

NEBRASKA STATEWIDE WIND INTEGRATION STUDY

SUMMARY of Technical Review Committee Meeting #2

January 15, 2009 – 9:00 AM to 4:00 PM (Central Time)-WebEx tele-web conference

Reference Documents - Email to TRC and Observers dated 01.09.09 from Clint Johannes containing five attachments: the meeting Agenda, Roster, NPA Summary of SPP WITF meeting, Action Item Tracking Matrix, and Study Plan table, some of them having been updated from previous distributions. On 01.14 the Assumptions v3 document, the US Army Corps of Engineers presentation, and the SPP presentation were distributed to the group. All three documents from 01.14 plus the EnerNex, Ventyx, and WAPA presentations were provided in pdf format on 01.21.

TRC Members Participating:

Utility- Clint Johannes, Paul Malone, Dave Rich, Doug Kallesen, David Ried, Marc Nichols, Jon Iverson, Bruce Merrill, Billy Joe Cutsor.

Consultants- Bob Zavadil, Jack King, Gary Moland, Rick Hunt.

Technical Experts and Stakeholders- Michael Milligan, Matt Schuerger, Ed DeMeo, Laverne Kyriss, Mike Radecki, Jay Caspary, Sohrab Asgarpoor, Neil Moseman, Bruce Hauschild, Sarah Hurt, Tim Texel, Michael Goggin, Steve Eveans.

Observers Participating:

NREL Subcontract- Brian Parsons.

Utility- Randy Lindstrom, Rocky Plettner, Ron Steinbach.

Technical Experts and Stakeholders – Charles Hendrix, Jason Smith, Joe Sullivan, John Cochran, Tim McCoy, Mark Ahlstrom, Bill Doan. Rod O’Sullivan and Doug Hellekson of WAPA made presentations.

Overview of Meeting and Summary:

The complete agenda was covered and the general purposes achieved, that being to obtain pertinent background information directly from Western Area Power Administration (WAPA), U.S. Army Corps of Engineers (USACE), and Southwest Power Pool (SPP). Then to establish the specific processes and set action items to establish assumptions and methods for the study. Additional discussion on study schedule status.

This summary is intended to document key points of the discussion. The new and updated action items are listed in the associated Action Item Tracking List.

Questions and comments from the audience are usually identified in italics and plain type is intended to indicate statements by the presenter at the time. Usually the person involved will be clear, but not always.

Afterthoughts and suggestions can be emailed at any time to Doug Kallesen, drkalle@nppd.com, 402-563-5274, and they will get “logged” into the study process, or to Clint Johannes, Chair of the TRC, cjohannes@neb.rr.com, 402-910-1856.

Key Points of the Discussion:

1. Clint Johannes, Chair of the Technical Review Committee (TRC) and Chair of the NPA Joint Planning Subcommittee (JPS):
 - a. Welcomed all, took roll call, and provided an overview of the meeting purpose.
 - b. Asked for any additional comments to the TRC 1 Meeting Summary dated and distributed Nov 24, 2008. No comments offered.
2. Bob Zavadil, study technical manager, EnerNex, briefly covered through slide 4 of his presentation.
3. WAPA representatives covered three topics:
 - a. Rod O’Sullivan briefed the group on the Upper Great Plains Wind Energy Programmatic EIS process that is underway (details at www.plainswindeis.anl.gov) . Public meetings were held Sep-Oct of 2008. Expect an initial draft spring of 2009. Looking for areas of high wind generation potential (and transmission needed), interactions with natural and human resources, mitigation measures, and adaptive management of impacts (which laws are relevant and needed).
 - b. Doug Hellekson briefed the group on WAPA’s Power Marketing Plan regarding the potential of using the Nebraska allocations to support wind generation in Nebraska. “Marketing Plan” means essentially for this purpose, the contracts that are in place now and in the future through 2020, but renewal negotiations might start in 2011 or 2012. Contracts are specific to preference customers and protected by specified resale requirements (must go for local load serving). There has been historically a principle of following load.

Dave Rich asked if the load following requirement could be treated as following net load (defined as load minus wind generation). This might be a possibility, but the contracts would need to be reviewed.

Doug Kallesen indicated the two “modeling” aspects that hydro flexibility could offer might be classified as (a) shorter scheduling time (so that wind forecasting error effects could be reduced), and (b) shifting contract deliveries within hours of the day or within days of the week.

Brian Parsons indicated the study should find out what if existing customers with allocations could request changes in service characteristics, e.g., scheduling on net load.

Doug Hellekson concluded that key contract principles for WAPA are that the power goes to the customers intended and that cost allocations not be upset.

- c. Mike Radecki covered selected slides from his presentation that was used on Jan 13 in their Rapid City public meeting for their Wind-Hydro Feasibility Study (primarily slides 28, 29, 31, 40, 41, 42, and 58.

On slide 41, the 23% and 25% penetrations are capacity-based (meaning wind nameplate divided by peak load). *A rule-of-thumb conversion factor (divide by 150%) was offered by someone from the group, which would yield 15-17% on an energy basis (as the NPA is defining its penetration scenarios of 10%, 20% and 40%).*

On slide 42, one difference would be that the NPA study would include fast energy markets, which was not the approach taken in the WAPA study.

Mike gave some feedback from Watertown. Year 2018 could see high penetration levels because they have thousands of MWs in their generation interconnect queue. Also that some will be serving load and some for export. In the Eastern Wind Integration and Transmission (EWITS) study, it is Midwest Independent Transmission System Operator (MISO) that will control large wind operations in South Dakota. The NPA, for its higher penetration cases, will also need to decide what is the level of export (i.e., where is the wind going to?)

On slide 58, Mike indicated that after all the comment processes, WAPA expected to be issuing its final report in May 2009. Mike also indicated that there were not a lot of relevant and significant comments given at the Jan 13 public meeting.

Matt Schuerger indicated that the NPA study will have a different focus than the WAPA Wind Hydro Feasibility Study: including consideration of the operation of the river and not just substituting market sources for backup energy as was the basic look in the Feasibility Study.

4. Bill Doan, U.S. Army Corps of Engineers (USACE), Omaha, made a presentation on the Missouri River Mainstem System. Generation capability is 2,400 MW for seven authorized purposes (slide 4). The last Master Manual review/revision process took 15 years. Slide 10 indicates that WAPA has some hourly flexibility, depending on the particular dam's operating guidelines and other factors. I.e., USACE provides WAPA a daily water schedule and largely leaves it up to WAPA how to generate through the day. And there is usually a ± 200 MW range around the daily target.

Bob Zavadil indicated that one can forecast wind generation more accurately than how much rain. Perhaps we can factor this relatively positive aspect into the water operations and use the generation on an "opportunity" basis.

Gary Moland indicated that PROMOD can model hydro generation some as run of river, some based on load, and some based on wind generation (either as prediction before or as actual after).

Bob Zavadil related his understanding that the base setup for hydro generation would be operation as is relatively fixed schedules governed primarily by load) and then a sensitivity for this investigation of hydro flexibility – however we end up characterizing it.

Mike Radecki pointed out that slide 17 of his presentation is a 1-week snapshot in the fall for an average water year, with some excess sales in the on-peak periods and some buying of off-peak energy, indicating that some hydro “flexibility” is already being incorporated or used for economic reasons. The \pm 200 MW range around the daily target is available on an “informal” basis and does relate to some flexibility to shift energy generation within the daily schedule. We did discuss the ability to shift energy from day to day but that is a net sum process.

Clint Johannes suggested, and the group agreed, that a small subgroup should be formed to (a) explore further generation flexibility options for modeling in the NPA study, (b) wind generation siting criteria for the WAPA balancing area for the NPA scenarios, and transmission interconnection into South Dakota (see item 7q below). (There may need to be two separate groups because of the different expertises needed for the two questions.) People mentioned were, at least, Mike Radecki and Laverne Kyriss (and she will work on getting someone from WAPA-Watertown) and somebody in Marketing/Contracts, Gary Moland, Bob Zavadil, some utility people, NREL (Brian Parsons, Matt Schuerger, and/or Michael Milligan), and a USACE person(s)—Bill Doan will not be available as he is being assigned to a development project in Afghanistan. This is recorded as a continuation item in the Action Item Tracking Matrix #s 12 and 13.

5. Jay Caspary, Southwest Power Pool (SPP) Director of Engineering, made a presentation on SPP Updates with other SPP staff also on the call: Charles Hendrix, Juliano Freitas, and Jason Smith. Jay elaborated on slide 7 describing the SPP Wind Integration Task Force study plans that: penetration percentages are based on energy (same as NPA’s definition), existing system includes approved projects in the STEP (SPP Transmission Expansion Plan), and that existing system may not handle 10-15% penetration levels, especially due to the constraints within and in/out of the Southwestern Public Service (SPS) area, and because STEP is primarily based on reliability needs for generator outlet and load service with a focus on NERC Standards and SPP Criteria.

Jay described several transmission development phases shown in their 2027 EHV Overlay study being finalized for different scenarios of wind generation development, specifically 6.5 GW, 13.5 GW, and 21 GW of wind generation (not counting Nebraska generation): slides 10-12 for wind generation siting and slides 13-15 for transmission.

It was noted that these do not exactly line up with the 10, 20, 40% scenarios planned by NPA so NPA will need to decide whether they are “close enough” or tune them a bit, on the generation side (also go back through the calculation of these amounts to see what the amounts should be based on 2018 load projections for SPP and what capacity factor assumptions make sense). On the transmission side NPA will need to look back at the full SPP study where there is a bit more detail on these phases. Generally the SPP recommendation appears good, maybe with a bit of tuning up to the NPA assumptions. Bob Zavadil is working with Bruce Rew, who is secretary of the SPP Wind Integration Task Force, on some of this.

Clint Johannes asked about the assumptions for other generation besides wind. Gary Moland indicated Ventyx has some information sources and will propose plans to SPP for coordination in this study. Gary will also work through Bruce Rew.

Bob Zavadil indicated that the NPA study will need to include market developments and the increased operating reserve requirements and how to handle. Jay indicated SPP will be willing to help with this as we work together to support and coordinate the two studies: NPA's and SPP's Wind Integration Task Force (WITF).

6. Gary Moland, Ventyx, made a presentation NPA Wind Integration Assessment describing Ventyx plans for developing the PROMOD generation and transmission model.

Several questions on specific data centered around the idea that the Ventyx model necessarily relies on, and is primarily based on, data development procedures that rely on publicly available data for which the results may not completely align with specific data that could be obtained straight from the owner utility. So, should we leave our NPA unit data as is (to keep the consistency of data development by Ventyx) or fix the detailed NPA data while not fixing the outside data? Gary Moland felt and general consensus seemed to be to leave the NPA data as is except in cases where the difference between utility-supplied data and the Ventyx data was large.

Next step is that NPA put forward reply comments to the generation data we have in hand, including information on shared units like Laramie River and Walter Scott, Nebraska City, Gentleman Station, Cooper, etc. Gary Moland indicated that generation expansions are included in the model data, so that needs to be adjusted appropriately, including that the SPP wind generation capacity calculation method will be used. NPA should also compile information on forecast for 2018 loads for all of Nebraska demand and energy by month, and any additional pattern-type information for Ventyx to determine necessary adjustments to PROMOD loads to represent the requested loads. Also Ventyx will also take a look at examining the characteristics of the load vs. wind for modeling, indicating that they prefer 2004 as most representative load year (2005 was Katrina, and 2006 was mild). All agreed this data review and development method would be somewhat iterative in nature.

Brian Parsons asked about load forecast error assumptions. Bob Zavadil noted that only sparse data was available from the utilities so some synthesis will be needed for that aspect.

7. Bob Zavadil – EnerNex, continued with his presentation which focused on key parts of the Assumptions document that he had prepared (version 3). He summarized by saying the process for settling on generation and load data is forming, transmission plans need to be established for the scenarios, and the specific amounts of wind generation set with the associated criteria for siting. Goal is to finalize the Assumptions document by the end of January.
 - a. External representation can be from the EWITS study taking JCSP 2024 projections back to 2018. Joint Coordinated System Plan (JCSP) reference case has 60GW of wind.
 - b. *Question from Bruce Merrill on how WAPA contracts will be handled in the model. Gary Moland indicated that standard options are peak shaving, flat schedule, load pattern, and peak following. [Subsequent explanation from Gary Moland: Peak shave places as much energy as possible in the peak hours up to the capacity of the transaction until the*

transaction energy limit is met. Peak follow spreads the energy over the peak hours proportionally, basically following the load ramp, so that the full capacity of the transaction is only taken over the super-peak hours.] Primarily the contracts need to be isolated to some extent so they can be accessed so that the WAPA flexibility sensitivity case can be set up and run.

- c. *Paul Malone asked about the SPP Balancing Area Consolidation activity.* Gary Moland responded that yes PROMOD would normally be set to that mode, with there being a sensitivity case for Nebraska balancing on its own.
- d. *Ed DeMeo wondered about the possibility of an SPP-ERCOT combine by 2018.* No such modeling is included in the scope.
- e. *Michael Goggin expressed concern about the JCSP reference case not having sufficient wind generation (and being static) as the Nebraska system goes from 10% to 40%. SPP will also go 10-40%, at least approximately. Also reminding that the 845 MW reported for SPP was in the reference, was not the total but rather incremental over some amount – therefore misleading as such.*
- f. *Paul Malone expressed some concern that for the 40% Nebraska case that maybe the rest of SPP should be adjusted to make sure that they are not less than 40%, given that they are ahead at this point.*
- g. Discussion on what to use for a siting criteria for the Nebraska wind generation: queue-based vs. technical merit (capacity factor, diversity, and possibly environmental and transmission). *Clint Johannes expressed preference for technical approach, to which no one disagreed.* Bob Zavadil indicated that they could initially do two siting scenarios for best capacity factor and for best diversity – and that this process could perhaps start by Jan 23. *Michael Goggin felt it would be ok to do these two scenarios, then form a hybrid between the two bests.*
- h. For SPP wind generation siting, the group agreed to use Jay Caspary's recommendation to use SPP information already available, with doing perhaps a bit of tuning as mentioned in #5 above.
- i. *Clint Johannes described the western Nebraska wind generation opportunities and impediments (good sites showing up in EWITS data in the southwest corner of the Nebraska panhandle –west of the Eastern Interconnection , but essentially no available transmission capability going east from there). Clint described that Ron Steinbach has a plan to work with WAPA to identify some transmission characteristics and requirements going west from there, although not identifying production costs to integrate west.* Bob Zavadil indicated that because most of our cases will be showing new transmission into Nebraska that maybe this generation could be incorporated going to the east (especially if the 765kV loop would have a connection at Gentleman station). Need more modeling thought on this – do we want to consider this generation going east as well as west? For the east part, if it goes west, it will not count for the penetration percentages. There

will also be some background discussion describing the East-West split and why we are not able to do an wind integration study on the west side.

- j. *Paul Malone expressed concern about lack of transmission in the west and north for these penetrations and we do not have a plan ready to go to insert for these scenarios. Considerable discussion was held around this issue. We don't have study scope to develop and test a transmission plan – but we do want to learn something about transmission requirements for these scenarios. Here is the modeling procedure chosen to address these concerns:*
 - i. *Determine wind generation areas around the state according to the criteria described in 7g above.*
 - ii. *Connect these areas to major 230-345kV buses (including reasonable 765 kV nodes that could represent a refinement of the 765kV loop in the SPP study) throughout Nebraska with lossless connections and observe the flow patterns. This exercise could be an indication then of the basic wind generation collector system needed for the 765kV loop. And these requirements can then be a basis for the capital cost of transmission expansion, which is a part of the study scope (MW-mile considerations).*
 - iii. *Bob and Gary will construct a “collector” system of connections to buses like Gentleman, Norfolk, Grand Island, and Fort Calhoun, etc – suggestions by Randy Lindstrom, and show that to Lindstrom for additional input. There will be separate cases for the different penetrations and 345kV vs. 765kV.*
- k. *Steve Eveans made reference to NREL topographic maps. These are the basis for the EWITs map in the EnerNex Assumptions document and the underlying wind data is from AWS Truewind. [In followup, wind generation data for this study rely on the NREL data set, previously described, believing it to be the most complete and accurate data set available. NPA believes it used all of the sources of information available to it at the time – including, we presume, the 1999 NPA study (funded by NPA) available at http://www.neo.ne.gov/reports/ne_wind_energy_site_data_study_1999.pdf . NREL did provide funding for the 2005 wind maps available at http://www.neo.ne.gov/neq_online/july2005/july2005.01.htm . The 2005 maps were also done by AWS Truewind so if that work was useful to their most recent eastern interconnection analysis, we presume they made use of it. NPA does not intend to rely on other wind generation data sources for this study that members of the TRC might bring forward, as we believe the NREL data set to be satisfactory. It is the same data set that is being used in EWITS for the eastern interconnection. This study will not establish final wind generation sites nor make final transmission plans. Such will be an evolving process and that fact will continue to be stressed to all parties.]*
- l. *Indicated that we need also to work closely with SPP to make sure we have the underlying system included there to support the wind generation development in all scenarios.*

- m. More explanation was offered on the JCSP reference case: assumes 5% wind for the Eastern Interconnection, but concentrated in the Midwest; \$50 billion for transmission expansion in the Eastern Interconnection. PROMOD model will likely have transmission included for the entire Interconnection but loads and generation will likely not be included for the outer edges in order to manage solution time. MISO will be represented in detail.
- n. *Paul Malone expressed concern on potential “disconnect” between SPP-STEP and JCSP, especially for the heavy export cases. As soon as possible we need to check on the consistency of the JCSP reference case and the SPP STEP Overlay.*
- o. Gary Moland indicated that the cost data in the Assumptions document should be interpreted as current year dollars (2009). They will need to be projected to 2018 dollars – utilities need to specify the escalation rates.
- p. Group decided to make CO2 costs for the base case be \$25 per metric ton in 2018 dollars. Gary Moland indicated he thought the JCSP was using \$25, and would check if that were on a current year basis or a future year basis. Group was not able to decide on the low and high values of CO2 for the sensitivity cases, but that will likely need to be settled at the next meeting. *Mike Radecki-WAPA and Rick Hunt-Ventyx indicated that the WAPA study (that was the subject of Radecki’s presentation and for which Ventyx had done some of the modeling) use a CO2 allowance price assumption as shown on page G-6 of the WAPA report, and being about \$19/ton in 2018 in nominal (2018 \$). Radecki and Hunt added that the zero dollar sensitivity case they ran was helpful for helping confirm case validity.*
- q. *A question was raised about connections to the north into South Dakota. Modeling will have to address the need for some interchange with similar wind developments in the Dakotas. The transmission interconnection coordination will be included as a task for the small group described at the end of item 4. [Subsequent to the meeting, a question was asked whether the far-western Nebraska wind in EWITS Scenario 1 was connecting to Midwest Reliability Organization, SPP, or Western Electric Coordinating Council (western interconnection)?]*
- r. *A question on hurdle rates was offered. Answer that \$5-7/MWh is usually used. Group agreed on using \$5/MWh in 2018(??). [Subsequent explanation from Gary Moland: The “hurdle rates” we are modeling are used to represent both real transmission service charges from tariffs and to capture inefficiencies in dispatch between un-coordinated markets. In our data we only will have tariffs between ISOs (Independent System Operators) and the rates will be set to primarily reflect the lack of coordination in the dispatch, to keep the model from over-optimizing across the ISO boundaries.]*
- s. *A question on scenario description details. Zavadil to add a scenario table with all the key assumptions included for each one so we have good communication before runs are made.*

- t. *Randy Lindstrom inquired about the validity of the JCSP model since NPA transmission people were not really involved in its development. Bob Zavadil will send the JCSP case and also the Nebraska flow gate information to Randy for technical review. Bob Zavadil and Gary Moland will work out the necessary confidentiality arrangements involved. [The results of this review will be useful to SPP modeling efforts, as well.]*
 - u. *Mike Radecki asked about the subgroup to be set up (see end of item 4) and mentioned 1,000 MW wind expected in their balancing area by 2018. Also that Ed Weber would be needed for transmission planning interfacing (item 7q above).*
8. TRC #3 Face-to-Face Meeting in Omaha was rescheduled for Thursday, March 19, 10AM-4PM Central time. Although this change of meeting date is a slip in the calendar for the study schedule, it was agreed by the group that at our TRC #3 meeting we intend to be completed with the work task progress denoted in the study plan for holding TRC #3.

By Doug Kallesen, NPPD (for NPA)