BEFORE THE MINNESOTA OFFICE OF ADMINISTRATIVE HEARINGS

FOR THE MINNESOTA PUBLIC UTILITIES COMMISSION

In the Matter of the Application of Northern States Power Company d/b/a Xcel Energy for Certificates of Need for Four Large High Voltage Transmission Line Projects in Southwestern Minnesota	MPUC Docket No. E-002/CN-01-1958 OAH Docket No. 15-2500-14699-2

Prefiled Rebuttal Testimony of B. Art Hughes, Ph. D.

Regarding Xcel's Option 1-H and Comparing 1-H to Option 1 and Option 3, the Testimony of Richard Gonzalez, and Exhibits for Option 1-H

On Behalf of Public Intervenors Network

June 19, 2002

Q: Please state your name, and for whom you appear.

A: My name is Bernard A. (Art) Hughes. My address and C.V. are part of my previous testimony and part of the record in this proceeding. I am appearing and submitting this rebuttal testimony on behalf of Public Intervenors Network.

Q: Please describe your qualifications for making this testimony, including your educational background and employment experience.

A: I hold B.S., M.S. and Ph.D. degrees in Electrical Engineering, Electric Power Major. I hold a B.S. in Electrical Engineering from the University of Manitoba, 1972; and the M.S. and Ph.D. from the University of Texas in 1976 and 1978. My work experience has focused on power systems planning, the development of EMS (Energy Management Systems) and DMS (distribution management systems) for power systems, and selected projects for the Electric Power Research Institute. My full resume is attached as Exhibit 601, BAH-1, admitted previously.

Q: What is the basis for your knowledge or your experience that supports your ability to provide the examples, and discuss the issues and criteria in this rebuttal?

A: This testimony is based on my professional experience and education in power engineering, and therefore I am able to give my expert opinion and the examples, issues, and criteria based upon the following specific knowledge and experience:

1. General. I have a specific education and professional career focused on power system engineering directly and indirectly providing software solutions to the power industry. Most of the examples, issues and criteria stated are “common sense” power engineering and do not require specific knowledge of wind power or detailed information on the specific transmission system. My education and experience spanned power system transmission planning, and power systems operations including operations or short term planning. Operations is where strengths and limitations of planning become clear. Operations is where “could haves”, “should haves”, and “would haves” become real and the statements of “that was not known”, “that was not considered”, “but the conditions have changed” become rationalizations. Good planning is like a good architecture; it enables flexibility to handle future uncertainties by being based on what is presently knowable and projectable and rigorous understanding of the inherent uncertainties.
2. Specific. Wind power generation has many attributes that are similar to water, or hydro power because both have high initial costs, zero raw energy input costs, and power outputs that is uncontrollably a function of the weather. Hydropower generators with their water storage in dams do have much short-term time control. Longer term planning requires extensive modeling of project weather related flows and how to reap the benefits of hydro-power while ensuring regular and reliable power to the customers. Manitoba Hydro and BC Hydro, where I worked, were both more than 95% hydro energy based.

Overview

Q: Have you reviewed the Testimony of Richard Gonzalez and materials submitted by Xcel regarding Option 1-H?

A: Yes. This section provides an overview of the issues involved in evaluating option 1-H. Some of the issues considered here have been addressed in the documentation and testimony provided by the Applicants, while others are topics that were raised in my review of the option 1-H materials and which should have been addressed to ensure that option 1-H is comprehensively evaluated. A comprehensive evaluation requires consideration both with respect to how well Option 1-H performs relative to the other options and on how well it meets the need in an absolute sense as expressed as the basis for this application. Evaluation must be comprehensive because the issues raised by the Applicants related to Option 1-H and their supporting material is shallow, more explanations than analysis, and of limited scope. All the issues considered in evaluating and comparing Option 1 and 3 must be considered and given a thorough review. Specifically, the Applicants IR response (PIN-23, 24, 25, 26; SC-13) to the criteria which were simplistic, based upon errors in calculating the MW loss costs, highly suspect MW export assumptions that were biased towards Options 1 and 3, lacking understanding and focus on the needs of the emerging wind industry, and only considers one snapshot in time for transmission analysis. The thrust of my testimony is organized around consideration of what a correct set of evaluation criteria would have been and how use of inappropriate criteria may have affected the analysis and selection decision.

Q: Please state your overall impression of Mr. Gonzales testimony supporting the Option 1-H prior to a more detailed review.

A: Mr. Gonzales testimony lacks substance. Gonzales has set no defined criteria to act as a basis for measuring Options 1, 1-H or 3 against or to use in deciding which of the options, Option 1, 1-H or 3 is preferable. No corrections are made for the errors in previous analysis techniques such as in the calculations of MW losses and associated costs or assessing the costs required to eliminate preexisting limit violations, both of which were addressed in my previous testimony, and thus provided notice to Xcel and opportunity to correct the errors. Thus, the dollar numbers including losses that are used by the Applicants as a major reason, if not the dominant reason, for preferring Option 1-H are probably wrong. This is not an adequate basis for a major decision affecting the future of the wind power industry in Minnesota.

Q: Do you have any concerns about the way this Option 1-H construct came about and its basic structure?

A: Yes. In his testimony, Gonzalez explains how the Option 1-H came about, but this characterization of recent history is different from other versions, ranging from the original Don Jones Option 1-H testimony to the first Gonzalez testimony of May 20, and 24, 2002. The way this option appeared apparently from nowhere is indicative of both my concerns of the way the Applicants have approached the analysis and the electrical basis for this Option. Specifically, the Applicants have:

1. Identified and selected options without a clear definition or apparent understanding of a defined set of goodness criteria, that is, metrics that clearly identify what makes a good transmission outlet for wind generation. (This will be addressed later.) If criteria for good transmission outlet for wind have not been defined, engineering tends to lead to random results that do not stand the test of time. For example, a few short weeks ago Xcel was advocating Option 1, and yet Option 1 will not meet the criteria for the 50/50 split of wind power since it lacks access for the generation located in the north of Buffalo Ridge. Xcel at the Prehearing Conference admitted this June 18, 2002, in response to a Sierra Club Discovery request 2-7(c) See also Xcel Ex. 52. A plan for construction of infrastructure that lasts 50 years was superseded by events, and demonstrated not to meet requirements. This should give everyone pause – we can not logically assume that the present preferred Option is the right one this time.
2. Have selected the Options contained in the Application and Option 1-H without sufficient analysis under statutory criteria and that provided by the Minnesota Rules that had as its overarching intent the nurturing of a viable wind industry in Minnesota. Xcel has not and cannot demonstrate that Option 1-H is the most reasonable and prudent option to meet this intent and statement of need within the Application.
3. Have "selected" Option 1-H for further an analysis as a variation of Option 1 without an apparent understanding or consideration of the structural limitations of Option 1 that make it a poor choice for meeting the long term needs of wind power transmission. Because Option 1-H is essentially just an Option 1 variant, it has all the same basic inherent structural flaws that Option 1 has. Nothing appears to have changed; no conceptual improvements have been made.

4. Make claims that in Option 1-H, the second Nobles County – Fenton line is "swapped out" for a Buffalo Ridge to White line. However, this second Nobles – County Fenton line is shown in the TLTG tables. Xcel claims that "swapped out" "is a correct characterization of the principal difference between Options 1 and 1-H with respect to how to achieve the 825MW Buffalo Ridge area generation outlet level" in that the second Nobles Co. – Fenton line appears after the 825 MW is achieved, at 940MW and 1060 MW. Ex. 632, PIN IR 2-22. Nowhere has Xcel stated or stipulated that it will not build beyond 825MW generation outlet capacity. Moreover, this "deferment" only of the Nobles County to Fenton line demonstrably shows that Option 1-H is really only a minor variation of Option 1, that Option 1-H offers no distinction of significance.

Q: Why do you think Xcel, which is a credible company with experienced engineers, is making the fundamental mistakes you have previously outlined?

A: There appears, based upon the Gonzalez testimony, to be a number of mutually supporting reasons for the fundamental problems in the original application, the supplements, and Option 1-H, including:

1. Segmentation of focus, and apparent assigning of staff, that sees the issue as primarily transmission oriented in a narrowly focused project ostensibly designed for wind generation outlet, rather than considering the overall wind generation specific issues of generation transfer to market and the customers' demand for and use of green power. Ex. 50, Gonzalez Testimony, p. 2-4 (plus entire exhibit); Ex. 35, Xcel application. This can be seen by the Applicant's focus of essentially all their studies and testimony on

transmission with minimal consideration of the wind power suppliers and wind power uses – the transmission system's customers. Ex. 51, 52, 53, 54, 55, 56, 57, 58, 59; Ex. 25, Xcel Application, App. 2, SW MN Study, Ex. 44, SW MN Study Vol. II. That is, plans are proceeding without even a basic market analysis.

1. Extrapolation of needs and conditions of the past rather than assessing the needs and conditions of the present and future in a quickly and dramatically changing world of energy supply and use. Ex. 633, Wind Power for Pennies, Technology Review, July/August 2002. This can be seen by the Applicants commingling of preexisting transmission improvements, which appear to be driven by a desire to transfer high exports of Dakota power eastward to meet bulk transmission market needs, which are quite different from the generation outlet needs of wind generation in the Buffalo Ridge geographic area. This has resulted in:

   1.1. Engineering sloppiness where decisions, prioritizations and evaluations are being made without clear or overtly stated objectives and decision criteria and the resulting associated focus, flawed modeling, and conclusions unsupported by engineering fundamentals.

   1.2. Cavalier assumptions that MISO will, through its rules and policies, address the unique needs of wind power export rather than clearly showing MISO and the state have the means, jurisdiction and will to do so within their interrelated jurisdictions. Also without demonstration or stipulation as to how Xcel will cooperate, instigate and/or assure that MISO or the state can meet these needs or by addressing the issues, as far as practical within the electrical transmission plan as is implicitly required both by the Minnesota mandate for 425MW wind and PUC order for 425MW wind, and Xcel's merger

agreement specifying 825MW wind in Minnesota, which has the overarching desire of nurturing a local wind industry.

1.3. Primary consideration of only one snapshot in time rather than looking forward over the half century life of the transmission lines. Consideration needs to be given in a forward-looking sequence of transmission and other industry changes. Xcel's shortsightedness can be seen by the Applicants focusing minimal or no effort in their studies, and testimony as to which transmission option best enables or sets the basis for future transmission growth in a manner to best meet the needs of projected or even possible future needs of Buffalo Ridge wind power. Wind Power for Pennies shows that wind power technology is possibly on the verge of a break through that would revolutionize the wind power industry and thus dramatically effect the associated transmission demands. Ex. 633, Wind Power for Pennies, Technology Review, July/August 2002. Options 1 and 1-H on the one hand, and Option 3 on the other, have very different core characteristics and thus potentially have very different future impacts on the direction of the evolution of the transmission system.

1.4. No demonstration with powerflows that identify where the 825MW originates or is injected and flows in the transmission system, no clearly documented analysis that shows how the new 400 MW of mandated wind generation incrementally effects transmission lien MW flows, and no specific demonstration of ability to provide 825MW of outlet capacity for Buffalo Ridge under the range of grid conditions that are possible in the interim and longer term future.

2. No demonstration of an understanding or even an appreciation of the underlying needs of the emerging wind industry. This can be seen by the Applicant's lack of focus of their studies

and testimony on what it will take to really develop a truly entrepreneurial wind industry. For example, factors such as the following were not considered:

2.1. The relative high cost of connecting wind generation to the transmission system, especially for small wind generation units and entrepreneurial companies, necessitates that the collector system be a primary design consideration and not relegated to as an after thought. Interconnection is far more than it means literally – costs can be a deciding factor for a small wind development, and nurturing wind requires reasonably priced opportunities for interconnection. Nurturing smaller entrepreneurial companies also provides greater benefits locally. Ex. 611, Economic Impact Analysis of Windpower Development in Southwest Minnesota; Ex. 617, Distributed Wind Power Assessment, p. 13-19. How can defendable and supportable decisions be made on transmission for Buffalo Ridge wind energy when no studies have apparently been performed by the Applicant to determine where the potential for wind generation exists? Option 1-H assumes a 50%/50% split north and south. Option 1 was initially recommended based upon 100% being located in the south near Chanarambie, and does not, by the Applicant's IR responses, support the new 50/50 assumptions. This is best supported by Option 3, which provides greater flexibility of all the options. Because Option 1 has gone from the preferred option to being unable to support the new assumptions within a few short weeks clearly indicates that the studies are not adequate to make decisions for power line infrastructure construction that will last half a century and which will take irretrievable steps down a fork in the road in the future of windpower. Assumptions by Applicants without supporting cross-referenced

documentation of available wind resources, wind generation development and transmission studies are not supportable.

2.2. How potential customers for wind energy will be affected by decisions made on the transmission system. For example, how would a potential customer with back up generation, such as a Wal-Mart or a hospital, ensure reliable power by using low energy cost wind power when available, and otherwise buying reasonably priced power from the Power Exchange (the PX, the market), and as a final resort using their emergency back up generation.

Q: Do the important issues you raised in your previous testimony apply to Option 1-H?

A: Yes, these are fundamental issues that must be addressed for all Options. Success or failure of the emerging wind industry is at stake in this proceeding because the emerging wind industry's core nature and vitality are affected. This is a fork in the road for windpower. For example, it is through considerations such as those raised above, such as containment of initial capital costs of connection to the transmission outlets through a supportive collector system, and how customers can use environmentally friendly wind energy that also constitutes reliable power that will determine the success or failure of wind power to reach its potential.

Q: Provide example issues that must be considered and associated evaluation criteria that in your professional opinion are necessary to meaningfully perform an engineering study of

the magnitude necessary, particularly given the importance of making the correct decision at this juncture.

A: There are many issues that must be considered in an engineering study of this magnitude, importance and subtly. The purpose of the mandate, and the purported purpose of Phase I of the transmission study and this project is to support wind power generation, therefore a clear and definitive model of the wind power generation as present information and engineering projections will support is essential. Residual uncertainties can then be explicitly accommodated by the flexibility of the plan. For example, the definitive model of wind power generation would include:

1. A model of the wind generation characteristics including:

1.1. Locational inventory of present generation or projected future generation sites, the likely staging of wind power installation and the ultimate MW of wind power that will be produced in the individual locations and cumulatively on Buffalo Ridge. This has not been included in the Application.

1.2. Data from experience and projections of how wind/wind power generation varies over the course of the day and the seasons, how it varies between years, and whether wind power can be reasonable predicted in advance based on past experience and weather forecasts, etc. This has not been addressed in the Application.

1.3. The operating costs, as opposed to capital costs and nonexistent fuel costs, to produce a MW of energy and projections of whether wind power can compete with other forms of generation. That is, model how wind could and should become part of the overall electrical energy mix. This has not been addressed in the Application.

1.4. How high initial capital costs, which impede growth of wind power generation and use, and how these capital costs are affected by the design, cost and apportionment of costs of the collector system and how the design, cost and apportionment of costs of the collector system is affected by the transmission system plan and options proposed. This has not been addressed in the Application.

1.5. Conversely, the interplay between the collector system and options proposed, or the impact of the necessary collector system on appropriateness of a given transmission system upgrade plan or Option. This has not been addressed in the Application.

1.6. Potential wind power customers, particularly whether and how they can buy non-firm energy, as wind is inherently non-firm, and still have reliable firm power to meet their needs. What are the options for accomplishing firm customer power from a non-firm wind generation, the Power Market Exchange (PX), and biodiesel generation or on site and emergency generation? These issues have not been addressed in the Application.

2. A model of requirements that wind generation places upon the transmission grid including requirements that are common to other forms of generation and requirements that are unique to wind. For example, the following issues must be explicitly considered and factored into the planning process:

2.1. The sensitivity of the transmission solution to the location of the wind power generation, both what may be reasonably projected and what could develop in the future. Planned distribution of generation sites and coordination with transmission and substation development can result in deferral of transmission additions, decrease in transmission losses, a significant factor in this proposal, and can increase the overall capability and reliability of the transmission system. The differences between planning for a the wind

generation and planning transmission for a new coal plant are significant, and are somewhat subtle in that in that the location, and size of a potential new coal plant are definable, but this is not so for wind. Commercial viability requirements are common for both types of generation, although commercial viability of wind power may be more dependent on the nuances of the transmission system than is the case for a central station plant. This has not been addressed in the planning process, and the fact that it has not been addressed permitted the Applicants to advocate Option 1 a few weeks ago and yet Option 1 does not by the Applicants own statements satisfy there new improved assumptions of wind generation locations.

2.2. The issue of how wind with its inherently non-firm nature will compete electrically, contractually, and economically on the on the grid with other power sources must be defined and analyzed. For example, the Applicants must show MISO plans to handle non-firm wind power transmission needs without what are effectively punitive economic penalties by requiring wind power to contract and pay for transmission rights whether not the wind is blowing. Given the anticipated tariff changes and the uncertainty of impacts on wind, the Applicant should either request that the decision on the transmission to be delayed until MISO has laid out a plan, or develop and select a transmission plan or Option that minimizes as far as possible the commercial risk to the wind power generators and customers of possible MISO decisions in this area. The Applicants and Commission should remember that the wind power generators and users are the Applicant's customers and no engineering plan that does not definably meet the customers' needs should be accepted - ever. The Commission must also recognize its responsibility to the ratepayers and the public interest – if it cannot assure through

permit conditions and its Order that the transmission plan selected best nurtures wind development on Buffalo Ridge, best supports the diverse needs of the 825MW of wind as established in the application's need statement, it should delay its decision until uncertainties are resolved or deny the permit. To do otherwise is not supportable due to the evidence of material uncertainties of wind development shown in this proceeding.

Q: What do you mean when you use the phrase "nurture wind development."

A: There are may aspects to this that range far beyond creating room on the grid to ship the generated power including for example reasonable interconnection in terms of cost and accessibility; reasonable cost and contract terms for transmission right of way, general support of small and entrepreneurial wind developers who provide greater economic benefits to host communities; ensuring that the transmission supports the potential needs of wind power users so that supplier – customer relationships can be formed. Wind because of its unique non-firm characteristics may actually require a conceptually closer integration with transmission planning that do other generation sources.

Q: What should criteria for evaluating and selecting transmission options include?

A: Based on issues such as the ones introduced in this my testimony, the criteria for evaluating and selecting transmission options should include, but not be limited to:

1. Benefits. How well does the proposed option meet the intent of the mandate to nurture a wind power in Minnesota, in this case focusing on Buffalo Ridge generation industry? More specifically, this criteria will include:
    1.1. How well does the proposed option meet the needs of present and future wind power generators, developers and owners to export power to market when it is available, when the wind is blowing, without undue or punitive costs for transmission right of way.
    1.2. How well does the plan support the needs of potential customers of wind power to use wind energy as a base but ensure complementing power sources at periods of low wind.
2. Costs. Contain the costs, which may or may be borne by Minnesota ratepayers based upon future PUC decisions, and which in any event will be born by ratepayers in some manner and not by Xcel. Most particularly how well does a given proposal contain initial capital costs of connecting the generation to the transmission where that cost can be determinative of a project's economic viability? Dan Juhl has testified to this and a report authored by his DanMar Associates has been entered into evidence.
3. Uncertainty. How well does the selected option meet:
    3.1. Uncertainty in the location and volume of future wind generation. The nature of wind generation is changing and therefore has many future uncertainties. Ex. 633, Wind Power for Pennies, Technology Review, July/August 2002.
    3.2. Unknowns in tariffs, and contracts for inherently non-firm wind power generation.
    3.3. Possible variation in the characteristics power markets in general and wind power in particular due, for example, to potential of retail deregulation of power markets.
    3.4. Inherent, but predicable future competition from Dakota coal fired generation and other sources including Dakota wind.

4. Strategic flexibility through the importance of correct choice in the first instance Perhaps the most important criteria of all is to the necessity of selecting an option that will not lock into incorrect trends based on the lack of comprehensiveness and rigor in the application studies. The system that is chosen represents an irretrievable commitment of resources to a given path, and for this reason the choice of path at this point is important, as is flexibility of the option to meet both anticipated needs and correct for the unanticipated. In other words, the selected plan must be able to accommodate the future uncertainties some of which may be understood or even quantified with a more complete study and some of which are truly imponderables at this time.

Analysis

Q: Have you analyzed the testimony, exhibits and documentation, Information Request responses and provided by the applicants both with respect to how well Option 1-H performs relative to the other options, and on how well it meets the needs in an absolute sense, as claimed by the Applicant in its need statement?

A: Yes.

MW and Associated Cost Calculations

Q: Provide an overall assessment of the Application in this area applicable to Option 1-H based upon the Application, and the testimony and exhibits related to Option 1-H.

A: The application studies, used as the basis for those replicated separately for Option 1-H, also reflected in Exhibits 51-57, were shoddy, unprofessional and clearly wrong in this important area. Despite my professional opinion, as expressed in my Prefiled Direct six weeks ago and my oral testimony nearly one month ago, regarding their unsubstantiated and erroneous basis for this project's loss and cost calculations, the Applicant hasneither meaningfully attempted to refute my previous statements on why their loss calculations are biased and materially flawed, nor make the appropriate corrections and redone the studies. This is an important area for a number of reasons:

1. The MW loss costs are material with respect to the difference in costs between the options, and thus the MW loss costs may well determine the least cost option.
2. MW losses in a general way reflect the robustness of the solution and thus correct modeling and analysis is important.

It is purely an issue of engineering modeling and fact. For example, the Applicant's must explain in detail why all options have total MW losses hundreds of MW higher at 70% load than at peak or 100% load if their study results are to have any credibility in this area. Applicants have not done so, despite specific information requests. Such a counter intuitive result indicates either that there are unique conditions that need to be explained or that substantive errors in the modeling exist that must be corrected. .

Q: Please restate the primary errors in the Applicants MW loss calculations that they repeated when they made the calculations for Option 1-H using the original erroneous assumptions.

A: These errors specifically include:

1. Not reducing the wind power generator nameplate rating by an appropriate factor such as the 0.3 used in my prior testimony to account for the intermittent nature of the source wind energy when considering MW losses.

Using incorrect assumptions or using these assumptions inconsistently for the NDEX (North Dakota MW Exports). The applicants used the maximum possible export without ensuring that there was sufficient transmission to handle this export under the conditions modeled as clearly demonstrated by the material preexisting limit violations shown in the TLTG tables. Corrections to these limit violations would have tended to reduce the MW loses in addition to removing the limit violations especially for high export conditions especially for Option 3. Despite requests from PIN and the EQB for modeling based on a more reasonable number, Xcel has refused to complete the modeling. The EQB, in IR-2-21 asked:

> Please provide at least one year of historical data for the actual values of the North Dakota Export (NDEX) flow. This could be in the form of a flow duration curve. Develop and present an annual average hourly value for these flows.

Ex. 634, EQB IR 2-21. The EQB stated at the Prehearing Conference that MAPP set this number at 1,000 MW, which Xcel was ordered to verify. If this is the case, the impact on loss calculations the impact is very material as at this export level and peak load Option 3 was very attractive in this area.

2. Failing to correctly model the variation of load and export levels during the daily and yearly cycles. Specifically:

2.1. The load variations were modeled by reducing all calculated MW losses by a common factor (0.3). Since load variation and its total impact on losses are "well behaved," in other words they change somewhat predictably, this may not be too unreasonable.

2.2. Use of the maximum NDEX, (ND MW exports, for all non-peak conditions is a major error. Exports can and normally do change materially during the daily and yearly load cycles, as the 1,000 MW MAPP figure claimed by the EQB shows.

Q: What, in your expert engineering opinion, would have been the probable effects of the Applicants using correct modeling and performing appropriate analysis in the area outlined in the previous response.

A: In my opinion modeling using more accurate assumptions and the subsequent analysis would have had a number of material impacts including:

1. Reducing total construction costs by approximately 75% for each Option. This is shown in the TLTG tables by subtracting the base costs and the incremental costs required to eliminate preexisting conditions. Commingling preexisting limit violations caused or at least exacerbated by the NDEX modeling with the 400MW mandated wind power transmission needs greatly distorts the analysis. For example, with a much reduced total cost due to the removal of the cost of fixing the preexisting conditions:

1.1. MW loss costs become a very significant part of the total costs and perhaps the dominant part of the cost differential between options.

1.2. The collector system cost becomes a very material, perhaps even dominant, part of the total cost of building infrastructure to export wind power. Based upon this, not including

the collector system in an integrated plan is just plain bad engineering. It is not supportable since it is effectively moving money from the collector system (which is essential for wind power) to meeting preexisting conditions not caused by wind generation. (Note any argument that the existing wind is a material cause of the preexisting conditions is a fallacy as the preexisting wind generation is an extremely small part of the total existing power generation and flows in the area.)

2. Materially reduced or even eliminated the MW loss cost penalty assessed against Option 3 versus Option 1 and possibly even Option 1-H.
3. The most important impact of removal of the study distorting errors such as high export and associated preexisting limit violations is that it would have permitted a focus on the genuine needs of the wind generation. This focus was diverted. For example, in my judgment such a focus would clearly show that the central or dominant 345 kV component of Options 1 and 1-H are driven more by high MW export that causes or at least exacerbates the preexisting conditions rather than addressing the needs of the mandated wind generation, the purported purpose of this applicaiton.

In summary, comprehensive and rigorous studies with reasonable assumptions based in fact are needed to look at the needs of wind generation as a potential business with suppliers or generators and customers rather than looking at the transport, transmission component only.

Specific Comments on Option 1-H Supporting Documents and Mr. Gonzalez' Testimony

Q: Briefly describe how the responses are organized and why this organization was used.

A: Most of the responses to Mr. Gonzales' testimony, the documents for Option 1-H and the IR responses has been organized or grouped into "generic" responses elsewhere in this testimony. Organizing the material item by item in this response would be fragmentary and overlapping especially where rebuttal to the IR responses was required.

Q: Is the use of the use of the term Hybrid appropriate to describe Option 1-H (page 1, Line 11 through 13 of Mr. Gonzales Testimony)?

A: Option 1-H is not a hybrid, which is a fusion of or a cross between items, but rather it is a nominal variation of Option 1 that adds one line from Option 3. This distinction is important for two reasons – characteristics and limitations. Option 1-H has the same underlying characteristics and the same basic limitations of Option 1, and it does not merge with or draw from the core strengths from the two other options building on strengths and removing negative characteristics and limitations..

Q Do you agree with Mr. Gonzales description of the conceptual differences between Option 1-H and previous Options 1 and 3 (Page 3, line 10 forward).

A: No. Modeling half the wind generation in the North end of Buffalo Ridge rather than 100% in the South is a different modeling assumption and not a conceptual difference in the solution plans or Options. While this terminology may seem to be unimportant, it is very important for two reasons:

1. There are always many assumptions made in performing transmission-planning studies, for example, the modeling of the generation and MW export patterns. Why are these patterns selected? Why are they appropriate to the studies? All these are important questions that the applicants did not document in their reports and which Xcel refuses to answer when challenged in Information Requests. This is a major weakness in the Applicants studies as shown, for example, in how Intervenors, and not the Applicant, were shouldered with the Burden of Proof and held responsible for identifying and documenting errors in the MW loss evaluation modeling assumptions. Rigorous definitions and documentation of the assumptions would in all likelihood have highlighted these errors before the studies were performed, saving all parties effort and expense and producing a credible result.

2. There are major conceptual differences between Option 3 on the one hand, and Options 1 and 1-H on the other, that are not identified and described by the Applicants. This lack of conceptual clarity appears to have let the conceptually most attractive option slip through the cracks and not be identified and studied. More specifically: Option 1 and Option 1-H are conceptually centered around strengthening the 345 kV system south of Buffalo Ridge, and east of Sioux Falls, and then providing radial feeds from the Buffalo Ridge wind generation to connect to this 345 kV system. The line to west White in Option 1-H is conceptually similar, and is a parallel path flow because as it connects to the 345 kV system earlier where the MW flow is southward before it turns east through Lake field. Conceptually, it is odd that for Options 1 and 1-H transmission is primarily built south and west of Buffalo Ridge when a primary need and purpose is to ship Buffalo Ridge wind power northeast to the Twin City load center? While such an approach may be

tactically acceptable and even low cost, it lacks the strategic vision that would have become apparent if the Applicants had considered a long term time line rather than concentrating on one near term point in time during their transmission studies. For example, Option 1-H ships more than 250 MW west to White and then constructs new transmission to enable this power to flow back east on a parallel path further south at Lakefield and then possibly flow northeast. Could this new construction be reduced if this 250 plus MW had flowed directly northeast initially rather than taking the "scenic route" west to White, south to Sioux Falls, east to Lakefield? Similar statements could be made for the 200 MW from south Buffalo Ridge towards Lakefield.

3. Option 3, on the other hand, is conceptually oriented towards strengthening the 115 kV and 161 kV system in the Buffalo Ridge area and potentially providing outlets towards the northeast, towards the Twin City load center. There are anomalies that do not fit this concept in Option 3 such as the line towards White that is common to both Options 3 and 1-H. However, Option 3 does conceptually begin, and only begin, to develop a solution form that is intuitively correct in strategically strengthening the electrical system directly between the wind generation and its primary load center.

4. It is most curious that no option was considered that stated conceptually that directly strengthening the electrical system between the wind generation at Buffalo Ridge and the Twin City load center was its focus. I surmise that the high North Dakota MW exports and the commingling of the preexisting conditions clouded the issue that appears so conceptually clear and attractive. Such a conceptually direct approach has many possible attractions, as will be explained elsewhere since such a direct electrical path reduces the potential cost, congestion, and competition of the MISO controlled 345 kV system that is

a corridor for export of Dakota power that now must support wind power exports as well. More direct electrical routes towards the northeast create strategic flexibility for the wind generators and their customers. It also reduces the potential impact of terrorist action of taking out key transmission stations, which would be an attractive target for terrorists further attempting to damage the US economy. However, because the Phase II bulk power transfer part of the SW Minnesota study has not been completed, it is not appropriate to include a bulk power transfer component in this proposal supposedly "for wind."

Q: Are things as conceptually important and as simple as outlined in your previous response where you clearly differentiate the conceptual basis for Options 1 and 1-H and for Option 3? If so would it be simple to develop an Option that reflected your thoughts?

A: Yes, things are that conceptually simple and important. And no, it is not easy to suggest the components and other details of a solution option that reflects these concepts. Specifically:

1. The conceptual simplicity and importance can be seen by a review of Wind Power for Pennies, Ex. 633 which introduces the beginnings of a vision of how wind generation now, can lead towards applied fuel cell technology later, and overall development of related industry in the future. Over time this has the cumulative potential to materially change the economic - carbon use trade off that carries high secondary costs to society. Developing and supporting the wind industry correctly is a required first step.
2. The difficulty in developing a viable Option to implement the concepts that have been introduced has many forms. There is much complexity including the complex nature of

the power system itself, the large amount of data, the range of operating conditions effected by out of service transmission and generation/export patterns, and the need for specialized analysis tools. For example, when conceptually considering the flow of power towards the Twin Cities from Buffalo Ridge, actual flows on some lines in the area may under some conditions actually be away from the twin cities. When we state wind generation MW flows towards the Twin City load area we were talking of incremental or change MW inflows. Considering the Twin City area as the load center and Buffalo Ridge the generation center is valid for transmission planning. The Applicants Applicant implicitly do this when they incrementally vary the generation in these two areas step by step to generate the TLTG tables and determine when transmission lines become overloaded. The short answer is that to produce a viable Option, the proper studies must be done. That has not occurred in the Phase I study, the Application, or as a part of this proceeding.

Comparison of Options with Criteria

Q: Have you reviewed performance and evaluated if, how well and why each of Options 1, Option 1-H and Option 3 meet the criteria defined previously?

A: Yes, I have given it consideration.

Q: Describe in an absolute sense and comparatively how well Option 1, Option 1-H and Option 3 meet the "benefits" criteria previously stated.

A: The benefits criteria centers around the inquiry "how well does the proposed option meet the intent of the mandate to nurture a wind power in Buffalo Ridge Minnesota area," the basis for this proposal. Specifically, how well does the proposed option meet the needs of present and future wind power generators, developers and owners to:

1. Export wind power to market when it is available, when the wind is blowing, without undue or punitive costs for transmission right of way. A concern going forward is that since wind power is not firm, transmission access may have to be reserved as firm, as it is now, and therefore paid for when there is no wind and the transmission is not being used, effectively penalizing wind generators. The Applicants did not even consider this basic question in their selection of options, studies and evaluation, but rather disowned it and stated that it is a MISO issue. Thus none of the options have been demonstrated to meet this criterion.
2. Conceptually, Buffalo Ridge is located in an electrical geographic area surrounded by high voltage lines. All three options propose to install 115 kV and 161 kV lines to transfer wind generation from the collector system stations to the surrounding high voltage transmission. However, only Option 3 is centered on doing the two common sense things of establishing a stronger 115 kV and 161 KV overlay system to support the collector system on the one hand and potentially strengthen the electrical connections from Buffalo Ridge towards the primary Twin City load center on the other. Option 3 therefore begins, and only begins, to develop the two key requirements of a system that would nurture wind, a 115 kV and 161 kV overlay and connections from these voltages directly towards the Twin City load center, which is also necessary for increasingly reducing the dependence of MISO level rights of way over time as further transmission evolution takes place. Thus, Option 3 is preferred over Options 1 and

Option 1-H although with insight Option 3 may be greatly improved with focus on this objective and additional studies 2.

3. How well does the each plan support the needs of potential customers of wind power to use wind energy as a base but ensure complementing power sources at periods of low wind? Customers, or users, of wind power require flexibility in their transmission options to enable them to benefit from availability of low operating cost wind power when available. For the reasons described in the preceding items, this flexibly is enhanced when there is less dependence on critical MISO transmission access between the wind generation and the load center Option 3 is thus preferred over Options 1 and 1-H for supporting customer flexibility; however, Option 3 can surely be improved in this regard initially with focused studies and/or evolution over time as the system evolves.

Q: Describe in an absolute sense and comparatively how well Option 1, Option 1-H and Option 3 meet the "cost containment" criteria previously stated.

A: The cost containment criteria centers around "how well does the proposed option contains costs that are not explicitly included in the Applicant's analysis, but are still real costs that will effect the ability of wind power to compete," sometimes termed externalities. For example, how well does the proposed option meet the needs of present and future wind power generators to contain initial capital costs: All options fail this criteria since the collector system planning has been arbitrarily separated from transmission planning, essentially transferring the issue and associated cost to the local wind generator, whether landowners or companies. This is not entirely a dollar issue

since there is much more money allocated to correct the system's preexisting deficiencies and conditions than is required to build the collector system. It is more accurately a problem of the lack of clearly defined objectives that meet the overarching spirit of the mandate, and an issue of allocation of costs.

Q: Describe in an absolute sense and comparatively how well Option 1, Option 1-H and Option 3 meet the "uncertainty" criteria previously stated.

A: The uncertainty criteria centers around how well does the proposed option create future planning and design flexibility to accommodate the "future uncertainties". There are many forms of uncertainty and this sections briefly looks at how ell each of options 1, 1-H and 3 meet some of the more important uncertainties:

1. Uncertainty in the location and volume of future wind generation: With Option 1-H comes some limited analysis concerning the location within Buffalo Ridge of the possible future wind generation. However, assuming 100% in the south or 50% north and south is still a very rough approximation, and we see from the analysis that there are material differences in the limits violated depending on which of these two assumptions are made. Thus, problems and associated costs for correction can be expected in this area for all Options. Should wind technology advance and for example double or triple the volume of power that can be economically generated on Buffalo Ridge then the transmission requirements would change materially. Wind Power for Pennies Ex.633 indicates that such a technology break through may indeed be here with unstudied and unknown impacts on transmission requirements It is nearly impossible to state with certainty which of the options are best able to handle this type of uncertainty.

2. For example, my expectations are that where there are problems due to failure to analyze likely patterns of generation siting, they will first show up in the collector system. Collector design will be more complex, 34.5 kV lines will be longer with higher MW losses and overall the cost to connect wind generators will increase. Option 3 will probably be best, as it begins to lay out a foundation for an integrated 115 kV and 161 kV transmission overlay for the collector system.

3. Unknowns in tariffs and contract for inherently non-firm wind power generation. None of the options are shown to handle this uncertainty well because the Applicants have assumed the problem away by assuming MISO will take care of it. However, if the wind generation industry is not to be stifled it must have competitive costs for shipping power to markets and not be penalized economically or by effectively restricted access due to its non-firm nature. Because Option 3 is more farsighted, longer term in strengthening the 115 kV and 161 kV grid in the Buffalo Ridge area and building more to market outlets to the northeast, towards the Twin City load center, does open up the potential for Option 3 to be superior to other options in this area. How does the option address possible variation in the characteristics power markets in general and wind power markets in particular? The market place, especially the retail market, for electrical power will surely change dramatically in the years ahead given that deregulation is still evolving and the subject of many initiatives. The market for green power, and wind is very green, is in its infancy, so even more change can be expected. It is not clear how this will effect pricing, contracting for transmission rights, and customer contracts.

4. In my professional opinion, my expectation is that wind power will be premium power provided market power is ensured to be available during periods of low or no wind,

which will require flexibility in the transmission system. As mentioned in the previous response, a longer term vision, seen with strengthening the 115 kV and 161 kV grid in the Buffalo Ridge area and building more to market outlets to the northeast towards the Twin City load center, does open upon the potential for Option 3 to be superior to other Options in meeting these needs. How does the Option address the inherent, but predicable future competitive needs from Dakota coal fired generation and other sources including Dakota wind? The competition can take a number of forms, but only competition for transmission is considered here: By shipping power from Buffalo Ridge west to "White" in South Dakota, which then flows south and then partially east and possibly northeast towards the Twin City load center, or south to Lakefield and partially east and possibly northeast towards the Twin City load center there is sharing of electrical transmission access on the southern, eastern and northeastern flows. This sharing is between Buffalo Ridge wind power and Dakota coal (or wind) generation; and where there is sharing there is potential congestion, conflict and competition. All three options have this weakness, but as mentioned in the previous response, the longer term vision seen with strengthening the 115 kV and 161 kV grid in the Buffalo Ridge area and building more to market outlets to the northeast towards the Twin City load center does open upon the potential for Option 3 to be superior to other options in this area, in this case because it inherently more focused on Buffalo Ridge area transmission.

5. In summary, it is necessity to select an option that will not lock the future into incorrect trends. The Option that is chosen represents an irretrievable commitment of resources to a given path, and for this reason the choice of path is important, as is flexibility of the option to meet both anticipated needs and correct for unanticipated characteristics.

Finally, given the legislative and Commission wind mandate in Minnesota, and given that the primary load center is northeast of Buffalo Ridge, it is professionally inconceivable to me that an option that shipped the wind generation more directly with strengthened electrical lines and connections towards Minnesota Valley, Franklin etc. and on to the Twin Cities was not seriously studied. A strategic engineering view over the 50 year life time of generators and transmission lines would surely have identified such an option and found it attractive and probably compelling. The "base" selected by the engineers biases the computer generated TLTG studies and thus without an engineer selecting a base that looked northeast such an Option would not automatically arise

Conclusions

Q: State the primary conclusions that may be drawn from the provided documentation.

A: More detailed conclusions could be drawn, but here I consider only some key ones. The studies are neither comprehensive nor rigorous. For example: There is no wind power generation modeling either in generation locations or for how the wind power output tends to vary during the day and seasons. There is no business modeling, which would look at the wind generators and wind power users as transmission customers, to assess what is necessary to create a vibrant wind power industry in Minnesota.

The engineering modeling was fundamentally flawed. For example:

Including high NDEX without the necessary associated transmission as shown by the preexisting limit violations where the correlation is high as seen, in general, from the power flow studies. Commingling of preexisting transmission needs and the needs of the 400 MW wind

power mandate is bad engineering. The total failure to model the MW loss analysis correctly has been documented. To fail to model carefully and correctly under the "unusual" circumstances where total off peak off peak MW losses are higher than peak load MW losses brings the very foundation of the studies into question.

Only considering one point in time rather than considering possible scenarios of future transmission evolution is simplistic where major changes are anticipated. Option 3, as compared to Options 1 and 1-H, does set the basis (an initial stage if you like) to a sequential staging in the years ahead as necessary to a supportive solution for the wind power industry centered on Buffalo Ridge. Option 3 is both conceptually and directionally right. Options 1 and 1-H are both conceptually and directionally wrong – they are based upon extrapolations of the past and not on analysis of the future.

The only two alternatives supportable by the engineering information and studies is to select Option 3 or to delay and perform comprehensive and rigorous studies. The very fact that the Applicants in an add hoc and tardy manner now say that half of the wind generation may be at the north end of Buffalo Ridge and not 100% at the south end as previously assumed, clearly indicates that the Applicants have not thought through, defined and modeled the problem compressively and rigorously. There are more general points that support the selection of option 3 and the direction is sets for future system evolution:

Option 3 with its probable evolution over time towards strengthening the 115 kV and 161 kV system with more outlets towards the twin city load center will tend to keep more control of and support for the emerging wind energy business within Minnesota rather than under federal control through MISO. The need to contract transmission rights of way from MISO would also

be reduced, but not eliminated, especially in the bottleneck area that appear to be emerging south of the Buffalo Ridge area.

Option 3 with the system changes over time outlined in the previous item will naturally reduce the vulnerability of wind power export to terrorist attack. Terrorist vulnerability tends to increase with concentration and decrease with dispersal when the ability to transmit power is less vulnerable to one catastrophic "event". For example, the sustained loss of one major substation, a 345 kV in all likelihood.

With terrorism in the US likely increasingly to have economic focus there are few better ways that to disrupt the, mostly unprotected and unprotectable, electrical grid. Electricity is so necessary in our society that we regard it as an “essential service” deserving of special protections.

Q: Does this complete your testimony?

A: Yes.