AN OFFICIAL FILING
BEFORE THE
PUBLIC SERVICE COMMISSION OF WISCONSIN

Joint Application of Dairyland Power Cooperative, Northern States Power Company-Wisconsin, and Wisconsin Public Power, Inc., for Authority to Construct and Place in Service 345 kV Electric Transmission Lines and Electric Substation Facilities for the CapX Twin Cities-Rochester-La Crosse Project, Located in Buffalo, Trempealeau, and La Crosse Counties, Wisconsin	**Docket No: 05-CE-136**

DIRECT TESTIMONY OF STEPHEN BEUNING

<u>INTRODUCTION</u>

Q. Please state your name and business address.

A. My name is Stephen Beuning, and my business address is Xcel Energy Services Inc. 1800 Larimer, Suite 500, Denver, Colorado.

Q. By whom are you employed and in what capacity?

A. I am employed by Xcel Energy Services, Inc., the service company for four Xcel Energy Inc. operating companies including Northern States Power Company, a Wisconsin corporation ("NSPW" or "Company") and Northern States Power Company, a Minnesota corporation ("NSPM"). The two NSP operating companies operate their high voltage transmission and generation portfolio as a joint system and allocate costs according to the Interchange Agreement on file with the Federal Energy Regulatory Commission ("FERC"). Together the two comprise the NSP System ("NSP System"). My current job position is Director of Market Operations. My responsibilities include procurement of transmission service and new interconnection service for the NSP System as well as regional energy market design, including congestion management and renewable integration.

Q. Please describe your educational background and professional experience.

A. I graduated from the University of Minnesota in 1984 with a Bachelor of Science in Electrical Engineering. After graduation, I joined NSPM, as a transmission system operations engineer. Over the past 27 years, I have held various managerial positions within NSP and Xcel Energy Services Inc. Prior to becoming director of Market Operations in 2004, I served in various roles in the company, including responsibility for NSP transmission tariff administration and settlements, and supervising the operations technical support group for NSP's transmission control center in Minneapolis. My resume is attached as **Ex.-Applicants-Beuning-1**.

Q. For whom are you testifying?

A. I am providing testimony on behalf of NSPW, Dairyland Power Cooperative ("Dairyland"), and WPPI Energy, (collectively "Applicants") in support of the Hampton – Rochester – La Crosse 345 kV Project ("Hampton – Rochester – La Crosse 345 kV Project" or "345 kV Project") . Applicants seek approval from the Public Service Commission of Wisconsin ("PSCW") and the Wisconsin Department of Natural Resources ("WDNR") to construct the Wisconsin portion of the 345 kV Project. The Wisconsin portion includes a 345 kV line from Alma, Wisconsin to a new transmission substation located in Holmen and associated 161 kV system interconnections at the new substation ("La Crosse 345 kV Project" or "Project").

Q. What is the purpose of your testimony in this proceeding?

A. I am testifying to provide information regarding long-term regional benefits, including regional market benefits that would result from the 345 kV Project, coupled with added future upgrades made feasible by this preferred design. The lower voltage 161 kV alternatives to the 345 kV Project that include 161 kV ties from Southeast Minnesota to La Crosse, have some relative drawbacks. They are less able to support efficient renewable resource location for compliance with Renewable Portfolio Standards ("RPS") resulting in more congestion limitations on the grid as regional utilities attain compliance with their respective RPS obligations.

Q. Please summarize your conclusions.

A. The 345 kV Project is necessary for regional reliability purposes for the long-term eastward build out, as clarified by NSPW witness Ms. Amanda King. But the 345 kV Project also constitutes a key step as part of a regional plan to attain substantial economic dispatch benefits. With the 345 kV Project development in-place, future high voltage upgrades from La Crosse to the east will reduce regional energy production costs.

In contrast, as detailed in the SNS, the La Crosse 161 kV Alternative, with a 161 kV connection between Southeast Minnesota and La Crosse results in ***reduced*** transfer capability from west to east once the proposed eastward developments occur. Coupled with the lower expected capacity factor of production if significant wind resources were sited in Wisconsin, it is evident to me that the operational consequences of the 161 kV alternatives are less desirable. Little surprise, therefore, that the 161 kV alternatives would be incompatible with broader regional plans that are in development through the Midwest Independent Transmission System Operator Inc. ("MISO") regional process.

Lastly, I describe results of a production cost analysis that indicates the 345 kV Project, with 345 kV development fully to La Crosse, will enable future 345 kV transfer capability eastward from La Crosse, resulting in lower overall regional production cost through access to low-cost, high capacity factor wind production sites west of Wisconsin and will facilitate broad economic benefits for the region when the 345 kV Project is mated with planned future upgrades.

Q. What exhibits are attached to your testimony?

A. Ex.-Applicants-Beuning-1: Resume of Stephen Beuning;

Ex.-Applicants-Beuning-2: PROMOD Analysis Summary Results; and

Ex-Applicants-Beuning-3: Present Value Analysis.

BENEFITS OF AN EFFICIENT ENERGY MARKET

Q. Applicants have stated that the 345 kV Project will improve market efficiencies. Please describe what this means.

A. Market efficiency in this context can be characterized as the use of least-cost resources within the region to supply the load requirements on the electric transmission system. At times, given the finite capability of installed grid equipment, lowest-cost resources cannot be used to supply all loads due to grid congestion. When congestion occurs, the market prices show increased cost because more expensive resources were used to supply demand. Congested conditions may occur for several reasons, for example: due to outage of a transmission element resulting in reduced remaining grid capability, due to potential overload for next-contingency loss of a transmission element, due to loss or change of generator output, or congestion can arise over time due to fundamental market drivers such as demand growth and installation of low-cost supply resources.

Q. Is regional least-cost dispatch used to supply loads in Wisconsin?

A. Yes. MISO is a Regional Transmission Organization ("RTO") established pursuant to FERC Order 2000. The MISO established a regional energy market in April of 2005. The MISO market uses security-constrained economic dispatch to ensure that grid reliability is preserved while available least-cost resources are fully dispatched to supply the electric demand. Security-constrained economic dispatch achieves least-cost supply through specialized cost-optimization software that evaluates actual physical delivery impacts on the grid.

Q. Why is an efficient energy market beneficial for consumers?

A. An efficient market reduces the average cost of wholesale energy supply, which creates conditions where these savings can be reflected in customer retail rates.

Q. Does regional least-cost dispatch ever provide indications of inefficiency?

A. Yes. One signal that provides information about the potential for regional efficiency improvements is the congestion cost incurred in the market. When congestion costs occur, this information can be used to evaluate whether the costs of transmission upgrades would be more economic than continuing to incur the higher energy supply costs in the market footprint.

Q. Do marginal congestion costs ("MCCs") therefore represent inefficient operations?

A. No, not necessarily. The capability provided by the MISO market to dispatch regional supply given these transmission constraints was a tremendous efficiency improvement compared to prior grid operations. Prior to the regional market, transmission providers withheld delivery capability to ensure reliability because provision of transmission service was a separate operational function from the regional dispatch. Therefore the mere existence of congestion costs is an indication of increased grid access to obtain reduced cost energy supply and in itself is not an indication of inefficient operations. For example, if the regional market incurs $10 in congestion cost, but as a result reduces overall energy supply cost by $15, then incurring the congestion cost is a better overall outcome than losing the $5 aggregate savings.

Q. When might congestion costs indicate inefficient operations?

A. To illustrate, if we had a perfect grid, with sufficient capability that delivery limitation never occurred, the MCC component of Locational Marginal Price ("LMP") would always be zero. In reality the construction of such a hypothetical grid would be so costly as to be impractical. And as mentioned above some amount of congestion cost indicates that the existing grid resources are being used to the full extent practical. In this regard, the balancing point for long-run efficient operations lands between zero congestion cost and high chronic congestion costs that exceed the hurdle rates for transmission system upgrades.

Q. How can a transmission proposal be evaluated for its contribution to market efficiencies?

A. This involves analysis of supply costs with and without the system upgrades associated with the proposal. The tool we used to perform this evaluation is called PROMOD IV ("PROMOD"). PROMOD is a software tool developed by Ventyx that analyzes the effects of various factors including fuel costs, congestion, and generator availability on market prices. As noted by Ventyx, PROMOD performs a security constrained unit commitment and economic dispatch that is co-optimized with operating reserve requirements, similar to how ISOs set schedules and determine prices. LMP may be reported for selected nodes, user-defined hubs, or load-weighted or generator-weighted zones; this may be further broken down into a reference price, a congestion price, and a marginal loss price.

In sum, the PROMOD software simulates market dispatch in a manner comparable to the actual security-constrained economic dispatch employed by MISO. To evaluate the contribution of the proposed transmission upgrade to regional market efficiency, PROMOD is used to model regional production cost subject to grid limitations, combined with generation delivery made feasible through the transmission upgrades. This simulates market dispatch in a manner comparable to the actual security-constrained economic dispatch employed by MISO.

Q. Does the PROMOD analysis only evaluate benefits based on reduced congestion costs?

A. No. The total benefits are based on an adjusted production cost analysis. This analysis captures changes to both congestion and energy costs as well as system loss reductions. Congestion cost in total refers to the dollar value of supply cost in excess of that which would have been possible absent limitations on the transmission grid. However, in our analysis we recognize that eliminating the congestion costs associated with supply options is only one aspect to the benefit. The 345 kV Project and the future upgrades eastward will facilitate development of wind generation resources in an area with relatively strong winds on behalf of parties with RPS. (Please see the direct testimony of Ms. King.) By creating the option to site wind generation in an area with higher wind resource, the increased capacity factor of low-cost production also results in a savings on the energy supply component to the PROMOD simulation. I characterize the combined savings in energy supply and congestion cost in this analysis as the adjusted production cost savings.

PRODUCTION COST ANALYSIS

Q. Did Applicants perform a production cost analysis for the 345 kV Project?

A. Yes. Applicants conducted a production cost analysis using the PROMOD software discussed above. A copy of the summary report is attached as **Ex.-Applicants-Beuning-2**.

Q. What was your role in the analysis?

A. I was part of the engineering team that developed the scenarios for the analysis and I was responsible for reviewing and confirming the outputs from the PROMOD runs.

Q. In general, what were the results of the analysis?

A. The proposed 345 kV Project, combined with future eastward grid expansion already being planned, has the potential to provide regional economic benefits including adjusted production cost savings and carbon dioxide ("CO_2) emission reductions, particularly for Wisconsin utilities with RPS obligations. In addition, as noted in Ms. King's testimony, the 345 kV Project would also result in higher reduction in system losses compared with alternative scenarios using a 161 kV local transmission link between Southeast Minnesota and La Crosse.

Q. Describe the PROMOD analysis.

A. PROMOD was used to investigate the regional production cost impact of the 345 kV Project as compared to an alternative with 161 kV development, called the 161 kV North Rochester –Briggs Road (revised to serve 750 MW) alternative ("Briggs Road Alternative"), and also assuming future system upgrades contemplated under the MISO Midwest Transmission Expansion Plan ("MTEP"), which expand eastward delivery capability from La Crosse, for example through 345 kV system upgrades from La Crosse to Madison. PROMOD is an extremely resource-intensive and time-consuming program, and given the time constraints for the analysis, Applicants narrowed the scenarios used in the transfer analysis in the Supplemental Need Study ("SNS"). In the SNS, Applicants evaluated the immediate change in transfer capability between Minnesota and Wisconsin in the near term across alternatives and future transfer capability under a potential future where the 345 kV system is extended further into Wisconsin. In light of the time constraints referenced above, Applicants simplified the modeling of eastward capacity expansion, but ensured these elements remained consistent between the base case and the change case, in order to pinpoint the relative differences between the 345 kV Project and the Briggs Road 161 kV alternative. In my opinion, the performance of the modeled system with eastward 345 kV expansion is indicative of the type of performance that could be expected.

MISO's regional PROMOD models (for the year 2021) were used to develop the cases for analysis. Existing generation levels were used for the lower voltage alternative and higher levels of wind were used for the 345 kV Project. The reason wind generation levels were adjusted was due to the limitations of the existing system in delivering wind to eastern Wisconsin between the 161 kV alternative case and the higher capability cases with the future 345 kV construction to eastern Wisconsin installed.

As detailed by Ms. King in the transfer analysis, the 345 kV alternative provides increased regional transfer capability over the long term. This increased regional transfer capability accommodates significant generation additions in high capacity factor renewable energy zones, such as zones in Southwest Minnesota, North Dakota and South Dakota which can then reliably be delivered to loads in the broader MISO footprint.

Q. Why does your analysis include transmission lines that are not proposed as part of this proceeding?

A. The upgrades which are included in the Project are planned to integrate with future development identified through the MTEP process. Although the 345 kV Project has a higher initial cost than potential alternatives, the upgrade enables future development that will have substantial economic benefit to the area in terms of increased reliability and reduced energy supply costs.

Q. Describe the specific results.

A. The output from the PROMOD cases provided estimated differences in annual MISO production cost in millions of dollars and tons of CO_2 produced.

Over the 20 to 40 years beginning in 2019 (the first full year following anticipated in service date of the La Crosse-Madison 345 kV upgrades), the 345 kV Project, with its 345 kV tie to La Crosse, will allow approximately $354 to $445 million in present value benefits relative to the Briggs Road 161 kV alternative for the 345 kV Project under these assumptions. This calculation is provided in **Ex-Applicants-Beuning-3**.

Q. Would you expect the La Crosse 161 kV Alternative to provide similar PROMOD results?

A. Yes. Both the Briggs Road Alternative and the La Crosse 161 kV Alternative have 161 kV ties between Southeast Minnesota and La Crosse with similar electrical performance.

Q: How does this PROMOD analysis relate to the analysis provided in Mr. Tim Noeldner's testimony?

A: Mr. Noeldner's analysis looked at production of an equivalent amount of energy from wind resources at different geographic locations. A wind generation capital investment in an area with a higher capacity factor produces more energy per invested dollar compared to a lower capacity factor area. This difference in energy production is used to calculate a credit toward the value of transmission necessary to link the high capacity factor source area to the low capacity factor sink area. In contrast, the PROMOD analysis evaluates the production costs for the entire region, factoring in the unit commitment, congestion and loss impacts associated with the modeled scenario. The PROMOD analysis compares one transmission construction scenario (the Briggs Road Alternative, 161 kV case) with a second scenario (the 345 kV case). Both methods are used to illustrate value associated with the transfer capability provided by the 345 kV Project, but the dollar estimates established by the two techniques are not additive.

Q. Based on the PROMOD analysis, what alternative do you recommend?

A. The PROMOD analysis shows that a 161 kV alternative to the Project actually reduces the potential for economic benefits in the long run and could increase risks to regional system reliability. Therefore I recommend that the Commission approve the 345 kV Project as proposed.

<u>CONCLUSION</u>

Q. Does this complete your direct testimony?

A. Yes.

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