

# NEBRASKA STATEWIDE WIND INTEGRATION STUDY

## SUMMARY of Technical Review Committee Meeting #4

May 13, 2009 – 10:00 AM to 4:00 PM (Central Time)-Omaha – Gallup Headquarters Building

**Reference Documents** - Email to TRC and Observers dated 05.06.09 from Doug Kallesen (for Clint Johannes) containing three attachments: the meeting Agenda, TRC Meeting #3 Summary (revised final), and Roster, some of them having been updated from previous distributions. The EnerNex and two Ventyx presentation files were provided by email on 05.11.09 and then the Ventyx Results presentation file was updated on 05.12.09. A final Ventyx Results presentation file and the WAPA-west study presentation by Ron Steinbach was provided by email on 05.19.09.

### TRC Members Participating [(p) means by phone]:

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

Consultants- Bob Zavadil, Tom Mousseau, Gary Moland, Rick Hunt.

Technical Experts and Stakeholders- Michael Milligan(p), Matt Schuerger(p), Ed DeMeo, Charlie Smith, Laverne Kyriss(p), Jay Caspary(p), Sohrab Asgarpour, Neil Moseman, John Hansen, Tim Texel, Michael Goggin, Steve Eveans.

### Observers Participating:

Utility- Rocky Plettner, Mike Matheson, Jerry Krause, Ron Steinbach, Max VanSkiver(p), Eric Hixson.

Technical Experts and Stakeholders – Tim McCoy(p), Mark Ahlstrom(p), Patrick Dalseth.

### Overview of Meeting and Summary:

The complete agenda was covered and the general purposes achieved, that being to review developments in methodology, description and presentation of new work, discuss and conclude about future work including case definition and assumptions as well as schedule for work and meetings.

This summary is intended to document key points of the discussion. *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](mailto: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](mailto: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 3 Meeting Summary revised (dated 04.21.09) and distributed lastly 05.06.09. No comments offered. [After the meeting Kallesen noticed that Dave Mazour, Tri-State, had incorrectly not been listed as

attending TRC 3 – this correction will be included in the “official” summary of TRC 3 dated 05.14.09.]

2. Bob Zavadil, study technical manager, EnerNex, proceeded into the EnerNex presentation with some more background on meeting objectives and general work status.
3. Tom Mousseau continued the EnerNex presentation.
  - a. *Dave Mazour inquired about the adequacy of the 40% penetration case yielding 4,727 MW wind in Nebraska when the Legislative Resolution 83 study is calling for consideration of 7,800. (Slide 12).* Reply that we feel it is in that the 7,800 MW is a 2030 target whereas our 4,727 MW value is in 2018. A steady wind growth from the current wind nameplate of 152 MW in 2009 to 7,800 MW in 2030 would be about 350 MW per year. In 2018, this would amount to 3,652 MW, which is less than our modeled 4,727 MW. So our 40% scenario is judged to be more aggressive to 2018 than the LR83 study assumption. Additionally, there is the EWITS study that has even higher amounts of wind assumed in Nebraska than either the NPA or the LR83 assumptions due to modeling huge amounts of export from the Midwest to the east.
  - b. *Ed DeMeo asked if the average size of sites in SPP (not including Nebraska) being larger than in Nebraska (1,342 MW vs. 430 MW) had any significance or meaning. (Slides 18 and 22).* Reply that we believe there is not significance, in that Nebraska site selection needed to pick smaller sites to get some diversity for the smaller target energies than necessary for the rest of SPP.
  - c. *Malone asked about the load relationship between NPA and the rest of SPP (appears NPA is high at being 18% compared to the rest of SPP). (Slide 12).* Reply that these are wind energy amounts (which are proportional to load energy amounts because the assumed energy penetrations are approximately equal –although NPA is 42% and rest of SPP is 40%--2004 basis on Ventyx’s Scenario Overview slide). Suggested that Nebraska has a higher annual load factor (higher energy content) than the rest of SPP due to the large amount of summer irrigation load control. Further, Nebraska’s load growth rate might be higher than that assumed for SPP from now till 2018. Checking some of this out after the meeting:
    - i. Nebraska’s projections for 2018, with 2006 basis pattern, are 7,332 MW (coincident) and 39,402 GWh for a 2018 load factor of 61.4%, whereas the 2006 data was 6,306 MW (coincident) and 29,050 GWh for a 2006 load factor of 52.6%. This amounts to a 1.3% annual demand growth and 2.6% annual energy growth for Nebraska.
    - ii. SPP website indicates “2008 System Peak, non-coincident (summing utilities’ peaks that may be in different hours, that is not coinciding timewise): 43,703 megawatts (does not include Nebraska)”. Assuming SPP demand growth is the same as that for Nebraska, at 1.3% per year, non-coincident demand in 2018 would be 53,142, which would be 50,485 MW (coincident) if the coincidence factor is 95% (a guess). For the assumed SPP energy of 225,134 GWh for the rest of SPP (Ventyx’s Scenario Overview slide) this would yield a 2018 load factor of 50.9%, which is similar to that for Nebraska today. Then, assuming

- that SPP load factor does not increase like Nebraska has assumed for itself, all seems to check fairly well.
- iii. Using these values for load energy in 2018, the ratio of Nebraska to the rest of SPP yields essentially the same 18% ratio in wind energy penetration. In other words, the ratios of load and wind between Nebraska and the rest of SPP look ok.
  - d. *Jay Caspary indicated that from the SPP standpoint, they are doing all they can to coordinate data assumptions and planning between the SPP wind and transmission studies, EWITS studies and the NPA study. That is the SPP goal. The SPP Wind Integration Task Force has just recently selected a consultant and is beginning their study.*
  - e. *Max VanSkiver pointed out (e.g., looking at slide 24-25) wind generation in the 40% case can approach total load, e.g., 6AM average for fall at 40% penetration is 2,500 MW, whereas the load average is on 3,000 MW. So clearly there will need to be export. Reply – correct.*
  - f. On slides 33-35 it was pointed out that on the left end of the x-axis is the highest load hour, then the next highest, etc. The y-axis value is then the capacity factor computed over all the hours accumulated in the ordered fashion up to a given point. I.e., for the 1000<sup>th</sup> hour point it is the capacity factor for it and all 999 hours with higher load. So then, at the right end, the capacity factor is the annual capacity factor.
  - g. *Various comments that the SPP capacity value calculations end up being very low. Reply that the NERC Integration of Variable Generation Task Force has a two-year assignment to develop a methodology for variable capacity valuation that perhaps regions like SPP could adopt that may be more rigorous. The method will likely be LOLE-based (Loss of Load Expectation). Also pointed out that these sites are really aggregation of likely smaller farms and in some of the SPP capacity value slides are aggregations of aggregations. Intuitively known and clearly shown that aggregation leads to higher capacity value results because of diversity effects.*
  - h. Slide 43: “Persistence” forecast means that the next time segment’s forecasted wind (or load) is forecast to be the same as the previous hour’s value.
4. Bob Zavadil returned to the EnerNex presentation
- a. Mentioned the in-process status of the Assumptions document. Group decided that any of the participants could request a copy of the present version if they wanted and it would be sent as is.
  - b. Slide 72 shows how “exporting” wind integration burden from one area to the other can adversely affect the receiving area’s calculated integration cost (e.g., MISO-west’s large wind penetration driving up MISO-east’s calculation , where they have very little wind). *Comment – we need to evaluate this effect in our study as NPA and SPP increase penetration while holding external wind constant. We need more metrics than just \$/MWh – so we need to develop some other metrics.*
  - c. Slide 74 – using actual shape for the reference “ideal” resource may leave out some “shaping” integration costs and effects. This is not totally settled in the EWITS study. See slide 70 for definitions of ideal and actual wind resources as used for calculating integration cost. *Comment – we need to be sure we are not understating integration by virtue of methodology definitions.*

- d. *John Hansen inquired about the assumptions for the no-wind case that is being proposed for analysis. Reply that it would likely be the base assumptions except for wind. E.g., \$25/ton for CO2 emissions. Also that the point would not be so much to derive integration cost but rather effect on emissions. Believe that we have enough generation without the wind, at least for NPA.*
5. Ron Steinbach of Tri-State made a presentation summarizing the WAPA review of necessary condition to add up to 300 MW of wind in Nebraska connected to the western interconnection.
  - a. *Comment that when presented the study will need to be highly qualified with caveat, including that this is not an interconnection study, that generation had to be backed down in northern Wyoming to permit the interconnection, other transmission plans are in progress (and may alter), not including full contingency or stability analysis, etc.*
  - b. *Comment also that this work will afford a good opportunity to discuss all the considerations and transmission considerations necessary for this somewhat unique area set between interconnections with very little local load and considerable transmission restrictions in effect already. However, it is a windy area with a good wind resource.*
  - c. These three slides were not provided ahead of time but will be sent out with meeting summary or before.
6. After lunch, Gary Moland of Ventyx made a presentation on “Modeling Setup Updates”.
  - a. Slide 6 – EWITS Reference Case has two east-west big DC lines. In SPP scenarios 2 and 3 only the SPP Transmission Expansion Plan (STEP) as developed months back (not the recently approved Balanced Portfolio list) was included. *Comment – need to present for understanding what exactly future lines are in/out of the NPA and SPP area and interconnections to the external. Also review how the 765kV loop is connected in.*
  - b. Slide 10 – these are short tons (2,000 pound tons, not metric tons).
  - c. Slide 15 – PROMOD goes through at least three dispatch passes trying to reasonably match the calculated LMP’s with the final dispatch (necessary because the forecasted LMPs determine the dispatch and the dispatch influences the LMPs).
  - d. Slide 16 – Sohrab Asgarpour asked about PROMOD’s objective function – Moland replied that it is to minimize total production cost, but also requires load and generation to balance plus for the transmission flows to be at or below their required limits.
7. Rick Hunt of Ventyx went onto the PROMOD results presentation.
  - a. Slide 4 wind amounts are before curtailment (or call it scheduled or requested or available).
  - b. Slide 5:
    - i. Wind energy is priced for dispatch decision at -\$40/MWh cost to represent the potential loss of production tax credit and renewable energy credit if the wind is to be curtailed by the dispatch.
    - ii. “Transmission Overlay” refers primarily to the 765kV figure 8 overlay for SPP that was shown in the previous presentation by Moland.
    - iii. Constraint Relief was taken in SPP (especially SPS area) to not allow low voltage constraints to cause curtailment. So to do that, the model is run and constrained elements identified, then if it seemed reasonable, to relieve it. But in SPP many of these constraints consist of elements that are highly networked

- (rather than being simple radials). For this, six elements were relieved, but mostly “problems” focused on two of them as shown on slide 5.
- iv. *Comment as to why the overlay created so little reduction in curtailment? Reply that possibly the constraint relief process created a “virtual” overlay. Further comment that perhaps we could test this theory by running the case to determined curtailment with the overlay but keeping the constraints (i.e., fill in the blank on slide 3).*
  - v. Curtailment percentages are % of requested (available) wind.
  - vi. *Comment that it will be desirable to understand fully why there is no curtailment occurring in Nebraska under these high wind penetrations.*
- c. Slide 6 – “flo” stands for “for loss of”.
  - d. Slide 7 – these results are for the actual wind run.
  - e. Slide 10 - (and all these slides) pertains to the 2004 base wind/load pattern.
  - f. Slide 11:
    - i. Production and integration costs are not separated between NPA and SPP because some of the cost elements (e.g., reserves) are pool-wide, and no allocation methodology is available at this time.
    - ii. Wind energy here is the amount dispatched (after curtailment) and is for both NPA and the rest of SPP combined.
    - iii. Even though dispatch decision uses \$-40/MWh, the cost used in the average production cost is zero. That is, it does not include the cost to install and operate the wind plants.
    - iv. These results also do not include the potential cost to “export” the variability of the wind generation into external areas. Need to think about this and any other costs that may not be accounted for by the methodology.
  - g. Slides 12-16 – *need to include the wind generation here as well to get the complete picture.*
  - h. Slides 15-16 – *need some visuals (pie charts?) to summarize the changes to more clearly see what is going on.*
  - i. Slide 17 – shows a near-convergence of on- and off-peak locational marginal prices in May, where there is high wind compared to load.
  - j. Slide 19 – shows change in surplus generation by scenario. *Question raised (looking at the yellow SPP incl NPA line) as to why adding the overlay (going from scenario 2 to 3), the export is decreased slightly. Most explanations seemed to argue for an increase like shows up for Nebraska alone. More research needed here as a satisfactory explanation was not provided on the spot. [Probably there is some bad data shown in this added slide.]*
  - k. *Comment that it may be good to run a case using the previous definition of proxy resource for comparison (benchmarking) purposes – probably at the 10% level would be the most appropriate. The purpose would be to find out how much less the result is with the new definition of proxy resource, as to identifying a potential underestimation of this integration cost under the new definition.*
8. Bob Zavadil led the wrap-up segment discussing the next phases of the project using the slides found at the end of the EnerNex presentation for scenario and schedule planning.
- a. The group expressed interest in the following cases:

"Firm"

- i. High CO2 price of \$50/short ton (2,000# ton). (Base price remains at \$25/st)
- ii. Market sensitivity: but needs definition yet. Possibilities are (a) ancillary service market in SPP but no day-ahead market, (b) change hurdle rate assumptions to force more "local" commitment, (c) NPA having its own balancing obligation (maybe this wouldn't need PROMOD, just reserve statistical analysis).
- iii. WAPA alternative case (*needs further definition, coordination, and discussion*) – some possibilities are (a) assuming a contract re-structure that optimizes transactions for WAPA and its customers, (b) some energy shifting during the day.
- iv. Existing Wind (none additional) – NPA would have enough generation, would the rest of SPP?
- v. Previous proxy resource for benchmark (probably at the 10% case, possibly 20%)
- vi. Flatten load profile to represent significant demand side changes, but keep the same energy for comparison
- vii. Hydro-pumped storage case (*needs definition*)
- viii. Wind forecast alternative (*not sure if this is firm or not – its definition and status is dependent on further discussion – could be 12-hr forecast, or other basis, if needed*).

"Other possibilities"

- i. Zero CO2 price (Wait to see if 25 and 50 comparison shows that zero case may be of interest.)
  - ii. Alternative proxy resource (some options described on slide 74 of EnerNex) such as (a) rolling average, (b) longer flat period such as week, month or season, or (c) give all plants the same aggregate characteristic to reduce variability locationally.
  - iii. Nebraska hydro flexibility
- b. The schedule was revised and set as follows:
    - i. Conference telephone call on Thursday, July 2, at 10AM Central.
    - ii. Face-to-face meeting in Omaha on Tuesday, August 11, at 10AM Central.
    - iii. Possibly other calls and meetings as needed.
  - c. Case list and schedule to be re-issued to the TRC (provided as two PowerPoint slides concurrent with the distribution of this meeting summary).

By Doug Kallesen, NPPD (for NPA)

# Summary of Base, Sensitivity, and Mitigation Case Runs as of May 19, 2009

(based on the Study Plan – last issued on March 12, 2009 and discussions at May 13 TRC #4 Meeting)

SCHEDULED FUTURE MEETINGS: **July 2 (webinar); August 11 (face-to-face –Omaha);** phone conferences to be scheduled as needed.

Line #	Task # (Ventyx Hours)	Case Description “?” means undecided	Wind Energy Penetrations		Historical Years	Market Rep for NPA	CO <sub>2</sub> Price in 2018\$/short ton	Forecast Errors	Tent Date for Results to TRC
			NPA&SPP	Other					
1	10	Low Pen Sens Case – <u>no</u> NPA&SPP Overlay	10%	EWITS Ref	2004, 2005, 2006	SPP-2018	\$25.00	Base	May 12 (04) Jun 16 (05-06)
2	5	Base Case A – <u>no</u> NPA&SPP Overlay	20% A	EWITS Ref	2004, 2005, 2006	SPP-2018	\$25.00	Base	May 12 (04) Jun 16 (05-06)
3	10	Base Case B – <u>with</u> NPA&SPP Overlay	20% B	EWITS Ref	2004, 2005, 2006	SPP-2018	\$25.00	Base	May 12 (04) Jun 16 (05-06)
4	10	High Pen Sens Case – <u>with</u> NPA&SPP Overlay	40%	EWITS Ref	2004, 2005 2006	SPP-2018	\$25.00	Base	June 2 (04) Jun 16 (05-06)
5	11 (30)	HIGH CO <sub>2</sub> Cost Sensitivity	20% A?	EWITS Ref	Rep year	SPP-2018	\$50.00	Base	June 30
6	12a (33)	Market Sensitivity #1 - Neb alone?	20% A?	EWITS Ref	Rep year	Neb only	\$25.00	Base	June 30
7	12a (33)	Existing Wind Only model	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	June 30
8	13 (25)	Forecast Sensitivity #1 - (e.g. 12-hr fcst?)	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	“Best”	June 30
9	13 (25)	Previous proxy resource model	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	June 30
10	12a (33)	?Market Sensitivity #2 – add expmt mkt penalty	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	July 21
11	13b (40)	Mitigation - Flatten load profile for demand side	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	July 21
12	15 (200)	Mitigation – WAPA – multiple and/or other	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	July 21
13	13 (25)	?Third proxy resource model or Neb hydro flex	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	Aug 4
14	13a (25)	?3 <sup>rd</sup> CO <sub>2</sub> price sensitivity (zero or reducing coal)	20% A?	EWITS Ref	Rep year	SPP-2018		Base	Aug 4
15	16a (40)	Mitigation - Hydro-Pumped Storage	20% A?	EWITS Ref	Rep year	SPP-2018	\$25.00	Base	Aug 4

# Case Run Order and TRC Reporting Timeline *(note line numbers refer to previous table)*

Run the Initial Penetration Analysis on 2004 to define the primary costs and system requirements for the penetrations

- Line 1 Low penetration case (2004 wind-load pattern, 10% - Scenario 1) – no NPA&SPP Overlay
- Line 2 Base A penetration case - no NPA&SPP Overlay (2004 wind-load pattern, 20% - Scenario 2)
- Line 3 Base B penetration case - with NPA&SPP Overlay (2004 wind-load pattern, 20% - Scenario 3)
- Line 4 High penetration case (2004 wind-load pattern, 40% - Scenario 4) – with NPA&SPP Overlay

Report key findings to the TRC on May 12 and approximately June 2

Run alternative historical years to identify sensitivities to wind-load patterns and determine Representative Year

- Line 1 Low penetration cases (2005, 2006)
- Line 2 Base A penetration cases (2005, 2006)
- Line 3 Base B penetration cases (2005, 2006)
- Line 4 High penetration cases (2005, 2006)

Report key findings, including selection of Representative Year, to the TRC approximately June 16

Run initial sensitivity cases on Representative Year (representative wind-load pattern)

- Line 5 High CO2 cost sensitivity case
- Line 6 Market sensitivity case #1 - Nebraska alone?
- Line 7 Existing Wind Only Model
- Line 8 Forecast sensitivity case #1 (e.g., 12-hr forecast)
- Line 9 Previous proxy resource model

Report key findings to the TRC and set future case parameters approximately June 30 – **HOLD TRC #5 webinar on July 2**

Run additional sensitivity and mitigation cases on Representative Year , start developing final report draft

- Line 10 Market sensitivity case #2 (assume regions external to SPP place a market penalty on exporting wind beyond “normal” energy export)
- Line 11 Mitigation - Flatten load profile for demand side
- Line 12 Mitigation – WAPA –multiple and/or other

Report key findings to the TRC and set future case parameters approximately July 21

Run additional sensitivity and mitigation cases on Representative Year , finish developing final report draft

- Line 13 ?Third proxy resource model or Neb hydro flex
- Line 14 ?3<sup>rd</sup> CO2 price sensitivity (zero or reducing coal)
- Line 15 Mitigation - Hydro-Pumped Storage

Report key findings and provide **DRAFT Final Report** to the TRC approx Aug 4 , **HOLD TRC #6 face-to-face August 11**

Finalize report and any last runs, prepare presentations required by contract. Finish Oct 23 (e.g., UWIG Fall Workshop Oct 7-9, NWWG Nov 9-10.)