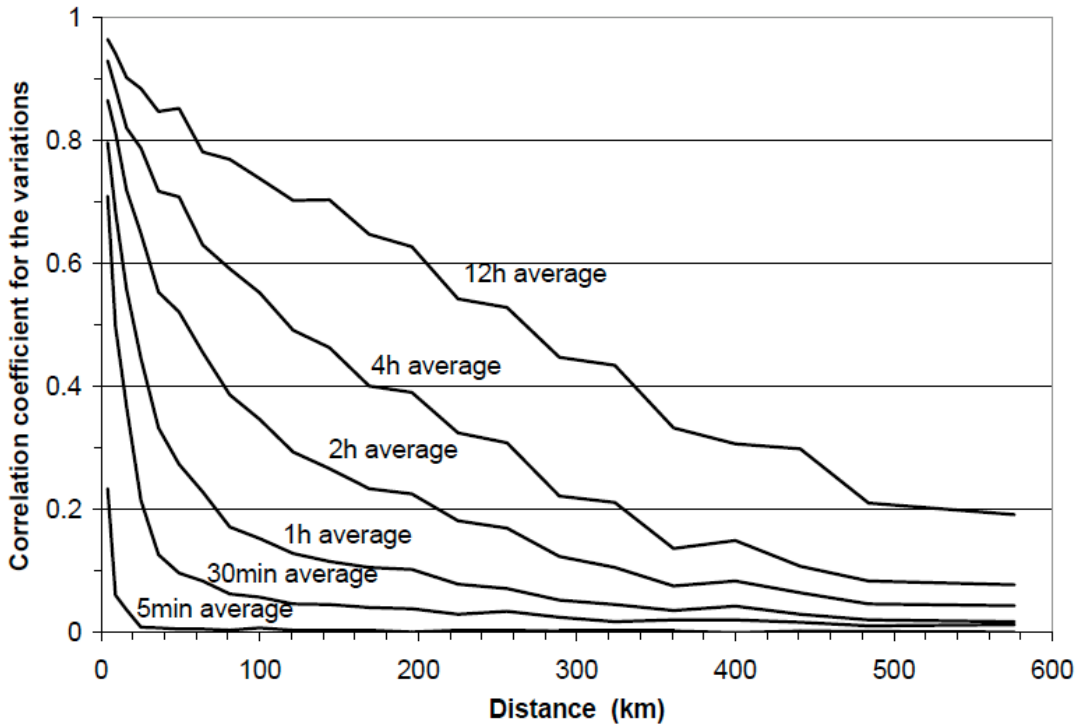

Figure 1: Correlations at different time scales and distances. Taken from "Design and Operation of Power Systems with Large Amounts of Wind Power: State of the Art Report" (www.ieawind.org/GWEC_PDF/GWEC%20Annex25.pdf).

This figure shows that even very closely spaced wind projects will exhibit 1-hour correlations significantly less than 100%. BPA's proposed method likely results (we don't have the data) in correlations very close to 100% on a one hour basis, almost irrespective of distance. In RNP's limited experience, twinned projects (different project phases in geographic proximity) may have hourly correlations of as much as 90%. Projects that are in similar geographic regions but that are distant by less than 200 miles may have correlations in the 70-80% range. This is an important amount of diversity that must be captured by BPA's methodology, but presently appears to be lacking. Either BPA needs to build in the expected amount of diversity, or show that it does not exist. For example, RNP found the correlation between the ten minute average output of a wind project with the same data time-shifted by 30 minutes and found a correlation of 94%--higher than is likely between two immediately adjacent wind projects, much less geographically distant ones.

BPA can determine the amount of diversity that exists among existing projects, by performing the kind of time-shift it proposes for future projects. In other words, project A can be approximated by the output of project B with a time shift. However, since the output of project A exists, BPA can determine the error in its approximation. This can be done for all pairs of existing projects, and the errors (perhaps as a function of distance) can be installed into the scaling methodology for the future projects. RNP recognizes

that BPA attempted to incorporate the expected diversity through time shifting the data. Nevertheless, the time shifts are in general small enough (most are well under one hour) that they likely did not sufficiently account for the majority of the natural diversity that exists.

Another consideration is that the methodology breaks down if the new projects exist in a geographic region with significantly different weather drivers. It is unclear just where some of the new projects are being sited, but none of them seem to be further than 90 minutes away (as the wind blows) from an existing site. For these projects, the time shift methodology may be woefully inadequate. BPA must estimate how the error term increases with distance and use a significantly higher amount for those projects likely to be in a significantly different climactic region.

The effect of having too little diversity results in BPA potentially estimating a significantly higher amount of wind variability than will likely be the case. This in turn causes an increase in the reserve requirements and an overestimate of the integration cost of wind because of the way in which BPA has simulated the behavior of wind schedulers. BPA assumes that wind generation will be scheduled based on actual output occurring at wind projects two hours prior to the operating hour. The resulting schedule error estimates will be higher than is likely to occur due to the overestimate of the wind variability over the two-hour time period.

There is another effect that adds to the problem—because both the wind output and the wind schedules are based on relatively few existing plants, there will be too much correlation in the scheduling errors. This is also an artifact of BPA's proposed method lacking the random diversity that exists between and among wind projects. It is of paramount importance for BPA to get the diversity correct.

Wind Scheduling Behavior

The Report's basing the analysis on current scheduling behavior was important and worth noting. It showed that most of the current wind schedules BPA receives are not generally as accurate as even the simplest of wind forecasts. It is unfortunate that the report conflated "forecasts" with "Schedules"—the distinction needs to be clear: Schedules are submitted to the balancing area and they may, or may not, be based on the best available forecasts of wind generation. It is incorrect to assume that poor schedules are the result of "abysmal forecasts" (page 11 of the Report). More likely is that the schedules are not based on the best available forecasts.

For BPA to assume that schedules continue to exhibit the current level of accuracy wildly overestimates the need for reserves. Without any changes in forecasting skill or technology, the schedules could, as BPA has demonstrated, be improved significantly. RNP commits to working with its own membership, and exhorts BPA to speak to other wind schedulers on its system, to make clear the importance of accurate wind schedules. This problem makes clear the importance of building into the wind integration rate some recognition of the accuracy of the submitted schedules. RNP notes that BPA's WI 09

proposal determination of reserve requirements was completely independent of schedule accuracy, potentially exacerbating the schedulers' inattention to the need to schedule carefully.

RNP has repeatedly noted that the best possible short term forecast can only be produced by accumulating real time data from as many wind projects as possible. Only BPA has access to that data. RNP urges the BPA analysts to develop an improved forecast that it can then use to set the schedules. While this is not a simple extrapolation of current scheduling behavior, it will show the value of putting in place a better system of forecasting and scheduling. The value of such a system almost certainly will exceed the cost, and RNP looks forward to working with BPA to help establish such a system of forecasting and scheduling.

Reserve Allocation Methodology

BPA changed its reserve allocation methodology between the WI 09 case and that proposed in the Report. BPA touts the new methodology as insuring that "neither wind nor load takes an inordinate amount of the total balancing requirements needed." RNP has noted in previous workshops that the selection of an allocation method is ultimately subjective. Other studies have allocated the incremental need for reserves to the wind—in other words, all of the increases in reserve requirements are assigned to wind, with load maintaining its original obligation.

BPA's proposed method allocates the reserves based roughly on the pro-rata share of the variance[1]. An important consequence of BPA's proposed methodology is to shift some of the existing reserve requirement over time from load to wind generators—In other words, wind generators receive an allocation in excess of the incremental reserve requirement they bring to the power system. RNP does not view this shift as fair, or that it somehow importantly avoids "inordinate" amounts of reserve allocated to wind or load as the Report claims. It is unclear why a policy of wind generation further subsidizing BPA loads over time is appropriate, or even an intended consequence of the proposal.

RNP found the explanation of the derivation of the allocation method presented in Appendix B of very limited value. We urge BPA to make itself as clear as possible in this regard.

Hour Time Scale Imbalance

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[1] Variance is defined as the square of the standard deviation of a set of numbers. BPA's methodology is somewhat more complex than the simplified description here, taking into account the correlation between load and wind generation-- the "Covariance" terms in BPA's equation. BPA analysts have stated that the covariance between wind and load is small. At least for the purposes of understanding the proposed allocation method, it can safely be ignored.

In WI 09 testimony, BPA sought to establish a wind integration rate for within-hour balancing services. The Report suggests that BPA is now proposing to include reserves for generation imbalance. This is a significant and important departure from the previous proposal, and may be unprecedented in the US. RNP does not oppose in principle the addition of such a reserve requirement, and has previously pointed out the potential need to BPA. However, RNP is concerned that the nature of such reserves has not been adequately addressed.

In the WI 09 case RNP advocated for different pricing between regulating reserves and following reserves. While regulating reserves must respond on a sub-minute basis to automated signals, to increase or decrease generation levels multiple times per minute, following reserve units will be operated much more smoothly—generally either increasing or decreasing (not both) output over the course of an hour. The distinctions are important as the cost and potential supply of regulating versus following reserves are different, with regulating timescale reserves typically representing the most costly services.

Hour time scale reserves representing the generation imbalance represent units that are need to be increased or decreased on the scale of an hour or more. Wind ramping events that such reserves would be needed to cover happen over periods of roughly from one to six hours—shorter ramping events fall under following reserve requirements, longer ones are captured by changes in wind schedules. This is a new category of operating reserve, and it is unclear how it might best be met. With better forecasting techniques, the maximum duration of such events might be shortened, with the difference being traded in hourly markets. For shorter term events, a combination of contractual arrangements with other balancing areas, demand side actions, and interconnected thermal units might well suffice.

In short, it is important to understand fully the nature of the reserve requirement, and the manner in which that requirement can most economically be met. RNP exhorts BPA to be expansive in its consideration, work closely with stakeholders, and not treat all reserves as equivalent to one another.

Stakeholder Communication

Page 8 of the Report expresses BPA's intent to adhere to the WI 09 Settlement agreement provision requiring it to engage in a robust stakeholder input process. While we welcome this recommitment to communication, we remain concerned about the level of input BPA has allowed in the current process. It may be symbolic that the Report itself was issued without notice, without having been circulated among stakeholders in draft form, and was posted in a format that did not allow electronic editing to facilitate providing comments to BPA. More directly, RNP has repeatedly requested dialogue with the Power Business Line staff developing so-called "generation inputs", the costing methodology to be attached to the specific reserve requirements identified by the Wind Integration Team. Despite these efforts, BPA PBL has declined to engage any communications prior to September 23 at which their initial proposal will be released. RNP finds BPA's

reluctance to engage on these issues contrary to the Settlement agreement, and ultimately counterproductive.

The region is adapting to a very new and different reality with significant amounts of wind on the power system, and more likely on the way. Efficiently and economically responding to the reality and the challenges will take the efforts of all stakeholders. The importance of accurate scheduling was noted above—how that can or should be incorporated into a wind integration methodology yet has yet to be defined. There are many such issues that remain, including how to determine what hour-long reserves are required, what their costs will be, and how to allocate those. BPA's steadfast refusal to begin a dialogue until it has developed its own proposal will result in a less productive and less efficient process in the end. While rate cases are adversarial processes by their nature, the time prior to ex parte (now!) is an opportunity to work toward consensus among the parties to the maximum possible extent. Consensus is not developed in isolation. RNP urges BPA to reconsider, and begin circulating any materials, or summaries of their thinking at the soonest possible opportunity—tomorrow!

Miscellaneous

The concepts covered in the Report are complex and new to both analysts and stakeholders. It behooves all of us to be as careful with language as reasonably possible. Already noted was the Report's tendency to conflate wind "forecasts" with wind "schedules". Although this may seem minor, it can lead to the erroneous conclusion that wind forecasts are of little value, and improvements in such forecasts are unlikely—neither conclusion would be correct.

Another word used with troubling imprecision is "capacity". Common usage of this word varies widely in the industry, meaning different things to different people at different times. There is apparently a common misconception that the reserve requirements represent some kind of "capacity" that is either available or not available from the hydro system, and that can be purchased for some market price.

Alternatively, it is proposed that the reserve requirement "capacity" can be equated to and acquired from the output of a gas turbine, for the cost of a gas turbine. In fact, BPA's computation of reserve requirements is the expected need for BPA to increase or decrease generation or deliveries of power within an operating hour. It is unlikely that these needs could economically or efficiently be met by adding gas turbines to the power system.

The imprecise use of "capacity" is leading many readers of the Report to overly simplistic and erroneous conclusions regarding the meaning of the analysis. RNP urges BPA to either drop the word entirely, or define what is specifically meant in this context and stick to that single definition. We note that BPA's own web site contains a full dozen separate definitions under the heading "Capacity" (www.bpa.gov/corporate/pubs/definitions/c.cfm) and another five terms in which the word "capacity" appears. In particular, the use of the word "capacity" in relation to the

need to decrement generation levels or increase load to absorb otherwise excess generation is a misnomer that has no place in BPA's own list of definitions of capacity.

Summary

BPA has clearly dedicated many more resources to the important issues surrounding wind integration, in accord with the WI 09 Settlement Agreement. RNP looks forward to increased communication and cooperation in devising not only a tariff that fairly compensates BPA for wind integration services, but does so to ensure the economic, efficient, and reliable operation of the power system with significant and growing contributions from wind powered generation.