BEFORE THE OFFICE OF ADMINISTRATIVE HEARINGS

FOR THE MINNESOTA PUBLIC UTILITIES COMMISSION

STATE OF MINNESOTA

In the Matter of the Request by Minnesota Power

For a Certificate of Need for the

Great Northern Transmission Line

OAH Docket No. 65-2500-31196

MPUC Docket No. E-015/CN-12-1163

Exhibit _______

PROJECT DESCRIPTION AND TRANSMISSION ALTERNATIVES

Direct Testimony and Exhibits of

CHRISTIAN WINTER

August 8, 2014

MR. CHRISTIAN WINTER

OAH Docket No. 65-2500-31196

MPUC Docket No. E-015/CN-12-1163

TABLE OF CONTENTS

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Christian Winter and my business address at Minnesota Power is 30 West Superior Street, Duluth, Minnesota 55802.

Q. What is your current position with Minnesota Power?

A. I am a Transmission System Planning Engineer.

Q. Please describe your educational and professional background.

A. I have a bachelor's degree in electrical engineering from North Dakota State University and am a licensed professional engineer in the State of Minnesota.

Q. How long have you been employed by Minnesota Power and what are your current duties with Minnesota Power?

A. I joined and assumed my present position with Minnesota Power in February 2009. In my position, I am responsible for providing technical leadership in a group of engineers focused on the long-term planning of Minnesota Power's high voltage transmission system. It is my group's job to identify and design the transmission upgrades that are necessary to provide reliable and efficient service to new and existing Minnesota Power customers in light of future load growth, generation additions or retirements, and other changes on the system.

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

A. I provide testimony describing the Great Northern Transmission Line Project ("Project") from a technical perspective. I also explain why existing facilities cannot meet the need met by the Project. Last, I provide testimony on Minnesota Power's analysis of transmission system alternatives to the Project and explain why those alternatives do not meet the need for new transmission as reasonably and prudently as the Project.

Q. Do you also sponsor certain sections of Minnesota Power's Certificate of Need Application ("Application")?

A. Yes, I sponsor the following sections of the Application:

- Sections 4.1, 4.2, 4.4 and 4.5 (Project Description, with the exception of Project cost estimates being addressed by Mr. Donahue);
- Sections 5.4.1 through 5.4.4 (Electric and Magnetic Fields, Stray Voltage, Ozone and NOx, Radio and Television Interference and Noise);
- Section 7.4 (Transmission System Alternatives);
- Section 7.5.2 (Existing Facilities Cannot Meet the Need for Increased Transmission); and
- Appendix P (New Tie Line Loop Flow Impact Study, October 14, 2013 Draft Study Scope).

Q. Are you sponsoring any exhibits in this proceeding?

A. Yes. I am sponsoring the following exhibits:

- Exhibit ___ (CW), Schedule 1 – Minnesota Power's Response to Department of Commerce ("DOC") Information Request ("IR") 8, regarding the Loop Flow Impact Study;
- Exhibit ___ (CW), Schedule 2 – Minnesota Power's Response to DOC IRs 11 and 12, regarding the calculation of line losses; and
- Exhibit ___ (CW), Schedule 3 – Minnesota Power's Response to DOC IRs 13 and 14, regarding the Direct Current ("DC") transmission alternative.

II. PROJECT DESCRIPTION

Q. Can you provide an overview of the Great Northern Transmission Line and the associated facilities included in this Project?

A. The Project includes the construction of a new 500 kV transmission line in Minnesota between the Minnesota-Manitoba border crossing northwest of Roseau and the existing Blackberry Substation near Grand Rapids, Minnesota (the "500 kV Line"), as well as associated substation facilities and transmission system modifications at Minnesota Power's existing Blackberry Substation site, and a 500 kV series compensation station. At the time of the Application, Minnesota Power stated that the Project would provide approximately 750 MW of transfer capability. However, subsequent analysis indicates that once completed, the Project will provide approximately 883 MW of transfer capability.

Given the route alternatives as presented to date in the Route Permit proceeding, MPUC Docket No. E-015/TL-14-21, the 500 kV Line will be approximately 220 miles in length, and will be constructed on a 200 foot wide right of way. The 500 kV Line will be part of a new 500 kV international transmission interconnection (the "500 kV Interconnection"). Manitoba Hydro will be constructing the Canadian portion of this new international interconnection.

Minnesota Power anticipates using 3-conductor bundle 1192.5 kcmil Aluminum Steel Conductor Reinforced ("ASCR") "Bunting" with 18 inch sub-spacing as the phase conductor for the Project. This conductor is the same as that used on the existing Dorsey - Chisago 500 kV transmission line. Final conductor selection for the Project will be based on a conductor optimization study. Minnesota Power continues to evaluate several structure types and configurations that will be used for the 500 kV Line, including: a self-supporting lattice tower, a lattice guyed-V structure and a lattice guyed delta structure. Minnesota Power currently estimates approximately 4 to 5 structures per mile of line. The type of structure in any given section of line will be dependent on land type and land use.

Q. Can you also address some of the potential human and environmental impacts that Minnesota Power examined in connection with the Project?

A. Yes. Mr. Atkinson sponsors Appendix G to the Application, covering the main environmental information to be considered in this proceeding. However, I will discuss two discrete issues -- electric and magnetic fields ("EMF") and noise that may be associated with the Project. These and other issues are discussed at length in Section 5.4 of the Application and I will simply summarize key points of that information here.

Q. Has either the State or federal government established a standard for electric fields?

A. No. However, the Environmental Quality Board ("EQB") historically enforced a maximum electric field limit of 8 kV/m measured at one meter above the ground for transmission line projects. This limit was designed, consistent with the National Electric Safety Code ("NESC") spark discharge limit, to prevent serious hazard from shocks when touching large objects placed under AC transmission lines of 500 kV or greater. As shown in the Application, the Project will comply with the NESC and EQB standards.

Q. Please also address the potential impacts of the Project associated with magnetic fields.

A. As the Application discusses in detail, while magnetic fields have been the subject of substantial research over the years, there are no Minnesota or federal standards for exposure to magnetic fields from transmission lines. However a few states and the International Commission on Non-Ionizing Radiation Protection ("ICNIRP") have developed standards for magnetic field exposure. The estimated magnetic fields at the edge of the transmission line right-of-way for the Project at projected peak loading are below all standards adopted by other states and below international standards. There is no reason to anticipate adverse health impacts from magnetic fields for persons living or working near the Project.

Q. Does the Company anticipate noise concerns from the Project?

A. No. While transmission conductors produce noise under certain conditions, the level of noise depends on conductor conditions, voltage level, and weather conditions. For transmission lines, in foggy, damp or rainy weather, there may be a crackling sound due to corona – the small amount of electricity ionizing the moist air near the conductors. During heavy rain the background noise level of the rain is usually greater than the noise from the transmission line. As a result, people do not normally hear noise from a transmission line during heavy rain. During light rain, dense fog, snow and other times when there is moisture in the air, transmission lines will produce audible noise equal to approximately household background levels. During dry weather, audible noise from transmission lines is barely perceptible. At substations, audible noise is generated primarily by transformers. New substations and substation upgrades will be designed and constructed to comply with State noise standards established by the Minnesota Pollution Control Agency ("MPCA"). Maximum and typical levels of audible noise attributable to Project facilities will be calculated and field monitored as needed.

Q. Can you also discuss the additional facilities that will be installed in the course of the Company's work on the Project?

A. The Project will terminate at a new substation ("Blackberry 500 kV Substation") located on the same site as Minnesota Power's existing Blackberry 230/115 kV Substation. The Blackberry 500 kV Substation will be located adjacent to and east of the existing substation and will be designed to accommodate the new 500 kV line, 500/230 kV transformation, existing 230 kV lines and all associated 500 kV and 230 kV equipment. Minnesota Power has entered a purchase option agreement with the owner of 200 additional acres of property adjacent to the Blackberry Substation. Existing 230 kV and 115 kV transmission lines currently located on the property will need to be rerouted to accommodate the placement and electrical interconnection of the Blackberry 500 kV Substation. The Project will also require a 500 kV series compensation station ("Series Comp Station"), which will include the 500 kV series capacitor banks necessary for the reliable operation and optimal performance of the Project, and all associated 500 kV equipment. In the Application, Minnesota Power indicated that the Series Comp Station may be located at the Blackberry Substation site subject to electrical optimization. However, Minnesota Power has since initiated electrical design optimization studies and identified that the preferred location of the Series Comp Station is at the overall midpoint of the 500 kV Line between the Dorsey and Blackberry substations.

Q. From a transmission engineering perspective, how will the Project impact the overall transmission system in the region?

A. As discussed in Ex. __ (CW), Schedule 1, while the analyses associated with the Loop Flow Impact Study are complete, the full study report is still being drafted. A final report will be available shortly and will be provided to parties and the record once it is available. In general, the study demonstrates that the Project would provide the desired incremental export capability for hydroelectric resources generated in Manitoba without inherently limiting potential transmission outlet capability for current and future North Dakota generation resources. This is due to the fact that the Project alleviates the main thermal constraint associated with the North Dakota – Manitoba "loop flow" phenomenon, and thereby facilitates less interaction between power generated in North Dakota and power generated in Manitoba. The end result is that the Project is capable of enabling the wind-water synergy described in the MISO Wind Synergy Study and discussed by Mr. Hoberg without restricting the system or the power market to such operation during times when high simultaneous output from North Dakota wind and Manitoba hydropower resources becomes desirable.

Q. Can you address the estimated system losses associated with the Project?

A. The estimated system losses are discussed in Section 4.5 of the Application and that discussion, as further explained in Exhibit ___ (CW), Schedule 2, continues to be accurate.

III. TRANSMISSION SYSTEM ALTERNATIVES

A. Existing Facilities Cannot Meet Minnesota Power's Need For Increased Transmission Capacity.

Q. Please discuss your overall approach to the consideration of transmission system alternatives to the Great Northern Transmission Line.

A. First, it is important to remember why Minnesota Power is proposing the Project. The Project enables Minnesota Power to take delivery of 383 MW of power from Manitoba Hydro under two sets of agreements (collectively, the "383 MW Agreements") discussed by other Minnesota Power witnesses. As Mr. McMillan discusses, when the Minnesota Public Utilities Commission ("Commission") approved the first set of agreements (the "250 MW Agreements"), the Commission recognized that Minnesota Power and Manitoba Hydro would need to construct their own new transmission facilities to allow the energy sales contemplated under those agreements to occur.

Q. And why can't existing facilities support the increased sales between Manitoba Hydro and Minnesota Power?

A. The existing interface between Manitoba and the United States, consisting of three 230 kV lines and one 500 kV line, is unable to accommodate increased transfer of energy from Manitoba into the United States. The current system intact capability on the interface is 2,175 MW from Manitoba to the United States, which includes firm transactions between Manitoba Hydro and utilities in the United States plus a reliability margin to cover uncertainty and allow Manitoba Hydro to fulfill its contingency reserve obligations to MISO. Above the 2,175 MW transfer level, historical studies of the Manitoba – United States transmission interface have identified that overloads will occur on the Roseau series capacitors, which are an element of the existing Dorsey – Forbes 500 kV Line required for the reliable and efficient operation of the line. Therefore, the Manitoba to United States interface is unable to accommodate increased transfer capability without upgrades or new transmission development to alleviate the overload on the Roseau series capacitors and any additional constraints identified at the targeted transfer level.

Q. So what transmission system alternatives did the Company consider?

A. To enable Minnesota Power to take delivery of power under the 383 MW Agreements, the Company examined a broad array of transmission system alternatives, including:

- Upgrading existing facilities;
- Building lines of other sizes, including a 230 kV, 345 kV and 765 kV line;
- Lines with different termination points, including a conceptual line further to the west ("Fargo Area Study Concept" or "Concept") and lines connecting to the Shannon or Forbes substations, rather than the Blackberry substation;
- Double circuiting existing lines;

- A DC line; and
- An Underground line.

In all, we examined ten different transmission system alternatives and concluded that no transmission alternative provides a preferable alternative to the Project.

B. Upgrading Existing Facilities

Q. Can you first discuss the upgrades to existing facilities that were considered?

A. As mentioned above, the existing interface between Manitoba and the United States consists of three 230 kV lines and one 500 kV line. The three 230 kV lines from Manitoba to the United States are G82R from Glenboro to Rugby (North Dakota), L20D from Letellier to Drayton (North Dakota), and R50M from Richer to Moranville (Minnesota). The Dorsey – Forbes 500 kV line, known as D602F, originates at the Dorsey Substation near Winnipeg, Manitoba and connects to the Forbes Substation on Minnesota's Iron Range. Another 500 kV line then continues on from Forbes to the Chisago Substation near the Twin Cities.

To increase transfer levels from Manitoba to the United States with no new transmission tie lines across the interface would require additional capacity on some or all of the existing tie lines. Since D602F is the largest, lowest impedance line on the interface, the majority of incremental transfers from Manitoba to the United States would flow on this line, requiring increased capacity on the line. Currently, the flow limit on D602F is based on the 2,000 amp (1732 MVA) rating of the Roseau series capacitors and line terminal equipment. While it is technically feasible to increase the rating of D602F from 2,000 amps to 2,500 amps (2165 MVA) by upgrading the Roseau series capacitors, this upgrade would be highly complex and raise a number of potential issues relating to the operation of the line and terminal equipment as well as the reliability of the regional transmission system, resulting from the electrical inefficiencies of increasing utilization of D602F beyond its existing capacity, as detailed in the Application. Moreover, loss of D602F was previously the largest single contingency in the MISO footprint. With the recent integration of the MISO South region utilities on December 19, 2013, this outage officially became the second-largest single contingency in MISO. In any case, attempting to increase total Manitoba to United States transfer capability by increasing the capacity of D602F only exacerbates this concern.

Finally, upgrading existing facilities would certainly not enable increases in hydroelectric power imports from Manitoba to the United States in excess of Minnesota Power's 383 MW Agreements, and potentially would not even facilitate the full 383 MW needed to fulfill the 383 MW Agreements. Appropriate long-term capacity for the interface between Manitoba and the United States can only be achieved efficiently, economically, and reliably with a single new transmission line build large enough to facilitate Minnesota Power's 383 MW and additional transfer capability up to 883 MW to meet future needs in the region.

C. Alternative Voltages Considered

Q. Please also discuss the alternative voltages Minnesota Power considered.

A. The Company considered three alternative voltage scenarios: a 230 kV line, a 345 kV line and a 765 kV line. For different reasons, each of these failed to provide a preferable alternative to the Project.

Regarding the 230 kV alternative, Mr. McMillan discusses how the financing and ownership of the Project impacts the overall consideration of this alternative in comparison to the Project. Aside from those considerations, though, a 230 kV project cannot meet the long-term needs of the region and would not prove to be cost-effective for customers or environmentally preferable over the long-term. It is anticipated that the demand for power in certain areas of the Upper Midwest will increase over the next decade. Given the favorable characteristics of hydropower resources and risks associated with carbon-emitting fuel sources, Manitoba Hydro has had several potential customers request transmission service for delivery of energy and capacity from Manitoba to the United States in the recent past. Developing a transmission solution now that delivers substantial hydropower to northern Minnesota, and that also has sufficient capacity to deliver additional hydropower to other utilities in the Upper Midwest will help meet the future energy needs of the region. Constructing a new 230 kV transmission line now would not provide an optimal long-term solution for an interface poised to see significant growth over the next 15-20 years and would simply require further construction in the future.

Q. Would a 230 kV line provide sufficient transmission capacity for Minnesota Power to support the 383 MW Agreements?

A. According to the "MH-US TSR Sensitivity Analysis Draft Report (Eastern Plan)" produced by MISO and dated July 13, 2013 (Appendix Q of the Application), a 230 kV line from the Riel Substation in southern Manitoba to Minnesota Power's Shannon Substation on the Iron Range could facilitate 250 MW of incremental Manitoba to United States transfer capability with no thermal constraints. It is unclear whether or not the same project could facilitate the total incremental transfer capability required by the 383 MW Agreements. Further, since the MISO study only covers thermal analysis, it is unclear whether or not stability constraints would exist at either the 250 MW or 383 MW incremental transfer level. In any case, as discussed earlier, a 230 kV alternative to the Project would not meet the long-term needs of the Manitoba – United States interface or the region and it would likely ultimately result in additional transmission development in Manitoba and the United States.

Q. Can you also discuss why the other two voltage alternatives the Company considered fail to provide a preferable solution?

A. A single 345 kV line would not be capable of the same capacity as a single 500 kV line. An equivalent project to a single 500 kV line would be a double circuit 345 kV line from Winnipeg to the Iron Range, which would be similar in construction cost or more expensive than a 500 kV line. Finally, there is no existing 345 kV equipment in the Winnipeg area where the line originates, meaning that expensive new substation equipment would be required at the Canadian endpoint that is not required for a 500 kV line.

Regarding the 765 kV alternative, since there is currently no 765 kV transmission in MISO north of Illinois, expensive transformation would be required at each substation to interconnect with existing 500 kV and/or 230 kV systems in Manitoba and Minnesota. Combined with the increased construction costs of a higher voltage line, the overall cost increase and operational complexity would not be worth the additional capacity gained by a 765 kV build, compared to a 500 kV build.

D. Alternative Endpoints

Q. Please also discuss the alternative endpoints Minnesota Power considered.

A. We examined three alternative end points for a new transmission line and determined none of the three better meets the needs of Minnesota Power and its customers as well as State and regional transmission needs when compared to the Project. The Application provides a detailed analysis of a Fargo Area Study Concept ("Concept") and I will not repeat that discussion here. Suffice it to say the Concept, if built, would result in regional transmission system inefficiencies that would constrain generation outlet capability for North Dakota, Manitoba, or both, requiring (potentially large-scale) transmission system upgrades that would not be required for the Project. Moreover, it is highly improbable that the Concept could be turned into a reality in time to meet Minnesota Power's contractual obligation in the 383 MW Agreements of an in-service date of June 1, 2020. As noted by Mr. Rudeck, despite the time, attention and analysis given this Concept by a variety of entities, to date no entity has indicated a willingness to develop and fund the construction of such a transmission line.

In addition to the Concept, Minnesota Power considered terminating the Project's 500 kV Line at either the Shannon or Forbes substations. Upon engineering and siting review, the Company determined that the Shannon Substation is an inferior long-term solution compared to the Blackberry Substation for several reasons. First, the Shannon Substation does not provide as much 230 kV transmission line outlet capability as the Blackberry Substation, and did not perform as well electrically as the Blackberry Substation in preliminary power flow studies. Second, the Shannon Substation is located adjacent to an active mine on property leased from the mine. Since the lease agreement for the Shannon Substation has an infrastructure relocation provision, there would be considerable risk in making significant new critical infrastructure investments on leased land.

Similar to the Shannon Substation, the Forbes Substation endpoint was found to have limited outlet capacity and inferior electrical performance compared to Blackberry. Additionally, the Forbes Substation is located south of the Iron Range formation in the midst of active mines. The most feasible locations for crossing the Iron Range formation appear to be further west, near Grand Rapids, meaning a Forbes endpoint would increase the overall length of the line, thereby increasing the overall human and environmental impact and cost of the Project.

E. Double Circuiting, DC Line and Undergrounding Alternatives

Q. Can you also summarize why double circuiting existing lines failed to provide a better alternative than the Project?

A. The only existing double circuit opportunities for the Project are two existing tie lines from Manitoba: the Richer – Moranville 230 kV line (R50M), which extends all the way to the Shannon 230 kV Substation on the Iron Range, and the Dorsey – Forbes 500 kV line (D602F), which extends all the way to the Forbes 500 kV Substation on the Iron Range. From a reliability perspective, double circuiting is typically avoided because a common structure failure could result in the loss of both lines. Double circuiting also creates maintenance constraints if only one line can be de-energized at a given time. Since both lines in this case would be tie lines between Manitoba and the United States, it would not be acceptable to de-energize both at the same time for maintenance purposes.

Furthermore, since double circuiting with an existing line is typically proposed as a method of limiting the proliferation of new transmission line corridors, it often requires an extended outage of the existing line to construct the new double circuit line in its place. Since an extended outage of one of the four existing Manitoba tie lines during the 48 months it will take to construct the Project would not be acceptable, the new double circuit line would have to be built adjacent to the existing line or in a completely new corridor to allow the existing line to stay in service during construction. Either of these options would add substantial cost to the Project and effectively defeat the main environmental purpose for double circuiting the line.

Q. Did the Company also examine the potential of a DC line or undergrounding the line?

A. Yes, but neither of these options provides a viable alternative to the Project. The high voltage direct current ("HVDC") alternative was considered since line losses associated with a HVDC line are generally less than those associated with an AC line of the same length. While the loss savings associated with an HVDC line may be economically beneficial, HVDC lines also require expensive conversion stations at each delivery point because the DC power must be converted to AC power before it can be interconnected to the AC transmission system and delivered to customers. Given these benefits and costs of HVDC transmission, the break-even line length at which HVDC becomes economically feasible compared to AC transmission is usually between 400 and 500 miles. Since the total length of the Project plus its Canadian counterpart will be less than 400 miles, an HVDC alternative would not be economically justified.

In addition, Manitoba Hydro raised concerns that if another HVDC link were developed with a terminus in the Winnipeg area, the risk of control interaction or frequency response issues would be considerable. Exhibit ___ (CW), Schedule 3 provides further discussion of these issues.

Due to the technical considerations expressed by Manitoba Hydro and the fact that HVDC is not economically justified by the distance of the Project and its Canadian counterpart, a DC line is not a preferable alternative to the Project.

Finally, we examined the possibility of undergrounding the line. As discussed in the Application, underground high voltage transmission lines are seldom used since they are significantly more expensive to engineer and construct than overhead lines. In addition, there are increased line losses and additional maintenance expenses incurred throughout the useful life of an underground high voltage line that further increase the total additional cost of building an underground line instead of an overhead line. Underground high voltage lines also present serious operating and maintenance challenges due to the relative inaccessibility of the underground conductors. Given the construction, maintenance, reliability, and cost drawbacks of high voltage underground transmission lines, and the fact that there is extremely limited experience in the United States with building an underground 500 kV transmission line, undergrounding does not provide a preferable alternative to the Project.

Q. Does this conclude your direct testimony?

A. Yes.

9378013v1

State of Minnesota
DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

Utility Information Request

Docket Number: E015/CN-12-1163 Date of Request:July 7, 2014

Requested From: David R. Moeller, Senior Attorney Response Due:July 17, 2014

Analyst Requesting Information: Stephen Rakow

Type of Inquiry:			
	[ ] Financial	[ ] Rate of Return	[ ] Rate Design
	[ ] Engineering	[ ] Forecasting	[ ] Conservation
	[ ] Cost of Service	[ ] CIP	[ ] Other:

If you feel your responses are trade secret or privileged, please indicate this on your response.

Request No.	
8	Please provide the status of the Loop Flow Impact Study mentioned on page 95 of the Petition.

Response:

The analyses associated with the Loop Flow Impact Study are complete and the full study report is currently being drafted. A final report is expected in mid-late August.

Response by: Christian Winter______________ List Sources of Information:

Title: Transmission System Planning Engineer_________________________________

Department: System Performance & Transmission Planning________________________

Telephone: 218-355-2908________________ ______________________________

State of Minnesota

DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

Utility Information Request

Docket Number: E015/CN-12-1163 Date of Request: July 7, 2014

Requested From: David R. Moeller, Senior Attorney Response Due: July 17, 2014

Analyst Requesting Information: Stephen Rakow

Type of Inquiry:			
	[ ] Financial	[ ] Rate of Return	[ ] Rate Design
	[ ] Engineering	[ ] Forecasting	[ ] Conservation
	[ ] Cost of Service	[ ] CIP	[ ] Other:

If you feel your responses are trade secret or privileged, please indicate this on your response.

Request No.	
11	Regarding the calculation of 21.1 MW of line losses, what percent of the load in the model is Minnesota Power?

Response:

In the model, Minnesota Power load makes up approximately 4.6 percent of the total load in the MISO West Planning Region, which is the region that the loss calculations are based on.

Response by: Christian Winter List Sources of Information:

Title: Transmission System Planning Engineer

Department: System Performance & Transmission Planning

Telephone: 218-355-2908

State of Minnesota

Department of Commerce
Division of Energy Resources

Utility Information Request

Docket Number: E015/CN-12-1163 Date of Request:July 7, 2014

Requested From: David R. Moeller, Senior Attorney Response Due:July 17, 2014

Analyst Requesting Information: Stephen Rakow

Type of Inquiry:	[ ] Financial	[ ] Rate of Return	[ ] Rate Design
	[ ] Engineering	[ ] Forecasting	[ ] Conservation
	[ ] Cost of Service	[ ] CIP	[ ] Other:

If you feel your responses are trade secret or privileged, please indicate this on your response.

Request No.	
12	Regarding the calculation of 21.1 MW of line losses, what percent of the load in the model is Minnesota?

Response:

In the model, load geographically located in the State of Minnesota makes up approximately 33.5 percent of the total load associated with the MISO West Planning Region, which is the region that the loss calculations are based on.

Response by: Christian Winter______________ List Sources of Information:

Title: Transmission System Planning Engineer_____________________________

Department: System Performance & Transmission Planning________________________

Telephone: 218-355-2908________________ _________________________________

State of Minnesota

DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

Utility Information Request

Docket Number: E015/CN-12-1163 Date of Request:July 7, 2014

Requested From: David R. Moeller, Senior Attorney Response Due:July 17, 2014

Analyst Requesting Information: Stephen Rakow

Type of Inquiry:

[ ] Financial	[ ] Rate of Return	[ ] Rate Design
[ ] Engineering	[ ] Forecasting	[ ] Conservation
[ ] Cost of Service	[ ] CIP	[ ] Other:

If you feel your responses are trade secret or privileged, please indicate this on your response.

Request No.	
13	Please explain what "risk of control interaction" as discussed on page 106 of the Petition means.

Response:

The example provided in the text on page 106 of the Petition is that a three phase AC fault in the Winnipeg area could cause simultaneous commutation failure for all HVDC converter stations in the area. This would be true for all converters that are operating as inverters (converting DC to AC and injecting power into the AC system) at the time of the fault. This is due to a number of factors, including the electrical proximity of the HVDC converter stations and the sensitivity of the converter stations to AC system voltages, especially during a fault and during the post-fault recovery period. Additional HVDC converter stations, especially if developed at locations electrically distinct from the existing Dorsey and Riel converter stations, would increase the complexity of the Winnipeg area transmission system and the likelihood that further developments on the AC system in southern Manitoba would exacerbate commutation failure vulnerability by coupling the converter stations more tightly together.

Response by: Christian Winter List Sources of Information:

Title: Transmission System Planning Engineer

Department: System Performance & Transmission Planning

Telephone: 218-355-2908

State of Minnesota

DEPARTMENT OF COMMERCE
DIVISION OF ENERGY RESOURCES

Utility Information Request

Docket Number: E015/CN-12-1163 Date of Request:July 7, 2014

Requested From: David R. Moeller, Senior Attorney Response Due:July 17, 2014

Analyst Requesting Information: Stephen Rakow

Type of Inquiry:	[ ]......Financial	[ ]......Rate of Return	[ ]......Rate Design
	[ ]......Engineering	[ ]......Forecasting	[ ]......Conservation
	[ ]......Cost of Service	[ ]......CIP	[ ]......Other:

If you feel your responses are trade secret or privileged, please indicate this on your response.

Request No.	
14	Please explain what “frequency response issues” as discussed on page 106 of the Petition means.

Response:

The example provided in the text on page 106 of the Petition is that a three phase AC fault in the Winnipeg area could cause simultaneous commutation failure for all HVDC converter stations in the area. During a commutation failure, no power is transmitted through the converter station. In the event of a simultaneous commutation failure of all converter stations in the Winnipeg area, the interruption of a large amount of power in a relatively weak southern Manitoba power system would cause a rapid rate of frequency decay. The southern Manitoba system is therefore highly dependent on strong AC ties to the United States, which are not interrupted by commutation failures, to maintain acceptable system frequencies in the event of a simultaneous failure of HVDC converter stations.

The Project as proposed would provide an additional AC tie line from southern Manitoba to the United States, improving frequency response capability during a simultaneous HVDC commutation failure event. An HVDC alternative to the Project would not provide the same benefits and when combined with the increased Manitoba – United States transfers that are driving the need for the Project, could actually erode Manitoba Hydro’s ability to maintain acceptable system frequencies during a simultaneous commutation failure.

Response by: Christian Winter______________ List Sources of Information:

Title: Transmission System Planning Engineer__________ ______________________

Department: System Performance & Transmission Planning_________________________

Telephone: 218-355-2908________________ ________________________________