

Date: December 12, 2016
To: PacifiCorp
From: 2016 Wind Integration Study UVIG Technical Review Committee (TRC)
Subject: PacifiCorp 2016 Wind Integration Study Technical Review - Final

Background

The purpose of this memo is to convey the comments, critiques, and suggestions of a UVIG (Utility Variable Generation Integration Group) Technical Review Committee (TRC) regarding PacifiCorp's most recent assessment of operational impacts of their wind fleet.

This is the third time that UVIG has been invited by PacifiCorp to provide this type of feedback. As a whole, the TRC feels that the PacifiCorp wind integration analysis has evolved positively over this time frame. This likely can be attributed to increased understanding of PacifiCorp system operations that comes along with more experience under conditions of increasing renewable penetration. This trend has been maintained in spite of the analysis becoming more complex due to factors such as the new NERC control performance standards (i.e. BAL-002-WECC-2.^{1,2}) and entry by PacifiCorp into the Energy Imbalance Market (EIM).

It must be noted, however, that the recent TRC engagement with PacifiCorp was not as broadly focused and of much shorter duration than the first two. Consequently, the TRC can comment on only those aspects of the study methodology and results that were the subject of the interactions with the PacifiCorp study team and discussed in at least some detail.

TRC Process

The Utility Variable-Generation Integration Group (UVIG) has encouraged the formation of a Technical Review Committee (TRC) to offer constructive input and feedback on wind integration studies conducted by industry partners for over a decade. The TRC is generally formed from a group of people who have some knowledge and expertise in these types of studies, can bring insights gained in previous work, have an interest in seeing the studies conducted using the best available data and methods, and who will stay actively engaged throughout the process. Over time, the UVIG has developed a set of principles which is used to guide the work of the TRC. A modified version of these principles was used in the conduct of this study, and the same version was used for the conduct of the TRC process for the previous studies. A copy is included as an attachment to this memo.

¹ NERC Standard BAL-001-2: <http://www.nerc.com/files/BAL-001-2.pdf>

² NERC Standard BAL-002-WECC-2 (<http://www.nerc.com/files/BAL-002-WECC-2.pdf>), which became effective October 1, 2014, replaced NERC Standard BAL-STD-002.

The composition of the TRC for the 2016 PacifiCorp study was as follows:

- Andrea Coon - Director, Western Renewable Energy Generation Information System (WREGIS) for the Western Electricity Coordinating Council (WECC)
- Michael Milligan – Principal Analyst at the National Renewable Energy Laboratory (NREL)
- J. Charles Smith - Executive Director, Utility Variable-Generation Integration Group (UVIG)
- Robert Zavadil - Executive Vice President, EnerNex LLC

The TRC was provided with a presentation in late September 2016 that documented PacifiCorp's analytical approach and results. Two teleconferences were then held. The purpose of the first was to describe the approach and results in detail to the TRC. Some weeks later, a second call was held to address questions from the TRC members after they had adequate time for additional review of the presentation originally provided by PacifiCorp.

General Comments

Overall, the TRC feels that the PacifiCorp team should be applauded for incorporating some recommendations from the review of the 2014 study into their current efforts. These include shifting from monthly reserves to dynamic reserve allocation on an hourly basis, using the new BAAL-001-2 standard as the basis for the analytical methodology, and considering the impacts of the EIM on PacifiCorp's obligation to procure regulating reserve capacity.

The analytical methodology for characterizing variability from all sources over the regulation time frame looks reasonable. When PacifiCorp attains more experience operating under the new BAAL standard and within the EIM, it would be useful to review actual operating experience to see what lessons may be learned and to facilitate possible improvements to this methodology.

While the conclusions of the study appear to be justified by the analysis presented and described to the TRC, the review documented here should not be interpreted as a substitute for the usual PUC review processes.

Specific Comments and Questions

- The TRC feels that it might be useful to state the role of key assumptions generally - but specifically how key requirements of the EIM may have an impact on reserves (don't study it, just point out key issues).
- On Slide page 8 of the presentation provided to the TRC, below the table: should that be 70 MW instead of 40 MW?
- Would be helpful to include a few sentences about the ACE cap of 4L10?
- The use of what has traditionally been a resource adequacy metric – LOLH – use in long term capacity planning as a key criterion for estimating regulation reserve requirements is both interesting and a departure from previous studies – by PacifiCorp as well as the general wind integration community in the U.S. This approach has been employed in a few recent integration

analyses, but given the uniqueness, it would be good if it were more clearly called out/highlighted in the description of the analytical methodology.

- The discussion of 0.88 LOLH was helpful on the call. It would be useful to have a similar explanation in the report - something along the lines that the RA target resulted in 0.88 LOLH/year and that was judged to be an acceptable reliability level. Using the same target for operations, there are different drivers, but assuming resource adequacy is not the constraint, the 0.88 LOLH may instead result from UC errors that result in too little regulation being available when needed.
- Would be useful to have discussion of how wind (and solar) are treated in the study - do they respond to AGC or dispatch or both? Impact of lost RECs vs. operational flexibility etc.
- Is there a reference to the method used by the CAISO to allocate the diversity benefits for each EIM participant?
- There is some remaining confusion on the part of the TRC regarding the assumptions and utilization of forecasting into the production simulations for calculating integration cost. Specifically, the forecast lead time is nearly one hour prior to the operating hour. The disconnect on the part of the TRC is likely driven by current operation in some larger RTOs, where very short term persistence forecasts (5 minutes ahead) are used to dispatch generators participating in the sub-hourly energy markets, which substantially reduces the remaining requirement for generators providing regulation.
- The use of actual high temporal resolution operating data, especially for wind generation (rather than synthesized data from numerical weather simulations) has been a key feature of the Pacificorp integration studies dating back to 2012. Going forward, the TRC feels that future Pacificorp integration studies could benefit greatly by a thorough comparison of “study results vs. real world”, especially since a current year baseline is part of the analysis. This would provide perhaps the strongest validation of the analytical methodology or otherwise give strong clues to adjustments that may be needed.

Summary

As evidenced by the 2016 analysis, Pacificorp continues to evolve and enhance its ability to analyze the impacts of variable renewable generation on the operations of its two Balancing Authority Areas (BAAs). The future will likely bring changes to which the analytical methodologies for assessing integration impacts must adapt. However, in the view of the UVIG TRC, Pacificorp has established a solid foundation in terms of methods, data, and intelligent staff which will allow them to meet these new challenges.

Because of the abbreviated and focused TRC review process, the TRC is not in a position to endorse or substantially comment on the costs and their allocation over the various aspects of the Pacificorp system. The comparative results summarized in the presentation which was the subject of the two

teleconferences appear to be trending appropriately – i.e. they are moderately declining as would be expected with the EIM and the new balancing standards. Because of the shortage of detail and discussion during the brief review process, though, the TRC must withhold endorsement of this aspect of the Pacificorp renewable integration analysis.

Concurrence:

Andrea Coon – Director of WREGIS, WECC

Michael Milligan - Lead researcher, Transmission and Grid Integration Team, NREL

J. Charles Smith - Executive Director, UVIG

Robert Zavadil - Executive Vice President, EnerNex

Principles for Technical Review Committee (TRC) Involvement in Studies of Wind Integration

A properly constituted TRC will assist the project sponsors in ensuring that the quality of the technical work and the accuracy of results will be as high as possible. TRC participation will also enhance the credibility and acceptance of the study results throughout the affected stakeholder communities. TRC members will be qualified to carry the key messages of the study to their respective sectors. Endorsement by the TRC is not intended to replace regulatory review and approval.

TRC Membership

TRC membership should include individuals that collectively provide expertise in all of the technical disciplines relevant to the study. A TRC facilitator should be selected from among the TRC members. Sponsorship and facilitation of the TRC should be independent from, but closely coordinated with, the project sponsors and the team conducting the work.

Functions and Requirements of TRC Members

The TRC will

1. Review study objectives and approach, and offer suggestions when appropriate to strengthen the study.
2. Help ensure that the study: a. Builds upon prior peer-reviewed wind integration studies and related technical work; b. Receives the benefit of findings from recent and current wind integration study work; c. Incorporates broadly supported best practices for wind integration studies; d. Is accurately portrayed to broader stakeholder groups.
3. Engage actively in the project throughout its duration. In general, project review meetings should be held nominally on a quarterly basis; some meetings can be held telephonically, but some should also occur face to face. A face to face kickoff meeting to establish and agree on the general direction of the work is preferred, but not required.
4. Engender a discussion of methods and results among TRC members, the study team, project sponsors and other interested parties. The aim of these discussions is to improve accuracy, clarity and understanding of the work, and reach consensus resolution on issues that arise.
5. Avoid public disclosure of meeting discussions and preliminary results. In general, findings should not be released until accepted and generally agreed upon by project sponsors, the study team and the TRC. When advisable, possible, and agreed to by all

project participants, interim progress reports can be provided to a broader stakeholder group.

6. Ensure that findings are based entirely on facts and accurate engineering and science. Project sponsors need to embrace this aim so that the results and findings are objectively developed and not skewed to support any desired outcome.
7. Document results of TRC meetings and distribute meeting presentation and minutes.

TRC requirements

To carry out these functions the TRC requires:

1. Access to all relevant information needed to properly evaluate the work and the results. When required, TRC members will enter into confidentiality agreements to protect this information. If specific information is determined to be needed by the TRC, it cannot be declared "off limits."
2. Assurance that the study results will be made public through published documentation or other suitable means, with the understanding that business-sensitive information will be maintained as confidential and not be made public.
3. Assurance that project sponsors will describe the project as having the benefit of expert review by the TRC only if the TRC has clearly expressed its acceptance of and agreement with the results or methodology of the study. To the extent the TRC has only clearly expressed its acceptance of and agreement with specific aspects of the study, the project sponsors will describe that only those aspects of the study as having the benefit of expert review by the TRC.
4. Assurance that, in the event agreement is not reached by the TRC and other project participants, any reference to the TRC will be removed from the final report and any associated documentation or publicity. To the extent that the TRC has only clearly expressed its acceptance of and agreement with specific aspects of the study, any reference to the TRC in connection with those aspects of the study in which the TRC has not expressed agreement will be removed from the final report and any associated documentation or publicity.
- 5.

If you agree with the above principles please sign below.

(For Project Sponsors)

For Technical Review Committee