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September 15, 2016

**VIA FEDEX**

Darrell Nitschke  
Executive Secretary  
North Dakota Public Service Commission  
Department 408  
600 East Boulevard Avenue  
Bismarck, ND 58505-0480

**Re: Northern States Power Company – Minot Load Serving Project –  
Public Convenience & Necessity  
Case No PU-\_\_\_\_\_**

Dear Mr. Nitschke:

Enclosed please find Applicant Northern States Power Company's, a Minnesota corporation ("Xcel Energy"), Application for a Certificate of Public Convenience and Necessity for the Minot Load Serving Project. You will find an original, two unbound and seven 3-ring bound copies of the application. In addition, you will find a CD containing the complete filing in a searchable PDF format and a check in the amount of \$10,000 for the filing fee.

Please feel free to contact me if you have any questions.

Sincerely,

Thomas G. Hillstrom

Enclosures

cc: J. Lein  
J. Schuh  
P. Fahn  
I. Jeffcoat-Sacco

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

NORTHERN STATES POWER COMPANY  
MINOT LOAD SERVING PROJECT  
PUBLIC CONVENIENCE & NECESSITY

**CASE NO. PU-\_\_\_\_\_**

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

**I. INTRODUCTION**

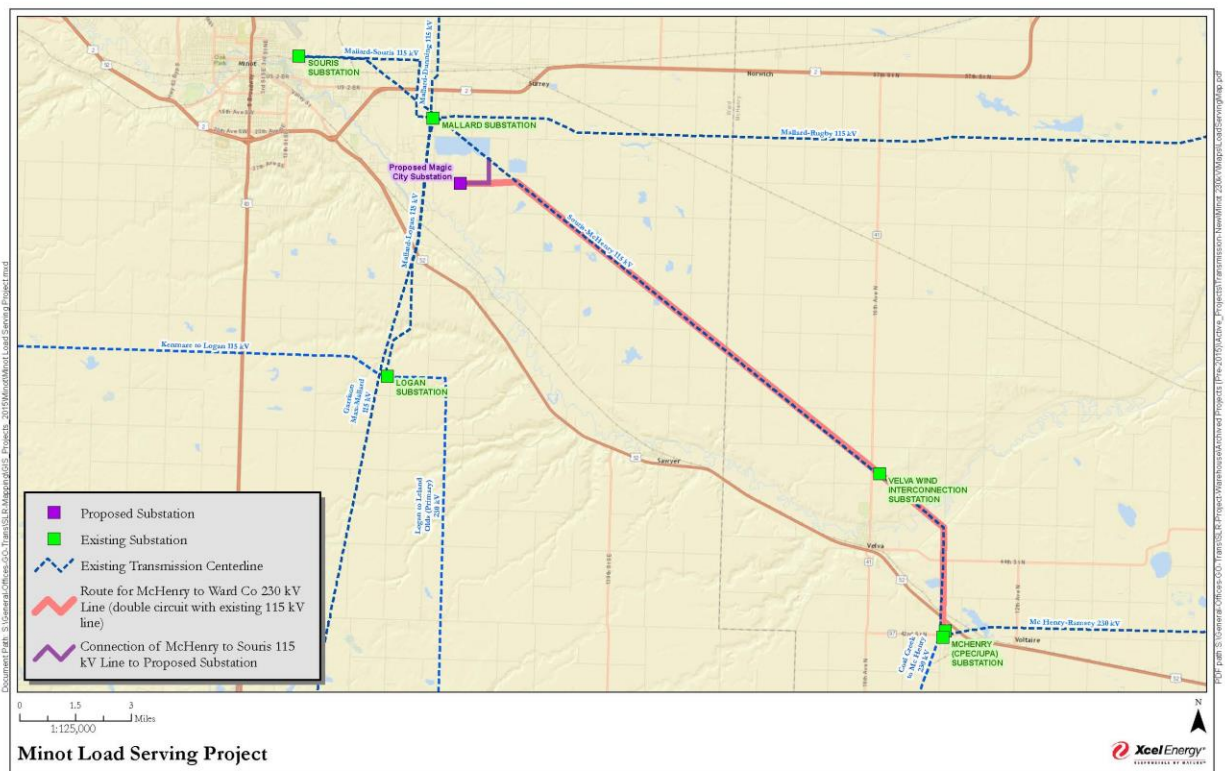
Pursuant to North Dakota Century Code Chapter 49-03, Northern States Power Company, doing business as Xcel Energy, respectfully submits this Application to the North Dakota Public Service Commission (Commission) for a Certificate of Public Convenience and Necessity to construct a new substation (Magic City substation) and a new 230 kilovolt (kV) transmission line between Great River Energy's McHenry substation and Xcel Energy's proposed Magic City substation near Minot, North Dakota (Minot Load Serving Project or Project).

Xcel Energy currently serves its entire load for the City of Minot from the Souris substation via two 115 kV lines that were built in the late 1950's and early 1960's. These lines are reaching capacity and experience low voltages conditions when certain elements of the system are out of service. In addition, the McHenry substation 230/115 transformer also experiences overloads when certain elements of the system are out of service. To address these low voltage and overload conditions in the Minot area, Xcel Energy along with Basin Electric Cooperative performed a joint electrical study (Minot Study) in 2015 to determine the best overall solution. The Minot Study, included as Appendix A, identified a new 230 kV line from the McHenry substation to a new 230/115 kV substation (Magic City), as well as reconfiguring and upgrading existing infrastructure, as the most effective solution to address the near term voltage issues and the long-term capacity issues in this area. The Minot Study also included potential additional future facilities that may be constructed by Xcel Energy or Basin Electric Cooperation. Xcel Energy also recently completed an Addendum to the Minot Study that focuses solely on the near term facilities proposed as part of the Minot Load Serving Project. This Addendum is included as Appendix B. The

facilities proposed as part of the Minot Load Serving Project are shown below in Figure 1.

Xcel Energy has conducted landowner outreach and is in the process of obtaining right-of-way and local permits for the Project. The majority of the proposed route of the new 230 kV line would follow an existing 115 kV line. The new 230 kV line would be built on new double circuit structures which would carry both the new 230 kV line and the existing 115 kV line, allowing the existing 115 kV structures to be removed. There is also a short (1.3 mile) segment on new right-of-way to connect the new 230/115 kV line to the new Magic City substation. The 230/115 kV line will enter the Magic City substation as a double circuit line where the new 230 kV line will terminate. A single circuit 115 kV line will exit the Magic City substation and connect to the existing 115 kV line, Line 0850, which serves Souris substation.

**Figure 1**



Consistent with N.D.C.C. § 49-03-02(2), the Company respectfully requests 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.

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 Company;
- Description of the Project; and
- Project Need.

## II. STANDARD OF REVIEW

### A. 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.

**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.** 1. 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:

- a. Issue the certificate prayed for;
- b. Refuse to issue such certificate;
- c. Issue it for the construction or operation of a portions only on the contemplated facility, line, plant, system, or extension thereof; or
- d. 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.

2. 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, all needs are well documented, the Project is the most prudent method to address these needs, and Xcel Energy is capable of constructing the Project. Specifically:

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

## **B. 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 (12) as “[a]n electric transmission line and associated facilities with a design in excess of one hundred fifteen kilovolts” that is one mile or more in length. The Project involves construction of a 20-mile new 230 kV line. Accordingly, the Project involves the construction of a transmission facility as defined by Chapter 49-22, and therefore a Route Permit is required.

Xcel Energy will also obtain and comply with all required local permits.

## **C. Filing Fees**

N.D.C.C. § 49-03-02 allows the Commission to impose an application fee of up to \$175,000 for the processing of a CPCN application. Enclosed with this application is a check for \$10,000 for this application fee. Xcel Energy will submit additional payments as requested for the processing of this application.

## D. Ten Factor Inquiry

The Commission has indicated it considers ten (10) factors in determining whether to grant a CPCN for a new electric facility.<sup>1</sup> 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.

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

Xcel Energy and Verendrye Electric Cooperative provide retail service to Minot and the surrounding areas. The Project does not provide direct retail service in competition with 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?*

The existing transmission facilities located within a two-mile radius of the location are denoted on Figure 1 presented in Section 1.

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

The Project will not provide direct retail service. By reducing overloads to transmission facilities in the area, the Project provides reliable electric service to all. Customers in the vicinity of the Project are served by Xcel Energy and Verendrye Electric Cooperative.

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

Adding a new substation and a new 230 kV transmission line will increase reliability in the Minot area. The Project will therefore assist all electricity suppliers in the Minot area by providing more reliable service.

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

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?*

The Project does not provide direct retail service. Rather, the Project will result in increased reliability to all electricity suppliers in the Minot 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 Minot area.

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

No. The Project will mitigate overloads and low voltage conditions 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 is entirely located in unincorporated limits of Minot and the Company is not aware of any plans to annex the territory in 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. Xcel Energy will also apply for the necessary Certificate of Corridor Compatibility and Route Permit, which are required to route and construct the Project pursuant to N.D.C.C. Ch. 49-22.

### III. DESCRIPTION OF APPLICANT

Northern States Power 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 on January 15, 2016 and are hereby incorporated by reference.

The Company presently serves approximately 89,000 retail electric customers in North Dakota 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**

Xcel Energy seeks to construct and operate a new 230 kV line between the existing McHenry substation and the proposed Magic City substation. As described below, the Project would reduce overloads and low voltage conditions on neighboring lines and transformers, and allow the Company to provide service in compliance with applicable reliability standards without interrupting electric service to customers. The Project is located southeast of Minot and is shown on the Figure 1 above.

The proposed McHenry – Magic City 230 kV line is located in Ward and McHenry counties in the following townships Nedrose, Sundry, and New Prairie (Ward County) and in North Prairie, Velva and Brown (McHenry County). The length of the new 230 kV line is approximately 20 miles and will be constructed as double circuit line with an existing 115 kV line for the majority of its length. The Project will also involve constructing a new Magic City substation.

It is anticipated that construction of the Project will begin in the fall of 2017 and will be complete at the end of 2018. These dates are approximate and subject to change depending on permitting and other contingencies. The cost for the Project is estimated to be \$49,000,000 and will be paid for by Xcel Energy.

#### **V. NEED FOR PROJECT**

Xcel Energy currently serves the city of Minot from its 115 kV Souris substation. A study of the Minot area identified transmission deficiencies including low voltages as well as thermal overloads of the 115 kV system that currently serves the Minot area. Severe low voltage conditions were identified on the existing Souris – McHenry 115 kV line and the existing Souris – Mallard 115 kV line when certain elements of the system are out of service. Xcel Energy also identified overloads on the McHenry 230/115 kV transformer when certain elements of the electrical system are out of service. The Addendum, Appendix B, describes these low voltage and overload conditions in greater detail. The Minot Study, Appendix A, and the Addendum identified a need for an additional source and transformation to adequately serve the load in the Minot area. The proposed new 230 kV line between the McHenry Substation and the new Magic City substation will address the identified low voltage conditions by bringing a new source to serve the load in Minot. The proposed Magic City substation and its new 230/115 kV transformer will relieve the overloads on the McHenry substation transformer by increasing the transformation capacity in the area.

## VI. COMMUNICATIONS AND SERVICE LIST

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

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## VII. CONCLUSION

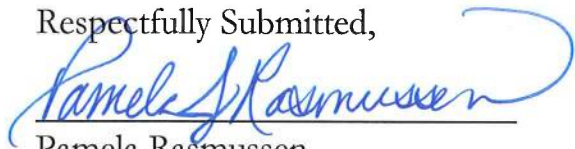
As demonstrated in this Application, the public convenience and necessity require the construction of the Project. The Project is necessary to allow the Company to meet applicable reliability standards and provide reliable electric service to customers.

We respectfully request that the Commission grant a Certificate of Public Convenience and Necessity for the Project. 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 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: Sept 9, 2016

Respectfully Submitted,



Pamela Rasmussen

Pamela Rasmussen  
Senior Manager, Siting and Land Rights  
Xcel Energy

# **APPENDIX A**



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# Joint Minot Load Serving Study

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FINAL REPORT.

Xcel Energy Services; Transmission Planning

Jeremy Severson Basin Electric Power Cooperative

David Brauch Xcel Energy

Philip Westby Basin Electric Power Cooperative

March 27, 2015

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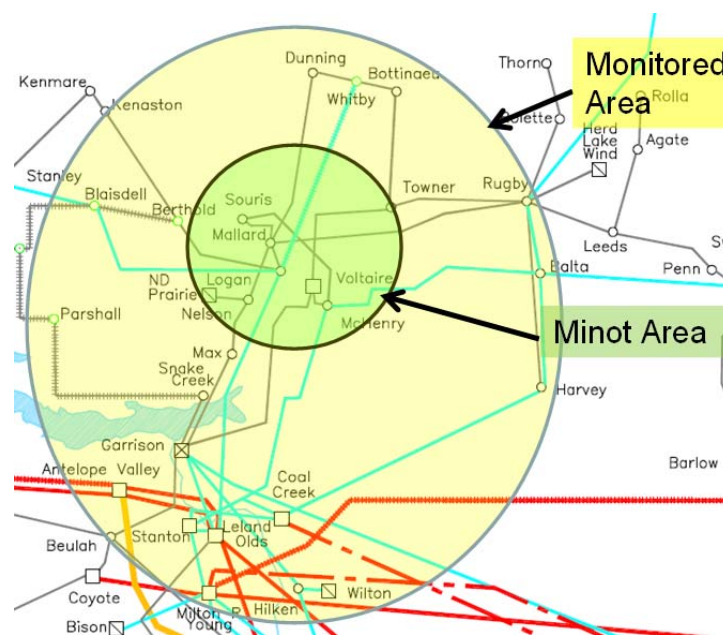
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## 1.0: Background & Scope of Study.

The Minot area is located in the north central part of North Dakota. The purpose of this analysis is to determine a long term solution that addresses NSP's and the Integrated System's (I/S) concerns for the Minot area. The Minot area is currently served by three bulk sources which are the Lelands Olds – Logan 230 kV line, the McHenry – Coal Creek Tap 230 kV line, and the Garrison – Max – Mallard 115 kV line with transformation at McHenry and Logan. The Minot area has four 115 kV load serving substations SW Minot, Souris, Mallard, and Ruthville.

NSP serves the city of Minot load from its Souris substation. NSP distribution has identified the potential need for a new substation closer to the western part of town to pick up new load growth as well as offload the existing Souris substation in the 2020 timeframe. NSP also has category C3 overloads and low voltage issues for the Minot area. Currently, there is an operator armed under voltage load shedding scheme installed at Souris substation to mitigate these issues.

The Integrated System provides the bulk power delivery for Basin Electric's Class A member Central Power Electric Cooperative at the Mallard, Logan, and SWMINOT 115 kV deliveries. Central Power supplies Verendrye Electric Power Cooperative with the power to serve their portions of the surrounding Minot Community and the Minot Air Force base, which is served from the Ruthville 115 kV substation. Continued load growth is stressing the local transmission system, and out year transmission planning cases are showing low voltage and thermal overloads that will need to be mitigated. Furthermore it is getting increasingly difficult for operations to take maintenance outages in the area without putting load at a greater risk. The Minot area is defined by the substations located in the green area and the yellow area contains the monitored lines and substations.



The scope of this study is to determine solution options that will sufficiently address NSP and I/S concerns for this area.

## **2.0: Conclusions & Recommended Plan.**

The preferred option as result of the study work is referred to as option A. This option includes the following:

- A new 230 kV line from McHenry up to Minot with a new 230/115 kV substation referred to as Ward County
- Convert the existing Logan – Mallard 115 to 230 kV and terminate at Ward County
- Construct an in and out of the McHenry – Souris 115 kV line into Ward County
- Construct an in and out of the Nelson Tap - Mallard 115 kV line into Logan
- Rebuild both Ward County – Souris 115 kV lines

This report recommends construction and interconnection of a Mouse River substation to serve growing loads in the western portion of the city. NSP distribution foresees this need in the 2020 timeframe, but will monitor the load growth and adjust the need time as necessary.

- Build new 115 kV distribution substation (Mouse River)
- Construct new Mouse River – Ruthville 115 kV line
- Construct new Souris – Mouse River 115 kV line

Both option A and option B address most category A and B issue that were observed on the Minot system. Option A was chosen over option B due to the greater extent in which the Minot area transmission is better interconnected. More interconnection of 115 kV system provides future ability to expand capacitor banks in this area to address any future low voltages issues for this area.

## **3.0: Study History & Participants.**

### **3.1: Study History**

There have been several studies completed recently that have identified voltage and loading violations in the Minot area. These reports include the following:

North Dakota Load Serving Capability Report

*Prepared by Excel Engineering for Xcel Energy*

## MN TACT Region Four Annual 2013 Transmission Assessment

*Prepared by Minnesota Transmission Assessment & Compliance Team*

Due to the localized Minot area, this study aims to find options to mitigate transmission issues observed in previous study work.

### **3.2: Study Participants**

Northern States Power, Xcel Energy (NSP)

Basin Electric Power Cooperative (BEPC)

Western Area Power Administration (WAPA)

### **4.0: Analysis.**

#### **4.1: NERC Criteria**

TPL-001-0.1

TPL-002-0b

#### **4.2: Models Development.**

This analysis utilized the 2024 winter peak models from the 2013 MRO series. A winter load model was chosen due to the historical winter peaking nature for the Minot area.

The base models were modified for this analysis as noted below:

- Updated Minot area loads in 2015 and 2024
- Added 30 Mvars of capacitors at Souris substation (In service by 6/1/2016)
- Turned off the Velva, ND Prairie Wind, and Rugby wind farms
- Removed the Logan to Whitby 230 kV project and associated load
  - This project was added to the 2013 MRO models to support the spearfish oil load growth, which is no longer expected to be as large. For this reason, this project was removed for this analysis.
- Set B10T to 65 MW's north
  - B10T is the Boundary dam phase shifter that controls the flow from the Tioga 230 kV substation to the Boundary Dam 230 kV substation. For this area, the conservative case assumption is a north dispatch.

- A second model was created using the MRO 2024 winter peak case with north transfers conditions

### **4.3: Options evaluated.**

The pressing need for the Minot area is for additional transformation and another bulk source into the area. The potential solutions, described below, are intended to address these needs. The options evaluated were broken into two main descriptors, one being a “bulk” fix due to the more regional extent of the project while the other were more localized to the city of Minot itself.

The bulk transmission options were identified by numerical descriptors and are as follows:

#### Option 1

- Connect the McHenry and Logan via a new 230 kV interconnection:
  - Construct a 230/115 kV substation near the Mallard substation (Ward County) with two 230/115 kV transformers
  - Construct a new 25 mile 230 kV line from McHenry to the new Ward County substation
  - Convert the existing Logan – Mallard 115 kV line to 230 and bring into the new Ward County substation.

#### Option 2

- Connect McHenry to the coal fields via a new 230 kV up from Stanton
  - New 230/115 kV substation near Mallard substation (Ward County) with two 230/115 kV transformers
  - Construct a new 25 mile 230 kV line from McHenry to the new Ward County substation
  - Construct a new 60 mile 230 kV line from Stanton to the new Ward County substation

#### Option 3

- Convert 60 miles Garrison – McHenry 115 kV into Garrison to Logan 230 kV
- New 20 mile 115 kV line from Logan to McHenry
- Second Logan 230/115 kV transformer

In addition to the bulk options analyzed there were several “distribution” options studied for direct service into and around the Minot area. These options are referred to via an alphabetical identifier. Two options were developed to be combined with the above bulk option and are as follows:

#### Minot area distribution transmission options

##### Option A - Souris – Mouse River – Ruthville 115 kV loop

- Build new 115 kV distribution substation (Mouse River)
- Construct new Mouse River – Ruthville 115 kV line
- Construct new Souris – Mouse River 115 kV line
- Rebuild both Ward County – Souris 115 kV lines
- Construct an in and out of the McHenry – Souris 115 kV line into Ward County
- Construct an in and out of the Nelson Tap - Mallard 115 kV line into Logan

##### Option B – Ward County – Mouse River – Ruthville 115 kV Loop

- Build new 115 kV distribution substation (Mouse River)
- Construct new Ward County – Mouse River 115 kV line
- Construct new Mouse River – Ruthville 115 kV line
- Construct an in and out of the McHenry – Souris 115 kV line into Ward County
- Construct an in and out of the Nelson Tap - Mallard 115 kV line into Logan

For initial bulk transmission screening purposes of options 1 and 2, option A was used as the distribution option for initial comparisons.

#### **4.4: Performance evaluation methods.**

The bulk transmission options were assessed by performing an ACCC analysis with Category A and B contingencies. The results of each option were then compared to determine the performance of each option relative to each other.

The following criteria to evaluate all options are below.

	<b>NSP Bus Voltage</b>	<b>I/S Bus Voltage</b>	<b>NSP Thermal Ratings</b>	<b>I/S Thermal Ratings</b>
<b>System Intact</b>	.95 - 1.05 p.u.	.95 - 1.05 p.u.	100% Rate A	100% Rate A
<b>N-1 contingency</b>	.92 - 1.05 p.u.	.95 - 1.05 p.u.	100% Rate A	100% Rate A
<b>N-1-1 Contingency</b>	.92 - 1.05 p.u.	N/A	100% Rate B	N/A

## 5.0: Results of detailed analyses.

### 5.1: Powerflow (system intact & contingency).

#### Base Model System Intact

This study begins by identifying the long term voltage or thermal issues in the Minot area given the current transmission system. The table below contains the system intact voltages for the load serving buses in the Minot Area in the base 2024 winter peak model with north transfers. The 2024 winter peak model is used for this analysis since this is the most stressed condition for the Minot area.

#### Minot Area Load Serving Bus Voltages

##### 2024 Winter Peak Model with North Transfers

Substation	System Intact Voltage
603022 SOURIS 7	0.946
603023 MALLARD7	0.949
659165 RUTHVILLECP7	0.925
659307 SWMINOT CP7	0.953

Most of these voltages are in violation of NSP and IS system intact criteria. The 2024 base model also shows system intact thermal issues on the Logan and McHenry transformers as they are loaded above 100 percent of their normal ratings. These thermal issues are shown in the table below.

#### Minot Area Thermal Issues

##### 2024 Winter Peak Model with North Transfers

Element	MVA Rating	Loading %
McHenry 230/115 kV Transformer	84.0	104
Logan 230/115 kV Transformer	200.0	101.4

## Base Model Contingency Analysis

A contingency analysis was also conducted for the study area. The table below shows the category B voltage violation results for the current transmission system in the Minot Area.

### Minot Area Category B Flagged Voltage Issues

#### 2024 Winter Peak Model with North Transfers

UNDERVOLTAGE			
Substation	Voltage	Voltage Drop	Contingency
Souris 115 kV	94.58		System Intact
	86.44	8.13	Loss of Souris to Mallard 115 kV
	80.66	13.91	Loss of Mallard to Logan 115 kV
	87.99	6.58	Loss of McHenry 230/115 kV Transformer
	89.07	5.51	Loss of Leland Olds to Logan 230 kV
	86.2	8.38	Loss of Logan 230/115 kV Transformer
	89.07	5.51	Loss of Souris – Velva – McHenry 115 kV
Mallard 115 kV	94.86		System Intact
	80.18	14.68	Loss of Mallard to Logan 115 kV
	89.54	5.32	Loss of McHenry 230/115 kV Transformer
	90.83	4.03	Loss of Balta to Rugby 230 kV
	90.66	4.2	Loss of Rugby 230/115 kV Transformer
	89.09	5.77	Loss of Leland Olds to Logan 230 kV
	86.06	8.8	Loss of Logan 230/115 kV Transformer
	90.69	4.17	Loss of Souris – Velva – McHenry 115 kV
Velva Tap 115 kV	98.88		System Intact
	94.15	4.73	Loss of Souris to Mallard 115 kV
	90.79	8.1	Loss of Mallard to Logan 115 kV
	88.38	10.51	Loss of McHenry 230/115 kV Transformer
	94	4.88	Loss of Logan 230/115 kV Transformer
Logan 230 kV	96.66		System Intact
	94.48	2.18	Loss of Mallard to Nelson 115 kV
	93.95	2.72	Loss of McHenry 230/115 kV Transformer
	94.54	2.12	Loss of Balta to Rugby 230 kV
	94.54	2.13	Loss of Rugby 230/115 kV Transformer
	94.51	2.16	Loss of Nelson to Max 115 kV
	91.15	5.51	Loss of Leland Olds to Logan 230 kV
	94.47	2.19	Loss of Souris – Velva – McHenry 115 kV
Logan 115 kV	96.23		System Intact
	93.53	2.7	Loss of Mallard to Nelson 115 kV
	92.11	4.12	Loss of McHenry 230/115 kV Transformer
	93.07	3.16	Loss of Balta to Rugby 230 kV
	92.99	3.24	Loss of Rugby 230/115 kV Transformer
	90.52	5.7	Loss of Leland Olds to Logan 230 kV
	87.08	9.15	Loss of Logan 230/115 kV Transformer
	92.97	3.26	Loss of Souris – Velva – McHenry 115 kV
Ruthville 115 kV	92.54		System Intact
	76.6	15.94	Loss of Mallard to Logan 115 kV

	86.84	5.7	Loss of McHenry 230/115 kV Transformer
	88.22	4.32	Loss of Balta to Rugby 230 kV
	88.04	4.5	Loss of Rugby 230/115 kV Transformer
	86.35	6.19	Loss of Leland Olds to Logan 230 kV
	83.07	9.48	Loss of Logan 230/115 kV Transformer
	88.07	4.47	Loss of Souris – Velva – McHenry 115 kV
SW Minot 115 kV	95.33		System Intact
	91.4	3.92	Loss of McHenry 230/115 kV Transformer
	92.35	2.97	Loss of Balta to Rugby 230 kV
	92.26	3.07	Loss of Rugby 230/115 kV Transformer
	89.69	5.64	Loss of Leland Olds to Logan 230 kV
	87	8.33	Loss of Logan 230/115 kV Transformer
	85.81	9.52	Loss of Logan to SW Minot 115 kV
	92.25	3.07	Loss of Souris – Velva – McHenry 115 kV

There are several category B contingencies that result in voltage violations for NSP’s and the I/S buses. The loss of the Logan – Mallard 115 kV line, in particular, results in severely low voltages at NSP’s Mallard and Souris substations. The same contingency results in the Ruthville substation approaching .75 p.u. voltage. This contingency removes the strongest source serving the Minot area load. The remaining Garrison-Max-Mallard and McHenry-Souris 115 kV lines are unable to maintain acceptable voltages. In general, contingencies involving one of the three sources into this area results in low voltage violations. A new source is needed to maintain acceptable voltages in the Minot area.

The following table shows the category B thermal violations. Most of the flagged thermal violations are on the 115 kV system serving the Minot load. Losing one of the 115 kV line in the Minot area tends to overload the other lines serving the Minot load. This is an indication that new 115 kV points of injection may be needed to offload existing 115 kV lines.

### Minot Area Category B Flagged Thermal Issues

#### 2024 Winter Peak Model with North Transfers

Circuit Element	MVA Rating	Loading Percent	Contingency
Mallard to Logan 115 kV	159.3	81.5	System Intact
		100.7	Loss of Souris to Velva Tap 115 kV
		117.7	Loss of Mallard to Nelson 115 kV
		100.5	Loss of Velva Tap to McHenry 115 kV
		103.3	Loss of McHenry to Coal Creek Tap 230 kV
		100	Loss of McHenry 230/115 kV Transformer
		100.3	Loss of Balta to Rugby 230 kV
		117.7	Loss of Nelson to Max 115 kV
		119.5	Loss of Garrison to Max 115 kV
		100.7	Loss of Souris – Velva – McHenry 115 kV
McHenry to Velva Tap 115 kV	119.5	41.1	System Intact
		102.3	Loss of Souris to Mallard 115 kV
		101.4	Loss of Mallard to Logan 115 kV

McHenry 230/115 kV Transformer	84.0	114.6	System Intact
		160.4	Loss of Souris to Mallard 115 kV
		178.7	Loss of Mallard to Logan 115 kV
		159.3	Loss of McHenry to Balta 230 kV
		188.2	Loss of Balta to Rugby 230 kV
		154.7	Loss of Rugby 230/115 kV Transformer
		145.4	Loss of Garrison to Voltaire 115 kV
		157.8	Loss of Leland Olds to Logan 230 kV
		165	Loss of Logan 230/115 kV Transformer
Garrison to Voltaire 115 kV	109.0	77.2	System Intact
		102.3	Loss of McHenry to Coal Creek Tap 230 kV
Logan 230/115 kV Transformer	200.0	101.4	System Intact
		113	Loss of Souris to Velva Tap 115 kV
		124.6	Loss of Mallard to Nelson 115 kV
		112.9	Loss of Velva Tap to McHenry 115 kV
		116.2	Loss of McHenry to Coal Creek 230 kV
		112.9	Loss of Balta to Rugby 230 kV
		124.6	Loss of Nelson to Max 115 kV
		125.8	Loss of Garrison to Max 115 kV
		115.9	Loss of Logan to Blaisdell 230 kV
	113	Loss of Souris – Velva – McHenry 115 kV	

## 5.2: Bulk Option Analysis

The full analysis of the base transmission system shown above as well as previous studies indicates the need for an additional high voltage source into the Minot area. Three potential solutions were considered for this analysis. The first step was to screen the potential solutions to determine which option demonstrated the best performance. Other considerations, such as costs and constructability were considered in determination of the overall best solution. The options as laid out in section 4.4 of the report include:

Option 1: Joint NSP and Integrated System solution

Option 2: NSP solution

Option 3: Integrated System solution.

### Minot Area Load Serving Bus Voltages (System Intact)

#### 2024 Winter Peak Model with North Transfers

	Option 1	Option 2	Option 3
Logan 230 kV bus	0.984	0.995	0.995
McHenry 230 kV bus	0.992	1.007	0.999
Ward County 230 kV bus	0.984	1.006	N/A
Mallard 115 kV bus	0.982	0.999	0.978
Ruthville 115 kV bus	0.968	0.986	0.957

Souris 115 kV bus	0.98	0.999	0.973
SW Minot 115 kV bus	0.975	0.99	0.985

The system intact voltages of Minot area buses are shown here with the 3 bulk transmission solutions applied. Option 2 generally has best voltage performance out of all three options with option 1 generally performing better than option 3.

### Minot Area Transformer Thermal Loading (System Intact)

#### 2024 Winter Peak Model with North Transfers

	MVA Rating	Option 1 Loading %	Option 2 Loading %	Option 3 Loading %
McHenry 230/115 kV Transformer	84	89	86	102
Logan 230/115 kV #1 Transformer	200	54	77	80
Logan 230/115 kV #2 Transformer (new)	200	N/A	N/A	80
Ward County 230/115 kV #1 (new)	336	23	21	N/A
Ward County 230/115 kV #2 (new)	336	23	21	N/A

The system intact loading for the transformers serving the Minot area are shown above for all three bulk transmission options. The option that does the overall best job of reducing transformer loading is Option 1. Option 3 has inadequate performance in reducing the loading on the McHenry transformer, while option 2 doesn't provide as much relief of the Logan transformer as option 1.

A full category B contingency analysis was performed on all three bulk transmission options. Only the 200 kV and above elements were monitored, including the 230/115 kV transformers. This is due to certain options that require changes to the 115 kV system to implement the bulk option that may skew the results. Also, the primary purpose of this screening is to determine which option addresses the transformation deficiency and voltages performance of the 230 kV buses. The condensed flagged results are shown in the table below. The table indicates the worst case loading and the number of contingencies that resulted in a loading violation. The full ACCC results table is included in appendix B. All three options had acceptable voltage performances on the 200 kV and above. Option 3 had the poorest thermal performance with respect to options 1 and 2. Option 1 and 2 had similar performance results.

### Minot Area Category B Flagged Thermal Violations Bulk Transmission Options (ACCC)

#### 2024 Winter Peak Model with North Transfers

Element	Bulk Base Case	Bulk Option 1	Bulk Option 2	Bulk Option 3
McHenry 230/115 kV Transformer	84 MVA	84 MVA	84 MVA	84 MVA
Worst Overload Percent	185.40%	130.30%	124.00%	171.20%
Total Contingencies with Violation	73	4	3	60
Logan 230/115 kV Transformer	200 MVA	200 MVA	200 MVA	200 MVA
Worst Overload Percent	119.10%	No Violations	No Violations	135.50%
Total Contingencies with Violation	20			1
Blaisdell 230/115 kV Transformer	166 MVA	166 MVA	166 MVA	166 MVA

Worst Overload Percent	124.00%	113.00%	115.60%	117.00%
Total Contingencies with Violation	2	1	2	1

The best overall bulk solution for the Minot area is option 1. Option 3 had the poorest system intact and contingency performance of the three bulk transmission solutions considered. While option 2 had a slightly better system intact voltage profile than option 1, option 1 can achieve the same performance with the installation of an 80 Mvar capacitor bank on the Ward County 230 kV bus. The cost difference of option 1 versus option 2 is quite considerable. Option 2 requires approximately 60+ miles of additional new 230 kV line than option 1. This makes option 2 substantially less desirable considering the performance of option 1 and option 2 are very comparable.

### 5.3: Distribution Option Analysis

With the regional analysis showing a need for a new source into the area, the rest of the analysis moved onto developing a distribution fix for the Minot area. This analysis proceeded by assuming option 1 (Logan – McHenry 230) as the preferred bulk transmission solution. There were two local transmission options studied in the Minot area. As laid out in section 4.4 they are as follows:

Option A - Souris – Mouse River – Ruthville 115 kV loop

Option B – Ward County – Mouse River – Ruthville 115 kV Loop

Both options look at a 115 kV loop from the east end of town to a new sub coined Mouse River and up to the Central Power Ruthville substation. The difference between the two options is whether the 115 kV line to Mouse River is terminated at Souris (going straight through the city of Minot) or at the new Ward County 115 kV sub (going around the south end of town).

#### 5.3.1: Option A

The first option analyzed looked at originating the 115 kV line from Souris and going straight through the city of Minot to a new sub on the west end of town called Mouse River. About half of the load from Souris is then shifted over to Mouse River.

### Minot Area Load Serving Bus Voltages

#### 2024 Winter Peak Model with North Transfers

Substation	System Intact Voltage
603022 SOURIS 7	0.980
603023 MALLARD7	0.982
659165 RUTHVILLECP7	0.968
659307 SWMINOT CP7	0.986
603268 MOUSE RIV (New)	0.976

This option improves the system intact voltages for the load serving buses by about four percent. Ideally, the system intact voltages should be closer to unity. The additional

transformation at the new Ward County 230/115 kV substation also relieves the loading on the Logan and McHenry transformers as shown below. Overall, Option A adequately addresses the category A violations observed in the Minot area.

### Minot Area Transformer Thermal Loading

#### 2024 Winter Peak Model with North Transfers

Element	MVA Rating	Loading %
McHenry 230/115 kV Transformer	84.0	89
Logan 230/115 kV Transformer	200.0	54
Ward County 230/115 kV #1 (new)	336	23
Ward County 230/115 kV #2 (new)	336	23

### Option A Contingency Analysis

A full category B contingency analysis was performed on the study area with Option A applied. The following table shows the flagged voltage violations.

### Minot Area Category B Flagged Voltage Issues Option A

#### 2024 Winter Peak Model with North Transfers

UNDERVOLTAGE			
Substation	Voltage Percent	Voltage Drop Percentage	Contingency
Ruthville 115 kV Bus	96.79		System Intact
	94.65	2.13	Loss of Souris to Mouse River 115 kV
	91.43	5.36	Loss of Mallard to Ruthville 115 kV
	94.48	2.3	Loss of Balta to Rugby 230 kV
	94.84	1.95	Loss of the Rugby 230/115 kV Transformer
	94.26	2.53	Loss of Leland Olds to Logan 230 kV
SW Minot 115 kV Bus	97.56		System Intact
	86.93	10.63	Loss of Logan to SW Minot 115 kV

Option A cleans up most of the low voltage issues for the Minot area. However, Ruthville substation experiences low voltages for certain contingencies. The most severe of these contingencies is the loss of the Mallard – Ruthville 115 kV line. The voltage issues at Ruthville substation may be addressed with the installation of capacitor banks.

The following table shows the category B thermal violations observed for Option A. Two of the lines flagged for overloads are new proposed lines in Option A. These lines were given a rating of 100 MVA to determine the minimum rating for the conductor needed. The Mallard – Ward County 115 kV line in this case will need at least a 130+ MVA rating. The Mouse River – Ruthville 115 kV line will need at least a 101+ MVA rated line. The Mallard – Logan 115 kV line overloads with the loss of the proposed Logan – Ward County 230 kV line. This overload was found to be erroneous since the expected winter ratings for this line should be 239 MVA not 182 MVA. The most of the overloads observed on the McHenry transformer are mitigated since the McHenry transformer has a 125 percent overload capability. The loss of Balta to Rugby 230 kV line results in an

overload that exceeds the emergency capability of the McHenry transformer. Upon closer inspection of the contingency, a large Mvar flow was observed through the transformer. By locking the McHenry transformer tap closer to unity, the mvar flow decreases from 77 Mvar to 33 Mvar. This reduces the loading to 98 percent of the normal rating of the McHenry transformer. This does aggravate the observed voltage violation at Ruthville for the same contingency. By locking the McHenry tap closer to unity, the Ruthville 115 kV bus has a .938 pu voltage for the loss of Balta to Rugby 230 kV line. This issue may be best addressed by the addition of capacitor banks at Ruthville or expanding the capacitor banks at Souris.

### Minot Area Category B Flagged Thermal Issues Option A

#### 2024 Winter Peak Model with North Transfers

Circuit Element	MVA Rating	Loading Percent	Contingency
Mallard to Ward County 115 kV	100.0	45.1	System Intact
		133.4	Loss of Mallard to Logan 115 kV
		110.9	Loss of Logan 230/115 kV Transformer
Mallard to Logan 115 kV	182.0	59.4	SYSTEM INTACT
		104.3	Loss of Logan to Ward County 230 kV
Mouse River to Ruthville 115 kV	100.0	18.9	SYSTEM INTACT
		101.1	Loss of Mallard to Ruthville 115 kV
McHenry 230/115 kV Transformer	84.0	89.5	System Intact
		106.5	Loss of McHenry to Balta 230 kV
		129.5	Loss of Balta to Rugby 230 kV
		109.3	Loss of Rugby 230/115 kV Transformer
		112.4	Loss of Garrison to Voltaire 115 kV

### 5.3.2: Option B

The second option analyzed looked at originating the 115 kV line from Ward County and going south and around the city of Minot to a new sub on the west end of town called Mouse River. About half of the load from Souris is then shifted over to Mouse River.

### Minot Area Load Serving Bus Voltages

#### 2024 Winter Peak Model with North Transfers

Substation	System Intact Voltage
603022 SOURIS 7	0.985
603023 MALLARD7	0.983
659165 RUTHVILLECP7	0.967
659307 SWMINOT CP7	0.976
603268 MOUSE RIV (New)	0.973

This option provides similar system intact voltage improvements as Option A. As with Option A, the additional transformation at the new Ward County 230/115 kV substation

also relieves the loading on the Logan and McHenry transformers as shown below. Overall, Option B also adequately addresses the category A violations observed in the Minot area.

### Minot Area Transformer Thermal Loading Option A

#### 2024 Winter Peak Model with North Transfers

Element	MVA Rating	Loading %
McHenry 230/115 kV Transformer	84.0	89
Logan 230/115 kV Transformer	200.0	54
Ward County 230/115 kV #1 (new)	336	23
Ward County 230/115 kV #2 (new)	336	23

### Option B Contingency Analysis

A full category B contingency analysis was performed on the study area with Option B applied. The table below shows flagged voltage violations.

### Minot Area Category B Flagged Voltage Issues Option B

#### 2024 Winter Peak Model with North Transfers

UNDERVOLTAGE			
Substation	Voltage Percent	Voltage Drop Percentage	Contingency
Ruthville 115 kV	96.71		System Intact
	88.87	7.83	Loss of Mallard to Ruthville 115 kV
	94.65	2.05	Loss of Mouse River to Ward County 115 kV
	94.4	2.31	Loss of Balta to Rugby 230 kV
	94.76	1.95	Loss of Rugby 230/115 kV Transformer
	94.21	2.5	Loss of Logan to Leland Olds 230 kV
SW Minot 115 kV	97.56		System Intact
	86.93	10.63	Loss of Logan to SW Minot 115 kV

Option B observed similar flagged voltage violation results as Option A. Upon closer inspection, Option B has a slightly lower performance than Option A. For example, Ruthville substation has an observed voltage of .88 p.u. for the loss of Mallard – Ruthville 115 kV line. The same contingency applied to Option A observed voltages of .91 p.u at Ruthville substation.

The following table shows the category B thermal violations observed for Option B. The results are very similar to Option A. Like Option A, two of the lines flagged for overloads are new proposed lines. These lines were given a rating of 100 MVA to determine the minimum rating for the conductor needed. The Mallard – Ward County 115 kV line in this case will need at least a 135+ MVA rating. The Mouse River – Ruthville 115 kV line will need at least a 104+ MVA rated line. Compared to Option A, Option B requires a

slightly higher minimum rating for both of these lines. The Mallard – Logan 115 kV line overloads with the loss of the proposed Logan – Ward County 230 kV line. Again, the overload of the Logan – Mallard 115 kV line was found to be invalid due to an incorrect winter rating in the model. Similar to option A, the remaining issues with the McHenry transformer can be addressed as explained in Option A.

### Minot Area Category B Flagged Thermal Issues Option B

#### 2024 Winter Peak Model with North Transfers

Circuit Element	MVA Rating	Loading Percent	Contingency
Ward County to Mallard 115 kV	100.0	46	System Intact
		135.1	Loss of Mallard to Logan 115 kV
		112.2	Loss of Logan 230/115 kV Transformer
Mallard to Logan 115 kV	182.0	59.4	System Intact
		104.3	Loss of Logan to Ward County 230 kV
Mouse River to Ruthville 115 kV	100.0	18.1	System Intact
		104.4	Loss of Mallard to Ruthville 115 kV
McHenry 230/115 kV Transformer	84.0	89.3	System Intact
		106.4	Loss of McHenry to Balta 230 kV
		129.3	Loss of Balta to Rugby 230 kV
		109	Loss of Rugby 230/115 kV Transformer
		112.2	Loss of Garrison to Voltaire 115 kV

A full system intact and contingency comparison of the base case, option A, and option B is included in Appendix C. Appendix C also contains the results for the monitored area as well as the Minot area. The condensed tables below show the performance of the base case and both options.

### Minot Area Category B Flagged Voltage Issues Comparison

UNDERVOLTAGE Substation	Base Model		Option A		Option B		Contingency
	Voltage	Voltage Drop	Voltage	Voltage Drop	Voltage	Voltage Drop	
Souris 115 kV	94.58						System Intact
	86.44	8.13					Loss of Souris to Mallard 115 kV
	80.66	13.91					Loss of Mallard to Logan 115 kV
	87.99	6.58					Loss of McHenry 230/115 kV Transformer
	89.07	5.51					Loss of Leland Olds to Logan 230 kV
	86.2	8.38					Loss of Logan 230/115 kV Transformer
	89.07	5.51					Loss of Souris – Velta – McHenry 115 kV
Mallard 115 kV	94.86						System Intact
	80.18	14.68					Loss of Mallard to Logan 115 kV
	89.54	5.32					Loss of McHenry 230/115 kV Transformer
	90.83	4.03					Loss of Balta to Rugby 230 kV
	90.66	4.2					Loss of Rugby 230/115 kV Transformer

	89.09	5.77					Loss of Leland Olds to Logan 230 kV
	86.06	8.8					Loss of Logan 230/115 kV Transformer
	90.69	4.17					Loss of Souris – Velve – McHenry 115 kV
Velve Tap 115 kV	98.88						System Intact
	94.15	4.73					Loss of Souris to Mallard 115 kV
	90.79	8.1					Loss of Mallard to Logan 115 kV
	88.38	10.51					Loss of McHenry 230/115 kV Transformer
	94	4.88					Loss of Logan 230/115 kV Transformer
Logan 230 kV	96.66						System Intact
	94.48	2.18					Loss of Mallard to Nelson 115 kV
	93.95	2.72					Loss of McHenry 230/115 kV Transformer
	94.54	2.12					Loss of Balta to Rugby 230 kV
	94.54	2.13					Loss of Rugby 230/115 kV Transformer
	94.51	2.16					Loss of Nelson to Max 115 kV
	91.15	5.51					Loss of Leland Olds to Logan 230 kV
	94.47	2.19					Loss of Souris – Velve – McHenry 115 kV
Logan 115 kV	96.23						System Intact
	93.53	2.7					Loss of Mallard to Nelson 115 kV
	92.11	4.12					Loss of McHenry 230/115 kV Transformer
	93.07	3.16					Loss of Balta to Rugby 230 kV
	92.99	3.24					Loss of Rugby 230/115 kV Transformer
	90.52	5.7					Loss of Leland Olds to Logan 230 kV
	87.08	9.15					Loss of Logan 230/115 kV Transformer
	92.97	3.26					Loss of Souris – Velve – McHenry 115 kV
Ruthville 115 kV	92.54		96.79		96.71		System Intact
	76.6	15.94					Loss of Mallard to Logan 115 kV
	86.84	5.7					Loss of McHenry 230/115 kV Transformer
	88.22	4.32	94.48	2.3	94.4	2.31	Loss of Balta to Rugby 230 kV
	88.04	4.5	94.84	1.95	94.76	1.95	Loss of Rugby 230/115 kV Transformer
	86.35	6.19	94.26	2.53	94.21	2.5	Loss of Leland Olds to Logan 230 kV
	N/A	N/A	94.65	2.13	88.87	7.83	Loss of Souris to Mouse River 115 kV
	N/A	N/A	91.43	5.36	94.65	2.05	Loss of Mallard to Ruthville 115 kV
		83.07	9.48				
	88.07	4.47					Loss of Souris – Velve – McHenry 115 kV
SW Minot 115 kV	95.33		97.56		97.56		SYSTEM INTACT
	91.4	3.92					Loss of McHenry 230/115 kV Transformer
	92.35	2.97					Loss of Balta to Rugby 230 kV
	92.26	3.07					Loss of Rugby 230/115 kV Transformer
	89.69	5.64					Loss of Leland Olds to Logan 230 kV
	87	8.33					Loss of Logan 230/115 kV Transformer
		85.81	9.52	97.56	10.63	86.93	10.63
	92.25	3.07					Loss of Souris – Velve – McHenry 115 kV

### Minot Area Category B Flagged Thermal Issues Comparison

Circuit Element	MVA Rating	Base Model	Option A	Option B	Contingency
		Loading Percent	Loading Percent	Loading Percent	
Mallard to Logan 115 kV	159.3	81.5			System Intact
		100.7			Loss of Souris to Velve Tap 115 kV

		117.7			Loss of Mallard to Nelson 115 kV
		100.5			Loss of Velva Tap to McHenry 115 kV
		103.3			Loss of McHenry to Coal Creek Tap 230 kV
		100			Loss of McHenry 230/115 kV Transformer
		100.3			Loss of Balta to Rugby 230 kV
		117.7			Loss of Nelson to Max 115 kV
		119.5			Loss of Garrison to Max 115 kV
		100.7			Loss of Souris – Velva – McHenry 115 kV
McHenry to Velva Tap 115 kV	119.5	41.1			System Intact
		102.3			Loss of Souris to Mallard 115 kV
		101.4			Loss of Mallard to Logan 115 kV
McHenry 230/115 kV Transformer	84.0	114.6	89.5	89.3	System Intact
		160.4			Loss of Souris to Mallard 115 kV
		178.7			Loss of Mallard to Logan 115 kV
		159.3	106.5	106.4	Loss of McHenry to Balta 230 kV
		188.2	129.5	129.3	Loss of Balta to Rugby 230 kV
		154.7	109.3	109	Loss of Rugby 230/115 kV Transformer
		145.4	112.4	112.2	Loss of Garrison to Voltaire 115 kV
		157.8			Loss of Leland Olds to Logan 230 kV
		165			Loss of Logan 230/115 kV Transformer
Garrison to Voltaire 115 kV	109.0	77.2			System Intact
		102.3			Loss of McHenry to Coal Creek Tap 230 kV
Logan 230/115 kV Transformer	200.0	101.4			System Intact
		113			Loss of Souris to Velva Tap 115 kV
		124.6			Loss of Mallard to Nelson 115 kV
		112.9			Loss of Velva Tap to McHenry 115 kV
		116.2			Loss of McHenry to Coal Creek 230 kV
		112.9			Loss of Balta to Rugby 230 kV
		124.6			Loss of Nelson to Max 115 kV
		125.8			Loss of Garrison to Max 115 kV
		115.9			Loss of Logan to Blaisdell 230 kV
		113			Loss of Souris – Velva – McHenry 115 kV

### 5.3.3: Prior Outage Analysis

Prior outage analysis was also performed on the 2024 winter peak north transfer model. The results for the entire monitored area are included in appendix C. Both options address most prior outage issues that were observed in the base case.

An item of concern flagged by the prior outage analysis is the loss of the second Ward County – Souris 115 kV line with a prior outage of the other Ward County – Souris 115 kV line. This Category C contingency results in low voltages at the Souris, Mouse River, and Ruthville 115 kV buses. There are a couple of options if the need arises to address this concern. One option is to re-conductor the existing Mallard – Ruthville 115 kV line to a larger conductor for an increased rating as well as improved impedance performance. Another option would be to bring another source into Mouse River substation from the South. Potential sources from the south include a 115 kV line from

SW Minot substation, Logan, or Ward County to Mouse River. This allows power to flow from the north and south into Mouse River to serve Souris in the event of Category C3 outages for the loss of both Ward County – Souris 115 kV lines. For this study, the near term recommendation would be to have 60 Mvars of capacitor banks at Souris substation to maintain .92 p.u. voltage at Souris and Mouse River for this prior outage event.

### 5.4: Dynamic Stability.

Not applicable for this load serving study

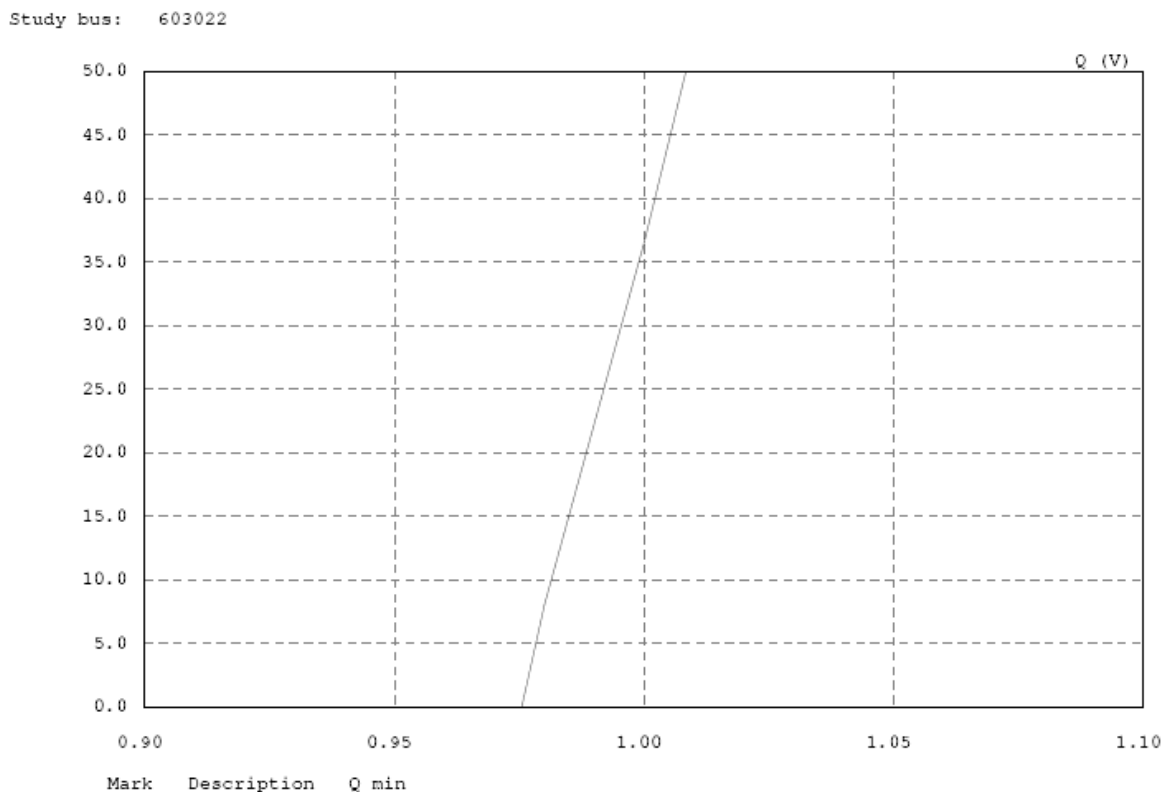
### 5.5: Constrained Interface Analysis.

Not applicable for this load serving study

### 5.6: Reactive Power Requirements.

A QV analysis was performed to determine the reactive needs to bring the voltages up to 1 p.u. for system intact conditions. The first bus chosen was Souris due to the fact this bus serves the most load in the Minot area.

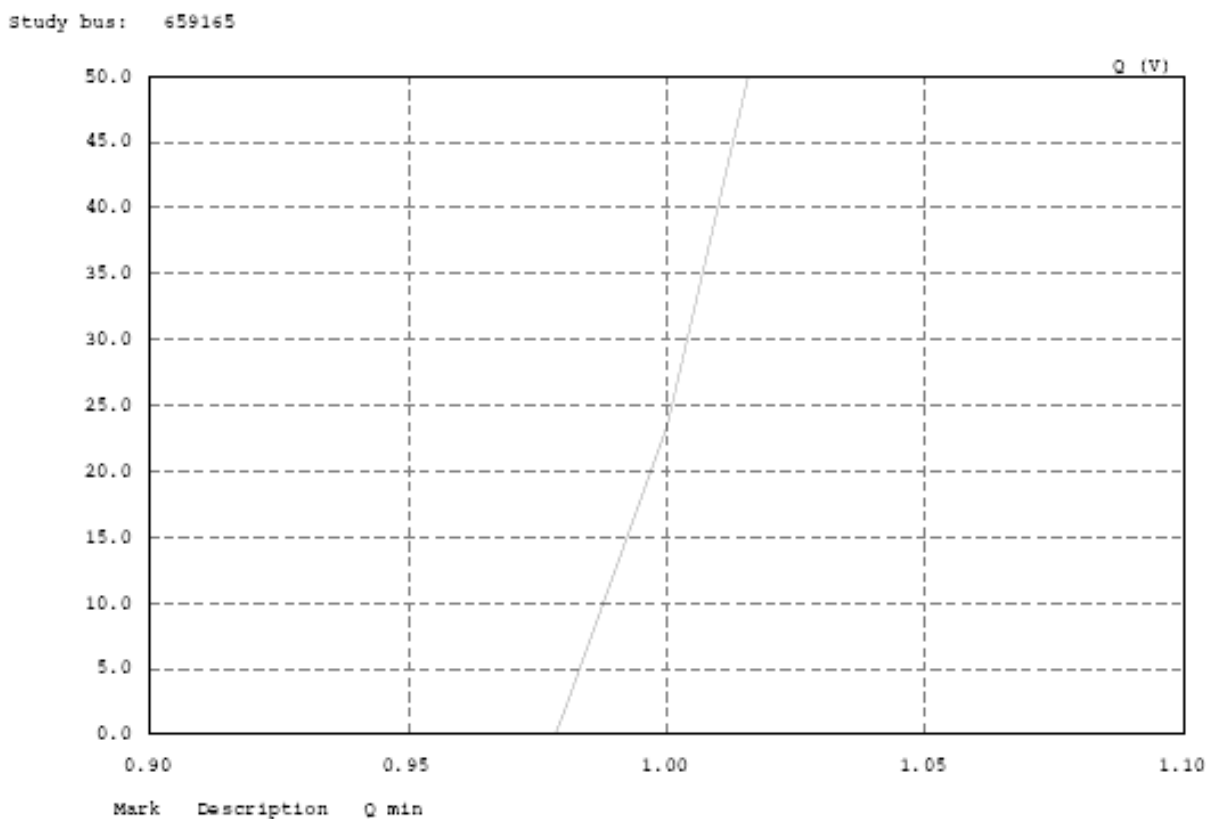
**Souris QV Chart**



The QV analysis indicates that Souris would need an increment of about 35 Mvars to bring the system intact voltage to unity. The capacitor banks at Souris were increased

from two steps of 15 Mvar to two steps of 30 Mvar. With the addition capacitor capability at Souris, Ruthville's voltage was still below unity. A QV analysis was performed at the Ruthville bus to determine the reactive needs to bring its bus voltage to unity.

### Ruthville QV Chart



The QV indicates the need for approximately 20 to 25 MVars of capacitor banks. A capacitor bank was added to Ruthville's bus consisting of two steps of 10 Mvar capacitor banks. Upon re-solving the model, most of the Minot area loads serving buses are near unity voltage for system intact conditions.

### Minot Area Load Serving Bus Voltages Option A

#### With Additional Capacitor Banks

Substation	System Intact Voltage
603022 SOURIS 7	1.014
603023 MALLARD7	1.009

659165 RUTHVILLECP7	1.005
659307 SWMINOT CP7	0.996
603268 MOUSE RIV (New)	1.010

### Minot Area Load Serving Bus Voltages Option B

#### With Additional Capacitor Banks

Substation	System Intact Voltage
603022 SOURIS 7	1.018
603023 MALLARD7	1.009
659165 RUTHVILLECP7	1.003
659307 SWMINOT CP7	0.996
603268 MOUSE RIV (New)	1.004

### 5.7: Losses: Technical Evaluation.

Since the Minot area proposed solution adds 230 kV lines to the area, an analysis was conducted for possible system loss savings. The 2024 winter peak model without north transfers was used for this analysis. This is a conservative model for losses since transfer models tend to have higher losses. Option A results in a system loss reduction of 5.4 MW and option B results in a system loss reduction of 5.2 MW. The primary reason option B doesn't perform as well as option A in loss reduction is due to the 115 kV lines serving Souris. These lines are not intended to be rebuilt to a lower impedance conductor as part of option B. The bulk of the loss savings is due to the offloading power flows from 115 kV system onto the new 230 kV system which reduces the losses. The 230 kV voltage requires less current to transmit an equivalent amount of power reducing I<sup>2</sup>R losses.

### 5.8: Losses: Economic Evaluation.

With option A saving 5.4 MWs and option B saving 5.2 MWs, a net present values of energy savings was calculated. The following assumptions were used.

- Cost of energy \$30/MWHR
- Assumed loss savings period of 20 years
- Assumed present worth factor of 9.59 (based on an 8.32% interest rate)
- Assumed loss factor of .3
- Yearly energy savings = MW loss reduction \* 8760 \* Energy Cost \* Loss Factor
- Net Present Value = Yearly energy savings \* Present Worth Factor

	Loss Saving (MW)	Yearly Loss Savings	Net Present Value
Base Model	0	\$0	\$0
Option A	5.4	\$425,736	\$4,082,808
Option B	5.2	\$409,968	\$3,931,593

### 5.9: Circuit Breaker Stress Analysis.

Not applicable for this load serving study

### 6.0: Economic Analysis.

Not applicable for this load serving study

### 6.1: Installed Cost (including base reactive power facilities).

The estimates provided for the facilities below are indicative level estimates.

#### Option A

<u>Element</u>	<u>Cost</u>
Ward County Substation	\$28 million
Ward County – McHenry 230 kV	\$15 million
Ward County – Souris #1 115 kV	\$4 million
Ward County – Souris #2 115 kV	\$4 million
Logan 230 kV bus expansion	\$10.7 million
McHenry 230 kV bus expansion	\$3.5 million
Logan 115 kV bus expansion	\$6.1 million
Mouse River Substation	\$4 million
Souris – Mouse River 115 kV line	\$4 million
Mouse River – Ruthville	\$3.9 million
Ruthville Substation expansion	\$3.5 million
Total	\$88.2 million

**Option B**

<u>Element</u>	<u>Cost</u>
Ward County Substation	\$28 million
Ward County – McHenry 230 kV line	\$15 million
Logan 230 kV bus expansion	\$10.7 million
McHenry 230 kV bus expansion	\$3.5 million
Logan 115 kV bus expansion	\$6.1 million
Mouse River Substation	\$4 million
Mouse River – Ward County 115 kV line	\$8 million
Mouse River – Ruthville	\$3.9 million
Ruthville Substation expansion	\$3.5 million
Total	\$84.2 million

**6.2: Evaluated Cost (with losses).****7.0: Relevant Concerns.**

With continued load growth in the Bakken area in western North Dakota, the 230 kV system running north out of the coal fields will come under more strain. The Leland Olds – Logan and Coal Creek Tap – McHenry 230 kV lines may show potential overloads in the future for loss of the other line. The currently proposed plan does allow accommodation for additional bulk sources to be brought into the Minot area should future studies determine the need. A potential future project, in this case, would be to extend the propose Basin Electric 345 kV line from Tioga to Ward County. This proposed project works with any future transmission expansion projects in the Minot area.

**7.1: Load-Serving Issues.**

This project addresses most of the near term and long term issues associate with the 115 kV lines in the Minot area. If future studies show more 115 kV needs, this project is well positioned to accommodate upgrades to address any future load serving transmission needs for the Minot area.

## 7.2: Constructability & Schedule Considerations.

The Minot area transmission is a fairly weak system. Outage windows are going to be very narrow. Outages are ideally available during the months of April and October when the loads are historically observed to be at their minimum. Since Ward County and the new Ward County – McHenry 230 kV line are new assets, the majority of their construction can occur without the need of outages in this area. In order to interconnect the Ward County – McHenry 230 kV line into McHenry substation, an outage of the 230 kV bus is required for approximately 1 month. Since this outage also removes the McHenry transformer out of service, this is an ideal time to loop in the McHenry – Velva – Souris 115 kV line into the Ward County substation. Given this information, the proposed in service date for Ward County substation and the Ward County – McHenry 230 kV, McHenry – Ward County 115 kV, and Ward County – Souris 115 kV line would be May 1, 2018.

Once this step is completed, the next phase of construction is to loop in the Mallard – Logan 115 kV line into Ward County and convert the Logan – Ward County line to 230 kV. Expanding the 230 kV bus at Logan requires XX outage for the duration of YY. The proposed in service date for the Logan – Ward County 230 kV and Ward County – Mallard 115 kV line is DD.

With both 230 kV lines in service, the next construction phase would be the rebuild of the 115 kV lines from Ward County to Souris. Only 1 line can be out of service at a time as the target completion of this construction would be October 1, 2018.

The final construction phase would be the line from Souris to Mouse River to Ruthville. The required in service date of these facilities will be determined by NSP distribution's request for interconnection of the Mouse River substation as well as Central Power's need for additional 115 kV sources into Ruthville substation. Mouse River would be a 115/13.8 kV distribution substation to serve load on the western side of the city of Minot. The targeted in service date is assumed to be June 1, 2020.

## 7.3: Double-Circuit Line Considerations.

A double circuit configuration was considered for the new Ward County – McHenry 230 kV line with the existing McHenry- Velva – Souris 115 kV line. This is not desirable due to the inability to take the existing McHenry – Velva – Souris 115 kV line out of service for an extended period of time in order to construct a double circuit line.

## 7.4: Joint Ownership Considerations.

The proposed Ward County substation recommended in this report would interconnect facilities owned by Northern States Power and Basin Electric Power Cooperative. This can result in a couple of different ownership configurations for Ward County. These configurations are as follows:

Configuration 1 – Sole Ownership

- The Ward County substation is owned by a single entity.
  - Pros – simple, lower cost
  - Cons – could results in one company or the other stranding a 230 kV asset.

#### Configuration 2 – Jointly Owned

- The Ward County would be a jointly owned substation in which both companies would own certain substation assets such as transformers etc
  - Pros – lower cost, smaller footprint
  - Cons – Difficult ownership structure, compliance and reporting coordination

#### Configuration 3 – Discrete facilities

- Ward County would be broken up into two discretely owned substations side by side.
  - Pros – Keeps facilities independent of one another, simple for NERC reporting and security, maintenance
  - Cons – Larger footprint, more expensive

The goal of this study is to analyze the technical viability of the transmission options. The ownership of the proposed substation at Ward County or other jointly planned facilities will be decided at a later time.

## 8.0: Detailed Listing of Recommended and System Alternative Plans’ Facilities.

This study shows the need for new bulk and distribution facilities in the Minot area to serve the existing and future load growth in the region. The recommendation from this report is a combination of bulk option 1 and distribution option A. These facilities include a new 230 kV line from McHenry to Ward County – Logan and a new 115 kV loop from Souris – Mouse River – Ruthville. In addition to new facilities, this report identified additional impacted facilities which will need to be upgraded. The new and existing facilities fall under several entities responsibility and is identified below.

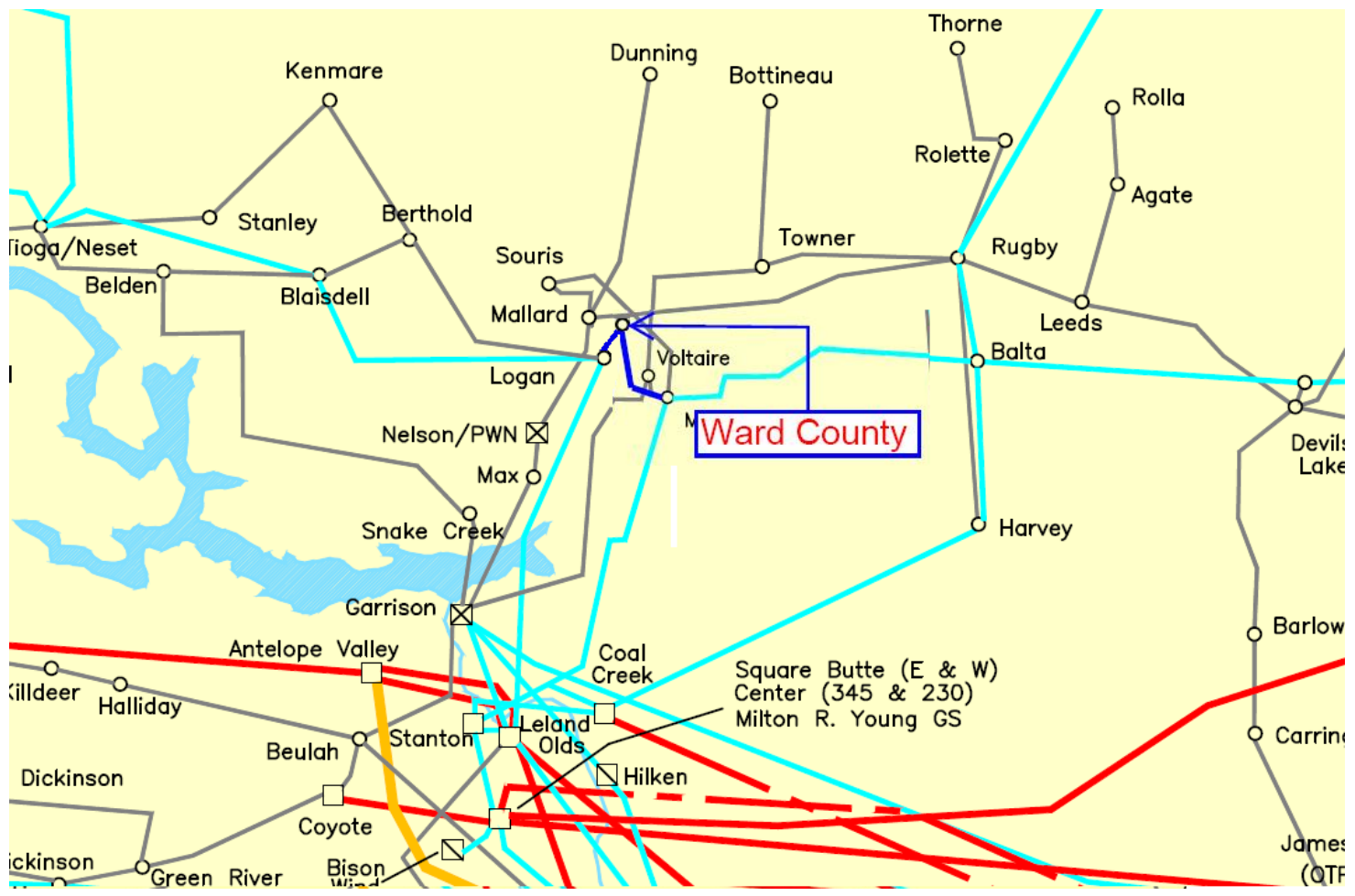
<u>Facility</u>	<u>Responsible Entity</u>
Ward County Substation	Joint NSP/BEPC

Ward County – McHenry 230 kV	NSP
Logan – Ward County 230 kV	BEPC
Nelson – Logan 115 kV	WAPA
Ward County – Souris #1 115 kV	NSP
Ward County – Souris #2 115 kV	NSP
Logan 230 kV bus expansion	BEPC
McHenry 230 kV bus expansion	GRE
Logan 115 kV bus expansion	BEPC
Mouse River Substation	NSP
Souris – Mouse River 115 kV line	NSP
Mouse River – Ruthville	Central Power

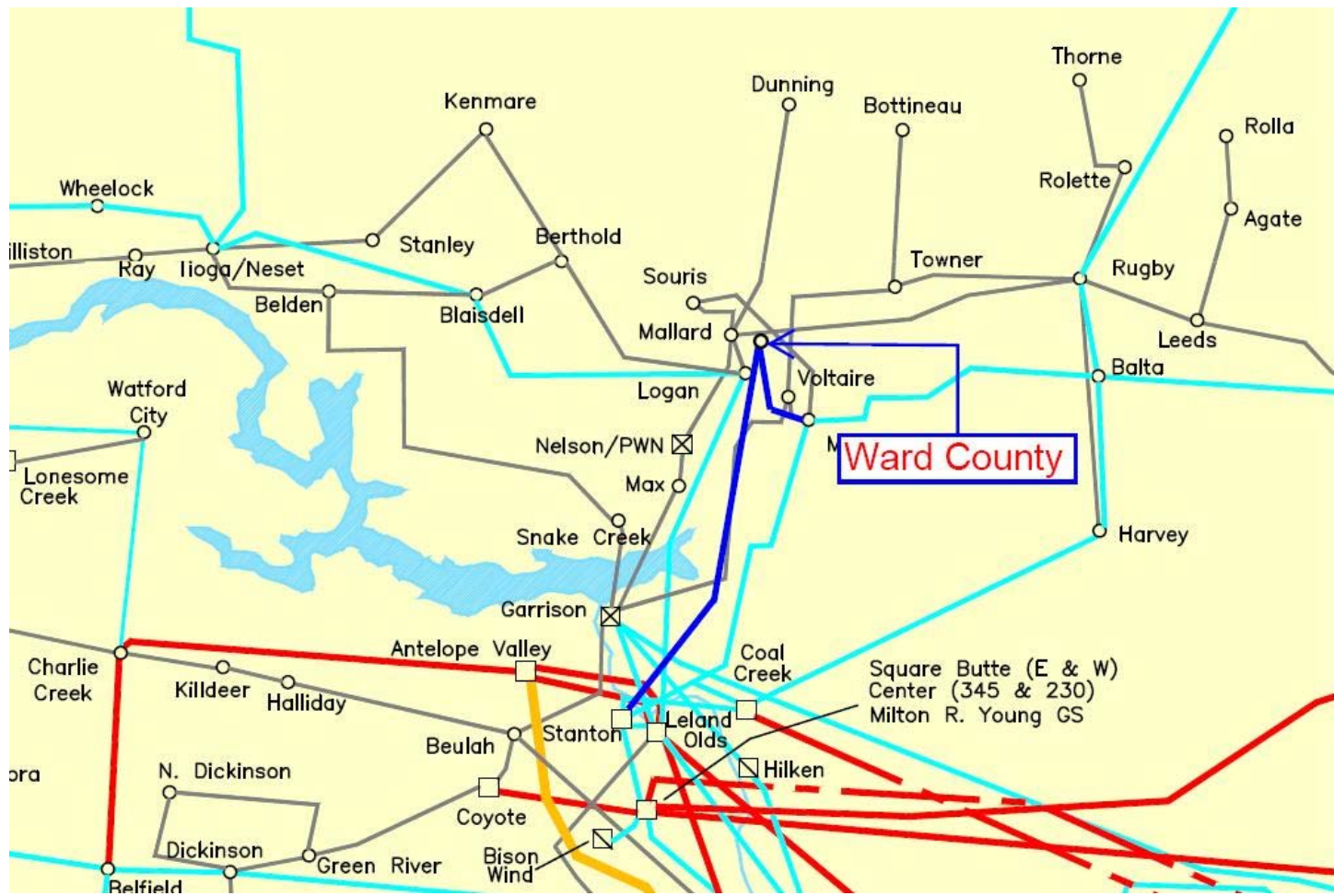
# Appendix A: Maps (Base Plan & System Alternative)

## Bulk Transmission Option Maps

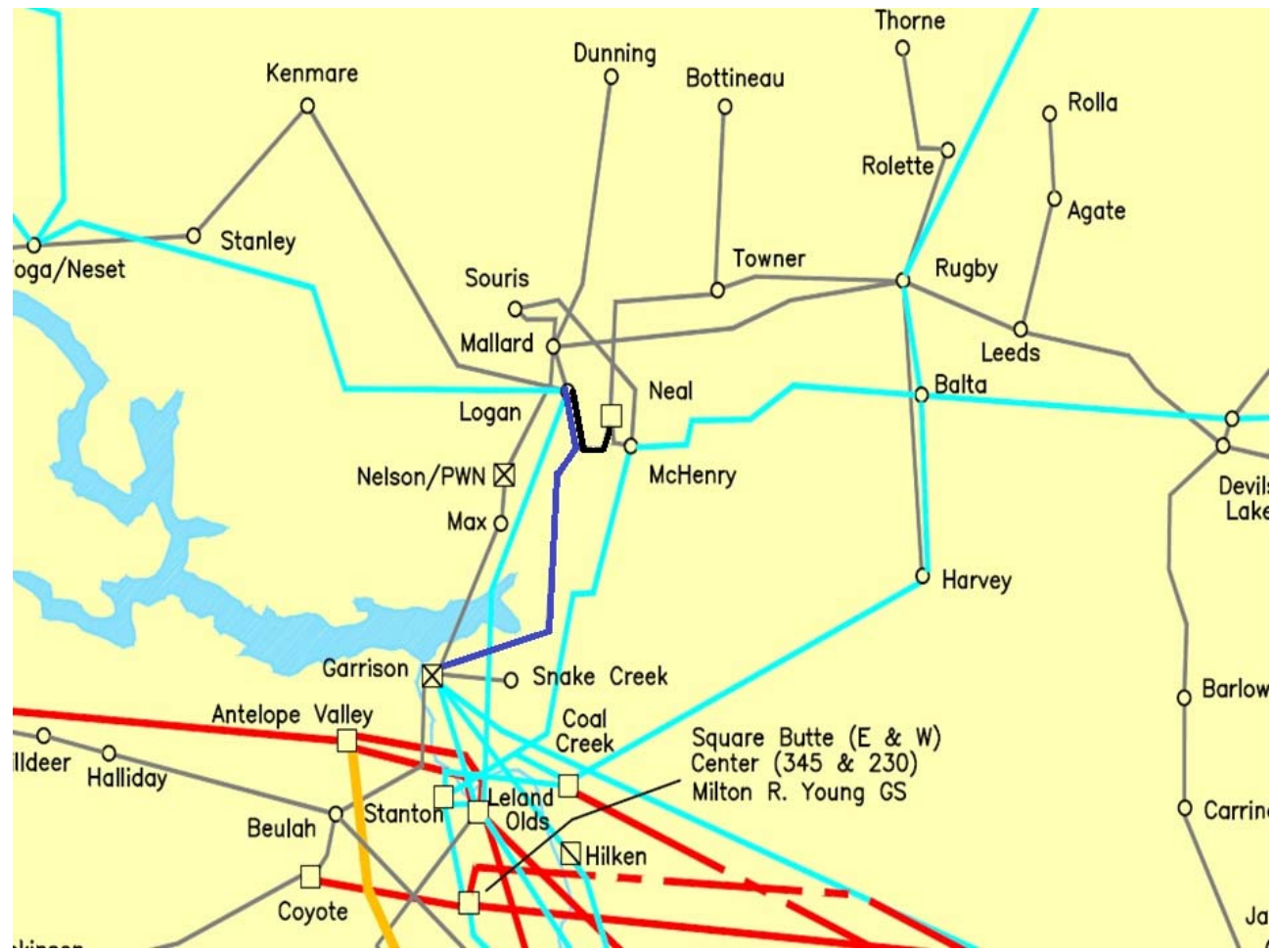
### Option 1



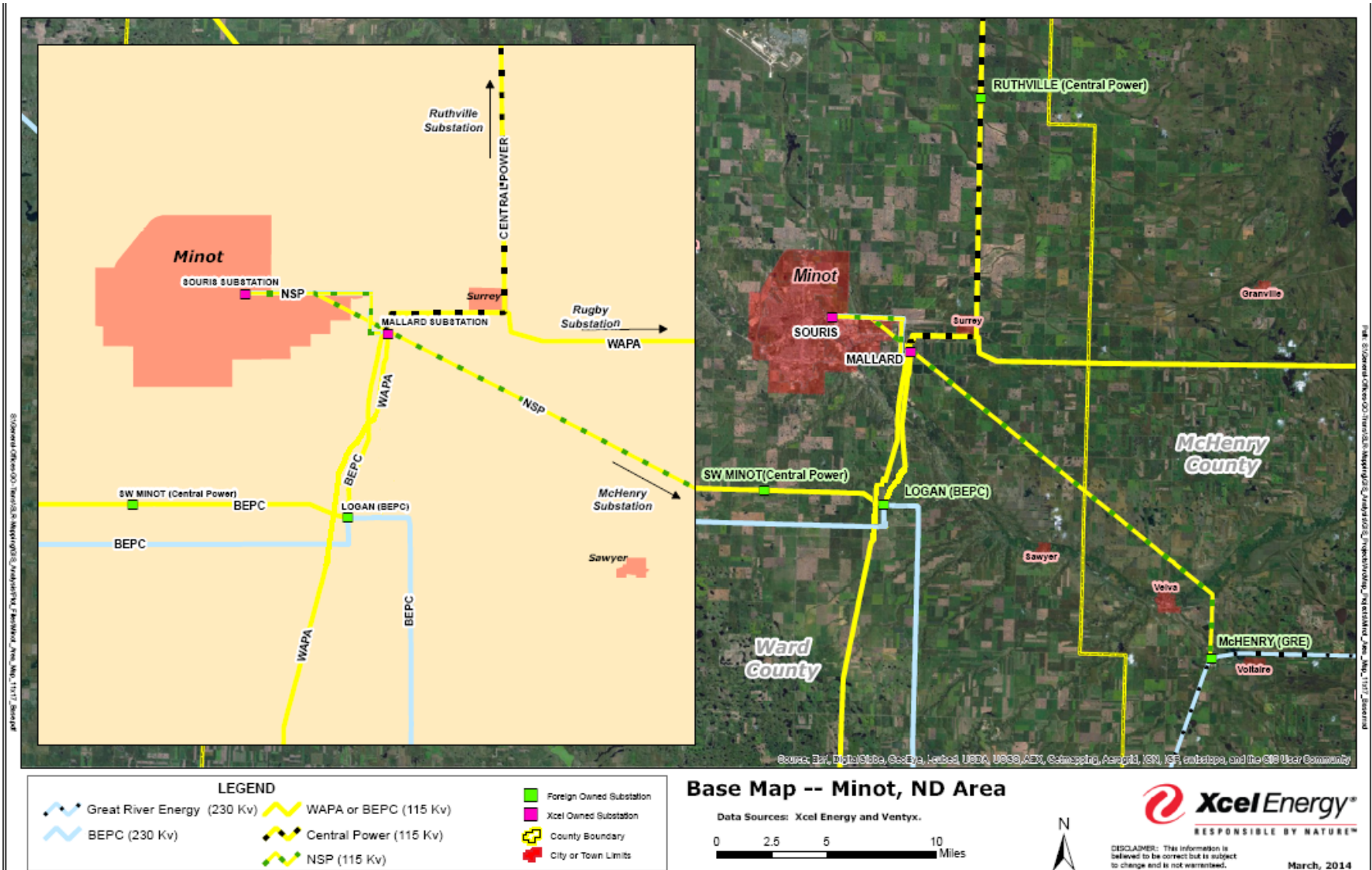
### Option 2



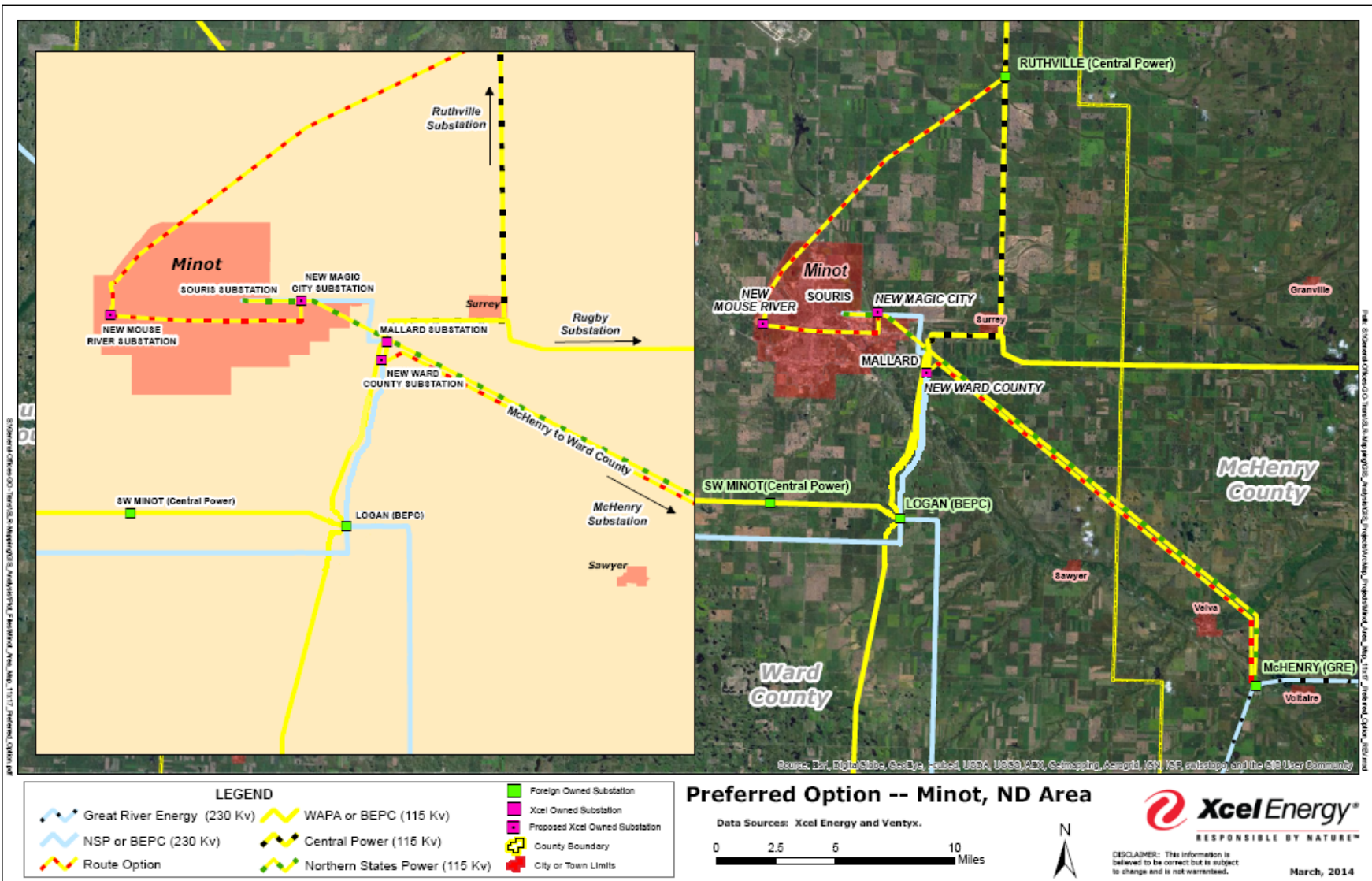
### Option 3



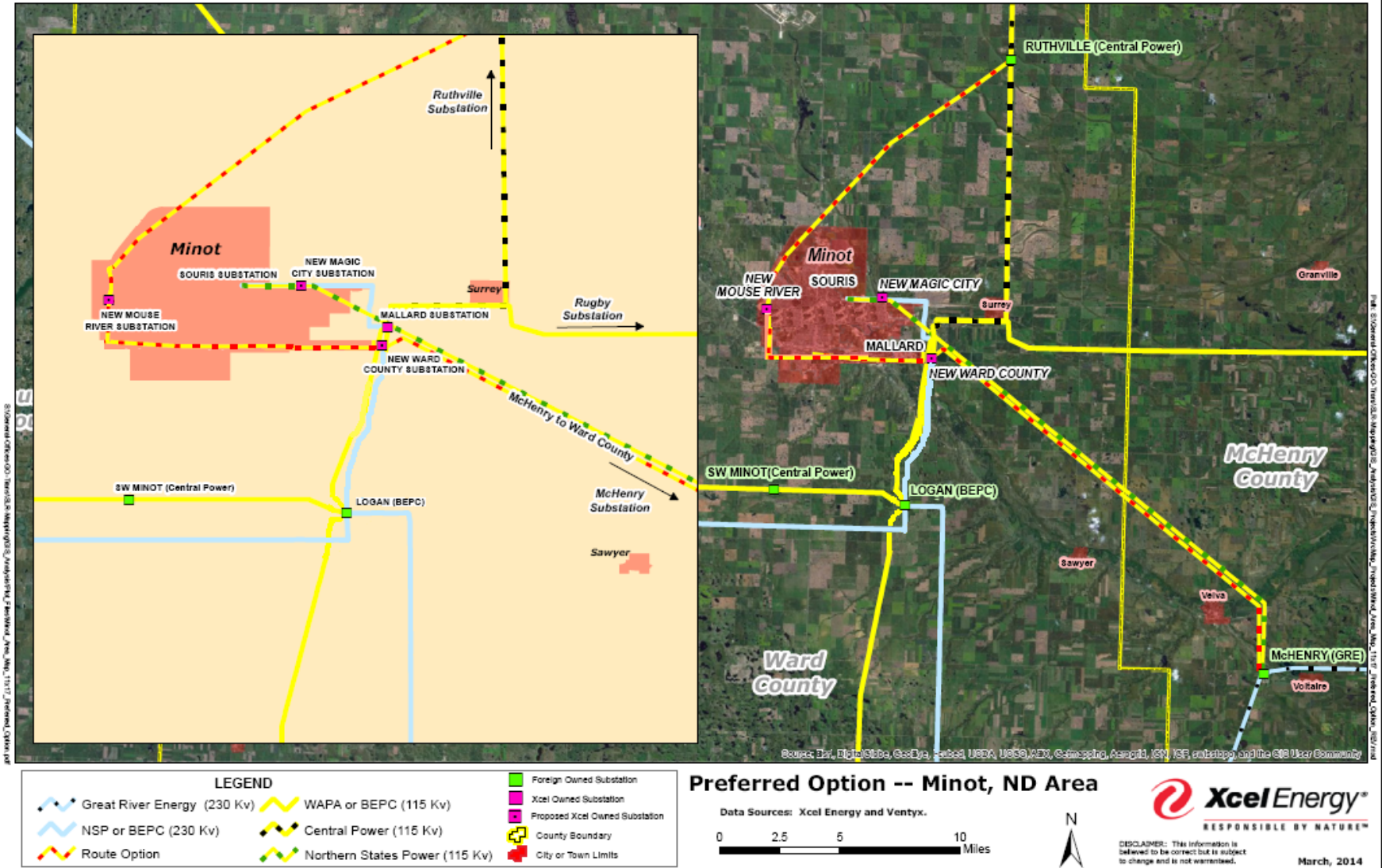
### Base Existing System Map



# Proposed Option A



## Proposed Option B



S:\Data\GIS\Projects\GIS\Projects\Minot\Map\_Series\Map\_Series\_Minot\Map\_Series\_Minot.aprx

S:\Data\GIS\Projects\GIS\Projects\Minot\Map\_Series\Map\_Series\_Minot\Map\_Series\_Minot.aprx

Source: Esri, DigitalGlobe, GeoEye, AeroGRID, USDA, USGS, AeroGRID, IGN, IGP, and the GIS User Community

**Appendix B: Initial Comparison of Bulk Transmission Options (ACCC).**

**BASE CASE MONITORED BRANCHES LOADED ABOVE 100.0% OF RATING SET A - ALL VIOLATIONS**

X--- MONITORED ELEMENT ----X	Bulk Base Case	Bulk Option 1	Bulk Option 2	Bulk Option 3
603023 MALLARD7 115.00				106.50%
659155 LOGAN 7 115.00 1				166MVA
615347 GRE-MCHENRY4230.00	113.80%			102.30%
3WINDTR 230/115 WND 2 1	96MVA			86MVA
615348 GRE-MCHENRY7115.00	104.10%			
3WINDTR 230/115 WND 1 1	87MVA			

**CONTINGENCY CASE MONITORED BRANCHES LOADED ABOVE 100.0% OF RATING SET A - ALL VIOLATIONS**

X--- MONITORED ELEMENT ----X	X---LABEL--X	Bulk Base Case	Bulk Option 1	Bulk Option 2	Bulk Option 3
615347 GRE-MCHENRY4230.00	SINGL1 1	157.10%			133.20%
3WINDTR 230/115 WND 2 1		132MVA			112MVA
615347 GRE-MCHENRY4230.00	SINGL1 3	127.40%			115.30%
3WINDTR 230/115 WND 2 1		107MVA			97MVA
615347 GRE-MCHENRY4230.00	SINGL1 4	112.40%			
3WINDTR 230/115 WND 2 1		94MVA			
615347 GRE-MCHENRY4230.00	SINGL1 5	173.90%			128.90%
3WINDTR 230/115 WND 2 1		146MVA			108MVA
615347 GRE-MCHENRY4230.00	SINGL1 10	109.90%			
3WINDTR 230/115 WND 2 1		92MVA			
615347 GRE-MCHENRY4230.00	SINGL1 12	155.30%	104.30%		148.20%
3WINDTR 230/115 WND 2 1		130MVA	88MVA		124MVA
615347 GRE-MCHENRY4230.00	SINGL1 15	111.80%			100.60%
3WINDTR 230/115 WND 2 1		94MVA			85MVA
615347 GRE-MCHENRY4230.00	SINGL1 16	111.10%			
3WINDTR 230/115 WND 2 1		93MVA			
615347 GRE-MCHENRY4230.00	SINGL1 17	108.20%			
3WINDTR 230/115 WND 2 1		91MVA			
615347 GRE-MCHENRY4230.00	SINGL1 18	113.80%			102.30%
3WINDTR 230/115 WND 2 1		96MVA			86MVA
615347 GRE-MCHENRY4230.00	SINGL1 19	109.10%			
3WINDTR 230/115 WND 2 1		92MVA			

615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 20	108.10%				
		91MVA				
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 22	185.40%	130.30%	124.00%	171.20%	
		156MVA	109MVA	104MVA	144MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 23	153.80%	107.60%	102.90%	131.80%	
		129MVA	90MVA	86MVA	111MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 24	112.50%			101.20%	
		95MVA			85MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 25	112.80%			101.40%	
		95MVA			85MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 26	114.10%			102.70%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 27	113.90%			102.30%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 28	113.80%			102.20%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 29	113.80%			102.20%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 30	121.50%			104.40%	
		102MVA			88MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 31	109.40%				
		92MVA				
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 33	114.60%			103.30%	
		96MVA			87MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 34	113.70%			102.20%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 35	114.30%			102.90%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 36	113.80%			102.20%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 37	112.80%			101.50%	
		95MVA			85MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 38	113.80%			102.30%	
		96MVA			86MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 39	113.90%			102.30%	
		96MVA			86MVA	

615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 40	113.80%			102.20%
		96MVA			86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 41	113.90%			102.30%
		96MVA			86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 42	113.90%			102.30%
		96MVA			86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 43	127.30%			115.20%
		107MVA			97MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 44	113.80%			102.30%
		96MVA			86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 45	122.70%			101.40%
		103MVA			85MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 46	115.20%			104.70%
		97MVA			88MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 47	115.20%			104.70%
		97MVA			88MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 48	115.20%			104.70%
		97MVA			88MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 49	114.40%			104.50%
		96MVA			88MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 50	131.60%			117.40%
		111MVA			99MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 51	121.30%			106.60%
		102MVA			90MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 52	121.30%			106.60%
		102MVA			90MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 53	144.40%	111.50%	104.90%	
		121MVA	94MVA	88MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 54	110.30%			
		93MVA			
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 55	102.30%			
		86MVA			
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 56	108.50%			
		91MVA			
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 58	108.70%			
		91MVA			

615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 59	111.50% 94MVA	100.40% 84MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 61	116.90% 98MVA	107.50% 90MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 62	156.00% 131MVA	126.80% 106MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 63	116.30% 98MVA	105.90% 89MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 64	113.60% 95MVA	101.80% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 65	113.40% 95MVA	100.00% 84MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 66	161.90% 136MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 67	116.40% 98MVA	104.40% 88MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 68	111.50% 94MVA	100.80% 85MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 69	111.90% 94MVA	100.60% 85MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 70	110.30% 93MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 71	106.00% 89MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 72	113.60% 95MVA	102.20% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 73	113.30% 95MVA	101.90% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 74	113.80% 96MVA	102.30% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 75	113.80% 96MVA	102.30% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 76	111.90% 94MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 77	111.80% 94MVA	100.90% 85MVA

615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 78	113.70% 96MVA	102.20% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 79	113.70% 96MVA	102.20% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 80	113.50% 95MVA	102.10% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 81	111.90% 94MVA	101.00% 85MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 82	111.70% 94MVA	100.90% 85MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL1 83	114.10% 96MVA	102.70% 86MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	C2.MAL FAULT	154.20% 130MVA	115.20% 97MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	C2.MAL FAULT	127.00% 107MVA	
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL4 1		114.00% 96MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL4 51		125.60% 106MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL4 67		114.00% 96MVA
615347 GRE-MCHENRY4230.00 3WINDTR 230/115 WND 2 1	SINGL4 68		123.00% 103MVA
659108 LOGAN 4 230.00 3WINDTR KW1A WND 1 1	SINGL1 2	106.70% 213MVA	
659108 LOGAN 4 230.00 3WINDTR KW1A WND 1 1	SINGL1 3	117.70% 235MVA	
659108 LOGAN 4 230.00 3WINDTR KW1A WND 1 1	SINGL1 7	106.70% 213MVA	
659108 LOGAN 4 230.00 3WINDTR KW1A WND 1 1	SINGL1 11	111.00% 222MVA	
659108 LOGAN 4 230.00 3WINDTR KW1A WND 1 1	SINGL1 13	105.60% 211MVA	
659108 LOGAN 4 230.00 3WINDTR KW1A WND 1 1	SINGL1 17	105.40% 211MVA	

659108 LOGAN 4	230.00	SINGL1 19	100.30%			
3WINDTR KW1A	WND 1 1		201MVA			
659108 LOGAN 4	230.00	SINGL1 20	103.20%			
3WINDTR KW1A	WND 1 1		206MVA			
659108 LOGAN 4	230.00	SINGL1 22	106.80%			
3WINDTR KW1A	WND 1 1		214MVA			
659108 LOGAN 4	230.00	SINGL1 23	104.30%			
3WINDTR KW1A	WND 1 1		209MVA			
659108 LOGAN 4	230.00	SINGL1 43	117.80%			
3WINDTR KW1A	WND 1 1		236MVA			
659108 LOGAN 4	230.00	SINGL1 45	106.60%			
3WINDTR KW1A	WND 1 1		213MVA			
659108 LOGAN 4	230.00	SINGL1 50	119.10%			
3WINDTR KW1A	WND 1 1		238MVA			
659108 LOGAN 4	230.00	SINGL1 51	101.20%			
3WINDTR KW1A	WND 1 1		202MVA			
659108 LOGAN 4	230.00	SINGL1 52	101.20%			
3WINDTR KW1A	WND 1 1		202MVA			
659108 LOGAN 4	230.00	SINGL1 53	102.70%			
3WINDTR KW1A	WND 1 1		205MVA			
659108 LOGAN 4	230.00	SINGL1 65	111.30%			
3WINDTR KW1A	WND 1 1		223MVA			
659108 LOGAN 4	230.00	SINGL1 67	104.90%			
3WINDTR KW1A	WND 1 1		210MVA			
659108 LOGAN 4	230.00	B2.SOR-VEL-M	106.70%			
3WINDTR KW1A	WND 1 1		213MVA			
659108 LOGAN 4	230.00	C2.MAL FAULT	117.70%			
3WINDTR KW1A	WND 1 1		235MVA			
659108 LOGAN 4	230.00	SINGL4 67				135.50%
3WINDTR KW1A	WND 1 1					271MVA
659143 BLAISDELL	4230.00	SINGL1 66	124.00%	103.60%		
3WINDTR BLAISDL KV2A	WND 1 1		206MVA	172MVA		
659143 BLAISDELL	4230.00	SINGL1 70	114.40%	113.00%	115.60%	117.00%
3WINDTR BLAISDL KV2A	WND 1 1		190MVA	188MVA	192MVA	194MVA

CONTINGENCY LEGEND:

X--LABEL---X EVENTS

- SINGL1 1 : OPEN LINE FROM BUS 603022 [SOURIS 7 115.00] TO BUS 603023 [MALLARD7 115.00] CKT 1
- SINGL1 2 : OPEN LINE FROM BUS 603022 [SOURIS 7 115.00] TO BUS 605634 [VELVA TAP 115.00] CKT 1
- SINGL1 3 : OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652440 [NELSON 7 115.00] CKT 1
- SINGL1 4 : OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652452 [RUGBY 7 115.00] CKT 1
- SINGL1 5 : OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659155 [LOGAN 7 115.00] CKT 1
- SINGL1 6 : OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659165 [RUTHVILLECP7115.00] CKT 1
- SINGL1 7 : OPEN LINE FROM BUS 605634 [VELVA TAP 115.00] TO BUS 615348 [GRE-MCHENRY7115.00] CKT 1
- SINGL1 9 : OPEN LINE FROM BUS 615002 [GRE-COAL 42G22.000] TO BUS 615600 [GRE-COAL CR4230.00] CKT 1
- SINGL1 10 : OPEN LINE FROM BUS 615010 [GRE-STANT41G18.000] TO BUS 615901 [GRE-STANTON4230.00] CKT 1
- SINGL1 11 : OPEN LINE FROM BUS 615347 [GRE-MCHENRY4230.00] TO BUS 615900 [GRE-COAL TP4230.00] CKT 1
- SINGL1 12 : OPEN LINE FROM BUS 615347 [GRE-MCHENRY4230.00] TO BUS 615903 [GRE-BALTA 4230.00] CKT 1
- SINGL1 13 : OPEN LINE FROM BUS 615347 [GRE-MCHENRY4230.00] TO BUS 615348 [GRE-MCHENRY7115.00] TO BUS 615349 [GRE-MCHENRYT12.470] CKT 1
- SINGL1 15 : OPEN LINE FROM BUS 615600 [GRE-COAL CR4230.00] TO BUS 615900 [GRE-COAL TP4230.00] CKT 1
- SINGL1 16 : OPEN LINE FROM BUS 615600 [GRE-COAL CR4230.00] TO BUS 615901 [GRE-STANTON4230.00] CKT 1
- SINGL1 17 : OPEN LINE FROM BUS 615600 [GRE-COAL CR4230.00] TO BUS 620381 [UNDERWD4 230.00] CKT 1
- SINGL1 18 : OPEN LINE FROM BUS 615600 [GRE-COAL CR4230.00] TO BUS 615601 [GRE-COAL FM869.000] TO BUS 615602 [GRE-COALFM1T12.470] CKT 1
- SINGL1 19 : OPEN LINE FROM BUS 615900 [GRE-COAL TP4230.00] TO BUS 615901 [GRE-STANTON4230.00] CKT 1
- SINGL1 20 : OPEN LINE FROM BUS 615901 [GRE-STANTON4230.00] TO BUS 659106 [LELANDO4 230.00] CKT 1
- SINGL1 21 : OPEN LINE FROM BUS 615903 [GRE-BALTA 4230.00] TO BUS 620290 [HARVEY 4 230.00] CKT 1
- SINGL1 22 : OPEN LINE FROM BUS 615903 [GRE-BALTA 4230.00] TO BUS 620379 [RUGBY 4 230.00] CKT 1
- SINGL1 23 : OPEN LINE FROM BUS 620179 [RUGBY T 13.800] TO BUS 620379 [RUGBY 4 230.00] TO BUS 620279 [RUGBOTP7 115.00] CKT 1
- SINGL1 24 : OPEN LINE FROM BUS 620182 [BOTNO1 9 41.600] TO BUS 652455 [BOTTNO 7 115.00] CKT 1
- SINGL1 25 : OPEN LINE FROM BUS 620183 [BOTNO2 9 41.600] TO BUS 652455 [BOTTNO 7 115.00] CKT 1
- SINGL1 26 : OPEN LINE FROM BUS 620276 [NHARVEY7 115.00] TO BUS 659696 [HARVEY 7 115.00] CKT 1
- SINGL1 27 : OPEN LINE FROM BUS 620277 [SELZ 7 115.00] TO BUS 620292 [CPESMON7 115.00] CKT 1
- SINGL1 28 : OPEN LINE FROM BUS 620278 [ESMDOTP7 115.00] TO BUS 620292 [CPESMON7 115.00] CKT 1
- SINGL1 29 : OPEN LINE FROM BUS 620278 [ESMDOTP7 115.00] TO BUS 659178 [BALTA 7 115.00] CKT 1
- SINGL1 30 : OPEN LINE FROM BUS 620279 [RUGBOTP7 115.00] TO BUS 659264 [RUGBCPC7 115.00] CKT 1
- SINGL1 31 : OPEN LINE FROM BUS 620279 [RUGBOTP7 115.00] TO BUS 659694 [ROLETTE7 115.00] CKT 1
- SINGL1 32 : OPEN LINE FROM BUS 620290 [HARVEY 4 230.00] TO BUS 620381 [UNDERWD4 230.00] CKT 1
- SINGL1 33 : OPEN LINE FROM BUS 620290 [HARVEY 4 230.00] TO BUS 659695 [HARVEY Y 230.00] CKT 1
- SINGL1 34 : OPEN LINE FROM BUS 620292 [CPESMON7 115.00] TO BUS 659688 [ESMOND 7 115.00] CKT 1
- SINGL1 35 : OPEN LINE FROM BUS 620300 [HARVEY 9 41.600] TO BUS 659695 [HARVEY Y 230.00] CKT 1
- SINGL1 36 : OPEN LINE FROM BUS 620368 [RBYWWD4 230.00] TO BUS 620379 [RUGBY 4 230.00] CKT 1
- SINGL1 37 : OPEN LINE FROM BUS 652222 [MAX 9 41.600] TO BUS 652449 [MAX 7 115.00] CKT 1

SINGL1 38 : OPEN LINE FROM BUS 652257 [DEVAUL 8 69.000] TO BUS 652416 [DEVAUL 7 115.00] CKT 1  
SINGL1 39 : OPEN LINE FROM BUS 652257 [DEVAUL 8 69.000] TO BUS 659276 [NBCS7 1G 12.500] CKT 1  
SINGL1 40 : OPEN LINE FROM BUS 652324 [RUGBY 9 41.800] TO BUS 652452 [RUGBY 7 115.00] CKT 1  
SINGL1 41 : OPEN LINE FROM BUS 652416 [DEVAUL 7 115.00] TO BUS 652420 [NSALEM 7 115.00] CKT 1  
SINGL1 42 : OPEN LINE FROM BUS 652420 [NSALEM 7 115.00] TO BUS 659109 [BASIN 7 115.00] CKT 1  
SINGL1 43 : OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 652449 [MAX 7 115.00] CKT 1  
SINGL1 44 : OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 659190 [NDPRAIRWND 7115.00] CKT 1  
SINGL1 45 : OPEN LINE FROM BUS 652441 [GARRISN4 230.00] TO BUS 652442 [GARRISN7 115.00] CKT 1  
SINGL1 46 : OPEN LINE FROM BUS 652441 [GARRISN4 230.00] TO BUS 652457 [GARISN1G 13.800] CKT 1  
SINGL1 47 : OPEN LINE FROM BUS 652441 [GARRISN4 230.00] TO BUS 652458 [GARISN2G 13.800] CKT 1  
SINGL1 48 : OPEN LINE FROM BUS 652441 [GARRISN4 230.00] TO BUS 652459 [GARISN3G 13.800] CKT 1  
SINGL1 49 : OPEN LINE FROM BUS 652441 [GARRISN4 230.00] TO BUS 659106 [LELANDO4 230.00] CKT 1  
SINGL1 50 : OPEN LINE FROM BUS 652442 [GARRISN7 115.00] TO BUS 652449 [MAX 7 115.00] CKT 1  
SINGL1 51 : OPEN LINE FROM BUS 652442 [GARRISN7 115.00] TO BUS 652460 [GARISN4G 13.800] CKT 1  
SINGL1 52 : OPEN LINE FROM BUS 652442 [GARRISN7 115.00] TO BUS 652461 [GARISN5G 13.800] CKT 1  
SINGL1 53 : OPEN LINE FROM BUS 652442 [GARRISN7 115.00] TO BUS 659113 [VOLTAIR7 115.00] CKT 1  
SINGL1 54 : OPEN LINE FROM BUS 652446 [PLEASANT LK7115.00] TO BUS 652452 [RUGBY 7 115.00] CKT 1  
SINGL1 55 : OPEN LINE FROM BUS 652452 [RUGBY 7 115.00] TO BUS 652453 [TOWNER 7 115.00] CKT 1  
SINGL1 56 : OPEN LINE FROM BUS 652452 [RUGBY 7 115.00] TO BUS 659264 [RUGBCPC7 115.00] CKT 1  
SINGL1 57 : OPEN LINE FROM BUS 652453 [TOWNER 7 115.00] TO BUS 652464 [DENBIGH TAP7115.00] CKT 1  
SINGL1 58 : OPEN LINE FROM BUS 652453 [TOWNER 7 115.00] TO BUS 659151 [BOTTNJOJCTCP7115.00] CKT 1  
SINGL1 59 : OPEN LINE FROM BUS 652455 [BOTTNJO 7 115.00] TO BUS 659151 [BOTTNJOJCTCP7115.00] CKT 1  
SINGL1 60 : OPEN LINE FROM BUS 652464 [DENBIGH TAP7115.00] TO BUS 659113 [VOLTAIR7 115.00] CKT 1  
SINGL1 61 : OPEN LINE FROM BUS 659105 [LELANDO3 345.00] TO BUS 659111 [LELAN32G 20.000] CKT 1  
SINGL1 62 : OPEN LINE FROM BUS 659106 [LELANDO4 230.00] TO BUS 659108 [LOGAN 4 230.00] CKT 1  
SINGL1 63 : OPEN LINE FROM BUS 659106 [LELANDO4 230.00] TO BUS 659110 [LELAN41G 22.000] CKT 1  
SINGL1 64 : OPEN LINE FROM BUS 659106 [LELANDO4 230.00] TO BUS 659109 [BASIN 7 115.00] TO BUS 659200 [BASIN 9 13.800] CKT 1  
SINGL1 65 : OPEN LINE FROM BUS 659108 [LOGAN 4 230.00] TO BUS 659143 [BLAISDELL 4230.00] CKT 1  
SINGL1 66 : OPEN LINE FROM BUS 659108 [LOGAN 4 230.00] TO BUS 659155 [LOGAN 7 115.00] TO BUS 659208 [LOGAN 913.800] CKT 1  
SINGL1 67 : OPEN LINE FROM BUS 659144 [BLAISDELL 7115.00] TO BUS 659261 [BTHOLD 7 115.00] CKT 1  
SINGL1 68 : OPEN LINE FROM BUS 659149 [THORNE CP7115.00] TO BUS 659694 [ROLETTE7 115.00] CKT 1  
SINGL1 69 : OPEN LINE FROM BUS 659150 [WHITBY -CP7115.00] TO BUS 659166 [DUNNING7 115.00] CKT 1  
SINGL1 70 : OPEN LINE FROM BUS 659155 [LOGAN 7 115.00] TO BUS 659307 [SWMINOT CP7115.00] CKT 1  
SINGL1 71 : OPEN LINE FROM BUS 659165 [RUTHVILLECP7115.00] TO BUS 659166 [DUNNING7 115.00] CKT 1  
SINGL1 72 : OPEN LINE FROM BUS 659178 [BALTA 7 115.00] TO BUS 659179 [RUGBYNP7 115.00] CKT 1  
SINGL1 73 : OPEN LINE FROM BUS 659179 [RUGBYNP7 115.00] TO BUS 659264 [RUGBCPC7 115.00] CKT 1

SINGL1 74 : OPEN LINE FROM BUS 659190 [NDPRAIRWND 7115.00] TO BUS 659325 [NDPRAIRWND 934.500] CKT 1  
 SINGL1 75 : OPEN LINE FROM BUS 659194 [NDPRAIRWND1W0.6900] TO BUS 659325 [NDPRAIRWND 934.500] CKT 1  
 SINGL1 76 : OPEN LINE FROM BUS 659261 [BTHOLD 7 115.00] TO BUS 659307 [SWMINOT CP7115.00] CKT 1  
 SINGL1 77 : OPEN LINE FROM BUS 659264 [RUGBCPC7 115.00] TO BUS 659697 [RUGBYCP9 41.600] CKT 1  
 SINGL1 78 : OPEN LINE FROM BUS 659688 [ESMOND 7 115.00] TO BUS 659689 [ESMOND Y 115.00] CKT 1  
 SINGL1 79 : OPEN LINE FROM BUS 659689 [ESMOND Y 115.00] TO BUS 659690 [ESMOND 8 69.000] CKT 1  
 SINGL1 80 : OPEN LINE FROM BUS 659691 [ROLETTE9 41.600] TO BUS 659693 [ROLETTEY 115.00] CKT 1  
 SINGL1 81 : OPEN LINE FROM BUS 659692 [ROLETTE8 69.000] TO BUS 659693 [ROLETTEY 115.00] CKT 1  
 SINGL1 82 : OPEN LINE FROM BUS 659693 [ROLETTEY 115.00] TO BUS 659694 [ROLETTE7 115.00] CKT 1  
 SINGL1 83 : OPEN LINE FROM BUS 659695 [HARVEY Y 230.00] TO BUS 659696 [HARVEY 7 115.00] CKT 1  
 B2.SOR-VEL-M: OPEN LINE FROM BUS 605634 [VELVA TAP 115.00] TO BUS 615348 [GRE-MCHENRY7115.00] CKT 1  
     OPEN LINE FROM BUS 605634 [VELVA TAP 115.00] TO BUS 603022 [SOURIS 7 115.00] CKT 1  
 C2.MAL FAULT: OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652440 [NELSON 7 115.00] CKT 1  
     OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652452 [RUGBY 7 115.00] CKT 1  
     OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659155 [LOGAN 7 115.00] CKT 1  
     OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659165 [RUTHVILLECP7115.00] CKT 1  
     OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 603022 [SOURIS 7 115.00] CKT 1  
 C2.MAL FAULT: OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 652449 [MAX 7 115.00] CKT 1  
     OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 659190 [NDPRAIRWND 7115.00] CKT 1  
     OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 603023 [MALLARD7 115.00] CKT 1  
     OPEN LINE FROM BUS 652449 [MAX 7 115.00] TO BUS 652222 [MAX 9 41.600] CKT 1  
     OPEN LINE FROM BUS 652449 [MAX 7 115.00] TO BUS 652442 [GARRISN7 115.00] CKT 1  
 SINGL4 1 : OPEN LINE FROM BUS 10 [LOGAN TERT 13.800] TO BUS 659108 [LOGAN 4 230.00] TO BUS 659155 [LOGAN 7 115.00] CKT 1  
 SINGL4 51 : OPEN LINE FROM BUS 652441 [GARRISN4 230.00] TO BUS 659108 [LOGAN 4 230.00] CKT 1  
 SINGL4 67 : OPEN LINE FROM BUS 659108 [LOGAN 4 230.00] TO BUS 659155 [LOGAN 7 115.00] TO BUS 659208 [LOGAN 913.800] CKT 2  
 SINGL4 68 : OPEN LINE FROM BUS 659113 [VOLTAIR7 115.00] TO BUS 659155 [LOGAN 7 115.00] CKT 1

CONTINGENCY CASE BUSES WITH VOLTAGE LESS THAN 0.9500 - ALL VIOLATIONS

X--- MONITORED ELEMENT ----X	X---LABEL--X	Bulk basecase	Bulk Option 1	Bulk Option 2	Bulk Option 3
659108 LOGAN 4 230.00	SINGL1 2	0.94477			
659108 LOGAN 4 230.00	SINGL1 3	0.94484			
659108 LOGAN 4 230.00	SINGL1 7	0.94541			
659108 LOGAN 4 230.00	SINGL1 13	0.93948			
659108 LOGAN 4 230.00	SINGL1 22	0.94513			
659108 LOGAN 4 230.00	SINGL1 23	0.94557			

659108 LOGAN 4	230.00	SINGL1 43	0.94506
659108 LOGAN 4	230.00	SINGL1 50	0.94619
659108 LOGAN 4	230.00	SINGL1 62	0.91593
659108 LOGAN 4	230.00	B2.SOR-VEL-M	0.94473
659108 LOGAN 4	230.00	C2.MAL FAULT	0.94476
659143 BLAISDELL	4230.00	SINGL1 13	0.94786
659143 BLAISDELL	4230.00	SINGL1 62	0.9277
659143 BLAISDELL	4230.00	SINGL1 70	0.94738

CONTINGENCY LEGEND:

X--LABEL---X EVENTS

- SINGL1 2 : OPEN LINE FROM BUS 603022 [SOURIS 7 115.00] TO BUS 605634 [VELVA TAP 115.00] CKT 1
- SINGL1 3 : OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652440 [NELSON 7 115.00] CKT 1
- SINGL1 7 : OPEN LINE FROM BUS 605634 [VELVA TAP 115.00] TO BUS 615348 [GRE-MCHENRY7115.00] CKT 1
- SINGL1 13 : OPEN LINE FROM BUS 615347 [GRE-MCHENRY4230.00] TO BUS 615348 [GRE-MCHENRY7115.00] TO BUS 615349 [GRE-MCHENRY12.470] CKT 1
- SINGL1 22 : OPEN LINE FROM BUS 615903 [GRE-BALTA 4230.00] TO BUS 620379 [RUGBY 4 230.00] CKT 1
- SINGL1 23 : OPEN LINE FROM BUS 620179 [RUGBY T 13.800] TO BUS 620379 [RUGBY 4 230.00] TO BUS 620279 [RUGBOTP7 115.00] CKT 1
- SINGL1 43 : OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 652449 [MAX 7 115.00] CKT 1
- SINGL1 50 : OPEN LINE FROM BUS 652442 [GARRISN7 115.00] TO BUS 652449 [MAX 7 115.00] CKT 1
- SINGL1 62 : OPEN LINE FROM BUS 659106 [LELANDO4 230.00] TO BUS 659108 [LOGAN 4 230.00] CKT 1
- SINGL1 70 : OPEN LINE FROM BUS 659155 [LOGAN 7 115.00] TO BUS 659307 [SWMINOT CP7115.00] CKT 1
- B2.SOR-VEL-M: OPEN LINE FROM BUS 605634 [VELVA TAP 115.00] TO BUS 615348 [GRE-MCHENRY7115.00] CKT 1
  - OPEN LINE FROM BUS 605634 [VELVA TAP 115.00] TO BUS 603022 [SOURIS 7 115.00] CKT 1
- C2.MAL FAULT: OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652440 [NELSON 7 115.00] CKT 1
  - OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652452 [RUGBY 7 115.00] CKT 1
  - OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659155 [LOGAN 7 115.00] CKT 1
  - OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659165 [RUTHVILLECP7115.00] CKT 1
  - OPEN LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 603022 [SOURIS 7 115.00] CKT 1
- C2.MAL FAULT: TRIP LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 652452 [RUGBY 7 115.00] CKT 1
  - TRIP LINE FROM BUS 603023 [MALLARD7 115.00] TO BUS 659165 [RUTHVILLECP7115.00] CKT 1
- C2.MAL FAULT: OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 652449 [MAX 7 115.00] CKT 1
  - OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 659190 [NDPRAIRWND 7115.00] CKT 1
  - OPEN LINE FROM BUS 652440 [NELSON 7 115.00] TO BUS 603023 [MALLARD7 115.00] CKT 1
  - OPEN LINE FROM BUS 652449 [MAX 7 115.00] TO BUS 652222 [MAX 9 41.600] CKT 1
  - OPEN LINE FROM BUS 652449 [MAX 7 115.00] TO BUS 652442 [GARRISN7 115.00] CKT 1

## Appendix C: Comparison of Base Plan and System Alternative.

### System Intact and Category B Voltage Results for Monitored Area (GRE Contingency Program)

MRO 2013 Winter Peak North Transfer Model			2024 Winter Peak Base Model M700-wp24aa-bus		2024 Winter Peak Option A M701-wp24aa-bus		2024 Winter Peak Option B M702-wp24aa-bus				
UNDERVOLTAGE											
SUBSTATION #	NAME	KV	VOLTAGE %	DROP %	VOLTAGE %	DROP %	VOLTAGE %	DROP %	CONTINGENCY PERFORMED FROM TO CKT		
603022	SOURIS 7	115.0	94.58						SYSTEM INTACT		
			86.44	8.13				603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1			
			89.08	5.5				603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1			
			80.66	13.91				603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1			
			89.27	5.31				615347-615348-615349 GRE-MCHENRY4 230/115/12 1			
			87.99	6.58				659106 LELAND04 230.0 659108 LOGAN 4 230.0 1			
			89.07	5.51				659108-659155-659208 LOGAN 4 230/115/13 1			
			86.2	8.38				CONTINGENCY B2.SOR-VEL-MCH			
603023	MALLARD7	115.0	94.86						SYSTEM INTACT		
			90.7	4.16				603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1			
			80.18	14.68				603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1			
			90.84	4.02				615347-615348-615349 GRE-MCHENRY4 230/115/12 1			
			89.54	5.32				615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1			
			90.83	4.03				620179-620379-620279 RUGBY 4 230/115/13 1			
			90.66	4.2				659106 LELAND04 230.0 659108 LOGAN 4 230.0 1			
			89.09	5.77				659108-659155-659208 LOGAN 4 230/115/13 1			
605634	VELVA TAP	115.0	98.88						SYSTEM INTACT		
			94.15	4.73				603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1			
			90.79	8.1				603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1			
			89.34	9.54				615347-615348-615349 GRE-MCHENRY4 230/115/12 1			
615348	GRE-	115.0	88.38	10.51					659108-659155-659208 LOGAN 4 230/115/13 1		
			94	4.88				SYSTEM INTACT			

MCHENRY7		88.45	11.63					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
652440 NELSON 7	115.0	95.05						SYSTEM INTACT
		91.32	3.73					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		81.29	13.76					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		91.45	3.61					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		90.12	4.93					615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		91.34	3.71					620179-620379-620279 RUGBY 4 230/115/13 1
		91.26	3.8					659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		89.04	6.01					659108-659155-659208 LOGAN 4 230/115/13 1
		86.39	8.66					CONTINGENCY B2.SOR-VEL-MCH
		91.31	3.74					
652446 PLEASANT LK7	115.0	98.3		98.88		98.91		SYSTEM INTACT
		90.98	7.33	91.62	7.26	91.66	7.25	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		88.38	9.92	90.98	7.89	91.05	7.87	620179-620379-620279 RUGBY 4 230/115/13 1
				93.64	5.24	93.65	5.26	652446 PLEASANT LK7115.0 652452 RUGBY 7 115.0 1
		94.77	3.53					CONTINGENCY C1.MAL FAULT-5T12, 5T11
652447 LEEDS 7	115.0	97.24		97.67		97.7		SYSTEM INTACT
		92.27	4.97	92.35	5.32	92.38	5.32	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		90.65	6.59	92.01	5.66	92.06	5.64	620179-620379-620279 RUGBY 4 230/115/13 1
				93.75	3.93	93.76	3.94	652446 PLEASANT LK7115.0 652452 RUGBY 7 115.0 1
652449 MAX 7	115.0	96.63						SYSTEM INTACT
		94.31	2.32					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		87.17	9.46					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		92.85	3.79					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		94	2.63					615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		94.01	2.62					620179-620379-620279 RUGBY 4 230/115/13 1
		91.37	5.26					652442 GARRISN7 115.0 652449 MAX 7 115.0 1
		91.49	5.15					659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		90.04	6.59					659108-659155-659208 LOGAN 4 230/115/13 1
		94.3	2.33					CONTINGENCY B2.SOR-VEL-MCH
652452 RUGBY 7	115.0	98.61		99.23		99.26		SYSTEM INTACT
		90.69	7.92	91.47	7.76	91.5	7.76	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		87.84	10.77	90.76	8.47	90.82	8.44	620179-620379-620279 RUGBY 4 230/115/13 1
652453 TOWNER 7	115.0	98.15		98.87		98.92		SYSTEM INTACT
		93.86	4.3					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		91.82	6.33					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		93.08	5.08	93.81	5.06	93.83	5.08	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
		91.03	7.13	92.06	6.81	92.11	6.81	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		89.83	8.32	92.54	6.33	92.61	6.31	620179-620379-620279 RUGBY 4 230/115/13 1

652455 BOTTNO 7	115.0	94.8		95.55		95.6		SYSTEM INTACT 603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1 615903 GRE-BALTA 4230.0 620290 HARVEY 4 230.0 1 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1 620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1 652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1 652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1 659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1 659108-659155-659208 LOGAN 4 230/115/13 1	
		92.74	2.06						
		90.29	4.51						
				94.77	0.78				
		88.15	6.65	92.27	3.28	92.32	3.28		
		89.47	5.33	90.24	5.31	90.27	5.33		
		92.73	2.07	93.72	1.83	93.78	1.82		
		92.67	2.13	93.79	1.76	93.86	1.74		
		87.31	7.49	88.4	7.15	88.45	7.14		
		86.05	8.75	88.91	6.64	88.98	6.62		
						93.67	1.93		
		94.24	1.31	94.27	1.33				
		93.63	1.92	93.66	1.94				
		94.21	1.34	94.28	1.32				
		92.34	2.46						
652464 DENBIGH TAP7	115.0	98.3		99.04		99.09		SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1	
		93.78	4.52						
		91.36	6.94						
		92.66	5.64	93.42	5.62	93.44	5.65		
		91.46	6.84	92.54	6.5	92.59	6.5		
90.46	7.84	93.12	5.92	93.19	5.89				
652590 SNAKECR7	115.0	96.76					SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1 659108-659155-659208 LOGAN 4 230/115/13 1		
		94.78	1.98						
		94.17	2.59						
		92.89	3.87						
94.11	2.65								
659108 LOGAN 4	230.0	96.66					SYSTEM INTACT 603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1 CONTINGENCY B2.SOR-VEL-MCH		
		94.48	2.19						
		94.48	2.18						
		94.54	2.12						
		93.95	2.72						
		94.54	2.12						
		94.54	2.13						
		94.51	2.16						
		91.15	5.51						
		94.47	2.19						
659113 VOLTAIR7	115.0	100.03		100.99		101.05		SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1	
		93.79	6.24						
		88.45	11.58	94.99	6				

		90.22	9.81	91.11	9.88	91.13	9.92	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
659143 BLAISDELL 4	230.0	96.82						SYSTEM INTACT
		94.79	2.04					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		92.45	4.38					659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		94.74	2.08					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
659144 BLAISDELL 7	115.0	95.71		97.13		97.17		SYSTEM INTACT
		93.8	1.91					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		93.86	1.85					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		93.1	2.61					615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		93.84	1.87					620179-620379-620279 RUGBY 4 230/115/13 1
		93.75	1.96					659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		90.65	5.06	94.93	2.2	94.99	2.18	659108-659155-659208 LOGAN 4 230/115/13 1
		92.45	3.26					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		91.73	3.98	92.73	4.4	92.77	4.4	CONTINGENCY B2.SOR-VEL-MCH
		93.8	1.91					
659149 THORNE CP7	115.0	90.94		91.54		91.58		SYSTEM INTACT
		89.79	1.14					603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
		88.22	2.71					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
				91.06	0.48	90.96	0.62	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
		88.44	2.5	90.5	1.04	90.54	1.04	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		89.4	1.54	89.94	1.6	89.97	1.6	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
								615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1
		89.31	1.63	90.09	1.45	90.14	1.43	615903 GRE-BALTA 4230.0 620290 HARVEY 4 230.0 1
		89	1.94	89.97	1.57	90.03	1.55	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		81.62	9.32	82.43	9.11	82.48	9.1	620179-620379-620279 RUGBY 4 230/115/13 1
		77.71	13.23	81.21	10.33	81.29	10.29	620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1
						89.85	1.73	652442 GARRISN7 115.0 652449 MAX 7 115.0 1
				91.16	0.38			652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
				90.99	0.55	91.03	0.55	659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
				90.65	0.89	90.71	0.87	659108-659155-659208 LOGAN 4 230/115/13 1
		89.73	1.21					
659150 WHITBY -CP7	115.0	90.78		95.59		95.5		SYSTEM INTACT
				93.18	2.41			603022 SOURIS 7 115.0 603268 MOUSE RIV 115.0 1
		85.67	5.11					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		72.15	18.64					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
				89.52	6.08	86.58	8.92	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
						93.18	2.32	603268 MOUSE RIV 115.0 603270 WARD CO 115.0 1
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		85.85	4.93					615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1
				93.48	2.12	93.41	2.09	

		84.24	6.55					615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1
		85.83	4.95	93.79	1.8	93.71	1.8	1
		85.63	5.16	92.99	2.6	92.89	2.61	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
				93.4	2.2	93.3	2.2	620179-620379-620279 RUGBY 4 230/115/13 1
		83.67	7.11			93.72	1.79	620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1
		79.84	10.94	92.74	2.86	92.68	2.83	659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		85.66	5.12					659108-659155-659208 LOGAN 4 230/115/13 1 CONTINGENCY B2.SOR-VEL-MCH
659151 BOTTOJCTCP7	115.0	94.85		95.6		95.65		SYSTEM INTACT
		92.79	2.06					603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
		90.35	4.5					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
				94.82	0.78			615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1
		88.21	6.64	92.32	3.28	92.37	3.27	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		89.53	5.32	90.29	5.3	90.32	5.32	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
								615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1
		92.78	2.07	93.77	1.83	93.83	1.82	1
		92.72	2.13	93.84	1.76	93.91	1.74	615903 GRE-BALTA 4230.0 620290 HARVEY 4 230.0 1
		87.37	7.48	88.46	7.14	88.51	7.14	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		86.1	8.75	88.96	6.64	89.03	6.61	620179-620379-620279 RUGBY 4 230/115/13 1
								620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1
				94.29	1.31	94.32	1.32	652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1
				93.68	1.92	93.71	1.94	652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
				94.26	1.34	94.33	1.32	659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		92.39	2.46					659108-659155-659208 LOGAN 4 230/115/13 1
659155 LOGAN 7	115.0	96.23						SYSTEM INTACT
		92.97	3.26					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		93.53	2.7					603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		93.08	3.15					1
		92.11	4.12					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		93.07	3.16					615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		92.99	3.24					620179-620379-620279 RUGBY 4 230/115/13 1
		90.52	5.7					659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		87.08	9.15					659108-659155-659208 LOGAN 4 230/115/13 1
		92.97	3.26					CONTINGENCY B2.SOR-VEL-MCH
659165 RUTHVILLECP7	115.0	92.54		96.79		96.71		SYSTEM INTACT
				94.65	2.13			603022 SOURIS 7 115.0 603268 MOUSE RIV 115.0 1
		88.08	4.46					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		76.6	15.94					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
				91.43	5.36	88.87	7.83	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1

		88.23	4.31			94.65	2.05	603268 MOUSE RIV 115.0 603270 WARD CO 115.0 1 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1 615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1 659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1 659108-659155-659208 LOGAN 4 230/115/13 1 CONTINGENCY B2.SOR-VEL-MCH
		86.84	5.7	94.92	1.87	94.86	1.85	
		88.22	4.32	94.48	2.3	94.4	2.31	
		88.04	4.5	94.84	1.95	94.76	1.95	
		86.35	6.19	94.26	2.53	94.21	2.5	
		83.07	9.48					
		88.07	4.47					
659166 DUNNING7	115.0	91.16		95.94		95.85		SYSTEM INTACT 603022 SOURIS 7 115.0 603268 MOUSE RIV 115.0 1 603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1 603268 MOUSE RIV 115.0 603270 WARD CO 115.0 1 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1 615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1 620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1 659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1 659108-659155-659208 LOGAN 4 230/115/13 1 CONTINGENCY B2.SOR-VEL-MCH
		86.08	5.08	93.54	2.4			
		72.67	18.49					
				89.9	6.04	86.99	8.86	
						93.54	2.31	
		86.26	4.9					
				93.84	2.1	93.78	2.08	
		84.66	6.5					
				94.15	1.79	94.07	1.79	
		86.24	4.92	93.35	2.59	93.26	2.59	
		86.04	5.12	93.76	2.19	93.67	2.19	
						94.08	1.77	
		84.09	7.07	93.1	2.84	93.04	2.81	
		80.3	10.86					
		86.07	5.09					
659178 BALTA 7	115.0	98.56		99.17		99.2		SYSTEM INTACT 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1
		90.59	7.96	91.37	7.8	91.4	7.8	
		87.71	10.85	90.64	8.53	90.7	8.5	
659179 RUGBYNP7	115.0	98.6		99.21		99.25		SYSTEM INTACT 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 620179-620379-620279 RUGBY 4 230/115/13 1
		90.67	7.93	91.44	7.77	91.48	7.77	
		87.79	10.81	90.72	8.5	90.78	8.47	
659261 BTHOLD 7	115.0	94.51		96.08		96.12		SYSTEM INTACT 603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1 615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		92.29	2.22					
		92.36	2.15					
				94.59	1.5	94.64	1.48	
		91.54	2.97					

			94.92	1.16	94.96	1.16	615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1	
		92.35	2.16	94.68	1.41	94.72	1.4	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		92.24	2.26	94.93	1.15	94.98	1.14	620179-620379-620279 RUGBY 4 230/115/13 1
						94.98	1.14	620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1
		89.28	5.22	93.84	2.24	93.9	2.22	659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		89.78	4.72					659108-659155-659208 LOGAN 4 230/115/13 1
		90.67	3.83	93.14	2.94	93.18	2.94	659144 BLAISDELL 7115.0 659261 BTHOLD 7 115.0 1
		88.92	5.59	89.92	6.16	89.96	6.16	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				94.48	1.61	94.51	1.61	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
		92.29	2.22					CONTINGENCY B2.SOR-VEL-MCH
659264 RUGBCPC7	115.0	98.61		99.22		99.26		SYSTEM INTACT
		90.68	7.93	91.45	7.77	91.49	7.77	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		87.81	10.8	90.73	8.49	90.79	8.46	620179-620379-620279 RUGBY 4 230/115/13 1
659307 SWMINOT CP7	115.0	95.33		97.51		97.56		SYSTEM INTACT
		92.26	3.06					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		92.36	2.96					615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		91.4	3.92					615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		92.35	2.97					620179-620379-620279 RUGBY 4 230/115/13 1
		92.26	3.07					659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		89.69	5.64					659108-659155-659208 LOGAN 4 230/115/13 1
		87	8.33					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		85.81	9.52	86.89	10.62	86.93	10.63	CONTINGENCY B2.SOR-VEL-MCH
		92.25	3.07					
659308 KENASTON 7	115.0	93.37		94.79		94.82		SYSTEM INTACT
		91.37	2					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
								605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		91.43	1.93					615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1
				93.33	1.46	93.38	1.44	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		90.68	2.68					615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1
				93.69	1.1	93.73	1.09	615903 GRE-BALTA 4230.0 620290 HARVEY 4 230.0 1
				93.82	0.97	93.86	0.96	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		91.44	1.92	93.53	1.26	93.56	1.26	620179-620379-620279 RUGBY 4 230/115/13 1
		91.33	2.04	93.76	1.03	93.8	1.03	620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1
						93.76	1.06	659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
		88.14	5.22	92.46	2.33	92.52	2.3	659108 LOGAN 4 230.0 659143 BLAISDELL 4230.0 1
				93.89	0.9			659108-659155-659208 LOGAN 4 230/115/13 1
		89.13	4.24					659144 BLAISDELL 7115.0 659261 BTHOLD 7 115.0 1
		90.41	2.96	92.57	2.22	92.61	2.21	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		88.29	5.07	89.16	5.63	89.19	5.63	

				93.27	1.52	93.29	1.53	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1 CONTINGENCY B2.SOR-VEL-MCH
659694 ROLETTE7	115.0	91.37	2	94.69		94.72		SYSTEM INTACT
		94.11						603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
		93.01	1.09					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		91.51	2.59					603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
				94.22	0.46	94.13	0.59	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		91.72	2.39	93.69	1	93.73	0.99	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
		92.63	1.47	93.16	1.53	93.19	1.53	615600 GRE-COAL CR4230.0 620381 UNDERWD4 230.0 1
				93.3	1.38	93.35	1.37	615903 GRE-BALTA 4230.0 620290 HARVEY 4 230.0 1
		92.55	1.56	93.18	1.5	93.24	1.48	615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
		92.25	1.86	86.01	8.68	86.05	8.67	620179-620379-620279 RUGBY 4 230/115/13 1
		85.24	8.87	84.85	9.84	84.92	9.8	620290 HARVEY 4 230.0 620381 UNDERWD4 230.0 1
		81.54	12.56			93.07	1.65	652442 GARRISN7 115.0 652449 MAX 7 115.0 1
				94.32	0.36	94.19	0.53	652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
				94.16	0.52	93.89	0.83	659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
				93.83	0.85			659108-659155-659208 LOGAN 4 230/115/13 1
		92.95	1.16					

**System Intact and Category B Thermal Results for Monitored Area**

MRO 2013 Winter Peak North Transfer Model      2024 Winter Peak Base Model      2024 Winter Peak Option A      2024 Winter Peak Option B  
M700-wp24aa-bus      M701-wp24aa-bus      M702-wp24aa-bus

CIRCUIT/WINDING TO CKT # NAME #	SI	CONT	M700-wp24aa-bus		M701-wp24aa-bus		M702-wp24aa-bus		CONTINGENCY		
	RATE	RATE	LOADG	CURRENT	LOADG	CURRENT	LOADG	CURRENT	FROM	TO	CKT
	MVA	MVA	%I	MVA	%I	MVA	%I	MVA			
603023 MALLARD7 115.0 603270 WARD CO 115.0 1	100.0	100.0			45.1 133.4 110.9	45.1 133.38 110.9	46 135.1 112.2	45.98 135.14 112.25	SYSTEM INTACT		
603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	159.3	159.3	81.5	129.79					SYSTEM INTACT		
			100.7	160.43					603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1		
			117.7	187.5					603023 MALLARD7 115.0 652440 NELSON 7 115.0 1		
			100.5	160.1					605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1		
			103.3	164.52					615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1		
			100	159.32					615347-615348-615349 GRE-MCHENRY4 230/115/12 1		

			100.3	159.85						615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
			117.7	187.45						652440 NELSON 7 115.0 652449 MAX 7 115.0 1
			119.5	190.29						652442 GARRISN7 115.0 652449 MAX 7 115.0 1
			100.7	160.46						CONTINGENCY B2.SOR-VEL-MCH
603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	182.0	182.0			59.4	108.06	59.4	108.06		SYSTEM INTACT
					104.3	189.83	104.3	189.75		602052 WARD CO 230.0 659108 LOGAN 4 230.0 1
603268 MOUSE RIV 115.0 659165 RUTHVILLECP7115.0 1	100.0	100.0			18.9	18.94	18.1	18.07		SYSTEM INTACT
					101.1	101.14	104.4	104.36		603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
605634 VELVA TAP 115.0 615348 GRE- MCHENRY7115.0 1	119.5	119.5	41.1	49.07						SYSTEM INTACT
			102.3	122.26						603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			101.4	121.15						603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
615347 GRE- MCHENRY4230.0 GRE- MCHENRY7 230/115 1	84.0	84.0	114.6	96.28	89.5	75.16	89.3	75.03		SYSTEM INTACT
			160.4	134.72						603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			178.7	150.12						603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
			159.3	133.82	106.5	89.47	106.4	89.37		615347 GRE-MCHENRY4230.0 615903 GRE-BALTA 4230.0 1
			188.2	158.11	129.5	108.79	129.3	108.64		615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
			154.7	129.97	109.3	91.78	109	91.59		620179-620379-620279 RUGBY 4 230/115/13 1
			145.4	122.12	112.4	94.41	112.2	94.25		652442 GARRISN7 115.0 659113 VOLTAIR7 115.0 1
			157.8	132.54						659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1
			165	138.58						659108-659155-659208 LOGAN 4 230/115/13 1
615348 GRE- MCHENRY7115.0 GRE- MCHENRY4 230/115 1	84.0	84.0	104	87.38	81.1	68.16	81	68.03		SYSTEM INTACT
			145.6	122.35						603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			162.3	136.34						603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
			144.7	121.55						615347 GRE-MCHENRY4230.0 615903 GRE-BALTA 4230.0 1
			171	143.62	117.6	98.75	117.4	98.63		615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
			140.5	118.01						620179-620379-620279 RUGBY 4 230/115/13 1
			132	110.91	102	85.7	101.8	85.55		652442 GARRISN7 115.0 659113 VOLTAIR7 115.0 1
			143.3	120.35						659106 LELANDO4 230.0 659108 LOGAN 4 230.0 1

			149.8	125.85					659108-659155-659208 LOGAN 4 230/115/13 1
620279 RUGBOTP7 115.0 659264 RUGBCPC7 115.0 1	135.0	135.0			5.7	7.75	5.7	7.67	SYSTEM INTACT 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1
					103.8	140.06	103.8	140.09	
652442 GARRISN7 115.0 659113 VOLTAIR7 115.0 1	109.0	109.0	77.2	84.18					SYSTEM INTACT 615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1
			102.3	111.56					
659108 LOGAN 4 230.0 LOGAN 7 KW1A 1	200.0	200.0	101.4	202.89					SYSTEM INTACT 603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 605634 VELVA TAP 115.0 615348 GRE- MCHENRY7115.0 1 615347 GRE-MCHENRY4230.0 615900 GRE-COAL TP4230.0 1 615903 GRE-BALTA 4230.0 620379 RUGBY 4 230.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652442 GARRISN7 115.0 652449 MAX 7 115.0 1 659108 LOGAN 4 230.0 659143 BLAISDELL 4230.0 1 CONTINGENCY B2.SOR-VEL-MCH
			113	225.93					
			124.6	249.19					
			112.9	225.77					
			116.2	232.31					
			112.9	225.87					
			124.6	249.21					
			125.8	251.64					
			115.9	231.73					
			113	225.95					
659143 BLAISDELL 4230.0 BLAISDELL 7 BLAISDL KV2 1	166.0	166.0	88.1	146.27	81.3	134.92	81.3	134.88	SYSTEM INTACT 659108-659155-659208 LOGAN 4 230/115/13 1 659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1 659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
			130.1	215.94					
			120.8	200.5	118	195.95	118	195.89	
			100.6	167.04					
659144 BLAISDELL 7115.0 BLAISDELL 4 BLAISDL KV2 1	166.0	166.0	88.1	146.23	81.3	134.88	81.2	134.84	SYSTEM INTACT 659108-659155-659208 LOGAN 4 230/115/13 1 659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1 659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
			130.1	215.91					
			120.8	200.46	118	195.91	118	195.85	
			100.6	167.01					
659155 LOGAN 7 115.0 LOGAN 4 KW1A 1	200.0	200.0	101.4	202.89					SYSTEM INTACT 603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
			113	225.93					
			124.6	249.19					





603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1	144.0	144.0			53.1	76.47	51.8	74.53	SYSTEM INTACT 603022 SOURIS 7 115.0 603270 WARD CO 115.0 1	603022 SOURIS 7 115.0 603270 WARD CO 115.0 2
					160.6	231.28	146.3	210.73		
603268 MOUSE RIV 115.0 659165 RUTHVILLECP7115.0 1	100.0	100.0			18.9	18.95	18.5	18.47	SYSTEM INTACT 603022 SOURIS 7 115.0 603270 WARD CO 115.0 1	603022 SOURIS 7 115.0 603270 WARD CO 115.0 2
					126.4	126.36			603023 MALLARD7 115.0 603270 WARD CO 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
							122.7	122.74	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	603023 MALLARD7 115.0 603270 WARD CO 115.0 1
605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	119.5	119.5	41.1	49.07					SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			105.8	126.38					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1
			109.5	130.82					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
			111	132.63					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
			103.1	123.21					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			136.5	163.14					615347-615348-615349 GRE- MCHENRY4 230/115/12 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
			111.1	132.72					652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
			103	123.11					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
615347 GRE-MCHENRY4230.0 GRE-MCHENRY7 230/115 1	84.0	84.0	114.6	96.28	89.5	75.17	85.4	71.74	SYSTEM INTACT 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1
					115.1	96.67	104.4	87.69	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
					106.9	89.78			602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
					107.1	89.95			602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1
					107	89.9			602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
					114.8	96.47	104.2	87.49	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0
					106.8	89.71			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0

			181.2	152.21			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	1
			175.7	147.63			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			176.4	148.21			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	620182 BOTNO1 9 41.60 652455 BOTTNO 7 115.0 1
			178.7	150.13			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	620183 BOTNO2 9 41.60 652455 BOTTNO 7 115.0 1 652440 NELSON 7 115.0 659190 NDPRAIRWND 7115.0 1
			182.1	152.97			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1 659190 NDPRAIRWND 7115.0 659325 NDPRAIRWND 934.50 1
			178.7	150.12			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
			180.2	151.35			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
					106.9	89.76	652440 NELSON 7 115.0 652449 MAX 7 115.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
					106.8	89.71	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
			181.9	152.84			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	147.8	147.8	30.5	45.11			SYSTEM INTACT 615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
615348 GRE-MCHENRY7115.0 GRE-MCHENRY4 230/115 1	84.0	84.0	104	87.38	81.2	68.17	SYSTEM INTACT 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
					104.4	87.73	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
			164.6	138.24	104.2	87.55	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	620182 BOTNO1 9 41.60 652455 BOTTNO 7 115.0 1
			159.6	134.07			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	620183 BOTNO2 9 41.60 652455 BOTTNO 7 115.0 1
			160.2	134.59			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652440 NELSON 7 115.0 659190 NDPRAIRWND 7115.0
			162.3	136.35			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	

			165.4	138.92					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	1
			162.3	136.34					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1 659190 NDPRAIRWND 7115.0 659325 NDPRAIRWND 934.50 1
			163.6	137.45					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
			165.2	138.81					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
652442 GARRISN7 115.0 659113 VOLTAIR7 115.0 1	109.0	109.0	77.2	84.18	70.7	77.1	70.9	77.32	SYSTEM INTACT 602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1
652452 RUGBY 7 115.0 652453 TOWNER 7 115.0 1	117.0	117.0	25.9	30.34					SYSTEM INTACT 615347-615348-615349 GRE- MCHENRY4 230/115/12 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
659108 LOGAN 4 230.0 LOGAN 7 KW1A 1	200.0	200.0	101.4	202.89	53.7	107.33	53.6	107.27	SYSTEM INTACT 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1 602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1 602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
			151.2	302.31						

			151.1	302.11					605634 VELVA TAP 115.0	652440 NELSON 7 115.0
									615348 GRE-MCHENRY7115.0 1	652449 MAX 7 115.0 1
			140.7	281.33					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603023 MALLARD7 115.0
										652440 NELSON 7 115.0 1
			140.6	281.29					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0
										652449 MAX 7 115.0 1
			151.3	302.58					652440 NELSON 7 115.0	603022 SOURIS 7 115.0
									652449 MAX 7 115.0 1	605634 VELVA TAP 115.0 1
			151.1	302.11					652440 NELSON 7 115.0	605634 VELVA TAP 115.0
									652449 MAX 7 115.0 1	615348 GRE-MCHENRY7115.0 1
			140.6	281.3					652440 NELSON 7 115.0	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
									652449 MAX 7 115.0 1	
			151.3	302.61					652440 NELSON 7 115.0	CONTINGENCY B2.SOR-VEL-MCH
									652449 MAX 7 115.0 1	
									652440 NELSON 7 115.0	602052 WARD CO 230.0
									659155 LOGAN 7 115.0 1	659108 LOGAN 4 230.0 1

109.9 219.78 110.6 221.19

**Prior Outage Voltage Results for Monitored Area**

MRO 2013 Winter Peak North Transfer Model

2024 Winter Peak Base Model

2024 Winter Peak Option A

2024 Winter Peak Option B

prior-m700-wp24aa-bus

prior-m701-wp24aa-bus

prior-m701a-wp24aa-bus

SUBSTATION														
#	NAME	KV	VOLTAGE	DROP	VOLTAGE	DROP	VOLTAGE	DROP	PRIOR OUTAGE APPLIED			CONTINGENCY PERFORMED		
			%	%	%	%	%	%	FROM	TO	CKT	FROM	TO	CKT
603022	SOURIS 7	115.0	94.58		98.05		101.39		SYSTEM INTACT					
					83.8	14.25			603022 SOURIS 7 115.0 603270 WARD CO 115.0 1			603022 SOURIS 7 115.0 603270 WARD CO 115.0 2		
			81.15	13.43					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			620183 BOTNO2 9 41.60 652455 BOTTNO 7 115.0 1		
			80.66	13.92					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			652440 NELSON 7 115.0 659190 NDPRAIRWIND 7115.0 1		
			80.17	14.4					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1		
			79.82	14.76					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1			652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1		

		79.84	14.74			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		80.66	13.91			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659190 NDPRAIRWIND 7115.0 659325 NDPRAIRWIND 934.50 1
		80.29	14.29			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
		34.57	60			615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
		79.78	14.8			652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		79.88	14.7			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
603023 MALLARD7 115.0		94.86		98.25		SYSTEM INTACT	
				91.57	6.68	603023 MALLARD7 115.0 603270 WARD CO 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		74.69	20.17			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
				91.58	6.68	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	603023 MALLARD7 115.0 603270 WARD CO 115.0 1
		79.75	15.11			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1
		79.38	15.48			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
		79.33	15.53			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		79.79	15.07			603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
		79.34	15.52			652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		79.37	15.49			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
603268 MOUSE RIV 115.0				97.59		SYSTEM INTACT	
				84.15	13.44	603022 SOURIS 7 115.0 603270 WARD CO 115.0 1	603022 SOURIS 7 115.0 603270 WARD CO 115.0 2
605634 VELVA TAP 115.0		98.88		100.33		SYSTEM INTACT	
		82.3	16.59			605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
		82.43	16.45			605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1

		49.31	49.57					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
		84.48	14.4					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
				91.04	9.29			615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603270 WARD CO 115.0 605634 VELVA TAP 115.0 1
		84.51	14.38					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
		86.42	12.46					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1
		82.43	16.46					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		84.5	14.38					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
615348 GRE-MCHENRY7	115.0	100.08		101.05		102.79		SYSTEM INTACT	
				90.96	10.09	91.94	10.84	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		54.16	45.92					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1
		84.87	15.21					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
				91.03	10.02			615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603270 WARD CO 115.0 605634 VELVA TAP 115.0 1
				90.97	10.08	91.94	10.84	615347-615348-615349 GRE-MCHENRY4 230/115/12 1	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		87.79	12.3					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
		84.88	15.2					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
		86.21	13.87					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1
		86.47	13.61					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
				90.95	10.1	91.93	10.86	615347-615348-615349 GRE-MCHENRY4 230/115/12 1	CONTINGENCY B2.SOR-VEL-MCH
		87.79	12.3					615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		84.88	15.2					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		86.47	13.61					652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1

<p>652440 NELSON 7      115.0</p>	<p>95.05</p> <p>76.78      18.27</p> <p>80.95      14.11</p> <p>80.63      14.42</p> <p>80.46      14.59</p> <p>80.92      14.13</p> <p>80.59      14.47</p> <p>80.5      14.55</p>	<p>98.53</p>		<p>SYSTEM INTACT</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1</p> <p>659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1</p>	<p>603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1</p> <p>652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1</p> <p>652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1</p> <p>659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1</p> <p>659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p>
<p>652449 MAX 7      115.0</p>	<p>96.63</p> <p>84.84      11.79</p> <p>87.17      9.46</p> <p>87.01      9.62</p> <p>86.82      9.81</p> <p>86.4      10.23</p> <p>86.84      9.79</p> <p>86.79      9.84</p> <p>86.44      10.2</p>			<p>SYSTEM INTACT</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1</p> <p>659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1</p>	<p>603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1</p> <p>652440 NELSON 7 115.0 659190 NDPRAIRWND 7115.0 1</p> <p>652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1</p> <p>652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1</p> <p>659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1</p> <p>659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p>
<p>652452 RUGBY 7      115.0</p>	<p>98.61</p> <p>94.79      3.82</p> <p>90.27      8.35</p> <p>94.87      3.74</p>			<p>SYSTEM INTACT</p> <p>603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1</p> <p>615347-615348-615349 GRE-MCHENRY4 230/115/12 1</p> <p>615347-615348-615349 GRE-MCHENRY4 230/115/12 1</p>	<p>603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1</p> <p>603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1</p> <p>603023 MALLARD7 115.0 652440 NELSON 7 115.0 1</p>

		94.89	3.73			615347-615348-615349 GRE-MCHENRY4 230/115/12 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1
652453 TOWNER 7	115.0	98.15				SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 659190 NDPRAIRWND 7115.0 1 659190 NDPRAIRWND 7115.0 659325 NDPRAIRWND 934.50 1 659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1
652455 BOTTNO 7	115.0	94.8		95.57	97.12	SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1 615347-615348-615349 GRE-MCHENRY4 230/115/12 1	89.88 5.69 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 659190 NDPRAIRWND 7115.0 1 659190 NDPRAIRWND 7115.0 659325 NDPRAIRWND 934.50 1 659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
		87.39	7.41				
		68.58	26.22				
		85.82	8.98				
		85.83	8.97				
		88.15	6.65				
		88.15	6.65				
		88.14	6.66				

		87.4	7.4						615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
				89.86	5.71					
				89.61	5.96	90.7	6.42			
				89.63	5.94	90.73	6.39			
		85.83	8.97							
				89.63	5.94	90.71	6.41			
				89.66	5.91	90.73	6.39			
652464 DENBIGH TAP7	115.0	98.3		99.06		100.57			SYSTEM INTACT 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1 603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1 659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1 603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1 652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1
		90.61	7.69							
		71.2	27.1							
		88.99	9.31							
		89.01	9.29							
		85.88	12.42							
		91.35	6.95							
		90.61	7.69							
		88.1	10.2	89.15	9.91	89.64	10.94			
		89.01	9.29							
659108 LOGAN 4	230.0	96.66							SYSTEM INTACT 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1 605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1 615347-615348-615349 GRE- MCHENRY4 230/115/12 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1 652440 NELSON 7 115.0 652449 MAX 7 115.0 1 603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
		90.08	6.58							
		90.13	6.53							
		90.78	5.88							

		90.8	5.86						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0	652449 MAX 7 115.0 1
		90.02	6.64						652440 NELSON 7 115.0 652449 MAX 7 115.0 1	603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1	
		90.13	6.53						652440 NELSON 7 115.0 652449 MAX 7 115.0 1	605634 VELVA TAP 115.0	615348 GRE-MCHENRY7115.0 1
		90.8	5.86						652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1	
		90.01	6.65						652440 NELSON 7 115.0 652449 MAX 7 115.0 1	CONTINGENCY B2.SOR-VEL-MCH	
659113 VOLTAIR7	115.0	100.03		101		102.73			SYSTEM INTACT		
		87.68	12.35						603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	615348 GRE-MCHENRY7115.0	659113 VOLTAIR7 115.0 1
		54.31	45.72						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603022 SOURIS 7 115.0 603023 MALLARD7 115.0 1	
		84.88	15.15						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603023 MALLARD7 115.0	652440 NELSON 7 115.0 1
		84.9	15.14						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0	652449 MAX 7 115.0 1
		86.2	13.83						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652453 TOWNER 7 115.0	652464 DENBIGH TAP7115.0 1
		86.46	13.57						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652464 DENBIGH TAP7115.0	659113 VOLTAIR7 115.0 1
		84.83	15.21						615347-615348-615349 GRE-MCHENRY4 230/115/12 1	CONTINGENCY C2.MAL FAULT-5T9 BKR	
		87.68	12.35						615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0	659155 LOGAN 7 115.0 1
				90.24	10.76	91.04	11.69		615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	652440 NELSON 7 115.0	652449 MAX 7 115.0 1
				90.29	10.71	91.09	11.64		615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	652440 NELSON 7 115.0	659155 LOGAN 7 115.0 1
				89.44	11.56	89.93	12.81		615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	652453 TOWNER 7 115.0	652464 DENBIGH TAP7115.0 1
				90.11	10.89	90.58	12.15		615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	652464 DENBIGH TAP7115.0	659113 VOLTAIR7 115.0 1
		84.9	15.14						652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1	
				90.25	10.75	91.05	11.69		652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615348 GRE-MCHENRY7115.0	659113 VOLTAIR7 115.0 1
				90.31	10.69	91.1	11.63		652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	615348 GRE-MCHENRY7115.0	659113 VOLTAIR7 115.0 1





		85.87	8.98					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
		85.89	8.96					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
		88.2	6.65					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0 659190 NDPRAIRWND 7115.0 1
		88.2	6.64					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	659190 NDPRAIRWND 7115.0 659325 NDPRAIRWND 934.50 1
		88.19	6.66					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
		87.45	7.4					615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
				89.91	5.71			615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
				89.66	5.96	90.75	6.42	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
				89.69	5.93	90.78	6.39	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1
		85.89	8.96					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
				89.68	5.94	90.76	6.41	652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
				89.71	5.91	90.78	6.38	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	615348 GRE-MCHENRY7115.0 659113 VOLTAIR7 115.0 1
659155 LOGAN 7	115.0	96.23		98.58				SYSTEM INTACT	
		87.15	9.08					605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
		87.24	8.99					605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
		87.87	8.36					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
		87.91	8.32					615347-615348-615349 GRE-MCHENRY4 230/115/12 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
		87.05	9.18					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		87.24	8.99					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		87.91	8.32					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		87.04	9.19					652440 NELSON 7 115.0 652449 MAX 7 115.0 1	CONTINGENCY B2.SOR-VEL-MCH



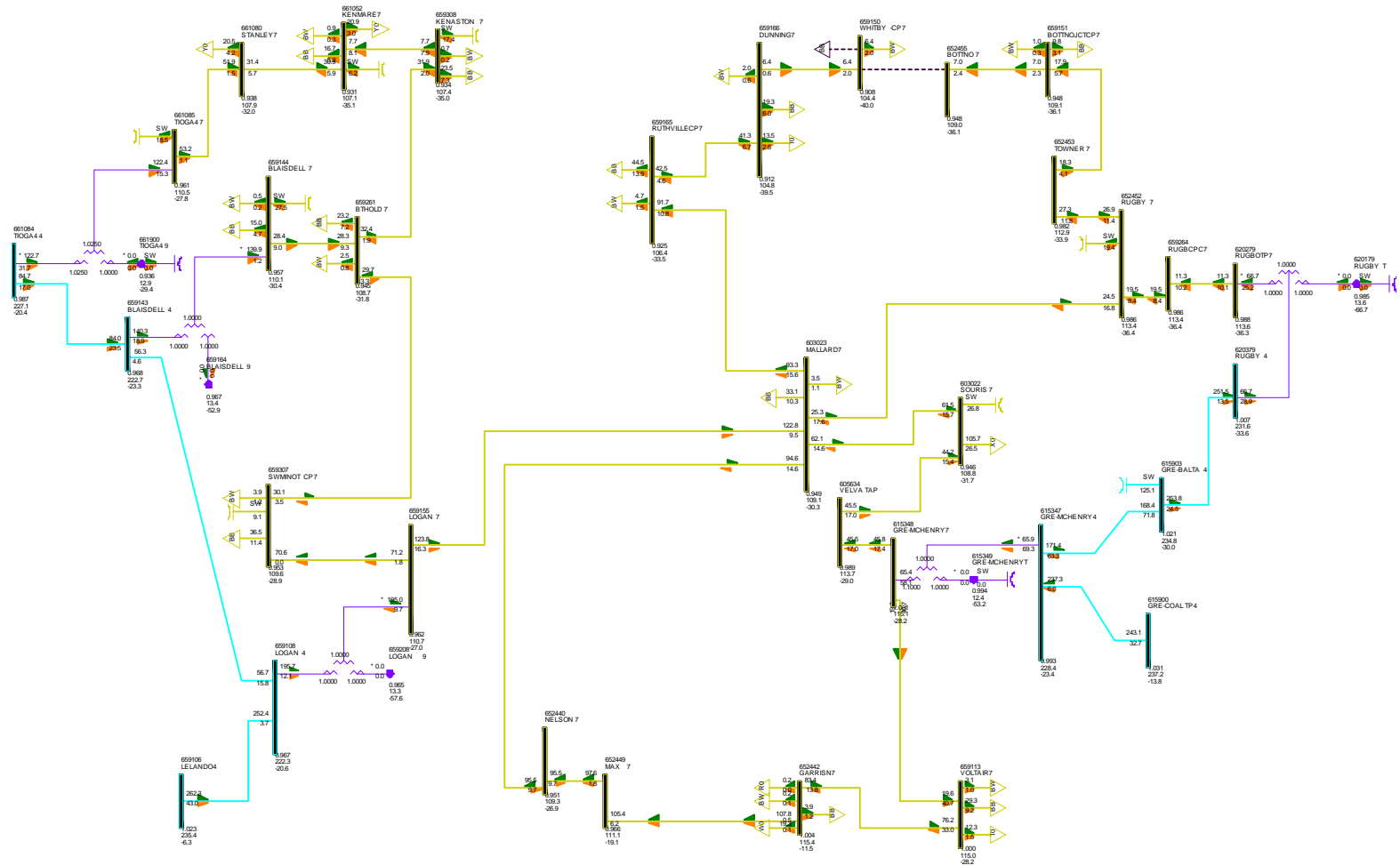
		80.95	14.11					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652453 TOWNER 7 115.0 652464 DENBIGH TAP7115.0 1
		80.63	14.42					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1
		80.46	14.59					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		80.92	14.13					603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1	659261 BTHOLD 7 115.0 659307 SWMINOT CP7115.0 1
		80.59	14.47					652464 DENBIGH TAP7115.0 659113 VOLTAIR7 115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
		80.5	14.55					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659155 LOGAN 7 115.0 1
659261 BTHOLD 7	115.0	94.51		96.08		97.64		SYSTEM INTACT	
				89.22	6.86	90.65	6.99	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
						90.65	6.99	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				89.44	6.64	90.76	6.88	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		87.79	6.71					605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		86.85	7.66			90.78	6.86	615347-615348-615349 GRE-MCHENRY4 230/115/12 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		87.94	6.57	89.51	6.57			652440 NELSON 7 115.0 652449 MAX 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				89.52	6.56			652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				89.23	6.85	90.66	6.98	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
						90.65	6.99	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1
		87.4	7.11					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		87.6	6.9					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
				89.44	6.64	90.76	6.88	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
		87.45	7.06					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		86.88	7.62					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1

		87.6	6.91	89.51	6.57			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
				89.53	6.55			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1
659307 SWMINOT CP7	115.0	95.33		97.51		99.62		SYSTEM INTACT	
				86.14	11.37	87.68	11.94	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
						87.68	11.94	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				86.37	11.14	87.8	11.82	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		84.59	10.73					605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		83.57	11.75			87.82	11.8	615347-615348-615349 GRE-MCHENRY4 230/115/12 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
		84.75	10.57	86.44	11.07			652440 NELSON 7 115.0 652449 MAX 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				86.46	11.05			652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
				86.15	11.36	87.69	11.93	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
						87.68	11.94	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1
		84.17	11.16					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
		84.39	10.94					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
				86.37	11.14	87.8	11.82	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
		84.22	11.1					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
		83.61	11.72					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	615347-615348-615349 GRE-MCHENRY4 230/115/12 1
		84.39	10.94	86.45	11.06			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
				86.47	11.04			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1
		84.16	11.16					659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	CONTINGENCY B2.SOR-VEL-MCH
659308 KENASTON 7	115.0	93.37		94.78		96.16		SYSTEM INTACT	

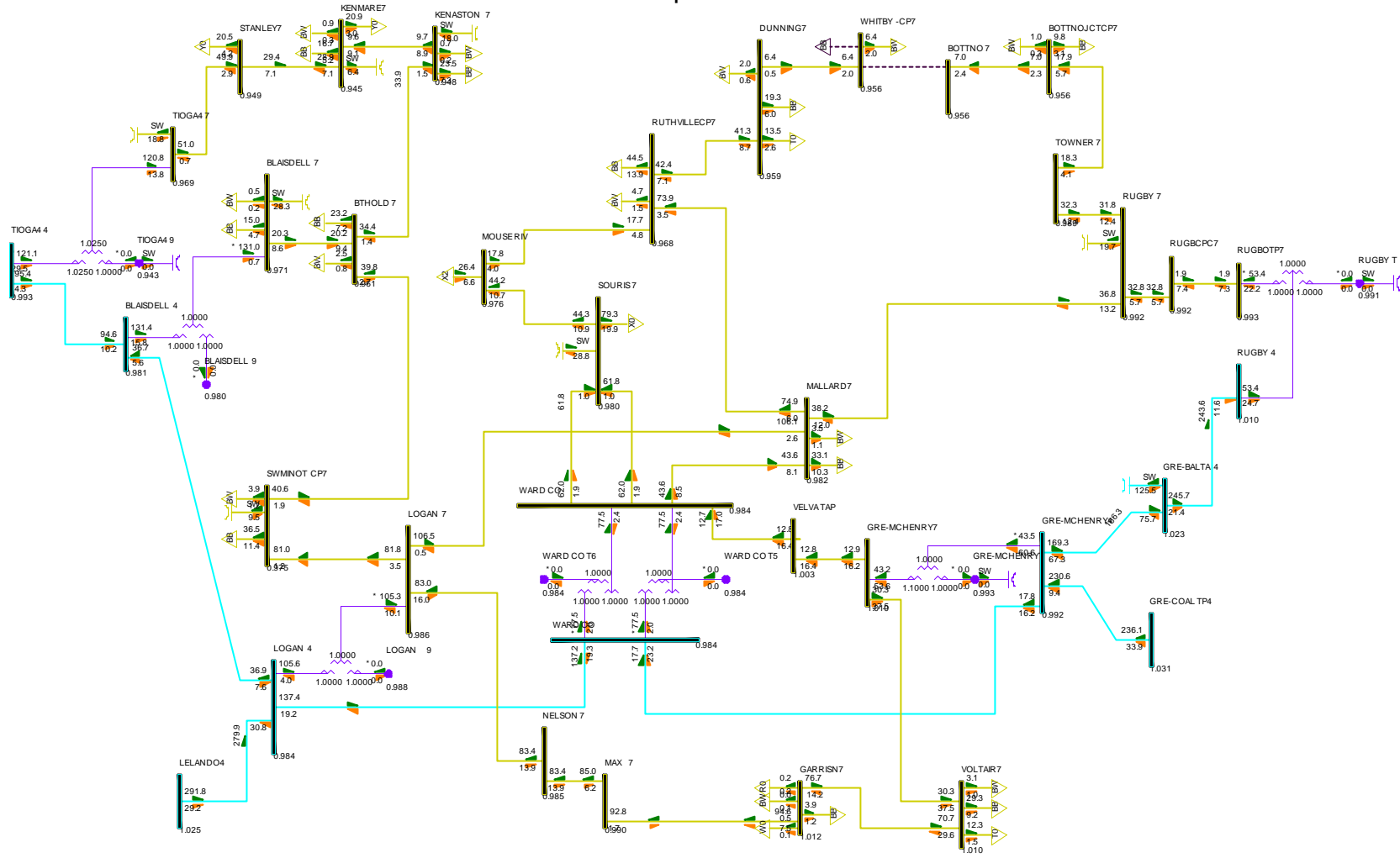
			88.54	6.24	89.84	6.33	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
					89.88	6.28	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
			88.71	6.07	89.94	6.22	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
87.27	6.1						605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
86.38	6.99						615347-615348-615349 GRE- MCHENRY4 230/115/12 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
87.4	5.97		88.75	6.03	89.95	6.22	652440 NELSON 7 115.0 652449 MAX 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
			88.77	6.02			652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1
			88.55	6.23	89.84	6.32	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	602052 WARD CO 230.0 615347 GRE-MCHENRY4230.0 1
					89.88	6.28	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	602052 WARD CO 230.0 659108 LOGAN 4 230.0 1
86.87	6.5						659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603022 SOURIS 7 115.0 605634 VELVA TAP 115.0 1
87.04	6.32						659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 652440 NELSON 7 115.0 1
			88.71	6.07	89.94	6.22	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	603023 MALLARD7 115.0 659165 RUTHVILLECP7115.0 1
86.91	6.45						659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	605634 VELVA TAP 115.0 615348 GRE-MCHENRY7115.0 1
86.41	6.95						659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	615347-615348-615349 GRE- MCHENRY4 230/115/12 1
87.04	6.32		88.76	6.02	89.95	6.21	659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	652440 NELSON 7 115.0 652449 MAX 7 115.0 1
			88.78	6.01			659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	652440 NELSON 7 115.0 659155 LOGAN 7 115.0 1
86.86	6.5						659155 LOGAN 7 115.0 659307 SWMINOT CP7115.0 1	CONTINGENCY B2.SOR-VEL- MCH

# Appendix D: Powerflow Diagrams & Log sheets.

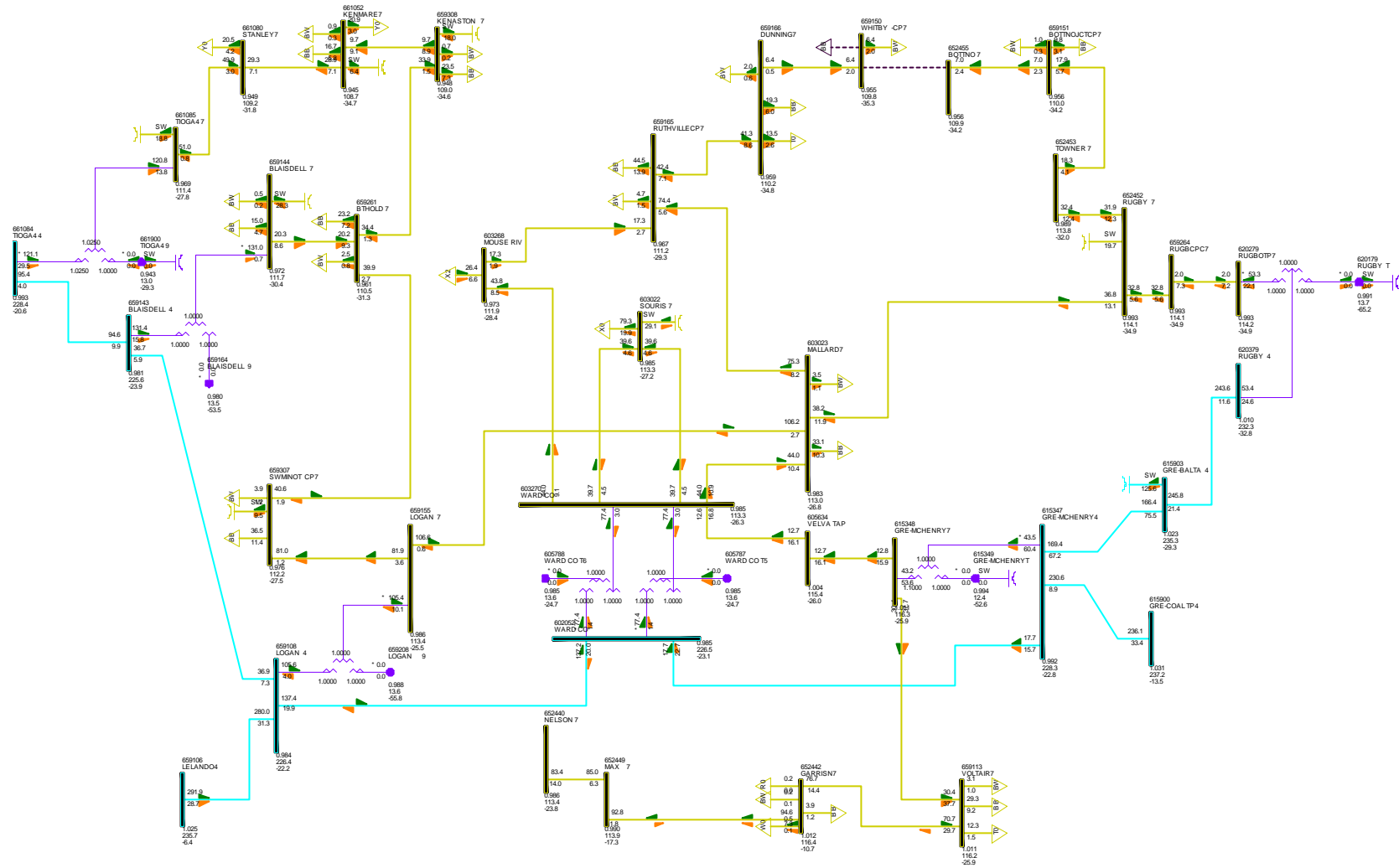
## Base Case



### Option A

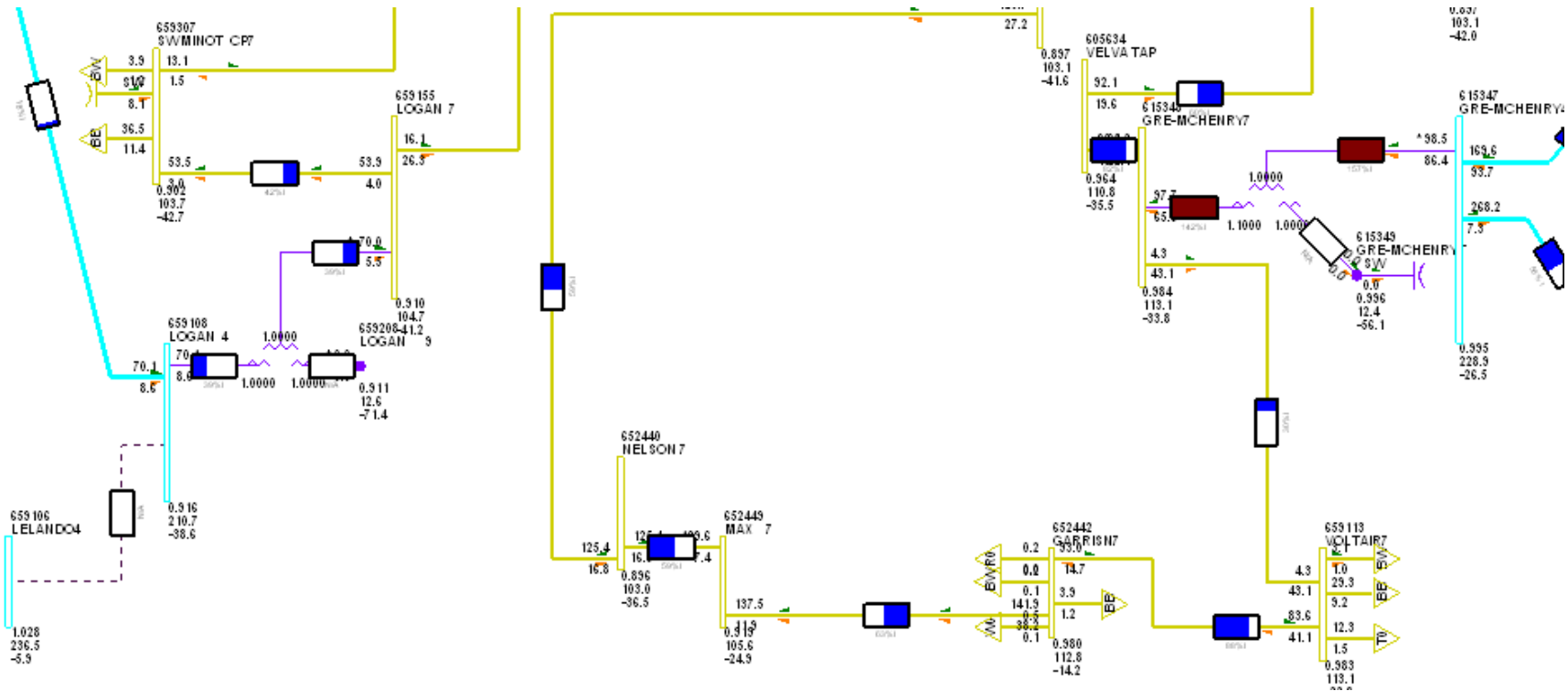


### Option B



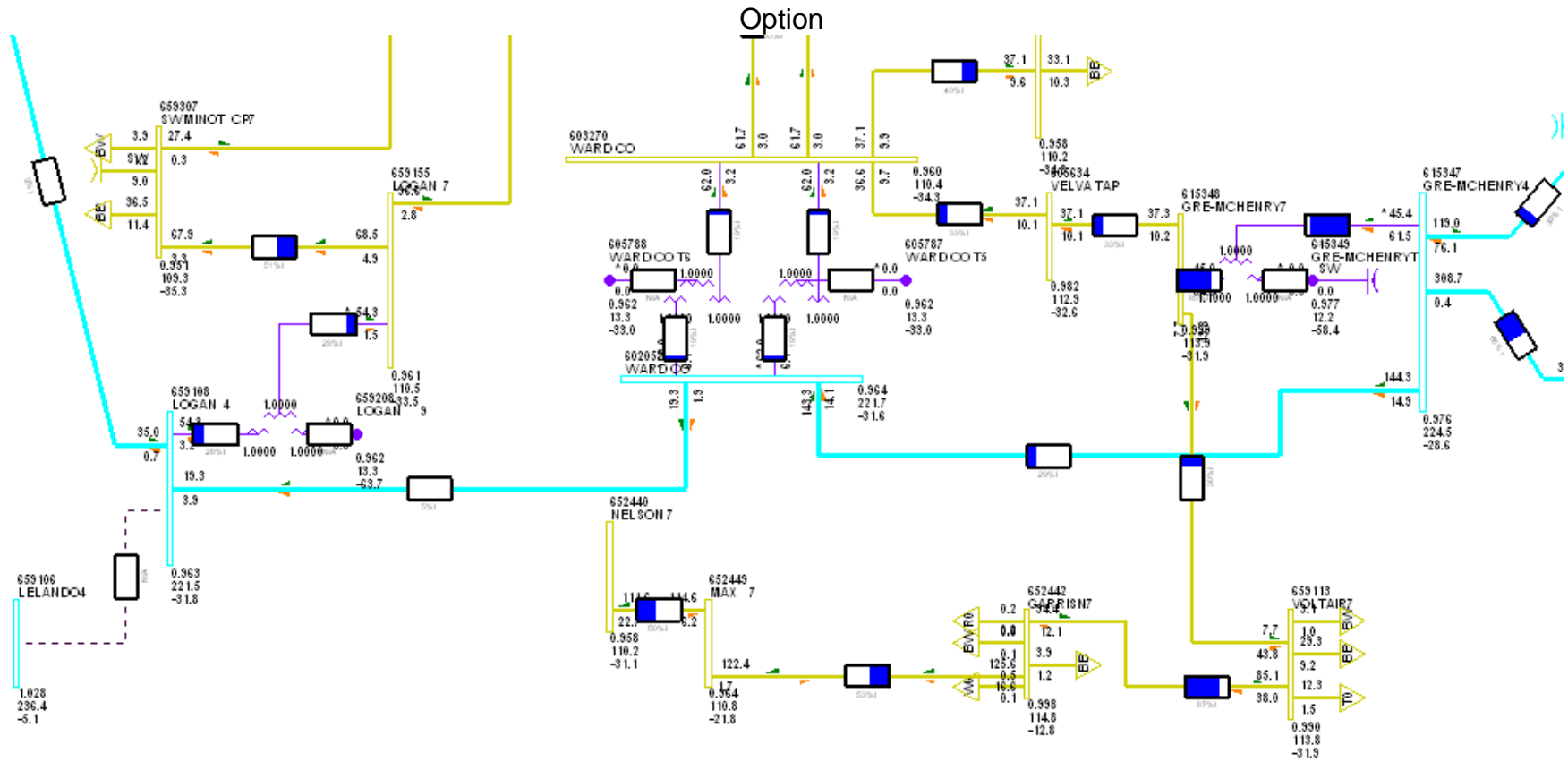


### Base Case Loss of Leland Olds – Logan 230 kV

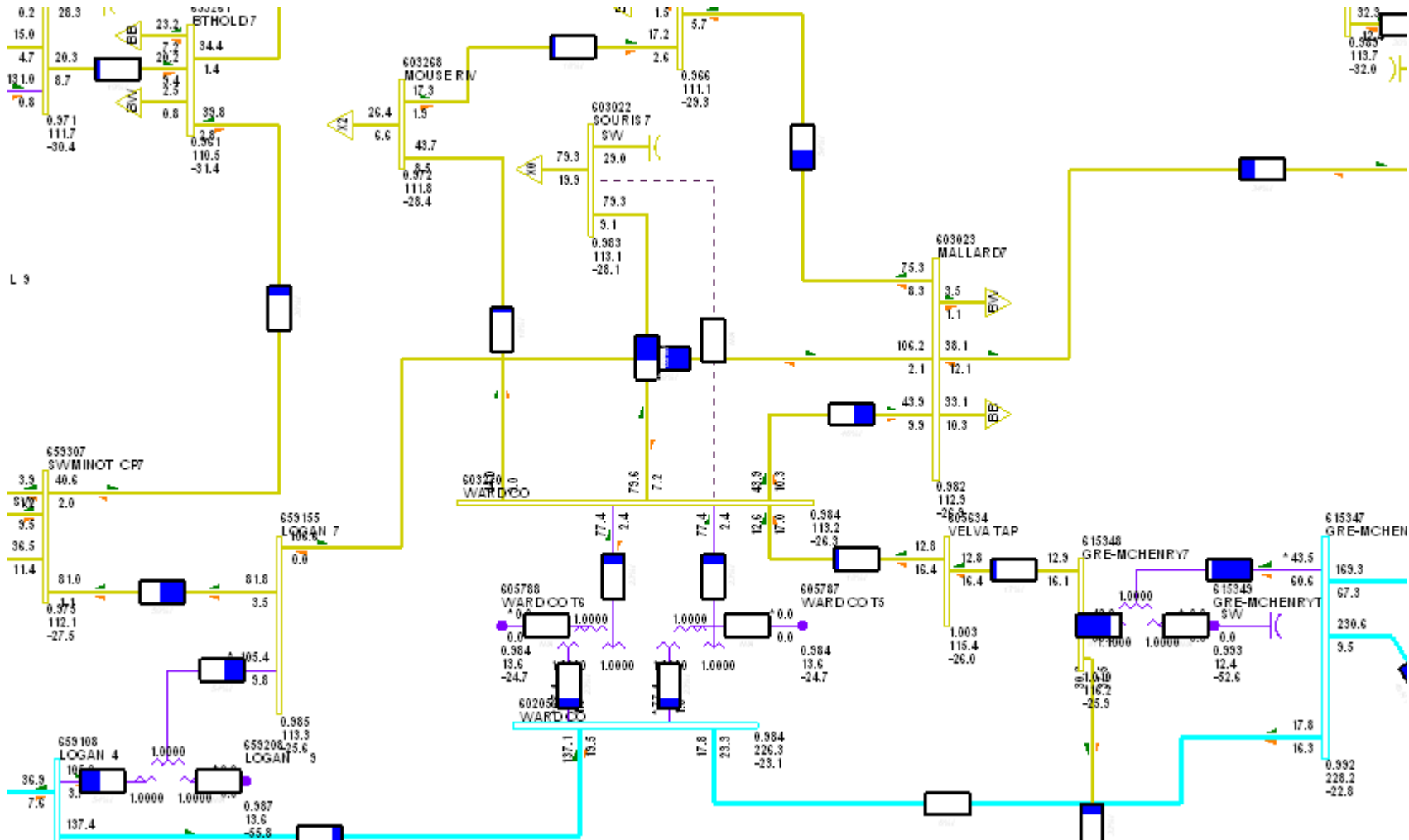




Option A Loss of Leland Olds – Logan 230 kV



### Option B Loss of Ward County – Souris 115 kV





## Appendix E: Constrained Interface Analysis.

Not Applicable

## Appendix F: Power System Losses data.

```

Base Model
PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, OCT 30 2013  9:36
M000-WP24AA.SAV;WINTER;PK LD;SYSTEM INTACT           :
ND=-296,MH=810,Mw=708,OHMH=0,OHMP=0,EWTW=206,BD=-65  :
FROM TO LOAD TO BUS GNE BUS TO LINE FROM TO -NET INTERCHANGE-
GENE- AT AREA TO BUS GNE BUS TO LINE FROM TO TO TIE TO TIES
DESIRED
X-- AREA --X RATION BUSES SHUNT DEVICES SHUNT CHARGING LOSSES LINES + LOADS NET IN
113.3          637727.6 621687.0 -2.6 0.0 227.6 0.0 15815.6 0.0 0.0

Option 1
PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, OCT 30 2013  9:40
M001-WP24AA.SAV;WINTER;PK LD;SYSTEM INTACT           :
ND=-293,MH=811,Mw=709,OHMH=0,OHMP=0,EWTW=206,BD=-67  :
FROM TO LOAD TO BUS GNE BUS TO LINE FROM TO -NET INTERCHANGE-
GENE- AT AREA TO BUS GNE BUS TO LINE FROM TO TO TIE TO TIES
DESIRED
X-- AREA --X RATION BUSES SHUNT DEVICES SHUNT CHARGING LOSSES LINES + LOADS NET
INT
113.3          637722.2 621686.9 -2.6 0.0 227.6 0.0 15810.2 0.0 0.0

Option 2
PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS®E      WED, OCT 30 2013 10:52
M002-WP24AA.SAV;WINTER;PK LD;SYSTEM INTACT           :
ND=-292,MH=811,Mw=709,OHMH=0,OHMP=0,EWTW=206,BD=-67  :
FROM TO LOAD TO BUS GNE BUS TO LINE FROM TO -NET INTERCHANGE-
GENE- AT AREA TO BUS GNE BUS TO LINE FROM TO TO TIE TO TIES
DESIRED
X-- AREA --X RATION BUSES SHUNT DEVICES SHUNT CHARGING LOSSES LINES + LOADS NET
INT
113.3          637722.4 621686.9 -2.6 0.0 227.6 0.0 15810.4 0.0 0.0

```

## Appendix G: Options' Components & Indicative Costs.

## Appendix H: Incremental transfer analysis input & output.

Not Applicable

## Appendix I: Base Case Modeling Assumptions & Input Parameters.

### Base Case Modeling Assumptions

- Added the 30 Mvars of capacitors at Souris substation
- Total NSP load of 109 MVA (2024) with .97 powerfactor
- Turned off the Velva, ND Prairie Wind, and Rugby wind farms

- Removed the Logan to Whitby 230 kV project and associated load
- Set B10T to 65 MW's north
- A third model was created using the MRO 2024 winter peak case with north transfers

### **Bulk Transmission Modeling Assumptions**

25 mile McHenry – Ward Co 230 kV line (477 T-2 conductor assumed)

.00475 p.u. R                      .0355 p.u. X                      .075 p.u. B

517/568 MVA Normal/Emergency Rating

Ward County 230/115 kV transformers are 336 MVA with 7% impedance @200 MVA

### **Option A Modeling Assumptions**

Souris – Ward County 115 kV lines rebuild using 477 T-2 conductor

.00518 p.u. R                      .03752 p.u. X                      .0056 p.u. B

258/284 MVA Normal/Emergency Rating

5 mile Souris – Mouse River 115 kV (477 T-2 conductor assumed)

.0037 p.u. R                      .0268 p.u. X                      .004 p.u. B

258/284 MVA Normal/Emergency Rating

NSP Minot Load split 75%/25% for Souris/Mouse River substations

### **Option B Modeling Assumptions**

15 mile Ward County – Mouse River 115 kV (477 T-2 conductor assumed)

.0111 p.u. R                      .0804 p.u. X                      .012 p.u. B

258/284 MVA Normal/Emergency Rating

## **APPENDIX B**



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# **Addendum to Joint Minot Load Serving Study**

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Xcel Energy Services; Transmission Planning

David Brauch Xcel Energy

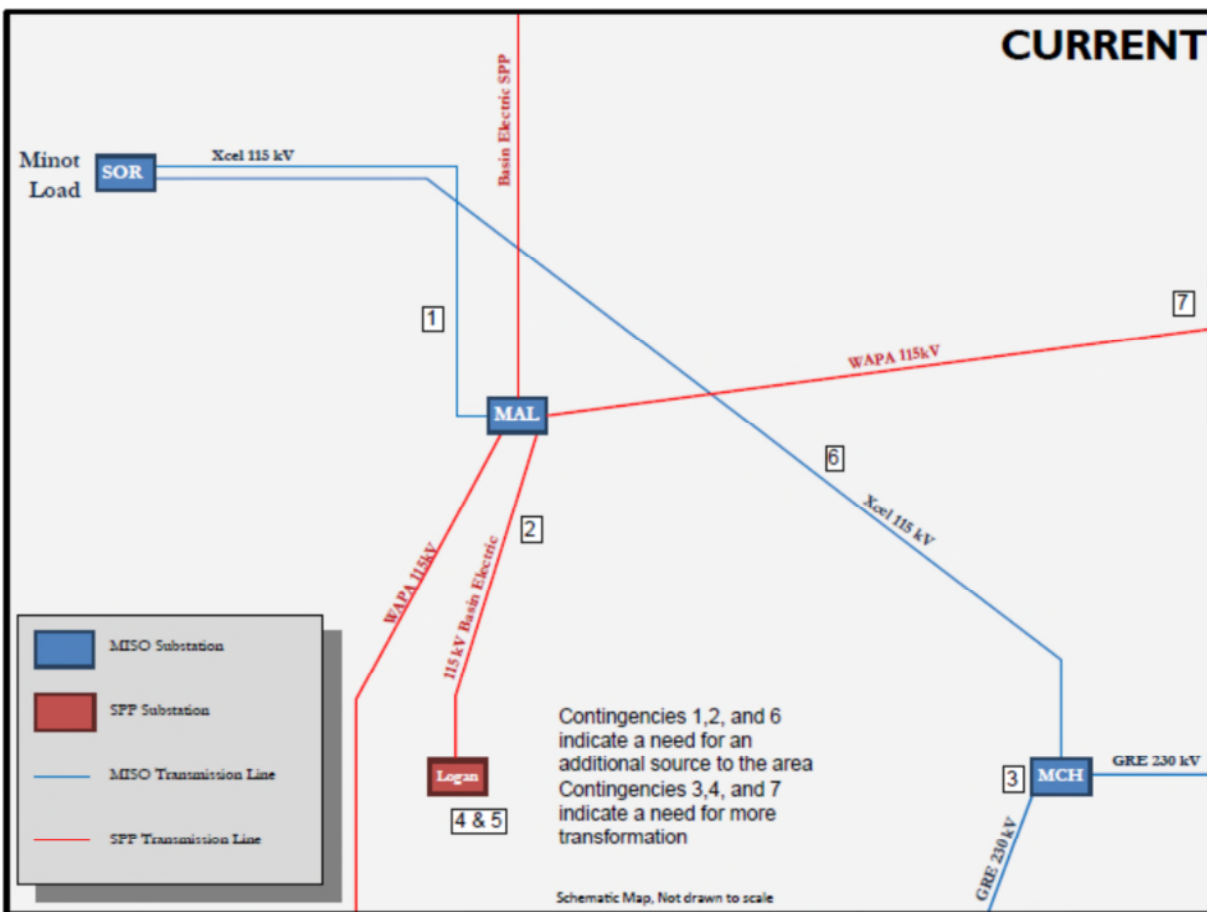
August 2016

This addendum has been prepared to clarify the phased approach to constructing the facilities identified in the Joint Minot Load Serving Study (Minot Study)( dated March 27, 2015) as necessary to address the transmission issues in the Minot area. The Minot Study included recommendations for proposed Xcel Energy and Basin Electric Power Cooperative transmission facilities.

At this time, Xcel Energy is proposing to construct a subset of these facilities to address the near term thermal overloads on the McHenry substation 230/115 kV transformer during certain contingency conditions. The facilities proposed by Xcel Energy will also address low voltage conditions on the Souris – McHenry and Souris – Mallard 115 kV lines, which currently serves Xcel Energy’s Minot load, during certain contingency conditions. The tables below summarize the overload and low voltage conditions that will be addressed with these proposed near term upgrades.

Figure 1 below shows the current facilities serving the load in and around Minot. The critical current and near term contingencies are also shown on Figure 1 and are numbered 1-7. The seven contingencies shown generate both thermal and voltage concerns for the loads in the Minot area.

**Figure 1**



**Table 1**

Transmission Line	Contingency Label	Voltage	Voltage Drop	Contingency
Souris-McHenry 115 kV line		94.58		System Intact
	1	86.44	8.13	Loss of Souris to Mallard 115 kV
	2	80.66	13.91	Loss of Mallard to Logan 115 kV
	3	87.99	6.58	Loss of McHenry 230/115 kV Transformer
	4	89.07	5.51	Loss of Leland Olds to Logan 230 kV
	5	86.2	8.38	Loss of Logan 230/115 kV Transformer
	6	89.07	5.51	Loss of Souris – Velva – McHenry 115 kV
Souris-Mallard 115 kV line		94.86		System Intact
		80.18	14.86	Loss of Mallard to Logan 115 kV
		89.54	5.32	Loss of McHenry 230/115 kV Transformer
		90.83	4.03	Loss of Balta to Rugby 230 kV
	7	90.66	4.2	Loss of Ruby 230/115 kV Transformer
		89.09	5.77	Loss of Leland Olds to Logan 230 kV
		86.06	8.8	Loss of Logan 230/115 kV Transformer
	90.69	4.17	Loss of Souris – Velva – McHenry 115 kV	

Please note that the minimum acceptable voltages on a transmission line under contingency conditions is 92 percent. As shown in Table 1, under the seven different contingencies, the voltage on either the Souris-McHenry 115 kV line or the Souris-Mallard 115 kV line drops below 92 percent and these facilities experience low voltage conditions.

Table 2 below documents the overloads observed on the McHenry substation 230/115 kV transformer. The transformer should not exceed 100 percent of its ratings. As shown in Table 2, under system intact conditions and in a variety of contingency conditions, this transformer experiences overloads.

**Table 2**

Circuit Element	MVA Rating	Loading Percent	Contingency
McHenry 230/115 kV Transformer	84.0	114.6	System Intact
		160.4	Loss of Souris to Mallard 115 kV
		178.7	Loss of Mallard to Logan 115 kV
		159.3	Loss of McHenry to Balta 230 kV
		188.2	Loss of Balta to Rugby 230 kV
		154.7	Loss of Rugby 230/115 kV Transformer
		145.4	Loss of Garrison to Voltaire 115 kV
		165	Loss of Logan 230/115 kV Transformer

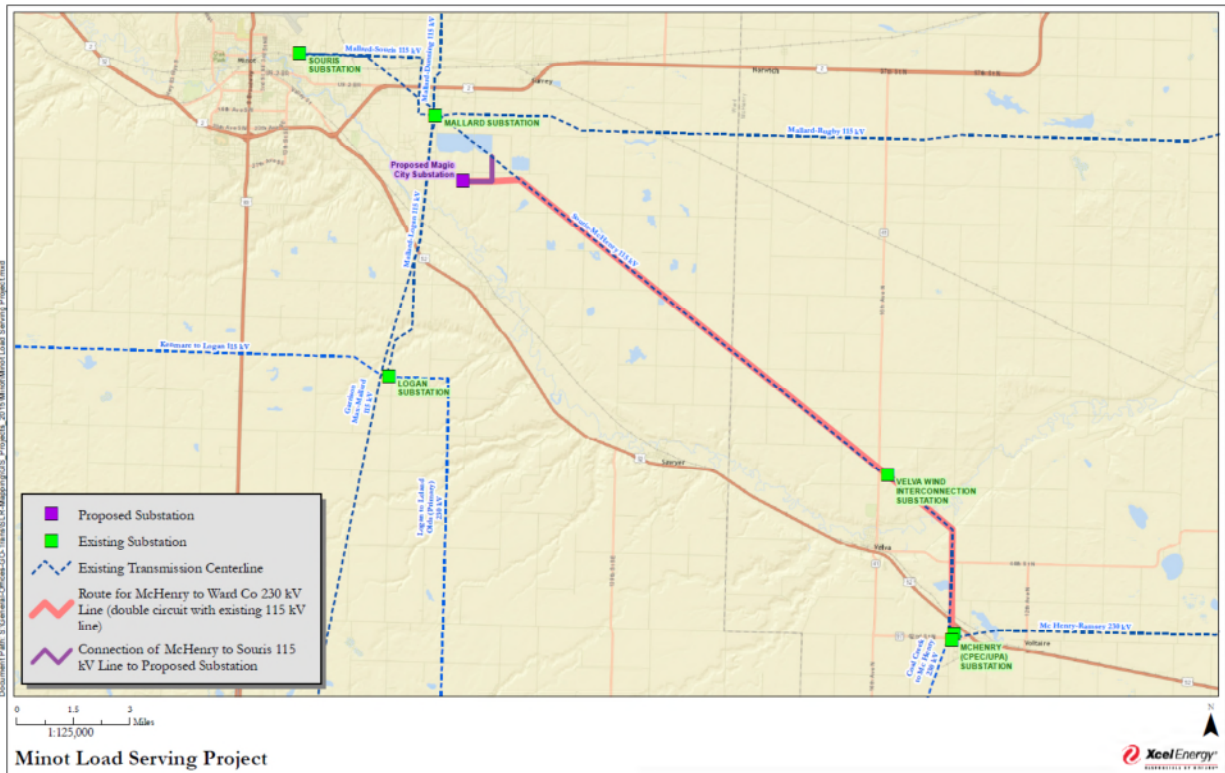
To address these existing and near term overloads and low voltage conditions, Xcel Energy proposes to construct the following facilities in 2018:

- A new 230/115 kV Magic City substation east of Minot; and
- A new 230 kV line connecting Great River Energy's (GRE) McHenry Substation to the new Magic City substation.

Collectively, these facilities are referred to as the Minot Load Serving Project and are shown in Figure 2 below. The new 230 kV transmission line and new 230/115 kV transformer will unload the identified overload facilities as well as provide voltage support to increase the reliability in the area. Specifically, the proposed new 230 kV line between the McHenry Substation and the new Magic City substation will address the low voltage conditions identified in Table 1 by bringing an new source to serve the load in Minot to support voltages and provide capacity for system intact and contingent conditions. The proposed Magic City substation and its new 230/115 kV transformer will relieve the overloads on the McHenry substation transformer by increasing the transformation capacity in the area to support the loads in the area of Minot.

The proposed 230 kV line is to be constructed as double circuited with the existing Souris-McHenry 115 kV line. To avoid taking the existing 115 kV line out-of-service to construct the new 230 kV circuit, the double circuit line would be built parallel to the existing line. Once the new line is in-service, the old 115 kV line will be taken out of service and removed. This will maintain reliable service to area as the proposed upgrades are constructed.

**Figure 2**



Xcel Energy will continue to monitor the load growth in the area and will propose additional projects as necessary to ensure reliable service in the area.

These potential future improvements are listed below:

- 1) Magic City to Souris 115 kV lines rebuild proposed when the load at Souris exceeds 120 MVA.
- 2) Mouse River Substation and new Souris to Mouse River 115 kV line proposed when the load exceeds the capacity of the existing Souris substation. Currently, Souris has three 50 MVA transformers and distribution forecasts that Souris will exceed its capacity in approximately 10 to 20 years depending on load growth in the area.

Xcel Energy submitted these proposed solutions into MISO’s open planning process and were approved as reliability projects in MTEP15.

In addition to the long-term facilities proposed by Xcel Energy, Basin Electric Power Cooperative may also propose to convert their existing Logan – Mallard 115 kV line to 230 kV and interconnect this line into the new Magic City Substation. It is anticipated that Basin will construct these upgrades when they receive Southwest Power Pool (SPP) notice to construct through SPP’s open planning process.

