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August 21, 2017

—Via Email & U.S Mail—

Darrell Nitschke, Executive Director
North Dakota Public Service Commission
State Capitol Building, Dept. 408
600 East Boulevard
Bismarck, ND 59505-0480

Re: CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY -FARGO 115KV
TRANSMISSION LINE
CASE NO. PU-17-____

Dear Mr. Nitschke:

Pursuant to North Dakota Century Code Chapter 49-03, Northern States Power Company, doing business as Xcel Energy, respectfully submits the enclosed Application to the North Dakota Public Service Commission (Commission) for a Certificate of Public Convenience and Necessity (CPCN) for the purpose of adding a 115 kilovolt transmission line between Xcel Energy's existing Maple River and Red River substations in the City of Fargo and Reed Township, Cass County, North Dakota.

The Project will provide for increased reliability of electric service in the Fargo area by reducing overloads on neighboring lines and transformers, and allows the Company to comply with North American Electric Reliability Corporation (NERC) reliability standards without having to interrupt electric service to customers.

Consistent with Section 49-03-02(2) of the North Dakota Century Code, the Company respectfully requests that the Commission issue a CPCN for the Project if no other interested party has requested a hearing on this Application after receiving appropriate notice of the opportunity to request such a hearing.

The enclosed Application provides support that the Company meets the standards necessary for the Commission to grant a CPCN for the Project. The Application addresses the Standard of Review, provides a Description of the Applicant and the Project, and describes the Project Need.

Mr. Nitschke
Case No. PU-17-____
August 21, 2017
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We look forward to working with the Commission on this filing. Should you have any questions related to this application, or the project itself, please contact me, or Senior Agent, Matt Langan (612-330-6954 or matthew.a.langan@xcelenergy.com).

A handwritten signature in blue ink that reads "David H. Sederquist".

David H. Sederquist
Sr. Consultant, Regulatory & Finance

cc: Jerry Lein

**BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF NORTH DAKOTA**

IN THE MATTER OF THE APPLICATION OF
NORTHERN STATES POWER COMPANY, FOR
A CERTIFICATE OF PUBLIC CONVENIENCE
AND NECESSITY FOR THE CONSTRUCTION
OF A SECOND CIRCUIT, 115kV
TRANSMISSION LINE BETWEEN THE
EXISTING MAPLE RIVER AND RED RIVER
SUBSTATIONS IN THE CITY OF FARGO AND
REED TOWNSHIP, CASS COUNTY, NORTH
DAKOTA.

CASE No. PU- 17-_____

**APPLICATION FOR CERTIFICATE OF
PUBLIC CONVENIENCE AND NECESSITY**

I. INTRODUCTION

Pursuant to North Dakota Century Code Chapter 49-03, Northern States Power Company, doing business as Xcel Energy (Xcel Energy or the Company), respectfully submits this Application to the North Dakota Public Service Commission (Commission) for a Certificate of Public Convenience and Necessity (CPCN) for the purpose of constructing an approximately five-mile, 115 kilovolt transmission line between the Maple River and Red River substations in the city of Fargo and Reed Township, Cass County, North Dakota (Project).

The Project will provide for increased reliability of electric service in the Fargo area by reducing overloads on neighboring lines and transformers. In the event that one element in the electric system fails, Xcel Energy's existing transmission system would require interrupting electric supply to customers in anticipation of the next contingency event in order to meet applicable reliability standards. The Project allows the Company to comply with North American Electric Reliability Corporation (NERC) reliability standards without having to interrupt electric service to customers.

Consistent with N.D.C.C. § 49-03-02(2), the Company respectfully requests the Commission issue a CPCN for the Project without a hearing if no other interested party has requested a hearing on this Application after appropriate notice of the opportunity.

The remainder of this Application provides support that the Company meets the standards for granting a CPCN for the Project. This Application will address:

- Standard of review;
- Description of the Applicant;
- Description of the Project; and
- Need for the Project.

II. STANDARD OF REVIEW

Statutory Provisions

The statutory provisions governing the requirement for a public utility to file for and obtain a CPCN are found in Title 49 of the N.D.C.C.

N.D.C.C. § 49-03-01. Certificate of public convenience and necessity - Secured by electric public utility. No electric public utility henceforth shall begin construction or operation of a public utility plant or system, or of an extension of a plant or system, except as provided below, without first obtaining from the commission a certificate that public convenience and necessity require or will require such construction and operation. This section does not require an electric public utility to secure a certificate for an extension within any municipality within which it has lawfully commenced operations. If any electric public utility in constructing or extending its line, plant, or system, unreasonably interferes with or is about to interfere unreasonably with the service or system of any electric public utility, or any electric cooperative corporation, the commission, on complaint of the electric public utility or the electric cooperative corporation claiming to be injuriously affected, after notice and hearing as provided in this title, may order enforcement of this section with respect to the offending electric public utility and prescribe just and reasonable terms and conditions.

N.D.C.C. § 49-03-01.1. Limitation on electric transmission and distribution lines, extensions, and service by electric public utilities. No electric public utility henceforth shall begin in the construction or operation of a public utility plant or system or extension thereof without first obtaining from the commission a certificate that public convenience and necessity require or will require such construction and operation, nor shall such public utility henceforth

extend its electric transmission or distribution lines beyond or outside of the corporate limits of any municipality, nor shall it serve any customer where the place to be served is not located within the corporate limits of a municipality, unless and until, after application, such electric public utility has obtained an order from the commission authorizing such extension and service and a certificate that public convenience and necessity require that permission be given to extend such lines and to serve such customer.

49-03-02. Prerequisites to issuance of certificate of public convenience and necessity. Before any certificate may issue under this chapter, a certified copy of the articles of incorporation or charter of the utility, if the applicant is a corporation, or a certified copy of the articles of organization of the utility, if the applicant is a limited liability company, shall be filed with the commission. At the hearing of said application upon notice as provided in this title, the utility shall submit evidence showing that such applicant has received the consent, franchise, permit, ordinance, or other authority of the proper municipality or other public authority, if required, or has or is about to make application therefor. The commission shall have the power, after notice and hearing to:

1. Issue the certificate prayed for;
2. Refuse to issue such certificate;
3. Issue it for the construction or operation of a portions only on the contemplated facility, line, plant, system, or extension thereof; or
4. Issue it for the partial exercise of the right or privilege sought, conditioned upon the applicant's having secured or upon the applicant's securing the consent, franchise, permit, ordinance, or other authority of the proper municipality or other public authority, and may attach to the exercise of the of the rights granted by any certificate such terms and conditions as in its judgment the public convenience and necessity may require.

Notwithstanding any of the foregoing provisions, the commission may grant a certificate if no interested party, including any local electric cooperative, has requested a hearing on said applicant after receiving at least twenty days' notice of opportunity to request such hearing.

Under these statutes, the standard applied by the Commission is whether the proposed system addition is needed under all the circumstances and whether the applicant is qualified to implement the proposed system addition. As demonstrated in this Application:

- The Project is necessary to: (i) reduce overloads on transmission facilities in the area; (ii) comply with applicable reliability standards; and (iii) provide operational flexibility by addressing near- and long-term load servicing needs in the Fargo area.
- The Company is an experienced electric utility who owns and has constructed numerous transmission facilities, including facilities in North Dakota. The Company's experience supports its ability to complete the Project.

Routing

N.D.C.C. § 49-22-07 requires a utility to obtain a Route Permit from the Commission before constructing a transmission facility in North Dakota. A transmission facility is defined by § 49-22-03 as “[a]n electric transmission line and associated facilities with a design in excess of one hundred fifteen kilovolts.” The Project involves construction and operation of a 115 kV transmission line. Accordingly, the Project does not involve the construction of a transmission facility as defined by Chapter 49-22, and therefore no Route Permit is required.

Ten Factor Inquiry

The Commission has indicated it considers ten (10) factors in determining whether to grant a CPCN for a new electric facility.¹ Below we provide our responses to each of these factors:

1. *From whom does the customer prefer electric service?*

No specific customer requested the Project, and the Project does not provide direct retail service. Rather, the Project aids Xcel Energy in providing bulk transmission service that can be used by many utilities and, ultimately, their retail customers.

¹ Testimony of Jerry Lein of the Commission staff, presented to the Interim Electric Industry Competition Committee, April 24, 2000.

2. *What electric suppliers are operating in the general area?*

Xcel Energy and Cass County Electric Cooperative (CCEC) serve the Fargo/West Fargo area. The Project does not provide direct retail service in competition with CECC or any other retail electric suppliers in the area, but instead ensures reliable service to all.

3. *What electric supply lines exist within a two-mile radius of the location to be served and when were they constructed?*

Figure 1 in Section IV shows the electric supply lines that surround the Project location. These lines have been in service for more than 60 years.

4. *What customers are served by electric suppliers within at least a two-mile radius of the location to be served?*

A fairly typical mix of residential, small commercial, and industrial customers are served within a two mile radius of the line. By reducing overloads to transmission facilities in the area, the Project provides reliable electric service to all.

5. *What are the differences, if any, between the electric suppliers available to serve the area with respect to reliability of service?*

Xcel Energy is an investor-owned utility serving most of the customers within the Fargo city limits. CCEC serves most of the customers in the extraterritorial areas around Fargo. Adding a 115 kV line between the Maple River – Red River substations will increase reliability in the Fargo area. The Project will therefore assist all electricity suppliers in the Fargo area by providing more reliable service.

6. *Which of the available electric suppliers will be able to serve the location in question more economically and still earn an adequate return on its investment?*

Xcel Energy. Again, the Project does not provide direct retail service. Rather, the Project will result in increased reliability to all electricity suppliers in the Fargo area.

7. *Which supplier's extended electric service would best serve orderly and economic development of electric service in the general area?*

The Project will not extend retail service. The Project is part of a plan to comply with NERC requirements and address the near- and long-term load serving needs of the Fargo area.

8. *Would approval of the application result in wasteful duplication of investment or services?*

No. The Project will mitigate overloads on other transmission lines and transformers by significantly improving voltages, eliminating contingencies, and/or mitigating overloads. Accordingly, the Project would neither result in a duplication of facilities, nor an expansion of our retail electric service territory. Furthermore, the Project does not duplicate the work performed by another electric utility.

9. *Is it probable that the location in question will be included within the corporate limits of a municipality within the foreseeable future?*

The Project will add a 115 kV line between the existing Maple River and Red River substations located within incorporated Fargo, as well as Reed Township in Cass County. Xcel Energy is unaware of any plans for Reed Township to be incorporated into the City of Fargo within the foreseeable future

10. *Will the service be either of the electric suppliers in the area unreasonably interfere with the service or system of the other?*

No. The Project will not provide retail service, and will not interfere with the service or systems of other electric suppliers.

In summary, the Project satisfies the relevant criteria of the ten factor inquiry.

III. DESCRIPTION OF THE APPLICANT

The Company is a Minnesota corporation duly authorized to do business in the State of North Dakota as a foreign corporation. The Company conducts business in the State of North Dakota as a public utility subject to the jurisdiction and regulation of the Commission pursuant to Title 49 of the N.D.C.C. The full name and address of the Company is:

Northern States Power Company,
a Minnesota corporation
414 Nicollet Mall
Minneapolis, Minnesota 55401

The Company also operates in North Dakota from the following address:

Northern States Power Company,
a Minnesota corporation
2302 Great Northern Drive
Fargo, ND 58102

The Company's most recent Articles of Incorporation, Certificate of Authority, and Certificates of Good Standing were filed with the Commission in Case No. PU-09-664 and are hereby incorporated by reference.

The Company has service territory in three upper Midwest states including North Dakota. Xcel Energy presently serves approximately 89,000 retail electric customers in and around Fargo, Grand Forks and Minot, North Dakota. The Company owns just over 250 miles of transmission lines and 14 substations in North Dakota.

IV. DESCRIPTION OF THE PROJECT

The Company seeks to construct and operate a 115 kV transmission line between the existing Maple River and Red River substations. As described below, the addition of the Project would reduce overloads on neighboring lines and transformers, and allow the Company to provide service in compliance with applicable reliability standards without interrupting electric service to customers (load shedding). Figure 1 below depicts the project location.

Figure 1
Project Location

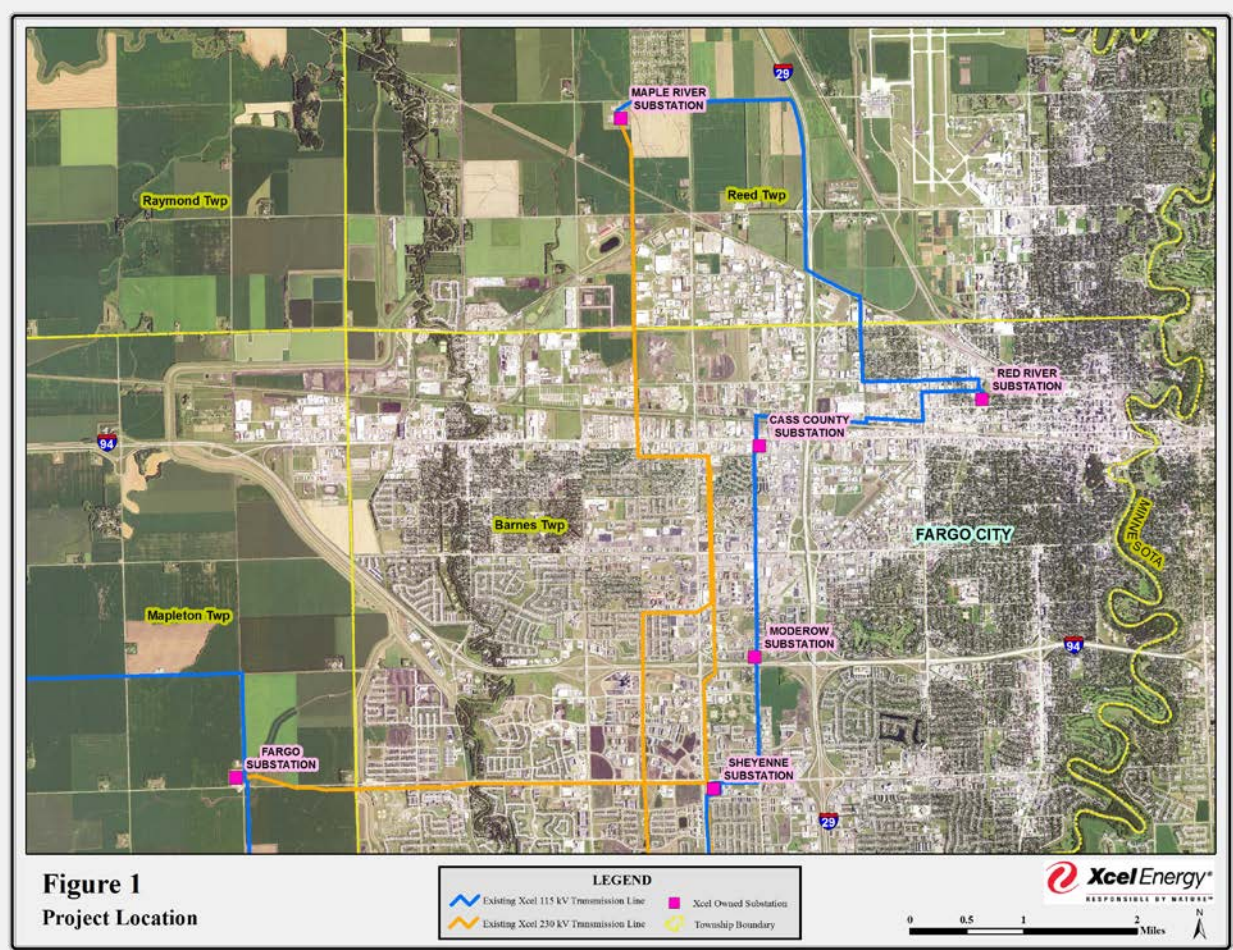
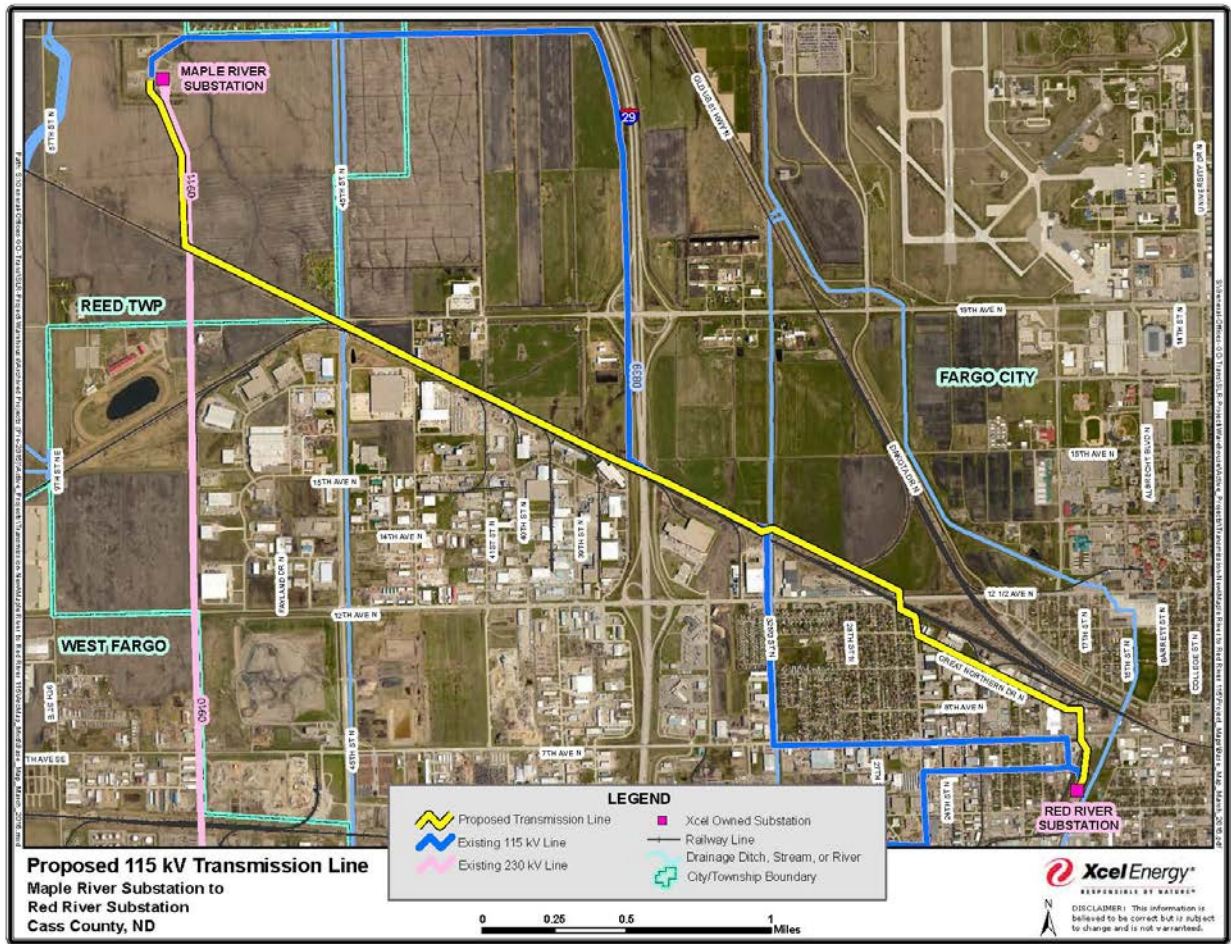


Figure 1 shows the existing transmission facilities in the project area. The proposed Project is located in the city of Fargo and Reed Township in Cass County. The length of the line is approximately five miles. Figure 2 below depicts the Project map.

Figure 2
Project Map



Project Timing and Costs

The Project is scheduled to be constructed sequentially from the Maple River substation to the Red River substation. It is anticipated that construction of the Project will be complete in 2019. This date is approximate and subject to change depending on permitting and other contingencies. The cost of the Project is estimated to be \$19,317,079 and will be paid for by Xcel Energy, but the costs of the project will ultimately be recovered from all customers served by the NSP System through the Company's electric rates. Pursuant to jurisdictional allocations, only a small portion (about 5 percent) of the project will be paid for by electric customers in North Dakota.

V. NEED FOR THE PROJECT

Reliability Standards

The Company is required to comply with North American Electric Reliability Corporation (NERC) transmission system standards in both normal and emergency conditions as set forth in NERC Transmission Planning Standards (TPL-001-4.) In a normal condition, all facilities are in service (*i.e.*, no contingencies). Emergency conditions occur when one or more elements in a facility are lost (*i.e.*, “single contingency” or “double contingency” events). TPL-001-4 provides the applicable reliability standards that transmission systems must meet in single contingency and double contingency events.

Fargo Load Serving Study

The need for the Project came to the attention of the Company after an annual assessment required by NERC identified several transmission deficiencies in the Fargo area of Xcel Energy’s service territory, provided as Appendix A to the Application. The assessment studied the 115, 230, and 345 kV lines between the Maple River, Sheyenne, West Fargo, and Bison substations.

The study demonstrated that, during a single contingency event, the Company would be forced to interrupt the electric supply to customers in order to provide permissible system performance in the event of a double contingency situation. For example, the combination of a loss of the existing 115 kV line between the Maple River and Red River substations and a loss of transformer 5 or 6 at Sheyenne substation would result in a thermal overload on the remaining transformer 5 or 6 at Sheyenne substation. Specifically, the combined load at the Cass County, Moderow, and Red River substations would be served by a single transformer at Sheyenne substation. Under this scenario, the Company would be forced to interrupt electric service to customers in order to comply with the applicable reliability standards in a double contingency event. The study also identified several double contingency events considered to be most severe for voltage stability, including the loss of the existing Maple River – Red River 115 kV line combined with the loss of the Maple River – Sheyenne 230 kV line.

Addition of a Second Circuit to the Maple River – Red River Line

To address the identified transmission needs, the study determined the best option to be the addition of another 115 kV line between the Maple River and Red River substations. By improving voltages and mitigating overloads on neighboring lines and transformers, the Project would meet many of the transmission needs identified in the study. Importantly, the Project would allow the Company to comply with applicable

reliability standards in a double contingency event without disrupting electric service to customers. Accordingly, the Project will increase the reliability of service to all electricity suppliers and their customers. Finally, the Project provides flexibility in the operation of the Company's transmission system in the Fargo area by addressing near- and long-term load servicing needs.

VI. COMMUNICATIONS AND SERVICE LIST

We respectfully request that the following Xcel Energy employees be placed on the Commission's official service list for all official communications in this case:

Matthew Langan
Senior Agent, Siting and Land Rights
414 Nicollet Mall, 414-6A
Minneapolis, MN 55401

David H. Sederquist
Sr. Consultant, Regulation & Finance
2302 Great Northern Drive
Fargo, ND 58102

VII. CONCLUSION

As demonstrated in this Application, public convenience and necessity requires the addition of a 115 kV transmission line between the Maple River and Red River substations. The addition of this line does not involve either the extension of existing service territory or the duplication of facilities. The addition of a second circuit is necessary to allow the Company to meet applicable NERC reliability standards in a second contingency condition without disrupting electric service to customers.

We respectfully request that the Commission grant a Certificate of Public Convenience and Necessity for the addition of a second circuit to the existing Maple River – Red River 115 kV transmission line. We further request, pursuant to N.D.C.C. § 49-03-02, that the Commission grant the requested Certificate not more than 20 days after the close of a notice of opportunity for hearing issued in this proceeding, if no party requests a hearing.

Please let us know if there is any other way we can assist the Commission in its review of this CPCN request.

DATED: August 21, 2017

Respectfully Submitted,

A handwritten signature in cursive script that reads "Pamela Rasmussen". The signature is written in black ink and is positioned above a horizontal line.

Pamela Rasmussen

Senior Manager, Siting and Land Rights

1414 West Hamilton Ave, Ste 3

Eau Claire, WI 54702

Fargo Load Serving Study

Prepared By:
Srinivas Vemuri
Northern States Power Company
04/25/2013

Executive Summary

The 2010 MN TACT yearly assessment has identified several deficiencies in the Fargo area that would require load shedding after first contingency, to meet the NERC TPL-003 standard requirements for second contingency. The intent of the study is to assess the area's long term load serving needs to meet Category C3 contingencies and improve operational flexibility.

The study takes into account the results of "CapX 2020 Group 1 Fargo Line Optimization Study" to ensure the near term plans proposed as part of this study would be compatible with the recommended plan (or equivalent) for the area.

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1. Introduction

The MN TACT 2010 yearly assessment has identified several transmission deficiencies in the Fargo area of NSP's service territory that would require shedding load during first contingency conditions to meet the requirements for TPL-003 standard (second contingency).

The intent of the study is to identify near and long-term solution to avoid shedding load for category C3 contingencies. The study area consists of 115, 230 and 345 kV lines between Maple River, Sheyenne, West Fargo and Bison. The map of the study region is shown below in Figure 1.1

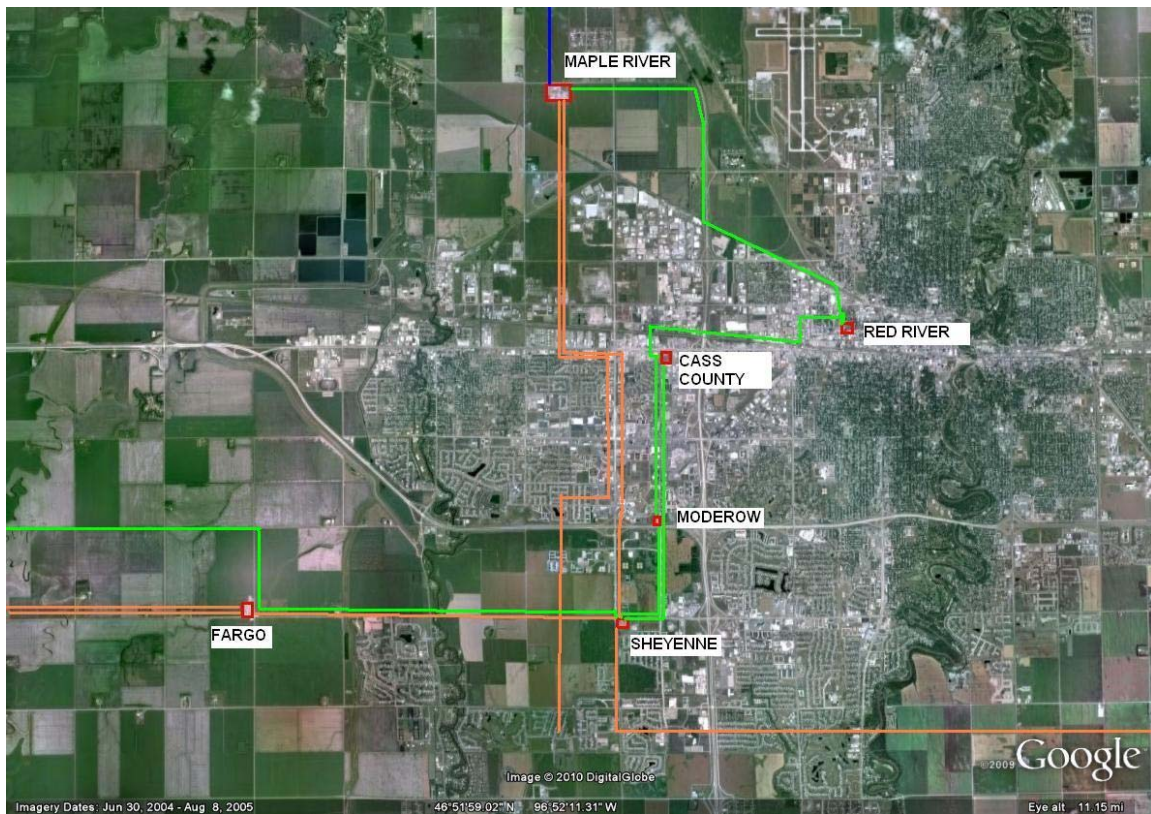


Figure 1.1

2. Analysis

2.1 Models and Criteria

The 2010 series 2016 summer peak and summer off peak models were used for this study. The models were updated with non-coincident peak loads at Red River and Cass County substations. The three terminal line connecting Red River, Cass County and Moderow was also assumed to be separated into Moderow – Cass County and Cass County – Red River 115 kV lines. This is a valid assumption as this would be completed in 2013 as part of new distribution transformer addition.

The proposed Buffalo – Casselton 115kV line, that would be in-service by 2013, is also included in the base model. All the major generating units in the study area were turned off in the summer peak model, this is considered a valid assumption as generation re-dispatch is allowed to meet TPL-003 standard during Category C3 contingencies. Therefore generators that would cause overloads can be turned off after the first contingency.

The ratings of existing NSP lines have been increased to match the new methodology, assuming there are no limits on equipment in the substations or transmission switches. This was done to ensure that the violations identified by the analysis are not due to limitations that can be mitigated without requiring a major upgrades or transmission additions. Table 2.1 below provides the list of line ratings that were changed in the study area to match the new ratings methodology.

Table 2.1

Facility	Old Rating	New	Reason
Maple River – Red River 115 kV line	317.7/349.5	361/397	Rating methodology
Red River –Cass County 115 kV line	190.8/199.2	230/253	Rating methodology
Sheyenne – Moderow 115 kV line	239/239	361/397	Rating methodology
Moderow – Cass County 115 kV line	224/239	286/314	Rating methodology and Moderow transmission switch limit.
Sheyenne – Cass County 115 kV line	224/239	259/285	Rating methodology
Maple River – Sheyenne 230 kV line	368.9/405.8	459/505	Existing rating of the line

The 2016 summer off peak model was setup to have approximately 2060MW on NDEX interface, without Bison – Alexandria 345 kV line (after

the transfers are setup, Bison – Alexandria line is closed through). This was used as base model for all the transfer limit analyses.

The monitored area consisted of all the 345, 230 and 115 kV facilities in the region between West Fargo, Maple River, Sheyenne and Bison. Since the load serving problems are localized within this region, the transmission plans studied would not impact the area beyond this region. The MN TACT contingency file developed by the regional utilities was used to perform contingency analysis, along with full n-2 analysis within the study region.

The voltages below 0.92 and greater than 1.05 were flagged as violations, the thermal violations on the transmission lines and transformers were identified using 100% of Rate A. Although the facilities can be loaded to Rate B during contingency conditions, Rate A was used in order to identify any potential violations that could occur in the near future.

2.2 Methodology

The study was performed by initially running a full ACCC analysis using category B and C contingencies, along with local C3 contingencies on the 2016 summer peak, base case. After the deficiencies were identified in the area, PV analysis was performed on the base case using contingencies that would have the most impact on the voltages in the area.

After the full list of deficiencies is identified using the summer peak model, mitigation plans were studied to address the deficiencies. The analysis of the options involved studying the incremental load serving capabilities, economic analysis and comparison of possible future expansion in the area and impact on generation outlet with the preferred plan.

2.3 Load Serving Deficiencies

Currently there are operational concerns in the study area as the cumulative non-coincident peak load at Red River, Cass County and Moderow substations is close to 290 MW. Any forced outage due to failure of transformer 5 or 6 at Sheyenne substation would be an operational concern, as the loss of Maple River – Red River 115 kV line during this condition would lead to a severe thermal overload on the other transformer.

During this condition, all the combined load at Cass County, Moderow and Red River would be served by a single 187 MVA transformer at Sheyenne substation. This overload on the transformer could happen even during off peak conditions with only 70% of the summer non-coincident peak load, therefore maintenance outages in this area can be obtained only during light load conditions.

Table 2.2 below provides the complete list of load serving deficiencies that need to be addressed for near and long term. The results shown below are based on the assumption that NSP’s Maple River – Red River and Sheyenne – Moderow 115 kV lines are re-rated to 361 MVA (this rating is not effective yet).

Table 2.2

Contingency	Overload or low voltage	Rating	% loading
Loss of Maple River – Red River 115 kV line + Loss of Sheyenne TR 5 or 6	Sheyenne TR 6 or 5	187	143%
Loss of Maple River – Red River + Loss of Sheyenne – Cass County	Moderow – Cass County Moderow –Sheyenne	224 316	125% 104%
Loss of Maple River – Red River + Loss of Sheyenne – Moderow 115 kV line	Sheyenne – Cass County	224	147%
Loss of Red River – Cass County + Loss of Maple River 230/115 kV TR 5 or 6	Maple River TR 6 or 5	187	100% ¹

Along with the deficiencies listed in Table 3.2, the following category C3 contingencies would be considered most severe for voltage stability for the study area:

- Loss of Maple River – Sheyenne 230 kV line combined with the loss of Maple River – Red River 115 kV line
- Loss of Sheyenne – Cass County 115 kV line combined with the loss of Sheyenne – Moderow 115 kV line.
- Fargo – Sheyenne 230 kV line combined with the loss of Maple River Bison 345 kV line.

¹ This is not a violation as the emergency rating of the transformer is 215 MVA.

Table 2.3 and Figure 2.1 below provide the results of PV analysis. The analysis was performed using the PV analysis tool in PSSE rev 32. The load at Cass County, Red River and Moderow was used as sink, the generation at Sherburne County was used as the source and the transfer level was incremented in steps of 5 MW. For all the contingencies used for PV analysis, voltage at Cass County bus was monitored.

Table 2.3

Contingency	Monitored bus	Voltage	Maximum power transfer
Loss of Maple River – Sheyenne 230 kV line + Loss of Maple River – Red River 115 kV line	Cass County	0.81	270
Loss of Sheyenne – Fargo 230 kV line + Loss of Maple River – Bison 345 kV line	Cass County	0.80	348
Loss of Sheyenne – Cass County 115 kV line + Loss of Sheyenne – Moderow 115 kV line	Cass County	0.73	218

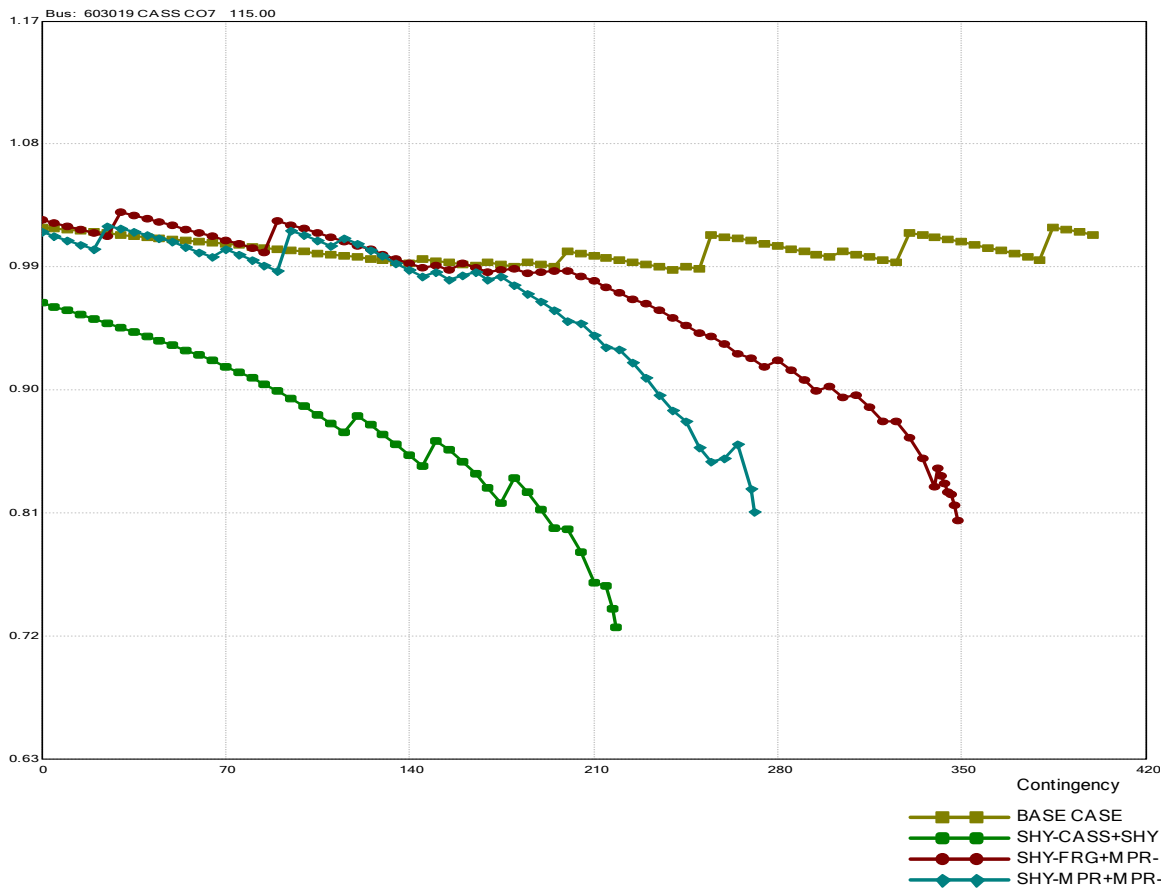


Figure 2.1

From the PV analysis, it can be seen that the loss of Sheyenne – Cass County 115 kV line combined with the loss of Sheyenne – Moderow 115 kV line would be the worst contingency for the study area. During this condition, the entire load at Red River, Cass County and Moderow would be served from Maple River substation through a single 115 kV line. Since the voltage collapse would occur beyond 200MW load growth, this is not considered a near term voltage stability concern. For the remaining contingencies, the Sheyenne capacitor banks provide adequate reactive power support to mitigate any voltage instability in the area.

2.4 Option 1

Based on the deficiencies identified in Table 2.2, the capacity of Sheyenne transformers, Sheyenne – Cass County and Sheyenne – Moderow 115 kV lines are limited during the loss of Maple River source. This can be addressed by introducing a new 230 or 345 kV source into Cass County. This can be achieved by building an ‘in-out’ double circuit 230 kV line into Cass County substation on the Sheyenne – Maple River 230 kV line and installing a 336 MVA 230/115 kV transformer at this location. The map of this option is shown in Figure 2.2

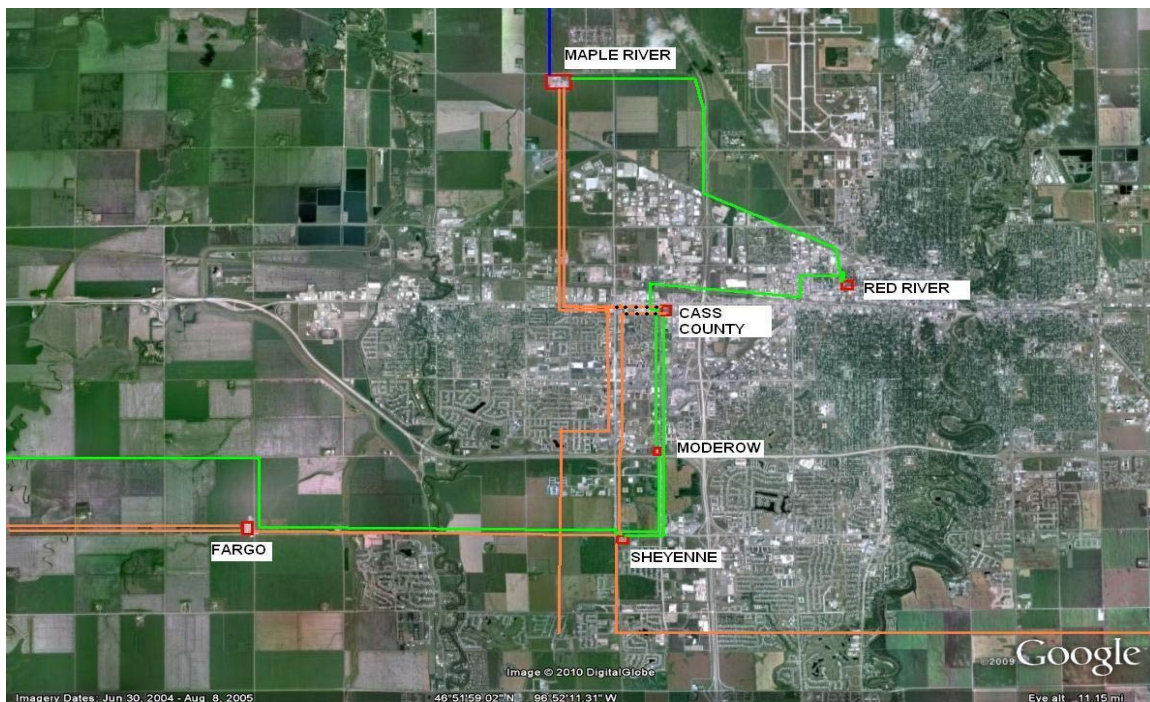


Figure 2.2
Map of Option 1

Applying this transmission option to base case and performing full AC contingency analysis indicated that all the deficiencies identified in Table 3.2 are mitigated by this option.

2.5 Option 2

This option involves building 4 miles of new 345 kV line from Maple River to Cass County substation along with a 336 MVA, 345/115 kV transformer. Similar to option 1, this provides a new 345 kV source to Cass County substation, thereby reducing the load on Sheyenne transformers and Sheyenne – Cass County double circuit. The map of option 2 is provided in Figure 2.4.

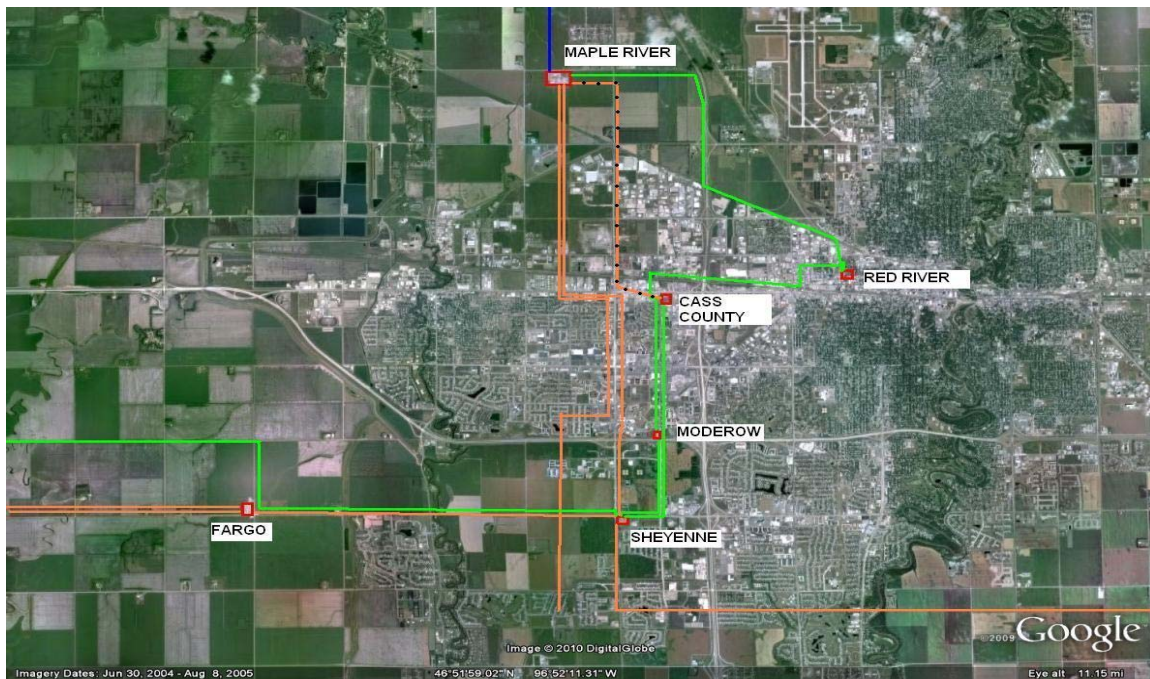


Figure 2.4

Applying this transmission option to base case and performing full AC contingency analysis indicated that all the deficiencies identified in Table 2.2 are mitigated by this option.

Due to existing development in the area, it would be extremely difficult to route 230 or 345 kV lines in to Cass County substation. In addition, Cass County substation would have to be expanded significantly in order to host a new 230-115 kV or a 345-115 kV transformer at this location.

The existing Cass County substation site is not sufficient to implement this plan, therefore these options are not studied any further.

2.6 Option 3

This options involves re-building the 1.9 mile double circuit 115 kV line between Moderow and Cass County substations to higher capacity (795kcmil ACSS or equivalent conductor) and upgrading the Sheyenne transformers 5 and 6 to 448 MVA² each. This would eliminate all the deficiencies in the near-term identified in Table 2.2. Applying this option to the base case and performing a full AC contingency analysis did not indicate any further problems in the study area.

As this option does not take into account any of the future EHV plans for the area, or voltage stability concerns, several improvements have to be made over time, to keep up with the load growth. Also the incremental load serving capability offered by this option is limited by the thermal capacity of 115 kV transmission system.

Transfer limit analysis was performed on this option with Cass County, Red River and Moderow substations as sinks and Sherburne County generation as source. The results of the analysis are shown in Table 3.6 below.

Table 2.6

Load growth	Contingency	Limiting element	Mitigation
45.7 MW	Sheyenne – Cass County + Sheyenne – Moderow 115 kV lines	Maple River – Red River 115 kV line	Convert Maple River – Red River 115 kV line to double circuit or build 2 nd circuit.
52.5 MW	Loss of Sheyenne – Cass County + Sheyenne – Moderow 115 kV lines	Maple River TR 6	Upgrade Maple River transformers to 336 MVA
55.2 MW	Loss of Sheyenne - Cass County + Sheyenne – Moderow 115 kV line	Maple River TR 5	Upgrade Maple River transformers to 336 MVA
54.8 MW	Sheyenne – Moderow 115 kV + Maple River – Red River 115 kV line	Sheyenne – Cass County 115 kV line	Convert Maple River – Red River 115 kV line to double circuit or build 2 nd circuit.

² 336 MVA is not sufficient as the loss of Maple River – Red River line + outage of one of Sheyenne transformers loading to 82% of the 336 MVA.

57.8 MW	Sheyenne – Cass County 115 kV + Maple River – Red River 115 kV line	Sheyenne – Moderow 115 kV line	Convert Maple River – Red River 115 kV line to double circuit or build 2 nd circuit.
94.7 MW	Loss of Sheyenne – Cass County 115kV line + Loss of Sheyenne – Moderow 115 kV line.	Red River – Cass County 115 kV	Upgrade Red River – Cass County 115 kV line to higher capacity
133.4 MW	Loss of Sheyenne – Cass County 115kV line + Loss of Maple River – Red River 115kV.	Cass County – Moderow 115 kV line	Convert Maple River – Red River 115 kV line to double circuit or build 2 nd circuit.
155 MW	Loss of Maple River – Sheyenne 230 kV line + Maple River – Red River 115 kV line	Sheyenne – Fargo 230 kV line	Convert Maple River – Red River 115 kV line to double circuit or build 2 nd circuit.

As it can be noticed from Table 2.6, several transmission upgrades will be needed over time to avoid overloading the 115 kV transmission system. It should also be noticed, from Figure 2.1 (base case analysis), that the loss of Sheyenne – Cass County double circuit 115 kV line would cause voltage violations at Cass County and Moderow after 70 MW of load growth. The upgrade of Sheyenne transformers and Sheyenne – Cass County lines would not help improve the voltage at Cass County, for this contingency. However, the addition of a second Maple River – Red River line would help significantly improve the voltages. The second Maple River – Red River line would also eliminate limitations as indicated in Table 2.6 by either eliminating the contingency or by mitigating the overload.

Option 3A

Since the outage of Maple River – Red River 115 kV line is considered to be the most limiting element, a second 115 kV circuit from Maple River to Red River would eliminate the overloads on Sheyenne – Cass County double circuit 115 kV line and Sheyenne transformers. Table 2.7 below provides the transfer limit analysis with the second Maple River – Red River 115 kV line.

Table 2.7

Load growth	Contingency	Limiting element	Mitigation
53 MW	Maple River TR 5 Sheyenne – Maple River 230kV line	Maple River TR 6	Upgrade Maple River TR 5 and 6 to 336 MVA
54.3 MW	Loss of Maple River TR5 Sheyenne – Maple River 230kV line	Maple River TR 5	Upgrade Maple River TR 5 and 6 to 336 MVA
87.6 MW	Loss of Sheyenne – Moderow 115 kV line and Maple River TR 5 or 6	Sheyenne – Cass County 115 kV line	Upgrade 477 ACSS section of the double circuit line to 795ACSS.
114.5 MW	Loss of Sheyenne – Cass County 115 kV line + Maple River TR 5 or 6	Red River – Cass County 115 kV line.	Upgrade line to 795 ACSS
138.5 MW	Maple River – Red River 115 kV lines 1 and 2	Sheyenne – TR 5 and 6	Upgrade Sheyenne TR 5 and 6 to higher capacity

Tables 2.6 and 2.7 provide the same set of upgrades, only the order in which the upgrades are made is different. For Option 3, the Red River – Cass County line is shown to overload for 94.7 MW load growth, and for option 3A, this upgrade is found to be needed at 114.5 MW load growth. This difference is due to presence of second Maple River – Red River line option 3A. The second Maple River – Red River line would be present in option 3 before the load reaches 95 MW. Therefore for both the options it is assumed that the Red River – Cass County 115 kV line upgrade is required at 114.5 MW load growth.

2.7 Cost analysis

The cost of options 3 and 3A are provided in Table 2.8 below. The future upgrades are identified by year, based on an assumption of 2% load growth at the existing Red River, Cass County and Moderow substations.

Table 2.8

Year	Load	Facility	Cost
Option 3			
Initial	0	Upgrade Sheyenne TR 5 and 6 to 448MVA and Upgrade Sheyenne – Cass County double circuit 115 kV line to 795ACSS	\$6900000
2023	45.7	Build 2 nd Maple River – Red River 115 kV line	\$6775000
2024	53.5	Upgrade Maple River TR 5 and 6 to 336 MVA	\$4500000
2032	115	Upgrade Cass County – Red River 115 kV line to 795 ACSS	\$1500000
Net present value			\$15,851,859
Option 3A			
Initial	0	Build 2 nd Maple River – Red River 115 kV line	\$6775000
2024	53.5	Upgrade Maple River TR 5 and 6	\$4500000
2028	87.6	Upgrade 477 ACSS section of Sheyenne – Cass County double circuit to 795 ACSS	\$2400000
2032	115	Upgrade Cass County – Red River 115 kV line to 795 ACSS	\$1500000
2034	138	Upgrade Sheyenne 230/115 kV transformers to 448 MVA	\$4500000
Net Present Value			\$ 13,521,819

From Table 2.8 it can be seen that initial facilities required for options 3 and 3A cost approximately the same, however option 3A would allow delaying the future expenses to a greater extent there by resulting in a reduced net present value cost. The advantage of delaying the costs would be greater if the load growth in the area reduces to less than 2%. In addition, building the second Maple River – Red River 115 kV line would provide a redundant source to the load at Fargo, such that the outage of double circuit 115 kV line from Sheyenne, along with an outage of the 115 kV line from Red River, would not result in a complete loss of power to the City of Fargo.

2.8 Generation outlet analysis for Fargo area

Since there is significant generation currently present on the West side of Fargo and several hundred mega watts being planned in this area, transfer limit analysis was performed for the study region to identify the limits to generation outlet from this area.

This analysis was performed on 2016 summer off peak model with the flow on NDEX set close to 2020 MW with Bison – Alexandria line open. After the transfers were set up, the Bison – Alexandria line was closed through. The models were set up such that the generation at Pillsbury is set to 371 MW. A proxy generator at Bison was used as source and the generators in Eastern Wisconsin were used as sink for the transfer limit analysis. Transfer limit analysis was performed on base case, and option 3A. The results of the analysis are tabulated below in Table 2.9.

Table 2.9

MW	Limiting element	Contingency	Rating	DF
<u>Base Case</u>				
411	Bison - Alexandria 345 kV line	Sheyenne - Audubon 230 kV line	279.2	0.15122
492	Maple River 230/115 kV transformer 5 or 6 Sheyenne - Maple River 230 kV line	Maple River 230/115 kV transformer 6 or 5	215	0.11646
493	Bison - Alexandria 345 kV line	Frontier - Maple River 230 kV line	262	0.19186
497	Maple River - Pillsbury 230 kV line Maple River 345/230 kV transformer	Maple River 345/230 kV transformer	420	0.4689
541	Bison - Alexandria 345 kV line	Bison - Maple River 345 kV line	792	0.7818
588	Alexandria - Bison 345 kV line	Sheyenne - Maple River 230 kV line	505	0.36207
616	Alexandria - Bison 345 kV line	Wahpeton - Frontier 230 kV line	262	0.19119
661	Fargo - Moorhead 230 kV line	Fargo - MSP Brook 115 kV line	127	0.04389
<u>Option 3A</u>				
400	Sheyenne - Maple River 230 kV line Maple River TR 5 or 5	Maple River TR 6 or 5	215	0.12214
408	Bison - Alexandria 345 kV line	Sheyenne - Audubon 230 kV line	279.7	0.15136
494	Alexandria - Bison 345 kV line	Frontier - Maple River 230 kV line	262	0.19175
495	Pillsbury - Maple River 230 kV line Maple River 345/230 kV TR	Maple River 345/230 kV transformer	420	0.46896
539	Bison - Alexandria 345 kV line	Bison - Maple River 345 kV line	792	0.7821
617	Alexandria - Bison 345 kV line	Sheyenne - Maple River 230 kV line	505	0.35862
618	Alexandria - Bison 345 kV line	Wahpeton - Frontier 230 kV line	262	0.19108
661	Fargo - Moorhead 230 kV line	Fargo - MSP Brook 115 kV line	127	0.0439

The Sheyenne – Audubon 230 kV line rating is planned to be increased to 350/385 MVA. With a 15% distribution factor, during the loss of Alexandria – Bison 345 kV line, the new rating would allow an additional 700 MW of generation at Bison, therefore this is not considered a limiting element in the near-term.

Table 2.9 demonstrates that Option 3A only impacts the load on Maple River 230/115 kV transformers, and the impact on other facilities is minimal. As the Maple River transformer upgrade is required for load serving purposes in 2024 (From Table 2.8), this is not considered a limiting element.

3. Conclusion

The recommended plan for the Fargo load serving problems is to convert the Maple River – Red River 115 kV line to double circuit, and expand Red River substation to a three position ring bus. This would provide the required redundancy to meet C3 contingency requirements without shedding load. The proposed plan also doesn't impact the generation outlet capability from the study area. The Maple River transformers have to be upgraded due to generation and load serving needs in the future.

Appendix A
Rating Corrections

Rating updates made study area

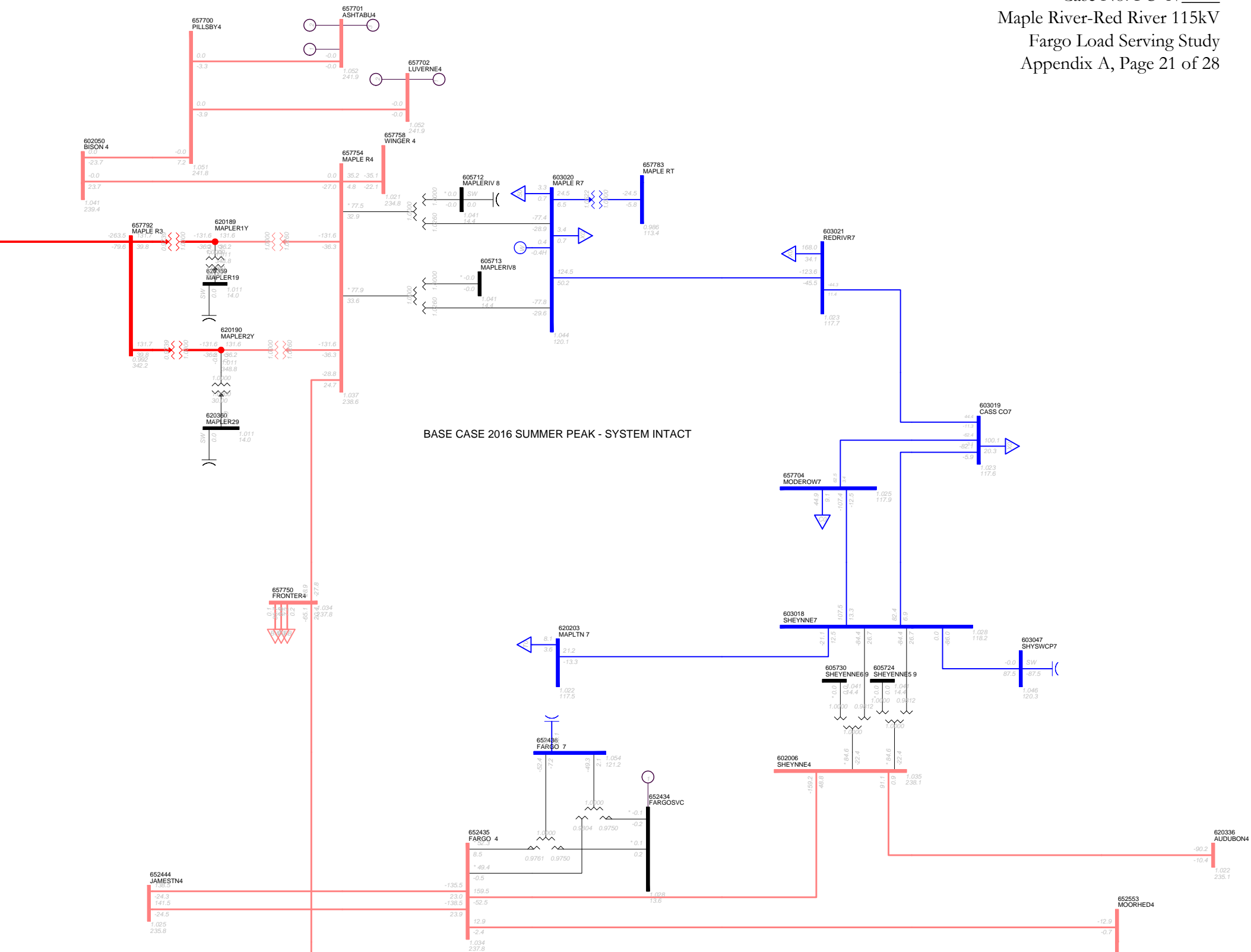
Facility	Old Rating	Rating used in the models
Maple River – Sheyenne 230 kV line	368.9/405	459/505
Maple River – Red River 115 kV line	317/349.5	361/397
Red River – Cass County 15 kV line	190.8/199.2	224/246
Cass County – Moderow 115 kV line	224.3/239	224/239
Moderow – Sheyenne 115 kV line	239/239	239/239
Sheyenne – Cass County 115 kV line	224/239	224/239
Sheyenne – Audubon 230 kV line	253.8/279.2	253.8/279.2
Buffalo - Bison – Maple River 345 kV line	720/792	720/792
Maple River – Frontier – Wahpeton 230 kV line	265/292	262/262

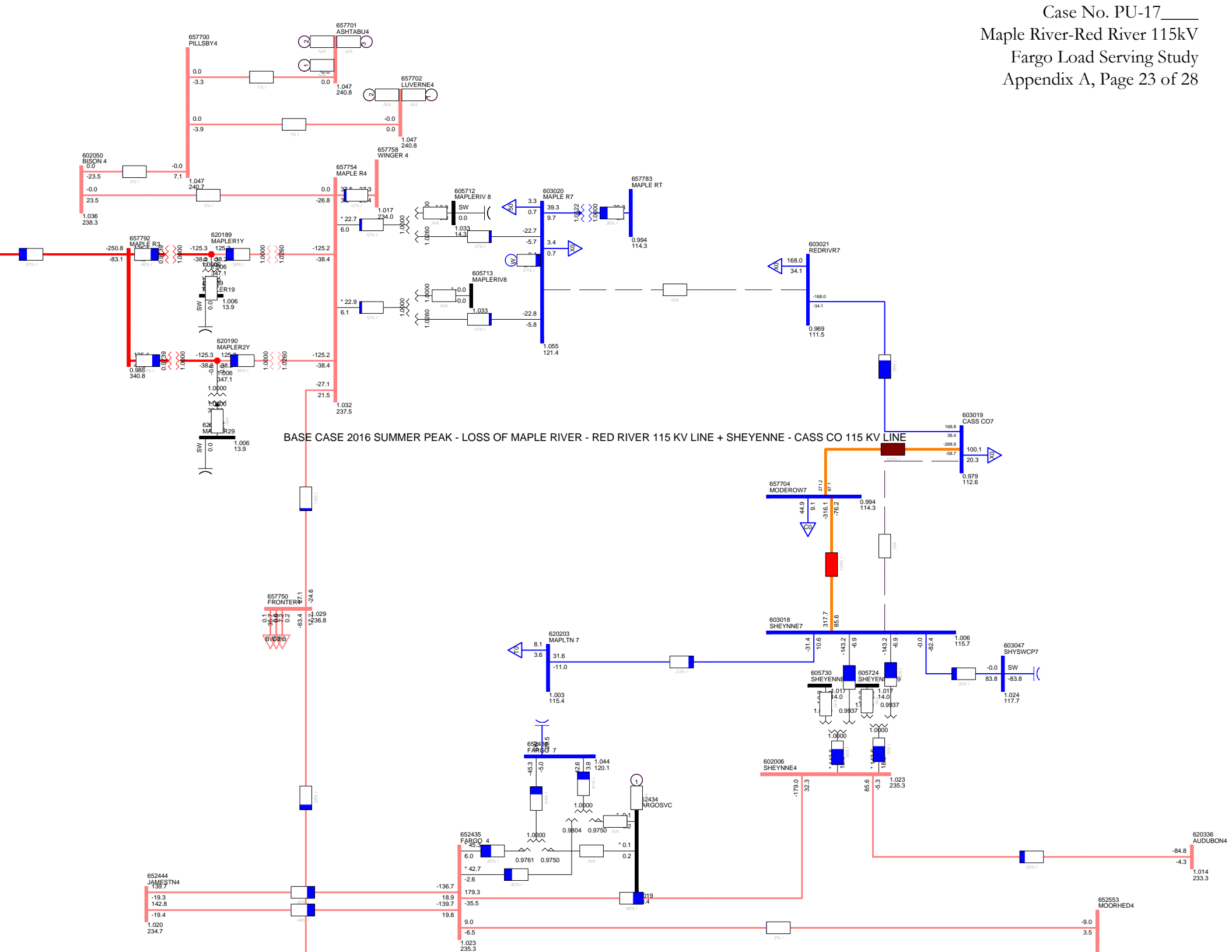
Other updates

Below is the script used to update the ratings of other MPC lines:

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psspy.branch_data(620369,657791,r"1",[i,i,i,i,i],[f,f,f,f,f,1017.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620358,620369,r"1",[i,i,i,i,i],[f,f,f,f,f,1017.0,f,f,f,f,f,f,f,f])
psspy.branch_data(601067,620358,r"1",[i,i,i,i,i],[f,f,f,f,f,1017.0,f,f,f,f,f,f,f,f])
psspy.branch_data(601067,657792,r"1",[i,i,i,i,i],[f,f,f,f,f,1017.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657751,661042,r"1",[i,i,i,i,i],[f,f,f,f,400.0,444.0,400.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657751,657756,r"1",[i,i,i,i,i],[f,f,f,f,400.0,444.0,400.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657754,657758,r"1",[i,i,i,i,i],[f,f,f,f,349.0,349.0,349.0,f,f,f,f,f,f,f,f])
psspy.branch_data(602050,657700,r"1",[i,i,i,i,i],[f,f,f,f,450.0,495.0,478.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657750,657754,r"1",[i,i,i,i,i],[f,f,f,f,262.0,262.0,262.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620329,657750,r"1",[i,i,i,i,i],[f,f,f,f,262.0,262.0,262.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657755,657758,r"1",[i,i,i,i,i],[f,f,f,f,400.0,400.0,400.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620345,657758,r"1",[i,i,i,i,i],[f,f,f,f,288.0,288.0,288.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657752,657755,r"1",[i,i,i,i,i],[f,f,f,f,400.0,400.0,400.0,f,f,f,f,f,f,f,f])
psspy.branch_data(602013,657757,r"1",[i,i,i,i,i],[f,f,f,f,230.0,230.0,288.0,f,f,f,f,f,f,f,f])
psspy.branch_data(602013,667046,r"1",[i,i,i,i,i],[f,f,f,f,230.0,230.0,288.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657757,657760,r"1",[i,i,i,i,i],[f,f,f,f,288.0,288.0,288.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657753,657760,r"1",[i,i,i,i,i],[f,f,f,f,288.0,288.0,288.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657710,657716,r"1",[i,i,i,i,i],[f,f,f,f,116.0,116.0,116.0,f,f,f,f,f,f,f,f])
psspy.branch_data(608638,657716,r"1",[i,i,i,i,i],[f,f,f,f,116.0,116.0,116.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657706,657722,r"1",[i,i,i,i,i],[f,f,f,f,157.0,157.0,157.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620249,657706,r"1",[i,i,i,i,i],[f,f,f,f,118.0,120.0,118.0,f,f,f,f,f,f,f,f])
psspy.branch_data(652443,657706,r"1",[i,i,i,i,i],[f,f,f,f,157.0,174.0,157.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657714,657722,r"1",[i,i,i,i,i],[f,f,f,f,157.0,157.0,157.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620255,657705,r"1",[i,i,i,i,i],[f,f,f,f,181.0,201.0,181.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620257,657705,r"1",[i,i,i,i,i],[f,f,f,f,132.0,132.0,132.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657709,657720,r"1",[i,i,i,i,i],[f,f,f,f,81.0,81.0,81.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620257,657709,r"1",[i,i,i,i,i],[f,f,f,f,211.0,211.0,211.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620253,657713,r"1",[i,i,i,i,i],[f,f,f,f,71.0,71.0,71.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620254,657713,r"1",[i,i,i,i,i],[f,f,f,f,116.0,116.0,116.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657713,657723,r"1",[i,i,i,i,i],[f,f,f,f,148.0,164.0,148.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657723,657726,r"1",[i,i,i,i,i],[f,f,f,f,148.0,164.0,148.0,f,f,f,f,f,f,f,f])
psspy.branch_data(620255,657718,r"1",[i,i,i,i,i],[f,f,f,f,132.0,132.0,132.0,f,f,f,f,f,f,f,f])
psspy.branch_data(657708,657718,r"1",[i,i,i,i,i],[f,f,f,f,132.0,132.0,132.0,f,f,f,f,f,f,f,f])
```

Appendix B
Power Flow Maps





Appendix C
Net Present Value Analysis

Title: Option 3

Cost of Capital	8.32%
Revenue Require Rate	12.17%
Investment Escalation	2.36%
Expense Escalation	2.36%

Starting year for study 2012
 Investments/Expenses 2012
 Ending Year 2047

35

*The 35 year totals below were calculated using the rates above.

Year	Cumulative Present Worth	Total Investment	Levelized Annual Cost
2047	15,851,859	24,502,071	1,390,236

Year	New Investments 2012 dollars	Expenses 2012 dollars	Escalated New Investments	Escalated Expenses	Investment Revenue Requirement	Revenue Requirements	Present Worth of Revenue Requirements	Cumulative Present Worth 2012 dollars	Cumulative Investment
2012	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0
2015	6,900,000	0	7,400,140	0	900,614	900,614	654,092	654,092	7,400,140
2016	0	0	0	0	900,614	900,614	603,828	1,257,920	7,400,140
2017	0	0	0	0	900,614	900,614	557,427	1,815,347	7,400,140
2018	0	0	0	0	900,614	900,614	514,592	2,329,940	7,400,140
2019	0	0	0	0	900,614	900,614	475,049	2,804,988	7,400,140
2020	0	0	0	0	900,614	900,614	438,544	3,243,532	7,400,140
2021	0	0	0	0	900,614	900,614	404,844	3,648,377	7,400,140
2022	0	0	0	0	900,614	900,614	373,734	4,022,111	7,400,140
2023	6,775,000	0	8,756,738	0	1,966,330	1,966,330	753,278	4,775,389	16,156,878
2024	4,500,000	0	5,953,548	0	2,690,891	2,690,891	951,634	5,727,023	22,110,425
2025	0	0	0	0	2,690,891	2,690,891	878,506	6,605,529	22,110,425
2026	0	0	0	0	2,690,891	2,690,891	810,998	7,416,527	22,110,425
2027	0	0	0	0	2,690,891	2,690,891	748,677	8,165,204	22,110,425
2028	0	0	0	0	2,690,891	2,690,891	691,146	8,856,349	22,110,425
2029	0	0	0	0	2,690,891	2,690,891	638,035	9,494,384	22,110,425
2030	0	0	0	0	2,690,891	2,690,891	589,005	10,083,390	22,110,425
2031	0	0	0	0	2,690,891	2,690,891	543,744	10,627,133	22,110,425
2032	1,500,000	0	2,391,645	0	2,981,960	2,981,960	556,256	11,183,390	24,502,071
2033	0	0	0	0	2,981,960	2,981,960	513,511	11,696,900	24,502,071
2034	0	0	0	0	2,981,960	2,981,960	474,051	12,170,951	24,502,071
2035	0	0	0	0	2,981,960	2,981,960	437,622	12,608,573	24,502,071
2036	0	0	0	0	2,981,960	2,981,960	403,994	13,012,567	24,502,071
2037	0	0	0	0	2,981,960	2,981,960	372,949	13,385,516	24,502,071
2038	0	0	0	0	2,981,960	2,981,960	344,290	13,729,806	24,502,071
2039	0	0	0	0	2,981,960	2,981,960	317,833	14,047,639	24,502,071
2040	0	0	0	0	2,981,960	2,981,960	293,409	14,341,048	24,502,071
2041	0	0	0	0	2,981,960	2,981,960	270,863	14,611,911	24,502,071
2042	0	0	0	0	2,981,960	2,981,960	250,048	14,861,959	24,502,071
2043	0	0	0	0	2,981,960	2,981,960	230,833	15,092,793	24,502,071
2044	0	0	0	0	2,981,960	2,981,960	213,095	15,305,888	24,502,071
2045	0	0	0	0	2,981,960	2,981,960	196,720	15,502,608	24,502,071
2046	0	0	0	0	2,981,960	2,981,960	181,603	15,684,211	24,502,071
2047	0	0	0	0	2,981,960	2,981,960	167,648	15,851,859	24,502,071

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Title: Option 3A

Cost of Capital	8.32%
Revenue Require Rate	12.17%
Investment Escalation	2.36%
Expense Escalation	2.36%

Starting year for study 2012
 Investments/Expenses 2012
 Ending Year 2047

35

*The 35 year totals below were calculated using the rates above.

Year	Cumulative Present Worth	Total Investment	Levelized Annual Cost
2047	13,521,819	26,614,608	1,182,422

Year	New Investments 2012 dollars	Expenses 2012 dollars	Escalated New Investments	Escalated Expenses	Investment Revenue Requirement	Revenue Requirements	Present Worth of Revenue Requirements	Cumulative Present Worth 2012 dollars	Cumulative Investment
2012	0	0	0	0	0	0	0	0	0
2013	0	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0	0
2015	6,775,000	0	7,266,079	0	884,299	884,299	642,242	642,242	7,266,079
2016	0	0	0	0	884,299	884,299	592,889	1,235,131	7,266,079
2017	0	0	0	0	884,299	884,299	547,329	1,782,461	7,266,079
2018	0	0	0	0	884,299	884,299	505,270	2,287,731	7,266,079
2019	0	0	0	0	884,299	884,299	466,443	2,754,173	7,266,079
2020	0	0	0	0	884,299	884,299	430,599	3,184,773	7,266,079
2021	0	0	0	0	884,299	884,299	397,510	3,582,283	7,266,079
2022	0	0	0	0	884,299	884,299	366,964	3,949,246	7,266,079
2023	0	0	0	0	884,299	884,299	338,765	4,288,011	7,266,079
2024	4,500,000	0	5,953,548	0	1,608,860	1,608,860	568,973	4,856,984	13,219,627
2025	0	0	0	0	1,608,860	1,608,860	525,251	5,382,235	13,219,627
2026	0	0	0	0	1,608,860	1,608,860	484,888	5,867,124	13,219,627
2027	0	0	0	0	1,608,860	1,608,860	447,627	6,314,751	13,219,627
2028	2,400,000	0	3,485,746	0	2,033,083	2,033,083	522,190	6,836,941	16,705,373
2029	0	0	0	0	2,033,083	2,033,083	482,063	7,319,004	16,705,373
2030	0	0	0	0	2,033,083	2,033,083	445,019	7,764,023	16,705,373
2031	0	0	0	0	2,033,083	2,033,083	410,822	8,174,844	16,705,373
2032	1,500,000	0	2,391,645	0	2,324,152	2,324,152	433,548	8,608,393	19,097,018
2033	0	0	0	0	2,324,152	2,324,152	400,233	9,008,625	19,097,018
2034	4,500,000	0	7,517,590	0	3,239,061	3,239,061	514,923	9,523,548	26,614,608
2035	0	0	0	0	3,239,061	3,239,061	475,354	9,998,902	26,614,608
2036	0	0	0	0	3,239,061	3,239,061	438,825	10,437,727	26,614,608
2037	0	0	0	0	3,239,061	3,239,061	405,104	10,842,831	26,614,608
2038	0	0	0	0	3,239,061	3,239,061	373,974	11,216,805	26,614,608
2039	0	0	0	0	3,239,061	3,239,061	345,236	11,562,042	26,614,608
2040	0	0	0	0	3,239,061	3,239,061	318,707	11,880,748	26,614,608
2041	0	0	0	0	3,239,061	3,239,061	294,216	12,174,964	26,614,608
2042	0	0	0	0	3,239,061	3,239,061	271,607	12,446,571	26,614,608
2043	0	0	0	0	3,239,061	3,239,061	250,736	12,697,307	26,614,608
2044	0	0	0	0	3,239,061	3,239,061	231,468	12,928,775	26,614,608
2045	0	0	0	0	3,239,061	3,239,061	213,681	13,142,456	26,614,608
2046	0	0	0	0	3,239,061	3,239,061	197,261	13,339,717	26,614,608
2047	0	0	0	0	3,239,061	3,239,061	182,102	13,521,819	26,614,608