Xcel Energy

414 Nicollet Mall
Minneapolis, MN 55401

November 1, 2017

—Via Electronic Filing—

Daniel P. Wolf
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

RE: DISTRIBUTION SYSTEM/HOSTING CAPACITY STUDY
DOCKET NO. E002/M-17-777

Dear Mr. Wolf:

Northern States Power Company, doing business as Xcel Energy, submits our Distribution System/Hosting Capacity Study in compliance with Minn. Stat. § 216B.2425, subd. 8, as well as the Commission's August 1, 2017 Order in Docket No. E002/M-15-962.

Pursuant to Minn. Stat. § 216.17, subd. 3, we have electronically filed this document with the Minnesota Public Utilities Commission, and copies have been served on all parties on the attached service lists.

Please contact me at bria.e.shea@xcelenergy.com or 612-330-6064 if you have any questions regarding this filing.

Sincerely,

/s/

BRIA E. SHEA
DIRECTOR, REGULATORY & STRATEGIC ANALYSIS

Enclosures
c: Service Lists

STATE OF MINNESOTA
BEFORE THE
MINNESOTA PUBLIC UTILITIES COMMISSION

Nancy Lange	Chair
Dan Lipschultz	Commissioner
Matthew Schuerger	Commissioner
Katie J. Sieben	Commissioner
John A. Tuma	Commissioner

IN THE MATTER OF THE XCEL ENERGY 2017 HOSTING CAPACITY REPORT UNDER MINN. STAT. § 216B.2425, SUBD. 8

DOCKET NO. E002/M-17-777

HOSTING CAPACITY REPORT

INTRODUCTION

Northern States Power Company, doing business as Xcel Energy, submits this Hosting Capacity Report in compliance with Minn. Stat. § 216B.2425 subd. 8, as well as the Commission's August 1, 2017 Order in Docket No. E002/M-15-962. As also required under Minn. Stat. § 216B.2425, today we are filing our Biennial Grid Modernization Report today in Docket E002/M-17-776 and the joint Biennial Transmission Projects Report with the other utilities that own or operate electric transmission lines in Minnesota in Docket No. E999/M-17-377.

Xcel Energy recognizes hosting capacity as a key element in the future of distribution system planning and anticipates it will have the potential to further enable Distributed Energy Resources (DER) integration by guiding future installations and identifying areas of constraint. As noted in the June 15, 2017 Commission hearing on this issue, we have made significant progress in our efforts to advance the value of this report in a meaningful way. We have made these improvements in response to stakeholder feedback, learnings from other utilities around the country, and our work with EPRI. Specifically, we have made the following improvements since our last report submitted in December 2016:

- *Visual representation.* In addition to Attachment A, which provides a Microsoft Excel spreadsheet with hosting capacity for more than 1,000 feeders in Minnesota, we also provide a heat map as a visual representation of these study results. Specifically, the 2017 hosting capacity analysis is displayed as a visual layer overlaid upon a geographical map in order to improve the experience and usefulness for end users of the data. The hosting capacity results are color coded based on the minimum available hosting capacity and displayed as a wider zone that encompasses the primary distribution line and a buffer on each side. The buffering was performed to alleviate customer privacy and security concerns associated with displaying detailed maps of how customers are fed by the Company's electric facilities. The interactive map is hosted on Xcel Energy's website at https://www.xcelenergy.com/working_with_us/how_to_interconnect

- *Existing DER.* The most recent revision of the hosting capacity tool allows for incorporating existing DER in the analysis which will lead to significant improvements in the accuracy of results for feeders with existing DER when compared to the 2016 analysis. The existing DER must be reflected in the geographical information system (GIS) in order to be included in the analysis. It is standard practice to include all DER in GIS, but recent experience with detailed studies has found some instances where mapping records are out of date. In addition to the existing DER, we also included all DER that would likely be in-serviced, but had yet to be built. We did that by adding projects into the analysis that had signed Interconnection Agreements as of July 31, 2017.

- *IEEE 1453 simplified method for voltage fluctuation.* Voltage fluctuation thresholds based on the Company's simplified adoption of the IEEE 1453 methodology[1] are included in this analysis for the primary voltage deviation. We used a value of two percent in our previous analysis for voltage deviation, and used three percent in our updated analysis.

  We maintained the voltage regulator deviation at 50 percent of voltage regulator bandwidth in our updated analysis. The voltage regulator bandwidth is set to 2.4 Volts on a 120 Volt based, which means the voltage regulator deviation is triggered at 1.2 Volts on a 120 Volt base, or a value of approximately one percent. The simplified IEEE 1453 approach allows for a two percent voltage deviation at voltage regulators. We discovered the bandwidth being set lower than intended (at 2.4 Volts) within the Synergi software script late in the analysis process, which accounts for the discrepancy. This threshold did not impact any feeders in our 2017 analysis, but we have flagged it for update to 4.8 Volts in our 2018 hosting capacity analysis.

- *Large Centralized Methodology.* We initially used our hosting capacity tool's "small distributed" methodology in our 2016 analysis due to our application of the Commission's Order to focus on "small-scale distributed-generation resources, defined as one megawatt (MW) or less." Based on feedback from stakeholders, which furthered our understanding of the value hosting capacity provides to

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[1] Compliance – Transition to Incorporating the Standards of IEEE 1453, Community Solar Gardens Program, Docket No E002/M13-867, April 26th, 2017

potential users of the analysis in Minnesota, we implemented the "Large Centralized" methodology for our 2017 hosting capacity analysis. The Large Centralized methodology more accurately reflects characteristics of DER deployment associated with programs such as Solar*Rewards Community.

- *Advanced Inverter Settings.* The updated version of our hosting capacity tool allows for setting DER to use a non-unity fixed power factor setting. The Company sees this method as a preferred low cost mitigation strategy that is currently supported by national standards and equipment type-testing certification. The non-unity fixed power factor is a common mitigation we use during detailed engineering studies. We require DER to be capable of operating with a fixed power factor in the range of +/-0.9, but typically limit initial deployment power factors to between unity and 0.95 leading (absorbing reactive power).

  Our 2017 hosting capacity results assume a fixed power factor of 0.98 leading for all new DER, in order to approximate the hosting capacity gains associated with use of non-unity power factors. We also modeled the power factors of the existing and anticipated DER on the system. It is unknown what power factor is optimal for new DER, which is why we chose a value of 0.98 leading, as it represents approximately the middle of the range of anticipated non-unity power factor values.

- *Inclusion of storage.* The new version of our hosting capacity tool results can be extended to energy storage that is acting as a source of power. This inverter-based technology impacts the system in a similar manner as solar photovoltaic or other inverter-based generation and thus the results apply to storage output modes. Standards do not currently fully define the requirements or characteristics of storage operating as a load, and thus the load aspects of storage are not considered in the hosting capacity analysis.

- *Excluding back-up DER.* Our initial 2016 hosting capacity analysis listed all installed DER regardless whether the DER would parallel or connect with the distribution grid. This included back-up generators that operate only in stand-alone mode once the customer has disconnected from the grid. DER that is not connected to the grid has no impact on hosting capacity. For our 2017 hosting capacity results, we only included DER that operates in grid-connected mode in the analysis. This will lead to a more accurate reflection of hosting capacity when compared to including stand-alone generation.

- *Protection change – Breaker Reduction of Reach.* The breaker reduction of reach threshold indicates where a DER may be desensitizing the feeder breaker protection to a level that faults on the line may not be detected. Our 2016 hosting capacity analysis used a threshold of five percent, and this threshold was frequently the limiting factor for minimum hosting capacity. Upon further inspection of detailed study results for interconnection and discussion with experts in system protection engineering, we raised the threshold to 10 percent for our 2017 hosting capacity analysis. The higher threshold should still indicate where system protection impacts require closer review, while not masking other limiting factors that may require more costly mitigations, such as thermal discharge limits that require a conductor upgrade.

And while the efforts discussed above demonstrate the significant progress we have made, we acknowledge that more work still needs to take place as we continue to refine our hosting capacity tool and its abilities. However, we think this report is an important step toward helping parties understand the process and gives additional insight as to potential feeder capacity. The determination of exactly where and how much DG can be added to our system will be determined through the interconnection process, and this analysis provides helpful insight to further improve that process.

We remind readers that this study presents the discreet hosting capacity of individual feeders without analysis of the cumulative effects of DER additions to substations or the transmission system. As distributed generation (DG) penetration increases, system constraints are likely to limit hosting capacity in various geographical areas. For instance, a substation may have three feeders with 3 MW of available capacity on each – but the substation or transmission systems may not have 9 MW of available capacity. As actual penetration increases, we will need to further analyze upstream ramifications. As a result, this study is not a holistic system view, but rather a snapshot of the capabilities of individual feeders as they are positioned today.

Industry experts suggest that a hosting capacity study should encompass six key requirements: (1) granular, (2) repeatable, (3) scalable, (4) transparent, (5) proven, and (6) available. Further, ICF's *Integrated Distribution Planning* report prepared for the Commission noted that a hosting capacity analysis should be robust enough to satisfy three purposes: (1) indication of distribution feeder capacity for DER, (2) streamlining interconnection studies, and (3) annual long-term distribution planning.[2] We believe our 2017 hosting capacity report satisfies all six of the fundamental requirements suggested by industry experts, furthers achievement of the three purposes identified by ICF, and meets the requirements of the underlying Minnesota statute and the Commission's Orders.

[2] *Integrated Distribution Planning*, August 2016, ICF International.

We present our study as follows:

A. Background
B. DER Defined
C. Hosting Capacity Tool – DRIVE
D. Methodology
E. Assumptions
F. Thresholds
G. Impacts and Mitigation
H. Accuracy
I. Results
J. Non-Public Data

DISTRIBUTION SYSTEM STUDY

A. Background

Minn. Stat. § 216B.2425, subd. 8. requires that a utility operating under an approved multiyear rate plan:

> *Shall conduct a distribution study to identify interconnection points on its distribution system for small-scale distributed generation resources and shall identify necessary distribution upgrades to support the continued development of distributed generation resources, and shall include the study in its report required under subdivision 2.*

Subsequently, Order Point 3 of the Minnesota Public Utilities Commission's June 28, 2016 Order in the above-referenced docket required we submit the distribution study by December 1, 2016, which will:

> a. *include the initial analysis of the hosting capacity of each feeder on the Xcel distribution system for small-scale distributed-generation resources, defined as resources that are 1 MW or less; and*
> b. *identify potential distribution upgrades necessary to support expected distributed generation resource additions including, in aggregate, distributed-generation resources that are in the Company's integrated-resource-plan filings and those that are active in the Company's community-solar-garden process.*

The Commission's August 1, 2017 Order clarified the purpose of the hosting capacity report as: (1) to inform and facilitate interconnection processes over time; and (2) to inform and facilitate distribution planning. The Order also set-out guidance and recommendations for our next Hosting Capacity Report as follows:

1. The Commission will require that the 2017 Hosting Capacity Report be detailed enough to provide developers with a reliable estimate of the available level of hosting capacity per feeder at the time of submittal of the report to the extent practicable. The information should be sufficient to provide developers with a starting point for interconnection applications.
2. The Commission will require that the 2017 Hosting Capacity Report be detailed enough to inform future distribution system planning efforts and upgrades necessary to facilitate the continued efficient integration of distributed generation.
3. Xcel shall provide a color-coded, map-based representation of the available Hosting Capacity down to the feeder level. This information should be provided to the extent it is consistent with what Xcel believes are legitimate security concerns. If security concerns arise, Xcel shall explain in detail the basis for those concerns.
4. Xcel shall provide the Hosting Capacity results in downloadable, MS-Excel or other spreadsheet file formats.
5. Xcel shall provide (at a minimum) in its next Hosting Capacity Report the information requested by Commission staff and parties in response to the 2016 Report (through comments or information requests) regarding data used in the modeling, including model assumptions and methodology, reasons for the model assumptions and methodological choices, additional detail on the model used and its inherent assumptions.
6. Xcel shall provide information on the accuracy of the Hosting Capacity Report information; both estimates on the accuracy of the 2017 report and an analysis of the 2016 results compared to actual hosting capacity determined through any interconnection studies or other reasonable metric.
7. Xcel shall file a Hosting Capacity Report on an annual basis, by November 1 of each year.

In support of order point 5 above, we provide a compliance matrix as Attachment B detailing both the information requested in response to our 2016 report as well as the location where we have provided the information.

B. DER Defined

For purposes of our hosting capacity analysis, our working definition of DER is:

> *Sources and groups of sources of electric power that are not directly connected to a bulk electric system. DER includes both generators and energy storage technologies capable of exporting active power to the area electric power system (EPS).*

We expect the next revision of IEEE 1547 will define DER, and we intend to adopt the definition found in the revised standard for DER interconnection-related efforts.

We note that the ability of DER to add or reduce capacity depends on the operating characteristics of the DER and the location on the system. DER that behaves primarily as an energy source (i.e. PV, wind, bio-mass) tends to only reduce hosting capacity. In contrast, battery storage has the potential to act as a load to reduce thermal and voltage impacts, effectively increasing the hosting capacity. It is possible for large amounts of energy storage on a feeder acting as a load, at times of no DER generation or when the storage load greatly exceeds the DER generation, to cause system constraints that appear like typical system loading limits managed by utilities for many years.

Our analysis is relevant for DER that acts as an energy source on the distribution system. We did not take the load characteristics of DER devices such as energy storage into consideration in our analysis. Therefore, inclusion of an under voltage threshold was not necessary. DER sources that create reverse power flow may cause high voltage conditions. A DER device such as a battery storage device acting as a large load could potentially create low voltage conditions. Future analysis aimed at understanding storage device load characteristic impacts on the distribution system would need to include both load and generation characteristics of DER. Due to the nascent nature of the energy storage market in Minnesota, we excluded energy storage load characteristics from our analysis. However, in the future we plan to monitor the ability of our hosting capacity tool with regard to energy storage, and work to extract value where it exists.

C. Hosting Capacity Tool – DRIVE

The Electric Power Research Institute (EPRI) has defined hosting capacity as the amount of DER that can be accommodated on the existing system without adversely impacting power quality or reliability. As a means to automate and streamline hosting capacity analysis, EPRI introduced the Distribution Resource Integration and Value Estimation (DRIVE) tool in 2016. The DRIVE tool is based on EPRI's streamlined hosting capacity method, which incorporates years of detailed hosting capacity analysis by EPRI in order to screen for voltage, thermal, and protection impacts from DER.

Due to EPRI's work in the field and our recognition of the value that a hosting capacity tool would bring, we sought out a partnership with EPRI in 2015 to assist in the development of the DRIVE tool. We believe that using an existing tool, such as DRIVE, will best guide the process at this time, given that it is a new process for the Company, and also a relatively new process to the industry.

A combination of lessons-learned from our first experience implementing the software solution, and updates in the development of DRIVE, have allowed us to provide an expanded and improved 2017 report – confirming our confidence in this tool. We note that the Joint Utilities of New York,[3] Salt River Project, Tennessee Valley Authority, and Southern Company, among others, are also currently using DRIVE. This benefits the industry in creating consistency with the application and methodologies, as well as ongoing collaboration through user group meetings and stakeholder participation.

There are currently four ways of performing a hosting capacity analysis, with two of them being widely accepted in the industry. One of the common methods has been proposed in California and is known as the Iterative Capacity Analysis (ICA), which is an intensive analysis that tries to precisely answer the specific level of DER that can be accommodated at each node, through detailed power flow analysis that is similar to an interconnection engineering study. While this process is still being fully developed and refined, the intent is to enable bypassing an interconnection study altogether – with the rigorous analysis being done prior to application.

The other common method, which we chose, is a more streamlined approach that EPRI developed and has proven over many years of work. This method originated from EPRI research comparing detailed power flow results with options to streamline the analysis. This method is less data intensive, but has proven to be reasonably accurate in steering DER interconnections to potential "best" locations. The intent of this analysis is to guide interconnections while also informing the planning of the system. Combining this analysis with a detailed interconnection study is the most efficient way to bring DER onto the distribution system.

[3] Con Edison, National Grid, Central Hudson, Orange and Rockland, NYSEG/RGE

Table 1: Processing Time for Iterative and Streamlined Simulations for San Diego Gas and Electric[4]

	Average run time per circuit	Average # of circuits per bus	Average run time per bus
Iterative	27 hours	4.6	124.2 hours
Streamlined	0.5 hours	4.6	2.3 hours

San Diego Gas and Electric, which also uses Synergi as their power flow program, reported that there were significant differences in the time it took to run the analysis between the ICA and streamlined approach.[5] As seen in Table 1 above, the time it took to produce the ICA result was more than 50 times longer per feeder than the streamlined approach. Applying this approach to the more than 1,000 feeders in Minnesota would result in very significant increase in study time.

The computational runtime associated with the iterative method might be manageable for a single scenario that is run system-wide annually, but may not be appropriate for objectives that require multiple scenarios or more frequent updates. For example, the ability to operate the distribution system in abnormal feeder configurations is becoming a growing concern with higher penetration of DER, and the number of scenarios to perform this type of analysis can be large. Adjusting inverter settings for sensitivity analysis is another example of how scenarios can quickly multiply.

The hosting capacity tool required to meet evolving system planning requirements needs to be agile. We are still exploring how to best meet the range of interconnection needs, and it is possible that an additional tool may be best suited if a future objective were to streamline detailed study analysis. A tiered approach such as this to tooling would be in sync with many state interconnection processes that use different types of tools for screening and studies. The level of accuracy associated with the methods in each process would be tailored to meet the specific need for the level of review.

Enhancements that EPRI has made to the DRIVE tool since our 2016 report include the ability to:

- Analyze available hosting capacity by including existing DER;
- Examine the hosting capacity when DER has reactive power control;
- Consider losses in the hosting capacity analysis;

[4] Demo A report, in regard to the California Distribution Resources Plan. *See* http://drpwg.org/wp-content/uploads/2016/07/R.14-08-013-DRP-Demos-A-B-Reports-SDGE.pdf

[5] Although very similar to the EPRI method, this streamlined approach was developed by PG&E and is not exactly like the EPRI Method.

- Perform thermal analysis based on element power flow ratings;
- Analyze non-three phase systems; and

There are also improvements to other functionality not related to hosting capacity analysis results (i.e., saving settings, plotting capabilities, etc.).

D. Methodology

1. Overview

For this 2017 hosting capacity analysis, we created 1,047 feeder models in Synergi Electric, which is the distribution load-flow program we use. The information for these models primarily came from our Geographic Information System (GIS). We supplemented the GIS information with data from our 2017 load forecast and customer demand and energy data. To create the feeder models, we extracted asset data from GIS to Synergi – after which, we ran a series of "clean-up" scripts to provide model assumptions and address any common issues that may be present in the data.

This includes tasks such as setting the head-end voltage, setting the burial depths on underground cable, setting the height of overhead conductor above the ground, placing equipment settings into capacitors, reclosers, and regulators, among other things. If errors persisted in the model, we dug deeper to find the source(s) of the issues, which included consulting other maps, asking field workers for visual inspections, or even calling Synergi to assist with unique occurrences.

Once we addressed all identified errors in a particular model, we allocated the load to the feeder based on demand data and customer energy usage data. At this point, we ran a load-flow and performed a final check for any abnormalities on the feeder. After creating all of the feeder models, we analyzed them using DRIVE, which performed the hosting capacity technical analysis.

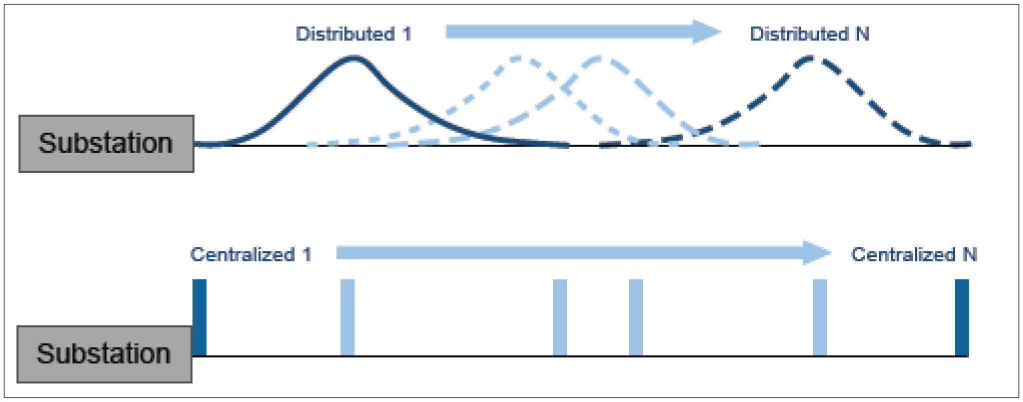
2. DER Allocation Method

Within the DRIVE tool there are three methods for allocating DER across a feeder, with each method intended to cover a different DER deployment scenario:

1. *Large Centralized:* Considers Large DER at a single location and does not consider DER at any other location on the feeder.
2. *Large Distributed:* Considers distribution of large DER at different feeder locations.

3. *Small Distributed:* Considers distribution of small DER at different feeder locations.

Figure 1: Difference Between the Distributed and Centralized DER Scenarios

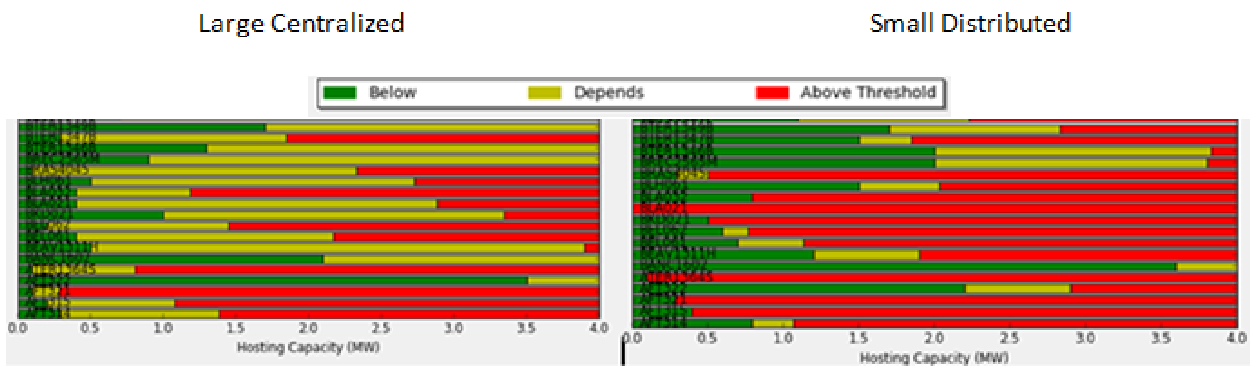


As discussed earlier, we used the Small Distributed method in our 2016 hosting analysis, and in this 2017 analysis, we used the Large Centralized method.

Use of the Large Centralized method does not affect *how* we model the system. However, it *does affect the results* by generally showing a larger maximum hosting capacity and smaller minimum hosting capacity. The Large Centralized methodology only focuses on installations on three phase lines, which generally have more capacity and better align with the types of installations we are seeing on our system. This smaller minimum hosting capacity that results from this method is due to the concentration at specific locations, which has the tendency to affect the over-voltage and thermal thresholds a little more than distributing the load across the feeder. Consequently, that concentration also unmasks the potential to add more generation at ideal locations on the feeder (maximum hosting capacity).

Figure 2 below shows a comparison between the two methods on a handful of our feeders. The feeders in the Small Distributed plot are more limited in the "above threshold" category, which corresponds with the maximum hosting capacity – while also having larger values in the "below" category, which corresponds to the minimum hosting capacity.

Figure 2: Illustrative Example of the
Small Distributed and Large Centralized Methodologies



E. Assumptions

Below are the series of assumptions we applied to our hosting capacity analysis.

Data – We assumed the data from GIS was correct. In some instances however, we made modifications to the data after verification. The primary validation technique occurred while creating the feeder models within Synergi, which is our distribution load flow tool – and is used to model different scenarios that occur on the distribution system. As we manually allocate load to the feeder and run a load flow process, exceptions sometimes occur. Areas of the feeder are then highlighted due to overloading, high or low voltage, connectivity issues, etc. The engineer would then further investigate the feeder model for any obvious issues, such as field equipment turned off or a lack of connectivity. If that did not fix the problem, the engineer would then consult GIS or feeder maps that may have information different from what is in the model. In rare occasions, we asked employees with more knowledge of the local areas to verify some of the perceived issues. When data modifications were necessary, they typically included conductor changes or various equipment updates.

Secondary Conductors – Secondary conductors connect from service transformers to the customer service entrance. The characteristics of secondary conductors combined with a high level of DER can lead to high voltage conditions on the customer premise. This has the potential to trigger conductor upgrades for interconnection of small residential or commercial DER systems. Since detailed secondary or low-voltage conductor information is not recorded in GIS, we were unable to account for the impacts beyond the medium-voltage (aka primary) distribution system. However, as discussed in our May 5, 2017 Reply Comments in Docket No. E002/M-15-962, we have traditionally assumed a 3 Volt drop across the secondary conductors and transformers to ensure compliance with ANSI C84.1. This means that when we model voltages on the primary system, we subtract three additional volts to better quantify the actual voltage at the customer level.

Conductor Spacing – Conductor spacing, or the distance between lines, impacts the electrical characteristics of distribution lines. In the Synergi impedance model, we assumed that the conductor spacing was the same for each voltage class. While we know this is not the case, the majority of our system is at 13.8 kV, and we used that standard as the default. While there are other configurations on our system, most of those were constructed over 30 years ago, and we do not have good historical information regarding their conductor spacing.

Capacitors – For modeling purposes, it is important to know the state of every capacitor bank. However, at any point in time this is not known for the entire system, because the on/off status of each capacitor bank is not recorded along with load. Consequently, we assumed that each capacitor bank was switched on at peak, unless known to be offline. The state of the capacitor banks is driven by voltage and not by the peak hour. Even though our base assumption was that all capacitor banks were on at peak, if an over-voltage condition was witnessed, the capacitor would automatically switch off in the analysis just like it would do in the field. Therefore, the hour of the peak condition is irrelevant with regard to the capacitor status. For off-peak load analysis, we used a feature inside the DRIVE tool to switch off the capacitor banks where possible to more closely mimic that particular condition.

Loading Levels – We populated each feeder model with peak load information that was scaled down to 20 percent by the DRIVE tool to represent the Daytime Minimum Loading. The source of the peak load data was our SCADA system. If SCADA data was not available, we obtained the peak load from our manual monthly peak substation read process. Similar to our approach in the interconnection study process, we use 20 percent of peak demand for calculating daytime minimum load for feeders that do not have SCADA enabled, or other methods of determining the actual daytime minimum load. We initially relied on this value as a result of a National Renewable Energy Laboratory (NREL) paper.[6] Since that time, we have compared it to nearly 150 feeders where we have SCADA data on our system and where interconnection requests have been submitted, concluding that it is representative of our system.

Load Allocation – We allocated loads for the models on a section-by-section basis, which were based on the combination of appropriate load curves by customer type

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[6] "Updating Interconnection Screens for PV System Integration." *See* http://www.nrel.gov/docs/fy12osti/54063.pdf

and customer energy usage. When available, we also used demand data from primary metered customers

*Feeder Topology – A*s a normal course of business, we regularly reconfigure feeders. For purposes of this analysis however, we assumed the configuration of the system is correct and static. Therefore, this analysis is a point-in-time snapshot of hosting capacity as of the date of our analysis – which is a reality of any analysis of the distribution system.

Head-end Voltage – For the analysis, we set the voltage at the head-end of a feeder to 125 Volts on a 120 Volt base. This corresponds to 104 percent of whatever the nominal voltage is of a particular feeder. While the actual head-end voltage at different substations varies slightly, the 104 percent is intended to provide a realistic worst-case scenario in order to catch potential overvoltage impacts.

Distributed Generation Output – 100 percent of the allowed distributed generation output was assumed to be flowing on the associated distribution feeders during the boundary conditions of Peak load and Daytime Minimum Loading which were used for the analysis.

In addition, we note that we excluded from the study 49 feeders serving low voltage networks located in the downtown Minneapolis and St. Paul areas. We excluded these feeders in our analysis because they are not detailed in the GIS system and have not previously been modeled. The special operating characteristics of secondary networks and processes to interconnect distributed generation is documented in "NSPM Network Connected PV Recommended Practice Based on Evaluation of Industry Practices, Standards and Experience" revision 2, dated June 17, 2014.[7]

We also did not analyze a handful of other feeders that we serve, because we do not own them.

F. Thresholds

DRIVE has eleven criteria thresholds that we can use to determine hosting capacity on a given piece of equipment. We chose to use six of those thresholds – excluding the remaining due to limitations of the calculation or non-applicability to DER. We describe the thresholds in more detail in Table 2 below.

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7 System Planning and Strategy (NSPM) and Electric Distribution System Performance (EDSP) https://www.xcelenergy.com/staticfiles/xe/Corporate/Corporate%20PDFs/NSPM_PVNetwork_06_17_2014_Final_R2.pdf

Table 2: Hosting Capacity Thresholds

Criteria	Description	Threshold	Basis
Primary Over-Voltage	High voltage exceeds nominal voltage by threshold	105%	ANSI C84.1 Range A – Maintain quality of service to customers
Primary Voltage Deviation	Change in Voltage from no DER to full DER	3%	MN Tariff Section 10, Sheet No. 146 – Maintain power quality for customers
Regulator Voltage Deviation	Change in bandwidth from no DER output to full DER output at a regulated node	50%	Prevent reliability and power quality issues by avoiding excessive regulator operations
Thermal for Discharging DER	Element rating	100%	Continue reliable customer service by staying within the normal ratings of existing elements
Additional Element Fault Current	Deviation in feeder fault currents	10%	Based on worst case scenarios from internal studies – maintain customer reliability
Breaker Relay Reduction of Reach	Deviation in breaker fault current	10%	Based on worst case scenarios from internal studies – maintain customer reliability
Sympathetic Breaker Tripping	*Breaker zero sequence current due to an upstream fault*	*Not used*	*For the analysis method used (Large Centralized) the criteria does not affect the hosting capacity*
Primary Under-Voltage	*Low voltage below nominal voltage threshold*	*Not used*	*Not a condition typically created by DER, unless considering the load aspects of energy storage*
Thermal for Charging DER	*Remaining element capacity at Peak Loading*	*Not used*	*Not a condition typically created by DER, unless considering the load aspects of energy storage*
Reverse Power Flow	*Element minimum loading*	*Not used*	*Criteria is applied on a section by section basis which lowers min hosting capacity to zero in all cases*
Unintentional Islanding	*Element minimum loading*	*Not used*	*Criteria is applied on a section by section basis which lowers min hosting capacity to zero in all cases*

G. Impacts and Mitigations

The Commission's June 28, 2016 Order required the Company to:

> *…identify potential distribution upgrades necessary to support expected distributed generation resource additions including, in aggregate, distributed-generation resources that are in the Company's integrated-resource-plan filings and those that are active in the Company's community-solar-garden process.*

The potential distribution upgrades necessary are dependent on the type(s) of constraints on each individual feeder.

For feeders that have constraints and require additional upgrades to support higher levels of DG integration, we have some options for increasing hosting capacity, depending on the individual situation. In the tabular study results provided as Attachment A, we identify the primary constraint impacting the feeder. Depending on the feeder, there may be additional constraints impacting the feeder as well, but these are not shown.

Table 3 below shows the impacts we analyzed and the potential mitigations that could be implemented to increase hosting capacity. The specifics of each feeder and DER interconnection proposal are instrumental in determining the most appropriate and lowest cost mitigation for that specific situation. The mitigations can vary in degree from being fairly straightforward, to relatively complex. Therefore, a detailed study is needed to determine the optimal solution when DER is proposed on our feeders.

Table 3: Potential Mitigations

Category	Impacts	Mitigation
Voltage	Over-voltage	Adjust DER power factor setting, reconductor
	Voltage Deviation	Adjust DER power factor setting, reconductor
	Equipment Voltage Deviation	Adjust DER power factor setting, adjust voltage regulation equipment settings (if applicable), or reconductor
Loading	Thermal limits	Reconductor, replace equipment
Protection	Additional element fault current	Adjust relay settings, replace relays, replace protective equipment
	Breaker Relay Reduction of Reach	Adjust relay settings, replace relays, move or replace protective equipment
	Sympathetic Breaker Relay Tripping	Adjust relay settings, replace relays, move or replace protective equipment

Our standard procedure is to first study using low-cost mitigation options such as adjusting DER power factor, before considering higher-cost options such as reconductoring. The specific characteristics of the feeder determine the effectiveness of certain mitigations (such as using a non-unity fixed power factor for the DER), and those mitigations may differ depending upon the location of the installation. Accordingly, providing blanket mitigations to increase the hosting capacity of each feeder will not always efficiently match the required needs for a particular installation.

H. Accuracy

In compliance with the Commission's August 1, 2017 order, in this section we provide information on the accuracy of the 2016 Hosting Capacity Report as well as an estimate of the accuracy of the 2017 report. And while the exact process to determine accuracy was not ordered by the Commission, it was suggested by parties that we use the interconnection study results as the point of comparison for accuracy. As we discussed in the Commission's June 2017 hearing on the hosting capacity report, it is extremely difficult to effectively compare our hosting capacity results to actual interconnection study and screening results for a variety of reasons, which we discuss below.

- The models used for our hosting capacity results are different than those used in studying interconnections. We have internally developed Synergi models for use in the hosting capacity analysis while our interconnection studies have primarily been developed by consultants, each using different software[8], that we hired to complete the interconnection studies. Some notable differences in the modeling include balanced versus unbalanced power flows and lumped versus distributed load allocation. We are in the process of changing this by asking our interconnection consultants to consistently use Synergi models.
- Our 2016 hosting capacity results did not include existing Distributed Generation in the analysis so any location with DG automatically shows a discrepancy when compared to study results.
- As discussed in our May 5, 2017 Reply Comments in Docket No. E002/M-15-962, we have updated many criteria. For instance, as of April 1, 2017, we updated our voltage deviation thresholds to be consistent with the IEEE 1453-2015 standard. Specifically, the new method uses a three percent voltage deviation threshold instead of the two percent found in the initial analysis. In addition, we also changed our breaker relay reduction of reach threshold from five percent to 10 percent from 2016 to 2017. The five percent value limited a lot of the feeders in 2016, making comparisons to the feeders that were limited by this threshold not valuable.
- Not all past interconnection studies specified the amount of generation that could be added to the distribution system without upgrades, hence the hosting capacity. Instead the studies stated the upgrades required to add the requested generation to the system, making the study results not comparable to our hosting capacity results. We are now working to implement a standard

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[8] SKM, PSSE, Open DSS, and others

interconnection study form that consultants fill that indicates the max capacity which should alleviate this issue going forward.

- For those studies that did provide the amount of generation that could be added without upgrades, quite often those amounts also included the use of a specific non-unity power factor. In our 2016 hosting capacity results the assumed power factor was unity while in 2017 the analysis assumed a 0.98 leading power factor for all new installations. This can have a fairly large effect, especially when trying to compare a hosting capacity value of unity to one that is 0.95, for instance.

- There are differing assumptions in the two processes due to the fact that the interconnection study is a detailed process and the hosting capacity study is performed at a higher system level. For instance, all feeders in the hosting capacity analysis were assumed to have a substation bus voltage of 1.04 Per Unit, while this is generally true across our service territory there are locations that employ bus voltages that differ and those were taken into account in the study process.

- In an attempt to look forward and incorporate future DER installations, many of the 2017 hosting capacity results already contained the projected installations that had been studied earlier in the year, making comparing it to the latest interconnection study irrelevant.

Taking the above issues into account, we identified 15 different feeders to compare for accuracy. They have all been analyzed in 2017 with the most up to date criteria, either through our screening or study process, and are considered "first in queue," meaning that no other large distributed generation exists on the feeder. Of the 15 feeders, 11 of them passed our "fast-track" technical screens and the remaining four went to a detailed interconnection study.

The 11 applications that passed the screens were divided into two groups: (1) six applications to compare to the 2016 results, and (2) five applications to compare to the 2017 results. This was determined by the fact that the 2017 results already contained the six applications in the analysis (as noted above), making it not possible to do a comparison. We provide a summary of the comparison below.

Table 4: Comparison of Hosting Capacity Results to Interconnection Screens and Studies

	Number of feeders/ applications	Number of favorable[9] results	Number of unfavorable[10] results	Value in which unfavorable Hosting Capacity results were below approved value (kW)
2016 Screens	6	5	1	700
2017 Screens	5	5	0	-
2017 Studies	4	3	1	300

The six technical interconnection screens that were compared to the 2016 hosting capacity results compared favorably. Three of the six screens fell below the minimum hosting capacity mark, while two of the others were slightly above the maximum. One of six was approved for over 700 kW greater than what the maximum hosting capacity value indicated. That is the only one that stands out, but still proves the hosting capacity method to be slightly conservative but reliable.

The five feeders/interconnection applications that were compared to the 2017 hosting capacity results all compared favorably. In four of those instances the DG value applied for was less than the calculated minimum hosting capacity, meaning that the value could be accommodated anywhere on the feeder. The remaining project applied, and was approved for a value that was greater than the minimum hosting capacity but less than the maximum, meaning that at the right location that value could be accommodated.

For the four studies that were comparable to 2017 hosting capacity results, one of them was comparable to the 2017 results straightaway and the remaining three needed modifications to the models in order remove the generation that was already accounted for. Once these modifications were completed and the analysis was rerun, all of the results compared favorably to the hosting capacity analysis. Three of the four studies were approved for installation values that fell between the minimum and maximum hosting capacity values. The lone project that had an installation value that exceeded the maximum hosting capacity was only 300kW different. Again, this proves that the analysis may lean slightly on the conservative side in regards to how much is allowed, but those values are small and still provide meaningful guidance.

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[9] Favorable defined as study or screening result values being either below the minimum hosting capacity or between the minimum and maximum hosting capacities indicated for that particular feeder.

[10] Unfavorable defined as study or screening result values being greater than the maximum hosting capacity indicated for that particular feeder.

It is important to note that in none of the comparisons did the hosting capacity indicate that the minimum hosting capacity for a given feeder was larger than what a study or screen result was. This means that the analysis is not inaccurately showing that there is capacity when there is not. Likewise, the comparison yielded no egregious errors that would indicate larger issues.

Overall, as we continue to strive for a consistent process from year to year and improve upon any discrepancies we encounter, our hosting capacity results, as well as our interconnections studies and screens, will continue to improve both in continuity and accuracy.

I. Results

The hosting capacity for a feeder is a range of values that depends on several variables including DER location, DER technology, feeder design, and feeder operation. Accordingly, the addition of new generation facilities on a feeder will reduce hosting capacity by an unknown value – predominately driven by the new DER location.

We provide the results of our 2017 hosting capacity study in both tabular form and as an interactive visual representation, or heat map. The results are a snapshot in time as of August 2017, and are just one tool for use in siting DER. The results are not intended to be used for approving interconnection requests at this time.[11] Rather, they are intended to be an initial indication as to how much DER can be placed on a given feeder. After consulting the heat map or tabular results, we recommend utilizing progressively more detailed tools, as follows:

1. Review the publicly-available Solar*Rewards Community interconnection queue. The queue is updated monthly and may include additional generation that was proposed after the snapshot in time from which hosting capacity analysis data is drawn.
2. Request pre-application data for the interconnection location of interest, in order to further identify characteristics of the circuit that may impact hosting capacity.
3. Submit an interconnection application for the site to initiate the screening and study process. A completed interconnection application is the mechanism in which a project enters into the queue and begins the process for reserving hosting capacity. The outcome of screening or studies will identify allowable interconnection size and mitigation costs.

[11] Our current Minnesota Electric Rate Book Section 9 and Section 10 interconnection tariffs provide the applicable processes for DER interconnections.

Figure 3 below is an example of the visual hosting capacity results as is now available on our https://www.xcelenergy.com/working_with_us/how_to_interconnect.

Figure 3: Example of Visual Hosting Capacity Results

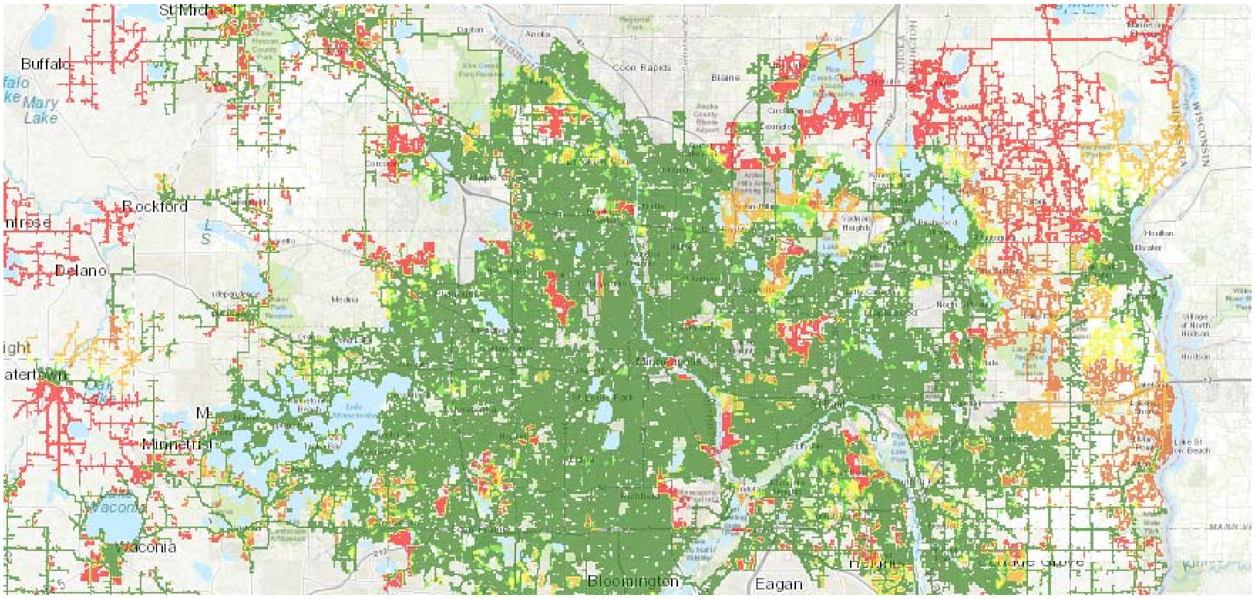
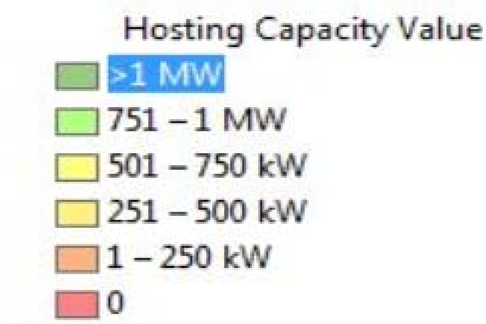


Figure 4 below provides the legend for the map, which is color-coded for varying levels of available hosting capacity.

Figure 4: Heat Map Legend



The map provides the amount of hosting capacity available without doing any mitigations. Therefore, while a location may show low hosting capacity, it is possible that mitigations could allow higher levels of DER to be interconnected; however, a study would need to be completed before that can be determined.

We note that we plan to dive further into the results, particularly where hosting capacity is low, to better understand and potentially address the areas with major constraints. For example, in our 2016 analysis we found a handful of locations that were limited by high voltage due to capacitor banks without controls that had recently been upgraded to have controls. We worked with our GIS department to properly document these in the system, which resulted in more accurate results for 2017.[12]

Users will be able to zoom in and zoom out – and will have the option for a full-screen view. For feeders that are in close proximity to another feeder that has differing available hosting capacity, we have indicated the higher of the two capacities.

J. Non-Public Data

In compliance with the Commission's August 1, 2017 Order requiring a discussion of the basis for any security concerns with the release of certain data, we note that we have removed certain feeders from the heat map in an effort to protect what we believe is private or confidential customer data, and/or critical distribution infrastructure information.

As we discussed in our September 21, 2017 Reply Comments in the Commission's grid modernization docket (Docket No. E999/CI-15-556), the issue of access and protection of distribution grid information is largely uncharted territory today. At the state level, the Commission has examined customer privacy and confidentiality in terms of Customer Energy Usage Data (CEUD) and customer Personally Identifiable Information (PII).[13] At a national level, we looked to guidance from the National Institute of Standards and Technology (NIST), North American Electric Reliability Corporation (NERC), and Federal Energy Regulatory Commission (FERC). We found that existing regulatory, legal, and industry frameworks provide little to no guidance with respect to data security protections and customer privacy and confidentiality considerations as it relates to distribution grid data.

We therefore considered these sources as advisory and developed criteria to apply to the visual hosting capacity results that would protect what we believe is sensitive and therefore non-public grid and customer information. We did this while also balancing public policy considerations that some may believe should result in full disclosure. In terms of customer privacy and confidentiality, we looked to the Commission's decisions on customer PII and CEUD. While grid and customer connection details are not a directly implicated in that proceeding, the Commission directed utilities to look to NIST principles for guidance with regard to collection and protection of

[12] This analysis is only meant as an initial look. Actual solutions and costs for constrained feeders need to come out of more detailed analysis.
[13] Docket No. E,G999/CI-12-1344.

customer PII – and required utilities to refrain from disclosing CEUD without the customer's consent unless the utility has adequately protected the customer's anonymity. In looking to NIST and other national standards that are generally applicable to the transmission grid, we found that they are broad and largely rely on utilities' judgement to apply them to their infrastructure.

We therefore applied our judgement within the broad guidance provided by these sources to develop criteria that we believe balances public policy objectives with the public interest, in terms of energy security – and our customers' interests, in terms of their privacy and confidentiality. We recognize that we are the first utility in Minnesota to encounter these privacy questions as they relate to hosting capacity, and look forward to Commission direction on the approach we have taken.

Specifically, we worked with our customer account management group to identify the customers and their associated feeder(s) that would fall into the following categories:

- Critical Energy Infrastructure on Distribution Feeder
- Critical Hospital - Level 1 or 2 Trauma Center on Distribution Feeder
- Critical Data Center on Distribution Feeder
- Critical Public Gathering Center on Distribution Feeder

We then identified feeders serving less than 15 premises, which we based on the threshold we apply to requests for aggregated CEUD – believing that feeders with such low density may provide insights into those customer locations that could compromise customer confidentiality and/or customer energy security.

We note that the Minnesota Government Data Practices Act (Minn. Stat. § 13.01 et seq.) addressing nonpublic data (Minn. Stat. § 13.02, subd. 9), private data on individuals (Minn. Stat. § 13.02, subd. 12), security information (Minn. Stat. § 13.37, subd. 1(a)), and trade secret information (Minn. Stat. § 13.37, subd. 1(b)), is not directly applicable here. The Minnesota Government Data Practices Act only addresses information held by state government. Here, the Hosting Capacity map developed by the Company has been publicly filed, and there is no Trade Secret or nonpublic version of this filed map on file with state government. Instead, in putting this map together, the Company has been sensitive to what could be considered to be nonpublic under this Act, and provided the heat map to reflect these concerns.

In light of these concerns, and the timing from the Commission's June 2017 hearing that set the requirement to provide the results of our study in a visual manner with submission of this report five months later, if there was a feeder with information we reasonably believed to be non-public, we excluded the entire feeder from the heat map by not providing any indicative color at all for that feeder. In total, we redacted 120 feeders out of a total of 1,047 in applying the criteria outlined above.

We believe the criteria we developed and applied to our heat map results are based on sound principles, and reasonably balance grid security, customer privacy, confidentiality, and energy security, and public policy objectives. For our 2018 report, we will look into refining our methodology after also considering feedback we receive on this report.

CONCLUSION

Xcel Energy recognizes hosting capacity as a key element in the future of distribution system planning. We anticipate it has the potential to further enable DER integration by guiding future installations and identifying areas of constraint. We will continue to work closely with stakeholders going forward and address other areas of opportunity in this analysis which provide value.

Dated: November 1, 2017

Northern States Power Company

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Afton	AFT314	0.1	Primary Over-Voltage - min	2.94	Breaker Relay Reduction of Reach - max
Afton	AFT315	0.1	Primary Over-Voltage - min	1.77	Breaker Relay Reduction of Reach - max
Afton	AFT321	0.1	Primary Over-Voltage - min	0.48	Breaker Relay Reduction of Reach - max
Afton	AFT322	4.8	Primary Over-Voltage - min	20	Primary Over-Voltage - max
Arden Hills	AHI021	0.4	Primary Over-Voltage - min	0.5	Primary Over-Voltage - max
Arden Hills	AHI022	0.4	Primary Over-Voltage - min	0.5	Primary Over-Voltage - max
Arden Hills	AHI024	0.4	Primary Over-Voltage - min	0.4	Primary Over-Voltage - max
Arden Hills	AHI025	0.4	Primary Over-Voltage - min	0.5	Primary Over-Voltage - max
Arden Hills	AHI063	0.9	Primary Over-Voltage - min	7.71	Breaker Relay Reduction of Reach - max
Airport	AIR060	0.29	Thermal for Gen - min	1.7	Breaker Relay Reduction of Reach - max
Airport	AIR061	1.8	Primary Over-Voltage - min	9.49	Thermal for Gen - max
Airport	AIR069	0.6	Primary Over-Voltage - min	6.92	Breaker Relay Reduction of Reach - max
Airport	AIR072	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Airport	AIR073	0.3	Primary Over-Voltage - min	5.54	Breaker Relay Reduction of Reach - max
Airport	AIR074	3.1	Primary Over-Voltage - min	8.41	Thermal for Gen - max
Airport	AIR077	1.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Airport	AIR078	5.53	Thermal for Gen - min	10	Primary Over-Voltage - max
Airport	AIR079	1.8	Primary Over-Voltage - min	8.12	Thermal for Gen - max
Airport	AIR62X	1.7	Primary Over-Voltage - min	8.39	Thermal for Gen - max
Albany	ALB021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Albany	ALB022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Aldrich	ALD071	0.49	Thermal for Gen - min	2.48	Breaker Relay Reduction of Reach - max
Aldrich	ALD072	1	Primary Over-Voltage - min	9.21	Breaker Relay Reduction of Reach - max
Aldrich	ALD073	1.17	Thermal for Gen - min	9.85	Breaker Relay Reduction of Reach - max
Aldrich	ALD075	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD076	0.22	Thermal for Gen - min	1.32	Breaker Relay Reduction of Reach - max
Aldrich	ALD081	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Aldrich	ALD082	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD083	0.15	Thermal for Gen - min	0.91	Breaker Relay Reduction of Reach - max
Aldrich	ALD084	1.17	Thermal for Gen - min	9.34	Breaker Relay Reduction of Reach - max
Aldrich	ALD085	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD086	0.6	Primary Over-Voltage - min	4.92	Breaker Relay Reduction of Reach - max
Aldrich	ALD087	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD088	1.17	Thermal for Gen - min	7.58	Breaker Relay Reduction of Reach - max
Aldrich	ALD091	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Aldrich	ALD092	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD093	1.1	Primary Over-Voltage - min	8.81	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Aldrich	ALD094	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD095	1.19	Thermal for Gen - min	10	Primary Over-Voltage - max
Aldrich	ALD096	0.49	Thermal for Gen - min	2.66	Breaker Relay Reduction of Reach - max
Aldrich	ALD097	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Aldrich	ALD098	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Air Lake	ALK063	1	Primary Over-Voltage - min	2.06	Breaker Relay Reduction of Reach - max
Air Lake	ALK064	1.17	Thermal for Gen - min	8.7	Breaker Relay Reduction of Reach - max
Air Lake	ALK067	3.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Air Lake	ALK072	0.7	Primary Over-Voltage - min	5.48	Breaker Relay Reduction of Reach - max
Air Lake	ALK073	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Altura	ALT021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Annandale	ANN021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Apache	APA061	2.1	Primary Over-Voltage - min	9.11	Breaker Relay Reduction of Reach - max
Apache	APA064	1.6	Primary Over-Voltage - min	8.61	Thermal for Gen - max
Apache	APA065	1.9	Primary Over-Voltage - min	8.96	Breaker Relay Reduction of Reach - max
Apache	APA067	0.8	Primary Over-Voltage - min	9.21	Thermal for Gen - max
Apache	APA068	1.5	Primary Over-Voltage - min	9.05	Thermal for Gen - max
Apache	APA069	1.6	Primary Over-Voltage - min	8.14	Thermal for Gen - max
Apache	APA071	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Apache	APA072	0.9	Primary Over-Voltage - min	5.51	Breaker Relay Reduction of Reach - max
Apache	APA073	1.7	Primary Over-Voltage - min	8.04	Breaker Relay Reduction of Reach - max
Apache	APA074	1.7	Primary Over-Voltage - min	8.05	Breaker Relay Reduction of Reach - max
Apache	APA075	1.5	Primary Over-Voltage - min	8.23	Breaker Relay Reduction of Reach - max
Apache	APA076	1.4	Primary Over-Voltage - min	8	Breaker Relay Reduction of Reach - max
Apache	APA077	2.1	Primary Over-Voltage - min	9.1	Breaker Relay Reduction of Reach - max
Apache	APA078	1.3	Primary Over-Voltage - min	8.67	Breaker Relay Reduction of Reach - max
Atwater	ATW061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Atwater	ATW062	0.1	Primary Over-Voltage - min	1.31	Breaker Relay Reduction of Reach - max
Avon	AVN021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Averill	AVR081	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Birch	BCH311	1	Primary Over-Voltage - min	4.4	Primary Over-Voltage - max
Battle Creek	BCK061	1.17	Thermal for Gen - min	1.17	Thermal for Gen - max
Battle Creek	BCK062	1.17	Thermal for Gen - min	1.17	Thermal for Gen - max
Battle Creek	BCK071	1.17	Thermal for Gen - min	1.17	Thermal for Gen - max
Battle Creek	BCK072	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Battle Creek	BCK073	0.6	Primary Over-Voltage - min	7.72	Breaker Relay Reduction of Reach - max
Battle Creek	BCK074	1.17	Thermal for Gen - min	1.17	Thermal for Gen - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Bassett Creek	BCR061	1.18	Primary Over-Voltage - min	8.44	Breaker Relay Reduction of Reach - max
Bassett Creek	BCR062	1.2	Primary Over-Voltage - min	7.06	Breaker Relay Reduction of Reach - max
Bassett Creek	BCR063	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Bassett Creek	BCR081	1.7	Primary Over-Voltage - min	8.83	Breaker Relay Reduction of Reach - max
Bassett Creek	BCR082	1.1	Primary Over-Voltage - min	8.75	Breaker Relay Reduction of Reach - max
Bassett Creek	BCR083	1.17	Thermal for Gen - min	7.29	Breaker Relay Reduction of Reach - max
Belgrade	BEG001	0	Primary Voltage Deviation - min	0	Primary Voltage Deviation - max
Becker	BEK021	0.1	Primary Over-Voltage - min	0.1	Primary Over-Voltage - max
Becker	BEK311	0	Primary Voltage Deviation - min	0	Primary Voltage Deviation - max
Belle Plaine	BEL061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Belle Plaine	BEL062	0	Primary Voltage Deviation - min	0	Primary Voltage Deviation - max
Buffalo Lake	BFL021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Bird Island	BIS001	0.1	Primary Over-Voltage - min	0.65	Breaker Relay Reduction of Reach - max
Bluff Creek	BLC061	1.3	Primary Over-Voltage - min	9.41	Breaker Relay Reduction of Reach - max
Bluff Creek	BLC062	0.8	Primary Over-Voltage - min	7.05	Breaker Relay Reduction of Reach - max
Bluff Creek	BLC063	0.9	Primary Over-Voltage - min	6	Breaker Relay Reduction of Reach - max
Bluff Creek	BLC071	1.3	Primary Over-Voltage - min	8.65	Breaker Relay Reduction of Reach - max
Bluff Creek	BLC072	0.9	Primary Over-Voltage - min	7.2	Breaker Relay Reduction of Reach - max
Blue Herron	BLH061	4.54	Thermal for Gen - min	7.64	Additional Element Fault Current - max
Blue Herron	BLH062	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Blue Lake	BLL062	1.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Blue Lake	BLL063	3.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Blue Lake	BLL064	3.6	Primary Over-Voltage - min	9.34	Thermal for Gen - max
Blue Lake	BLL071	1	Primary Over-Voltage - min	9.21	Breaker Relay Reduction of Reach - max
Blue Lake	BLL072	1.2	Primary Over-Voltage - min	4.21	Breaker Relay Reduction of Reach - max
Brooten	BRO021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Brooklyn Park	BRP061	1.1	Primary Over-Voltage - min	6.26	Additional Element Fault Current - max
Brooklyn Park	BRP062	0.8	Primary Over-Voltage - min	7.21	Additional Element Fault Current - max
Brooklyn Park	BRP063	1.7	Primary Over-Voltage - min	6.07	Additional Element Fault Current - max
Brooklyn Park	BRP071	1	Primary Over-Voltage - min	7.4	Breaker Relay Reduction of Reach - max
Brooklyn Park	BRP072	1.4	Primary Over-Voltage - min	9.45	Breaker Relay Reduction of Reach - max
Brooklyn Park	BRP073	1	Primary Over-Voltage - min	7.76	Breaker Relay Reduction of Reach - max
Brownton	BRW001	0.39	Thermal for Gen - min	0.39	Thermal for Gen - max
Butterfield	BTF001	0.3	Primary Over-Voltage - min	1.65	Additional Element Fault Current - max
Burnside	BUR022	1.06	Thermal for Gen - min	7.72	Breaker Relay Reduction of Reach - max
Burnside	BUR023	0.3	Primary Over-Voltage - min	3.4	Breaker Relay Reduction of Reach - max
Burnside	BUR032	0	Primary Over-Voltage - min	0	Additional Element Fault Current - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Baytown	BYT061	0.8	Primary Over-Voltage - min	6.84	Breaker Relay Reduction of Reach - max
Baytown	BYT071	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Baytown	BYT072	0.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Cannon Falls	CAF021	1.1	Primary Over-Voltage - min	2.81	Additional Element Fault Current - max
Cannon Falls	CAF022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Cedarvale	CDV061	1.3	Primary Over-Voltage - min	8.45	Breaker Relay Reduction of Reach - max
Cedarvale	CDV062	3	Primary Over-Voltage - min	9.35	Additional Element Fault Current - max
Cedarvale	CDV063	0.9	Primary Over-Voltage - min	7.14	Breaker Relay Reduction of Reach - max
Cedarvale	CDV071	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Cedarvale	CDV072	1.3	Primary Over-Voltage - min	8.33	Breaker Relay Reduction of Reach - max
Cedar Lake	CEL061	1	Primary Over-Voltage - min	7.93	Breaker Relay Reduction of Reach - max
Cedar Lake	CEL062	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Cedar Lake	CEL063	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Cedar Lake	CEL064	1	Primary Over-Voltage - min	7.15	Breaker Relay Reduction of Reach - max
Cedar Lake	CEL066	1.2	Thermal for Gen - min	9.29	Breaker Relay Reduction of Reach - max
Cedar Lake	CEL071	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Cedar Lake	CEL072	1.17	Thermal for Gen - min	9.26	Breaker Relay Reduction of Reach - max
Cedar Lake	CEL075	1.16	Thermal for Gen - min	10	Primary Over-Voltage - max
Cottage Grove	CGR061	0.6	Primary Over-Voltage - min	4.68	Breaker Relay Reduction of Reach - max
Cottage Grove	CGR062	2.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Cottage Grove	CGR063	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Cottage Grove	CGR064	0.8	Primary Over-Voltage - min	9.61	Breaker Relay Reduction of Reach - max
Cottage Grove	CGR071	1	Primary Over-Voltage - min	8.88	Breaker Relay Reduction of Reach - max
Cottage Grove	CGR072	1	Primary Over-Voltage - min	8.35	Breaker Relay Reduction of Reach - max
Cottage Grove	CGR073	6.02	Additional Element Fault Current - min	10	Primary Over-Voltage - max
Cottage Grove	CGR074	1	Primary Over-Voltage - min	8.93	Breaker Relay Reduction of Reach - max
Chemolite	CHE063	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Chemolite	CHE064	3.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Chemolite	CHE075	2.84	Additional Element Fault Current - min	4.4	Primary Voltage Deviation - max
Chemolite	CHE076	0.6	Primary Over-Voltage - min	5.35	Breaker Relay Reduction of Reach - max
Chisago County	CHI311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Clarks Grove	CKG041	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Clara City	CLC022	0.01	Breaker Relay Reduction of Reach - min	0.01	Breaker Relay Reduction of Reach - max
Clara City	CLC221	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Coon Creek	CNC061	1.9	Primary Over-Voltage - min	8.18	Breaker Relay Reduction of Reach - max
Coon Creek	CNC062	1	Primary Over-Voltage - min	6.33	Breaker Relay Reduction of Reach - max
Coon Creek	CNC063	1.2	Thermal for Gen - min	5.5	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Coon Creek	CNC071	1.2	Primary Over-Voltage - min	5.08	Breaker Relay Reduction of Reach - max
Coon Creek	CNC072	1.1	Primary Over-Voltage - min	6.43	Breaker Relay Reduction of Reach - max
Coon Creek	CNC073	0.5	Primary Over-Voltage - min	2.85	Breaker Relay Reduction of Reach - max
Cokato	COK061	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Crystal Foods	CRF061	2.1	Primary Over-Voltage - min	5.91	Additional Element Fault Current - max
Crystal Foods	CRF062	1.2	Thermal for Gen - min	5.91	Additional Element Fault Current - max
Crooked Lake	CRL027	1.06	Thermal for Gen - min	7.1	Breaker Relay Reduction of Reach - max
Crooked Lake	CRL031	1.06	Thermal for Gen - min	6.65	Breaker Relay Reduction of Reach - max
Crooked Lake	CRL033	1	Primary Over-Voltage - min	6.05	Breaker Relay Reduction of Reach - max
Crooked Lake	CRL065	1.4	Primary Over-Voltage - min	9.57	Breaker Relay Reduction of Reach - max
Castle Rock	CSR001	0.2	Primary Over-Voltage - min	1.02	Breaker Relay Reduction of Reach - max
Cannon Falls Transmission	CTF021	0.2	Primary Over-Voltage - min	1.61	Breaker Relay Reduction of Reach - max
Cannon Falls Transmission	CTF022	0.4	Primary Over-Voltage - min	2.06	Breaker Relay Reduction of Reach - max
Credit River	CTR021	1.06	Thermal for Gen - min	6.49	Breaker Relay Reduction of Reach - max
Credit River	CTR022	1.5	Primary Over-Voltage - min	8.21	Breaker Relay Reduction of Reach - max
Credit River	CTR031	0.4	Primary Over-Voltage - min	3.19	Breaker Relay Reduction of Reach - max
Danube	DAN021	0.2	Primary Over-Voltage - min	1.55	Breaker Relay Reduction of Reach - max
Dassel	DAS061	0.1	Primary Over-Voltage - min	1.77	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL060	0.3	Primary Over-Voltage - min	1.61	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL061	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL062	0.87	Thermal for Gen - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL063	1.1	Primary Over-Voltage - min	7.75	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL064	2.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL065	1.8	Primary Over-Voltage - min	9.92	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL066	0.37	Thermal for Gen - min	3.54	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL067	3.1	Primary Over-Voltage - min	8.93	Additional Element Fault Current - max
Dayton's Bluff	DBL068	0.7	Primary Over-Voltage - min	5.08	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL069	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Dayton's Bluff	DBL072	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL073	0.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL074	1.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL081	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Dayton's Bluff	DBL082	3.19	Thermal for Gen - min	10	Primary Over-Voltage - max
Douglas County	DGC061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Dahlgren	DHL061	0.6	Primary Over-Voltage - min	5.6	Breaker Relay Reduction of Reach - max
Delano	DLO021	0.7	Primary Over-Voltage - min	1.76	Additional Element Fault Current - max
Dundas	DND061	0.8	Primary Over-Voltage - min	5.67	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Dundas	DND062	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Dundas	DND071	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Dundas	DND072	2.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Dodge Center	DOC021	0.6	Primary Over-Voltage - min	5.45	Breaker Relay Reduction of Reach - max
Dodge Center	DOC031	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Dodge Center	DOC211	0.2	Primary Over-Voltage - min	1.43	Breaker Relay Reduction of Reach - max
Deephaven	DPN061	2.9	Primary Over-Voltage - min	9.99	Breaker Relay Reduction of Reach - max
Deephaven	DPN062	1.5	Primary Over-Voltage - min	9.58	Breaker Relay Reduction of Reach - max
Deephaven	DPN063	1.6	Primary Over-Voltage - min	8.94	Breaker Relay Reduction of Reach - max
Deephaven	DPN071	1.44	Thermal for Gen - min	8.87	Breaker Relay Reduction of Reach - max
Deephaven	DPN072	1.17	Thermal for Gen - min	9.11	Breaker Relay Reduction of Reach - max
Deephaven	DPN073	0.9	Primary Over-Voltage - min	6.34	Breaker Relay Reduction of Reach - max
East Bloomington	EBL062	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
East Bloomington	EBL063	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
East Bloomington	EBL064	5.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
East Bloomington	EBL065	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
East Bloomington	EBL066	9.72	Additional Element Fault Current - min	10	Primary Over-Voltage - max
East Bloomington	EBL067	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
East Bloomington	EBL071	8.6	Additional Element Fault Current - min	10	Primary Over-Voltage - max
East Bloomington	EBL072	3.4	Primary Over-Voltage - min	9.78	Thermal for Gen - max
East Bloomington	EBL073	4.89	Thermal for Gen - min	10	Primary Over-Voltage - max
East Bloomington	EBL074	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
East Bloomington	EBL075	8.96	Additional Element Fault Current - min	10	Primary Over-Voltage - max
East Bloomington	EBL076	2.8	Primary Over-Voltage - min	7.05	Breaker Relay Reduction of Reach - max
East Bloomington	EBL077	8.98	Additional Element Fault Current - min	10	Primary Over-Voltage - max
East Bloomington	EBL081	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
East Bloomington	EBL082	1.2	Primary Over-Voltage - min	6.9	Breaker Relay Reduction of Reach - max
East Bloomington	EBL083	5.49	Thermal for Gen - min	10	Primary Over-Voltage - max
East Bloomington	EBL084	1.7	Primary Over-Voltage - min	6.16	Breaker Relay Reduction of Reach - max
East Bloomington	EBL085	9.67	Additional Element Fault Current - min	10	Primary Over-Voltage - max
East Bloomington	EBL087	9.67	Additional Element Fault Current - min	10	Primary Over-Voltage - max
Elm Creek	ECK061	1	Primary Over-Voltage - min	8.27	Breaker Relay Reduction of Reach - max
Elm Creek	ECK062	1.5	Primary Over-Voltage - min	8.79	Breaker Relay Reduction of Reach - max
Elm Creek	ECK063	1	Primary Over-Voltage - min	7.29	Breaker Relay Reduction of Reach - max
Elm Creek	ECK081	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elm Creek	ECK082	1	Primary Over-Voltage - min	8.55	Breaker Relay Reduction of Reach - max
Elm Creek	ECK321	0.5	Primary Over-Voltage - min	6.54	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Elm Creek	ECK322	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Edina	EDA061	0.8	Primary Over-Voltage - min	8.35	Breaker Relay Reduction of Reach - max
Edina	EDA062	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Edina	EDA065	1.4	Primary Over-Voltage - min	7.17	Breaker Relay Reduction of Reach - max
Edina	EDA066	1.3	Primary Over-Voltage - min	8.48	Breaker Relay Reduction of Reach - max
Edina	EDA067	0.1	Primary Over-Voltage - min	0.87	Breaker Relay Reduction of Reach - max
Edina	EDA068	3.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Edina	EDA069	5.32	Thermal for Gen - min	7.37	Additional Element Fault Current - max
Edina	EDA071	1.6	Primary Over-Voltage - min	9.57	Breaker Relay Reduction of Reach - max
Edina	EDA072	2.35	Additional Element Fault Current - min	7.14	Breaker Relay Reduction of Reach - max
Edina	EDA073	0.9	Primary Over-Voltage - min	7.8	Breaker Relay Reduction of Reach - max
Edina	EDA074	1.3	Primary Over-Voltage - min	8.66	Breaker Relay Reduction of Reach - max
Edina	EDA075	1.2	Primary Over-Voltage - min	7.28	Breaker Relay Reduction of Reach - max
Edina	EDA076	4.68	Thermal for Gen - min	10	Primary Over-Voltage - max
Edina	EDA077	2.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Edina	EDA078	1.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Edina	EDA079	1.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Edina	EDA081	1.3	Primary Over-Voltage - min	8.84	Breaker Relay Reduction of Reach - max
Edina	EDA082	1.2	Primary Over-Voltage - min	4.41	Breaker Relay Reduction of Reach - max
Edina	EDA083	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Edina	EDA084	2.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Edina	EDA085	4.43	Thermal for Gen - min	10	Primary Over-Voltage - max
Edina	EDA087	2	Primary Over-Voltage - min	8.59	Breaker Relay Reduction of Reach - max
Edina	EDA088	1.5	Primary Over-Voltage - min	8.5	Breaker Relay Reduction of Reach - max
Edina	EDA089	0.9	Primary Over-Voltage - min	5.9	Breaker Relay Reduction of Reach - max
Eden Prarie	EDP062	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eden Prarie	EDP063	2.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eden Prarie	EDP071	1.1	Primary Over-Voltage - min	8.12	Breaker Relay Reduction of Reach - max
Eden Prarie	EDP072	2.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eden Prarie	EDP073	1.1	Primary Over-Voltage - min	9.42	Breaker Relay Reduction of Reach - max
Eden Prarie	EDP081	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eden Prarie	EDP082	0.41	Additional Element Fault Current - min	2.36	Breaker Relay Reduction of Reach - max
Eden Prarie	EDP083	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Eden Prarie	EDP084	4.33	Thermal for Gen - min	10	Primary Over-Voltage - max
Eden Prarie	EDP085	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eden Prarie	EDP091	0.8	Primary Over-Voltage - min	7.7	Breaker Relay Reduction of Reach - max
Eden Prarie	EDP092	1.1	Primary Over-Voltage - min	6.89	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Eden Prarie	EDP093	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eden Prarie	EDP094	1.5	Primary Over-Voltage - min	8.73	Breaker Relay Reduction of Reach - max
Eden Prarie	EDP095	3.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Eagle Lake	EGL021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Eagle Lake	EGL022	0.6	Primary Over-Voltage - min	3.62	Breaker Relay Reduction of Reach - max
Elko	EKO021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Elliott Park	ELP061	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP062	3.29	Thermal for Gen - min	10	Primary Over-Voltage - max
Elliott Park	ELP063	3.38	Thermal for Gen - min	10	Primary Over-Voltage - max
Elliott Park	ELP064	3.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP071	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP072	7.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP073	4.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP074	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP075	5.95	Thermal for Gen - min	10	Primary Over-Voltage - max
Elliott Park	ELP081	4.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP082	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Elliott Park	ELP083	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP084	2.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Elliott Park	ELP085	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Elliott Park	ELP086	1.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Essig	ESG001	0.1	Primary Over-Voltage - min	0.51	Additional Element Fault Current - max
Eastwood	ESW061	1.2	Primary Over-Voltage - min	7.77	Breaker Relay Reduction of Reach - max
Eastwood	ESW062	1.1	Primary Over-Voltage - min	6.51	Breaker Relay Reduction of Reach - max
Eastwood	ESW063	2.7	Primary Over-Voltage - min	9.11	Additional Element Fault Current - max
Eastwood	ESW071	1.3	Primary Over-Voltage - min	6.61	Breaker Relay Reduction of Reach - max
Eastwood	ESW072	1.5	Primary Over-Voltage - min	7.92	Breaker Relay Reduction of Reach - max
Eastwood	ESW073	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Eastwood	ESW081	1.21	Thermal for Gen - min	6.59	Breaker Relay Reduction of Reach - max
Eastwood	ESW082	0	Additional Element Fault Current - min	1.11	Breaker Relay Reduction of Reach - max
East Winona	EWI022	0.8	Primary Over-Voltage - min	3.41	Breaker Relay Reduction of Reach - max
Excelsior	EXC061	1.17	Thermal for Gen - min	6.11	Additional Element Fault Current - max
Excelsior	EXC062	1.17	Thermal for Gen - min	5.5	Breaker Relay Reduction of Reach - max
Faribault	FAB061	1.17	Thermal for Gen - min	4.76	Additional Element Fault Current - max
Faribault	FAB063	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Faribault	FAB071	1.17	Thermal for Gen - min	8.78	Breaker Relay Reduction of Reach - max
Faribault	FAB073	1.1	Primary Over-Voltage - min	5.26	Additional Element Fault Current - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Fair Park	FAP061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Fair Park	FAP071	0.9	Primary Over-Voltage - min	7.94	Breaker Relay Reduction of Reach - max
Fiesta City	FIC021	0.3	Primary Over-Voltage - min	0.7	Primary Over-Voltage - max
Fiesta City	FIC022	2.6	Primary Over-Voltage - min	5.76	Additional Element Fault Current - max
Fiesta City	FIC031	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Franklin	FRA001	0.1	Primary Over-Voltage - min	0.77	Breaker Relay Reduction of Reach - max
Franklin	FRA211	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Farmington	FRM061	0.99	Thermal for Gen - min	6.87	Breaker Relay Reduction of Reach - max
Farmington	FRM062	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Farmington	FRM071	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Frontenac	FRO021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
First Lake	FSL311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
First Lake	FSL312	0.1	Primary Over-Voltage - min	1.39	Breaker Relay Reduction of Reach - max
Fifth Street	FST067	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Fifth Street	FST068	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Fifth Street	FST077	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Fifth Street	FST078	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Fifth Street	FST085	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Fifth Street	FST086	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Fifth Street	FST087	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Fifth Street	FST088	1.42	Thermal for Gen - min	10	Primary Over-Voltage - max
Gaylord	GAY001	0.1	Primary Over-Voltage - min	0.69	Breaker Relay Reduction of Reach - max
Gaylord	GAY002	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Gaylord	GAY003	0.2	Primary Over-Voltage - min	1.67	Breaker Relay Reduction of Reach - max
Greenfield	GFD021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Greenfield	GFD022	0.4	Primary Over-Voltage - min	4.72	Breaker Relay Reduction of Reach - max
Gibbon	GIB021	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Glenwood	GLD021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Glenwood	GLD031	0.2	Primary Over-Voltage - min	1.5	Primary Over-Voltage - max
Goose Lake	GLK061	0.7	Primary Over-Voltage - min	7.21	Breaker Relay Reduction of Reach - max
Goose Lake	GLK062	1	Primary Over-Voltage - min	8.49	Breaker Relay Reduction of Reach - max
Goose Lake	GLK063	0.2	Primary Over-Voltage - min	6.38	Breaker Relay Reduction of Reach - max
Goose Lake	GLK064	1.2	Thermal for Gen - min	6.39	Breaker Relay Reduction of Reach - max
Goose Lake	GLK065	1.1	Primary Over-Voltage - min	5.36	Breaker Relay Reduction of Reach - max
Goose Lake	GLK071	0.9	Primary Over-Voltage - min	8.66	Breaker Relay Reduction of Reach - max
Goose Lake	GLK072	1.17	Thermal for Gen - min	7.47	Breaker Relay Reduction of Reach - max
Goose Lake	GLK073	1.17	Thermal for Gen - min	5.62	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Goose Lake	GLK074	0.3	Primary Over-Voltage - min	1.61	Breaker Relay Reduction of Reach - max
Glen Lake	GNL061	8.53	Additional Element Fault Current - min	8.54	Additional Element Fault Current - max
Glen Lake	GNL062	0.8	Primary Over-Voltage - min	6.3	Breaker Relay Reduction of Reach - max
Glen Lake	GNL063	0.8	Primary Over-Voltage - min	7.59	Breaker Relay Reduction of Reach - max
Glen Lake	GNL071	1.9	Primary Over-Voltage - min	8.45	Breaker Relay Reduction of Reach - max
Glen Lake	GNL072	1.1	Primary Over-Voltage - min	9.36	Breaker Relay Reduction of Reach - max
Glen Lake	GNL073	1.1	Primary Over-Voltage - min	8.38	Breaker Relay Reduction of Reach - max
Gopher	GPH061	1.22	Thermal for Gen - min	10	Primary Over-Voltage - max
Gopher	GPH062	1.11	Thermal for Gen - min	10	Primary Over-Voltage - max
Gopher	GPH068	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Gopher	GPH069	9.27	Additional Element Fault Current - min	10	Primary Over-Voltage - max
Gopher	GPH073	2.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Gopher	GPH074	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Gopher	GPH075	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Gopher	GPH079	7.17	Additional Element Fault Current - min	10	Primary Over-Voltage - max
Granite City	GRC062	1.1	Primary Over-Voltage - min	6.29	Breaker Relay Reduction of Reach - max
Granite City	GRC063	1.7	Primary Over-Voltage - min	8.85	Breaker Relay Reduction of Reach - max
Granite City	GRC073	0.2	Primary Over-Voltage - min	2.02	Breaker Relay Reduction of Reach - max
Granite City	GRC311	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Granite City	GRC312	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Granite City	GRC313	0.2	Primary Over-Voltage - min	4.2	Breaker Relay Reduction of Reach - max
Green Isle	GRI001	0.3	Primary Over-Voltage - min	1.74	Additional Element Fault Current - max
Gleason Lake	GSL061	1	Primary Over-Voltage - min	5.83	Breaker Relay Reduction of Reach - max
Gleason Lake	GSL064	1.17	Thermal for Gen - min	8.42	Breaker Relay Reduction of Reach - max
Gleason Lake	GSL065	1.17	Thermal for Gen - min	4.25	Breaker Relay Reduction of Reach - max
Gleason Lake	GSL074	0.8	Primary Over-Voltage - min	4.93	Breaker Relay Reduction of Reach - max
Gleason Lake	GSL075	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Gleason Lake	GSL076	0.8	Primary Over-Voltage - min	4.98	Breaker Relay Reduction of Reach - max
Gleason Lake	GSL079	1.17	Thermal for Gen - min	6.43	Breaker Relay Reduction of Reach - max
Gleason Lake	GSL341	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Gleason Lake	GSL342	1.6	Primary Over-Voltage - min	6.26	Breaker Relay Reduction of Reach - max
Goodview	GVW021	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Goodview	GVW022	2.4	Primary Over-Voltage - min	6.42	Breaker Relay Reduction of Reach - max
Goodview	GVW023	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Goodview	GVW031	0	Primary Over-Voltage - min	0	Additional Element Fault Current - max
Goodview	GVW032	0.4	Primary Over-Voltage - min	2.72	Breaker Relay Reduction of Reach - max
Hadley	HAD021	0.4	Primary Over-Voltage - min	2.01	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Hadley	HAD022	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Hastings	HAS021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Hastings	HAS022	0.6	Primary Over-Voltage - min	4.05	Breaker Relay Reduction of Reach - max
Hastings	HAS023	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Hastings	HAS031	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Hastings	HAS032	0.6	Primary Over-Voltage - min	6.45	Breaker Relay Reduction of Reach - max
Hastings	HAS033	1.4	Primary Over-Voltage - min	6.92	Breaker Relay Reduction of Reach - max
Hector	HEC001	0.1	Primary Over-Voltage - min	0.93	Breaker Relay Reduction of Reach - max
Henderson	HEN021	0.4	Primary Over-Voltage - min	1.31	Thermal for Gen - max
Hollydale	HOL061	0.8	Primary Over-Voltage - min	8.38	Breaker Relay Reduction of Reach - max
Hollydale	HOL062	0.7	Primary Over-Voltage - min	7.11	Breaker Relay Reduction of Reach - max
Howard Lake	HOW061	0.4	Primary Over-Voltage - min	5.3	Breaker Relay Reduction of Reach - max
Hassan	HSN311	0.2	Primary Over-Voltage - min	2.86	Breaker Relay Reduction of Reach - max
Hassan	HSN312	0.08	Breaker Relay Reduction of Reach - min	0.08	Breaker Relay Reduction of Reach - max
Hassan	HSN321	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Hassan	HSN322	1.7	Primary Over-Voltage - min	15.99	Breaker Relay Reduction of Reach - max
Hugo	HUG311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Hugo	HUG312	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Hugo	HUG321	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Hugo	HUG322	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Hiawatha West	HWW061	0.3	Primary Over-Voltage - min	1.74	Breaker Relay Reduction of Reach - max
Hiawatha West	HWW062	1.6	Primary Over-Voltage - min	8.9	Breaker Relay Reduction of Reach - max
Hiawatha West	HWW071	1.21	Thermal for Gen - min	10	Primary Over-Voltage - max
Hiawatha West	HWW072	3.28	Thermal for Gen - min	10	Primary Over-Voltage - max
Hiawatha West	HWW073	2.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Hiawatha West	HWW074	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Hiawatha West	HWW075	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Hyland Lake	HYL061	1.2	Primary Over-Voltage - min	6.32	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL062	1.5	Primary Over-Voltage - min	9.47	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL063	0.4	Primary Over-Voltage - min	4.75	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL064	0.7	Primary Over-Voltage - min	6.24	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL065	1.2	Primary Over-Voltage - min	9.15	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL071	1.9	Primary Over-Voltage - min	9.37	Thermal for Gen - max
Hyland Lake	HYL072	0.8	Primary Over-Voltage - min	7.06	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL073	1.4	Primary Over-Voltage - min	9.37	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL074	1.6	Primary Over-Voltage - min	8.61	Breaker Relay Reduction of Reach - max
Hyland Lake	HYL075	1	Primary Over-Voltage - min	8.14	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Indiana	IDA061	3.51	Thermal for Gen - min	10	Primary Over-Voltage - max
Indiana	IDA062	1.17	Thermal for Gen - min	8.29	Breaker Relay Reduction of Reach - max
Indiana	IDA063	3.28	Thermal for Gen - min	10	Primary Over-Voltage - max
Indiana	IDA064	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Indiana	IDA071	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Indiana	IDA072	1.1	Primary Over-Voltage - min	8.89	Breaker Relay Reduction of Reach - max
Indiana	IDA073	1.17	Thermal for Gen - min	9.17	Breaker Relay Reduction of Reach - max
Indiana	IDA074	1.17	Thermal for Gen - min	9.13	Breaker Relay Reduction of Reach - max
Jordan	JOR021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Jordan	JOR022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Kasson	KAN022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Kasson	KAN031	0	Primary Over-Voltage - min	0	Additional Element Fault Current - max
Kenyon	KEN021	0.3	Primary Over-Voltage - min	1.53	Breaker Relay Reduction of Reach - max
Kenyon	KEN022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Kimball	KIM021	0.79	Additional Element Fault Current - min	1.78	Additional Element Fault Current - max
Kegan Lake	KLK061	1	Primary Over-Voltage - min	7.02	Breaker Relay Reduction of Reach - max
Kohlman Lake	KOL061	2	Primary Over-Voltage - min	8.16	Breaker Relay Reduction of Reach - max
Kohlman Lake	KOL062	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Kohlman Lake	KOL063	2.4	Primary Over-Voltage - min	9.18	Breaker Relay Reduction of Reach - max
Kohlman Lake	KOL064	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Kohlman Lake	KOL065	1.17	Thermal for Gen - min	9.54	Breaker Relay Reduction of Reach - max
Kohlman Lake	KOL071	1	Primary Over-Voltage - min	7.46	Breaker Relay Reduction of Reach - max
Kohlman Lake	KOL073	0.9	Primary Over-Voltage - min	2.1	Primary Over-Voltage - max
Kohlman Lake	KOL074	0.8	Primary Over-Voltage - min	2.6	Primary Over-Voltage - max
Lake Bavaria	LAB311	0.2	Primary Over-Voltage - min	5.79	Breaker Relay Reduction of Reach - max
Lake Bavaria	LAB312	0.1	Primary Over-Voltage - min	2.61	Breaker Relay Reduction of Reach - max
La Crescent	LAC062	0.2	Primary Over-Voltage - min	1.22	Breaker Relay Reduction of Reach - max
La Crescent	LAC063	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lake Emily	LAE061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lafayette	LAF001	0.1	Primary Over-Voltage - min	1.17	Breaker Relay Reduction of Reach - max
Lake City	LAK032	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lake Pulaski	LAP311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lake Yankton	LAY061	0.2	Primary Over-Voltage - min	1	Breaker Relay Reduction of Reach - max
Lawrence Creek	LCR311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lexington	LEX061	0.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Lexington	LEX062	1.5	Thermal for Gen - min	10	Primary Over-Voltage - max
Lexington	LEX063	1.17	Thermal for Gen - min	9.93	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Lexington	LEX064	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Lexington	LEX065	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Lexington	LEX071	1.21	Thermal for Gen - min	10	Primary Over-Voltage - max
Lexington	LEX072	1.39	Thermal for Gen - min	10	Primary Over-Voltage - max
Lexington	LEX073	4.33	Thermal for Gen - min	10	Primary Over-Voltage - max
Lexington	LEX074	0.5	Primary Over-Voltage - min	0.94	Thermal for Gen - max
Lexington	LEX075	0.4	Primary Over-Voltage - min	2.96	Breaker Relay Reduction of Reach - max
Lexington	LEX331	0.9	Primary Over-Voltage - min	5.82	Breaker Relay Reduction of Reach - max
Lexington	LEX332	1.3	Primary Over-Voltage - min	10.69	Breaker Relay Reduction of Reach - max
Lexington	LEX333	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lake Lillian	LIL021	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Lindstrom	LIN022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lindstrom	LIN031	0.1	Primary Over-Voltage - min	2.32	Breaker Relay Reduction of Reach - max
Long Lake	LLK061	0.8	Primary Over-Voltage - min	6.62	Breaker Relay Reduction of Reach - max
Long Lake	LLK063	1.17	Thermal for Gen - min	8.29	Breaker Relay Reduction of Reach - max
Long Lake	LLK071	0.1	Primary Over-Voltage - min	2.16	Breaker Relay Reduction of Reach - max
Long Lake	LLK072	0.9	Primary Over-Voltage - min	6.86	Breaker Relay Reduction of Reach - max
Linn Street	LNS021	0.7	Primary Over-Voltage - min	5.96	Additional Element Fault Current - max
Linn Street	LNS022	4.81	Thermal for Gen - min	5.96	Additional Element Fault Current - max
Linn Street	LNS032	1.1	Primary Over-Voltage - min	5.96	Thermal for Gen - max
Linn Street	LNS033	0.6	Primary Over-Voltage - min	3.51	Breaker Relay Reduction of Reach - max
Lone Oak	LOK061	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Lone Oak	LOK062	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Lone Oak	LOK063	0.7	Primary Over-Voltage - min	2.6	Breaker Relay Reduction of Reach - max
Lone Oak	LOK081	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Lone Oak	LOK082	2.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Lone Oak	LOK083	1.1	Primary Over-Voltage - min	6.94	Breaker Relay Reduction of Reach - max
Lone Oak	LOK091	1.1	Primary Over-Voltage - min	8.31	Breaker Relay Reduction of Reach - max
Lone Oak	LOK092	1.4	Primary Over-Voltage - min	9.28	Breaker Relay Reduction of Reach - max
Lone Oak	LOK093	0.3	Primary Over-Voltage - min	2.86	Breaker Relay Reduction of Reach - max
Lowry	LOW021	0.3	Primary Over-Voltage - min	2.67	Breaker Relay Reduction of Reach - max
Lester Prarie	LSP021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Lester Prarie	LSP022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Maple Lake	MAP061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Mazeppa	MAZ021	0.2	Primary Over-Voltage - min	1.27	Breaker Relay Reduction of Reach - max
Medford Junction	MDF021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Midtown	MDT061	4.34	Thermal for Gen - min	10	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Midtown	MDT062	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Midtown	MDT067	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Midtown	MDT071	3.51	Thermal for Gen - min	10	Primary Over-Voltage - max
Midtown	MDT073	3.31	Thermal for Gen - min	10	Primary Over-Voltage - max
Midtown	MDT074	3.31	Thermal for Gen - min	10	Primary Over-Voltage - max
Midtown	MDT077	2.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Meire Grove	MEI021	0.3	Primary Over-Voltage - min	1.74	Additional Element Fault Current - max
Meeker	MEK021	0.3	Primary Over-Voltage - min	4.55	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL061	1.2	Primary Over-Voltage - min	7.27	Additional Element Fault Current - max
Medicine Lake	MEL062	1	Primary Over-Voltage - min	7.41	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL063	4.41	Thermal for Gen - min	10	Primary Over-Voltage - max
Medicine Lake	MEL064	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL065	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL066	3.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL067	2.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL068	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL069	1.5	Primary Over-Voltage - min	7.53	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL071	2.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL072	1.1	Primary Over-Voltage - min	9.47	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL073	2.1	Primary Over-Voltage - min	9.2	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL074	1.1	Primary Over-Voltage - min	7.77	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL075	1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL076	1.7	Primary Over-Voltage - min	9.81	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL077	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL078	1.3	Primary Over-Voltage - min	9.41	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL079	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
Medicine Lake	MEL081	1.3	Primary Over-Voltage - min	6.32	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL082	1.9	Primary Over-Voltage - min	4.55	Thermal for Gen - max
Medicine Lake	MEL083	1.2	Primary Over-Voltage - min	7.54	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL087	0.4	Primary Over-Voltage - min	4.73	Breaker Relay Reduction of Reach - max
Medicine Lake	MEL088	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Medicine Lake	MEL089	1	Primary Over-Voltage - min	5.61	Thermal for Gen - max
Morgan	MGN211	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Mayhew Lake	MHW311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Mayhew Lake	MHW312	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Mound	MND061	1.6	Primary Over-Voltage - min	9.46	Breaker Relay Reduction of Reach - max
Mound	MND062	0.7	Primary Over-Voltage - min	5.25	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Mound	MND063	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Mound	MND071	1	Primary Over-Voltage - min	7.38	Breaker Relay Reduction of Reach - max
Mound	MND072	0.9	Primary Over-Voltage - min	4.86	Breaker Relay Reduction of Reach - max
Minnesota Lake	MNL001	0	Thermal for Gen - min	0	Thermal for Gen - max
Minnesota Valley	MNV211	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Moore Lake	MOL061	1.1	Primary Over-Voltage - min	4.77	Breaker Relay Reduction of Reach - max
Moore Lake	MOL062	3.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Moore Lake	MOL063	1.5	Primary Over-Voltage - min	8.98	Breaker Relay Reduction of Reach - max
Moore Lake	MOL064	1.2	Primary Over-Voltage - min	8.47	Breaker Relay Reduction of Reach - max
Moore Lake	MOL065	1.9	Primary Over-Voltage - min	7.24	Additional Element Fault Current - max
Moore Lake	MOL066	1.1	Primary Over-Voltage - min	6.45	Breaker Relay Reduction of Reach - max
Moore Lake	MOL067	2.6	Primary Over-Voltage - min	6.79	Breaker Relay Reduction of Reach - max
Moore Lake	MOL068	1.5	Primary Over-Voltage - min	5.08	Breaker Relay Reduction of Reach - max
Moore Lake	MOL069	3.1	Primary Over-Voltage - min	7.14	Breaker Relay Reduction of Reach - max
Moore Lake	MOL071	3.53	Thermal for Gen - min	10	Primary Over-Voltage - max
Moore Lake	MOL072	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Moore Lake	MOL073	0.9	Primary Over-Voltage - min	6.28	Breaker Relay Reduction of Reach - max
Moore Lake	MOL074	2.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Moore Lake	MOL076	2.3	Primary Over-Voltage - min	9.87	Breaker Relay Reduction of Reach - max
Moore Lake	MOL077	1.2	Primary Over-Voltage - min	6.61	Breaker Relay Reduction of Reach - max
Moore Lake	MOL078	0.9	Primary Over-Voltage - min	4.93	Breaker Relay Reduction of Reach - max
Moore Lake	MOL079	1.1	Primary Over-Voltage - min	7.26	Breaker Relay Reduction of Reach - max
Merriam Park	MPK061	2.2	Thermal for Gen - min	2.2	Thermal for Gen - max
Merriam Park	MPK062	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Merriam Park	MPK063	0.9	Primary Over-Voltage - min	7.67	Breaker Relay Reduction of Reach - max
Merriam Park	MPK064	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Merriam Park	MPK065	3.28	Thermal for Gen - min	9.85	Breaker Relay Reduction of Reach - max
Merriam Park	MPK066	1.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Merriam Park	MPK067	1.23	Thermal for Gen - min	10	Primary Over-Voltage - max
Merriam Park	MPK068	0.3	Primary Over-Voltage - min	3.41	Breaker Relay Reduction of Reach - max
Merriam Park	MPK071	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Merriam Park	MPK072	9.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Merriam Park	MPK073	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Merriam Park	MPK074	1.16	Thermal for Gen - min	9.73	Breaker Relay Reduction of Reach - max
Merriam Park	MPK075	2.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Merriam Park	MPK076	5.09	Thermal for Gen - min	10	Primary Over-Voltage - max
Merriam Park	MPK077	1.4	Thermal for Gen - min	10	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Merriam Park	MPK078	0.1	Primary Over-Voltage - min	1.27	Breaker Relay Reduction of Reach - max
Merriam Park	MPK081	9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Merriam Park	MPK082	0.3	Primary Over-Voltage - min	2.17	Breaker Relay Reduction of Reach - max
Merriam Park	MPK083	0.3	Primary Over-Voltage - min	2.26	Breaker Relay Reduction of Reach - max
Merriam Park	MPK084	0.09	Thermal for Gen - min	0.47	Breaker Relay Reduction of Reach - max
Merriam Park	MPK085	1.6	Primary Over-Voltage - min	8.94	Breaker Relay Reduction of Reach - max
Merriam Park	MPK086	0.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Merriam Park	MPK087	1.1	Primary Over-Voltage - min	9.23	Breaker Relay Reduction of Reach - max
Mapleton	MPN081	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Meridian	MRN021	0.2	Primary Over-Voltage - min	1.2	Breaker Relay Reduction of Reach - max
Main Street	MST063	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Main Street	MST064	4.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Main Street	MST066	1.15	Thermal for Gen - min	10	Primary Over-Voltage - max
Main Street	MST068	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Main Street	MST069	1.5	Thermal for Gen - min	9.28	Thermal for Gen - max
Main Street	MST070	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Main Street	MST071	1.17	Thermal for Gen - min	2.74	Thermal for Gen - max
Main Street	MST074	3.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Main Street	MST075	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Main Street	MST076	0.8	Primary Over-Voltage - min	4.29	Breaker Relay Reduction of Reach - max
Main Street	MST080	0.1	Primary Over-Voltage - min	0.91	Breaker Relay Reduction of Reach - max
Main Street	MST082	1.17	Thermal for Gen - min	9.37	Thermal for Gen - max
Montrose	MTR021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Montevideo	MTV001	0.2	Primary Over-Voltage - min	1.85	Breaker Relay Reduction of Reach - max
Montevideo	MTV002	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Montevideo	MTV003	0.7	Primary Over-Voltage - min	2.32	Breaker Relay Reduction of Reach - max
Montevideo	MTV021	0.2	Primary Over-Voltage - min	2.05	Breaker Relay Reduction of Reach - max
Montevideo	MTV022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Morristown	MTW021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Maynard	MYN021	0.8	Primary Over-Voltage - min	2.36	Breaker Relay Reduction of Reach - max
Nerstrand	NER021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Nine Mile Creek	NMC063	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
Nine Mile Creek	NMC064	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
Nine Mile Creek	NMC082	1.1	Primary Over-Voltage - min	7.54	Breaker Relay Reduction of Reach - max
Nine Mile Creek	NMC083	2.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Nine Mile Creek	NMC092	2.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Nine Mile Creek	NMC093	1.4	Primary Over-Voltage - min	9.77	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Northfield	NOF061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Northfield	NOF062	3.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Northfield	NOF071	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Northfield	NOF072	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Northfield	NOF073	0	Additional Element Fault Current - min	3.7	Additional Element Fault Current - max
Oakdale	OAD061	1.2	Primary Over-Voltage - min	5.63	Breaker Relay Reduction of Reach - max
Oakdale	OAD062	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Oakdale	OAD063	2.5	Primary Over-Voltage - min	8.03	Breaker Relay Reduction of Reach - max
Oakdale	OAD064	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Oakdale	OAD065	1.17	Thermal for Gen - min	6.62	Breaker Relay Reduction of Reach - max
Oakdale	OAD071	0.9	Primary Over-Voltage - min	5.44	Breaker Relay Reduction of Reach - max
Oakdale	OAD072	0.84	Thermal for Gen - min	4.62	Breaker Relay Reduction of Reach - max
Oakdale	OAD073	1.9	Primary Over-Voltage - min	7.98	Breaker Relay Reduction of Reach - max
Oakdale	OAD074	1.1	Primary Over-Voltage - min	8.35	Breaker Relay Reduction of Reach - max
Oakdale	OAD075	0.9	Primary Over-Voltage - min	5.83	Breaker Relay Reduction of Reach - max
Oak Park	OPK010	2.5	Primary Over-Voltage - min	11.33	Breaker Relay Reduction of Reach - max
Oak Park	OPK065	0.4	Primary Over-Voltage - min	2.61	Breaker Relay Reduction of Reach - max
Oak Park	OPK066	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Oak Park	OPK067	0.3	Primary Over-Voltage - min	3.27	Breaker Relay Reduction of Reach - max
Oak Park	OPK071	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Oak Park	OPK072	2.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Oak Park	OPK073	0.3	Primary Over-Voltage - min	2.6	Breaker Relay Reduction of Reach - max
Oak Park	OPK074	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Oak Park	OPK075	9.36	Thermal for Gen - min	10	Primary Over-Voltage - max
Oak Park	OPK077	1.3	Primary Over-Voltage - min	3.09	Breaker Relay Reduction of Reach - max
Orono	ORO061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Orono	ORO062	0.5	Primary Over-Voltage - min	6.77	Breaker Relay Reduction of Reach - max
Osseo	OSS061	0	Thermal for Gen - min	0	Additional Element Fault Current - max
Osseo	OSS062	1.7	Primary Over-Voltage - min	8.39	Breaker Relay Reduction of Reach - max
Osseo	OSS063	0.7	Primary Over-Voltage - min	6.58	Breaker Relay Reduction of Reach - max
Osseo	OSS064	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Osseo	OSS065	1.17	Thermal for Gen - min	8.43	Breaker Relay Reduction of Reach - max
Osseo	OSS066	2.1	Primary Over-Voltage - min	8.2	Breaker Relay Reduction of Reach - max
Osseo	OSS071	1.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Osseo	OSS072	0	Additional Element Fault Current - min	2.08	Breaker Relay Reduction of Reach - max
Osseo	OSS073	1	Primary Over-Voltage - min	8.11	Breaker Relay Reduction of Reach - max
Osseo	OSS074	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Osseo	OSS075	2.3	Primary Over-Voltage - min	9.51	Breaker Relay Reduction of Reach - max
Osseo	OSS076	1.35	Thermal for Gen - min	10	Primary Over-Voltage - max
Osseo	OSS077	1.9	Primary Over-Voltage - min	5.67	Breaker Relay Reduction of Reach - max
Paynesville Transmission	PAT312	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Paynesville Transmission	PAT313	0	Thermal for Gen - min	0	Breaker Relay Reduction of Reach - max
Paynesville Transmission	PAT314	0.2	Primary Over-Voltage - min	4.13	Breaker Relay Reduction of Reach - max
Pine Bend	PBE061	0.8	Primary Over-Voltage - min	4.98	Breaker Relay Reduction of Reach - max
Pine Island	PIL021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Pine Island	PIL022	0.3	Primary Over-Voltage - min	3.57	Breaker Relay Reduction of Reach - max
Pipestone	PIP061	1.17	Thermal for Gen - min	7.59	Breaker Relay Reduction of Reach - max
Pipestone	PIP062	0.8	Primary Over-Voltage - min	6.69	Breaker Relay Reduction of Reach - max
Pipestone	PIP090	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Parkers Lake	PKL061	0.5	Primary Over-Voltage - min	6.62	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL062	1.18	Thermal for Gen - min	10	Primary Over-Voltage - max
Parkers Lake	PKL063	0.7	Primary Over-Voltage - min	6.93	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL064	1.17	Thermal for Gen - min	9.63	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL065	1.17	Thermal for Gen - min	7.88	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL066	1.4	Primary Over-Voltage - min	9.85	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL071	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Parkers Lake	PKL072	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Parkers Lake	PKL073	1.34	Thermal for Gen - min	10	Primary Over-Voltage - max
Parkers Lake	PKL074	0.9	Primary Over-Voltage - min	4.54	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL075	1.1	Primary Over-Voltage - min	6.55	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL081	0.9	Primary Over-Voltage - min	7.27	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL082	1.17	Thermal for Gen - min	7.28	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL083	2.2	Primary Over-Voltage - min	9.74	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL084	1	Primary Over-Voltage - min	3.71	Breaker Relay Reduction of Reach - max
Parkers Lake	PKL085	0.9	Primary Over-Voltage - min	5.67	Breaker Relay Reduction of Reach - max
Plato	PLA022	0.1	Primary Over-Voltage - min	1.24	Breaker Relay Reduction of Reach - max
Plato	PLA023	8.41	Additional Element Fault Current - min	10	Primary Over-Voltage - max
Prior	PRR061	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Prior	PRR062	1.17	Thermal for Gen - min	9.44	Breaker Relay Reduction of Reach - max
Prior	PRR063	1.17	Thermal for Gen - min	9.72	Breaker Relay Reduction of Reach - max
Ramsey	RAM061	1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Ramsey	RAM062	1.7	Primary Over-Voltage - min	9.43	Breaker Relay Reduction of Reach - max
Ramsey	RAM063	0.9	Primary Over-Voltage - min	9.38	Breaker Relay Reduction of Reach - max
Ramsey	RAM064	1.17	Thermal for Gen - min	7.18	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Ramsey	RAM071	1.1	Primary Over-Voltage - min	3.01	Thermal for Gen - max
Ramsey	RAM072	1.1	Primary Over-Voltage - min	7.31	Breaker Relay Reduction of Reach - max
Ramsey	RAM073	0.4	Primary Over-Voltage - min	5.14	Breaker Relay Reduction of Reach - max
Ramsey	RAM077	0.8	Primary Over-Voltage - min	6.74	Breaker Relay Reduction of Reach - max
Rapidan	RAP081	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Richmond	RCH061	0.4	Primary Over-Voltage - min	2.9	Primary Over-Voltage - max
Red River	RED091	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Red Wing	REW021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Red Wing	REW022	3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Red Wing	REW023	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Red Wing	REW031	1.06	Thermal for Gen - min	8.87	Breaker Relay Reduction of Reach - max
Red Wing	REW032	1.06	Thermal for Gen - min	10	Primary Over-Voltage - max
Red Wing	REW033	0.9	Primary Over-Voltage - min	4.26	Breaker Relay Reduction of Reach - max
Riverside	RIV061	2.4	Primary Over-Voltage - min	9.97	Breaker Relay Reduction of Reach - max
Riverside	RIV062	0.6	Primary Over-Voltage - min	2.53	Breaker Relay Reduction of Reach - max
Riverside	RIV063	1.17	Thermal for Gen - min	8.25	Breaker Relay Reduction of Reach - max
Riverside	RIV064	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Riverside	RIV065	5.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Riverside	RIV066	0.9	Primary Over-Voltage - min	8.42	Breaker Relay Reduction of Reach - max
Riverside	RIV071	1.5	Thermal for Gen - min	10	Primary Over-Voltage - max
Riverside	RIV072	2.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Riverside	RIV073	1.1	Primary Over-Voltage - min	9.88	Breaker Relay Reduction of Reach - max
Riverside	RIV074	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Riverside	RIV075	3.28	Thermal for Gen - min	10	Primary Over-Voltage - max
Riverside	RIV076	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Rogers Lake	RLK064	0.7	Primary Over-Voltage - min	6.11	Breaker Relay Reduction of Reach - max
Rogers Lake	RLK065	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Rogers Lake	RLK066	0.47	Additional Element Fault Current - min	3.65	Breaker Relay Reduction of Reach - max
Rogers Lake	RLK068	4.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Rogers Lake	RLK069	0.6	Primary Over-Voltage - min	5.03	Breaker Relay Reduction of Reach - max
Rogers Lake	RLK071	0.7	Primary Over-Voltage - min	6.83	Breaker Relay Reduction of Reach - max
Rogers Lake	RLK072	1.1	Primary Over-Voltage - min	9.88	Breaker Relay Reduction of Reach - max
Rogers Lake	RLK073	0.9	Primary Over-Voltage - min	7.54	Breaker Relay Reduction of Reach - max
Rogers Lake	RLK079	0.6	Primary Over-Voltage - min	5.83	Breaker Relay Reduction of Reach - max
Rosemount	RMT311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Rosemount	RMT312	0.05	Thermal for Gen - min	0.25	Breaker Relay Reduction of Reach - max
Renville	RNV021	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Rock River	ROC090	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Rock River	ROC091	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Rose Place	RPL061	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Rose Place	RPL062	8.91	Additional Element Fault Current - min	10	Primary Over-Voltage - max
Rose Place	RPL063	1.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Rose Place	RPL064	1.9	Primary Over-Voltage - min	9.86	Breaker Relay Reduction of Reach - max
Rose Place	RPL071	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Rose Place	RPL072	2.1	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Rose Place	RPL073	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Rose Place	RPL074	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Rose Place	RPL075	1.54	Thermal for Gen - min	10	Primary Over-Voltage - max
Red Rock	RRK061	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
Red Rock	RRK062	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Red Rock	RRK063	0.4	Primary Over-Voltage - min	4.19	Breaker Relay Reduction of Reach - max
Red Rock	RRK064	1.1	Primary Over-Voltage - min	5.85	Breaker Relay Reduction of Reach - max
Red Rock	RRK071	2.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Red Rock	RRK072	4.46	Thermal for Gen - min	10	Primary Over-Voltage - max
Red Rock	RRK081	5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Red Rock	RRK082	0.8	Primary Over-Voltage - min	4.38	Breaker Relay Reduction of Reach - max
Red Rock	RRK083	0.9	Primary Over-Voltage - min	5.11	Breaker Relay Reduction of Reach - max
Rich Spring	RSP061	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Rich Valley	RVA061	0.4	Primary Over-Voltage - min	5.07	Breaker Relay Reduction of Reach - max
Rich Valley	RVA062	0.1	Primary Over-Voltage - min	1.27	Breaker Relay Reduction of Reach - max
Rich Valley	RVA063	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Riverwood	RWD061	1.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Riverwood	RWD062	1.5	Primary Over-Voltage - min	9.75	Breaker Relay Reduction of Reach - max
Riverwood	RWD063	1.2	Primary Over-Voltage - min	7.97	Breaker Relay Reduction of Reach - max
Riverwood	RWD081	2.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Riverwood	RWD082	1.1	Primary Over-Voltage - min	7.05	Breaker Relay Reduction of Reach - max
Sauk River	SAK311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Sauk River	SAK312	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Savage	SAV063	0.7	Primary Over-Voltage - min	4.23	Breaker Relay Reduction of Reach - max
Savage	SAV067	0.8	Primary Over-Voltage - min	8.32	Breaker Relay Reduction of Reach - max
Savage	SAV069	0.7	Primary Over-Voltage - min	7.24	Breaker Relay Reduction of Reach - max
Savage	SAV071	1.7	Primary Over-Voltage - min	9.94	Breaker Relay Reduction of Reach - max
Savage	SAV072	3.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Savage	SAV073	0.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Scandia	SCA021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Sacred Heart	SCH001	0.2	Primary Over-Voltage - min	1.56	Thermal for Gen - max
Sacred Heart	SCH211	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Saint Cloud	SCL311	0.4	Primary Over-Voltage - min	5.03	Breaker Relay Reduction of Reach - max
Saint Cloud	SCL312	0.1	Primary Over-Voltage - min	0.93	Breaker Relay Reduction of Reach - max
Saint Cloud	SCL313	0.1	Primary Over-Voltage - min	1.97	Breaker Relay Reduction of Reach - max
Saint Cloud	SCL322	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Saint Cloud	SCL323	0.1	Primary Over-Voltage - min	3.32	Breaker Relay Reduction of Reach - max
Salida Crossing	SDX061	8.36	Additional Element Fault Current - min	8.38	Additional Element Fault Current - max
Sedan	SED061	0.4	Primary Over-Voltage - min	0.78	Thermal for Gen - max
Shepard	SHP061	2.3	Primary Over-Voltage - min	9.18	Additional Element Fault Current - max
Shepard	SHP062	0.9	Primary Over-Voltage - min	7.95	Breaker Relay Reduction of Reach - max
Shepard	SHP063	2.35	Additional Element Fault Current - min	4.92	Additional Element Fault Current - max
Shepard	SHP071	1.5	Primary Over-Voltage - min	8.06	Breaker Relay Reduction of Reach - max
Shepard	SHP072	2.5	Primary Over-Voltage - min	9.22	Additional Element Fault Current - max
Sibley Park	SIP061	0.7	Primary Over-Voltage - min	3.87	Breaker Relay Reduction of Reach - max
Sibley Park	SIP062	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Sibley Park	SIP063	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Sibley Park	SIP071	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Sibley Park	SIP072	0.3	Primary Over-Voltage - min	2.36	Breaker Relay Reduction of Reach - max
Sibley Park	SIP073	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Saint John's	SJO001	0.1	Primary Over-Voltage - min	1.05	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP071	1.4	Primary Over-Voltage - min	7.6	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP072	1	Primary Over-Voltage - min	8.56	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP073	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Saint Louis Park	SLP074	0.3	Primary Over-Voltage - min	1.87	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP075	1.14	Thermal for Gen - min	10	Primary Over-Voltage - max
Saint Louis Park	SLP076	1.17	Thermal for Gen - min	9.54	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP077	1.2	Primary Over-Voltage - min	6.27	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP081	0.9	Primary Over-Voltage - min	8.35	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP082	1.2	Primary Over-Voltage - min	5.48	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP083	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Saint Louis Park	SLP084	1.2	Primary Over-Voltage - min	7.35	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP085	1.17	Thermal for Gen - min	8.76	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP086	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Saint Louis Park	SLP087	1.17	Thermal for Gen - min	8.3	Additional Element Fault Current - max
Saint Louis Park	SLP091	1.17	Thermal for Gen - min	9.83	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Saint Louis Park	SLP092	1	Primary Over-Voltage - min	7.62	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP093	0.5	Primary Over-Voltage - min	5.54	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP094	2.81	Thermal for Gen - min	10	Primary Over-Voltage - max
Saint Louis Park	SLP095	1.7	Primary Over-Voltage - min	9.83	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP096	1.59	Thermal for Gen - min	9.47	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP097	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Saint Louis Park	SLP321	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Saint Louis Park	SLP322	0.49	Thermal for Gen - min	2.93	Breaker Relay Reduction of Reach - max
Slayton West	SLW061	1.42	Additional Element Fault Current - min	3.14	Breaker Relay Reduction of Reach - max
Slayton West	SLW062	1.18	Thermal for Gen - min	8.52	Additional Element Fault Current - max
Summit Ave	SMT061	2.2	Primary Over-Voltage - min	9.18	Breaker Relay Reduction of Reach - max
Summit Ave	SMT062	0.1	Primary Over-Voltage - min	0.86	Breaker Relay Reduction of Reach - max
Summit Ave	SMT063	0.9	Primary Over-Voltage - min	7.85	Breaker Relay Reduction of Reach - max
Summit Ave	SMT071	4.68	Thermal for Gen - min	10	Primary Over-Voltage - max
Summit Ave	SMT072	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Summit Ave	SMT081	1.3	Primary Over-Voltage - min	8.4	Breaker Relay Reduction of Reach - max
Summit Ave	SMT082	0.2	Primary Over-Voltage - min	1.13	Breaker Relay Reduction of Reach - max
Summit Ave	SMT091	1.2	Thermal for Gen - min	2.82	Breaker Relay Reduction of Reach - max
Summit Ave	SMT092	0.7	Primary Over-Voltage - min	4.73	Thermal for Gen - max
South Haven	SOH001	0.1	Primary Over-Voltage - min	0.94	Breaker Relay Reduction of Reach - max
Southtown	SOU061	1	Primary Over-Voltage - min	7.41	Breaker Relay Reduction of Reach - max
Southtown	SOU063	1.7	Primary Over-Voltage - min	2.87	Thermal for Gen - max
Southtown	SOU064	1.1	Primary Over-Voltage - min	6.25	Breaker Relay Reduction of Reach - max
Southtown	SOU065	1	Primary Over-Voltage - min	7.74	Breaker Relay Reduction of Reach - max
Southtown	SOU066	1.12	Thermal for Gen - min	10	Primary Over-Voltage - max
Southtown	SOU069	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Southtown	SOU072	2.1	Primary Over-Voltage - min	3.01	Thermal for Gen - max
Southtown	SOU073	3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Southtown	SOU075	1.17	Thermal for Gen - min	3.04	Thermal for Gen - max
Southtown	SOU076	1.17	Thermal for Gen - min	1.52	Thermal for Gen - max
Southtown	SOU077	1.17	Thermal for Gen - min	3.4	Thermal for Gen - max
Southtown	SOU078	0.2	Primary Over-Voltage - min	1.69	Breaker Relay Reduction of Reach - max
Southtown	SOU079	1.17	Thermal for Gen - min	2.55	Thermal for Gen - max
Southtown	SOU081	2.01	Thermal for Gen - min	2.02	Thermal for Gen - max
Southtown	SOU082	1.17	Thermal for Gen - min	3.05	Thermal for Gen - max
Southtown	SOU083	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Southtown	SOU084	1.69	Thermal for Gen - min	1.69	Thermal for Gen - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Southtown	SOU085	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Southtown	SOU086	1.1	Primary Over-Voltage - min	1.23	Thermal for Gen - max
Southtown	SOU087	1.17	Thermal for Gen - min	2.36	Thermal for Gen - max
Southtown	SOU088	1.17	Thermal for Gen - min	4.76	Thermal for Gen - max
South Ridge	SRD211	0.6	Primary Over-Voltage - min	3.15	Breaker Relay Reduction of Reach - max
Saint Joseph	STO001	1.91	Additional Element Fault Current - min	3.44	Thermal for Gen - max
Saint Joseph	STO002	0.2	Primary Over-Voltage - min	1.49	Breaker Relay Reduction of Reach - max
Stewart	STW021	0.1	Primary Over-Voltage - min	1.19	Breaker Relay Reduction of Reach - max
Stockyards	STY061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Stockyards	STY062	0.7	Primary Over-Voltage - min	8.95	Breaker Relay Reduction of Reach - max
Stockyards	STY063	0.5	Primary Over-Voltage - min	1.3	Primary Over-Voltage - max
Stockyards	STY065	0.6	Primary Over-Voltage - min	6.1	Breaker Relay Reduction of Reach - max
Stockyards	STY071	1	Primary Over-Voltage - min	6.33	Breaker Relay Reduction of Reach - max
Stockyards	STY072	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Stockyards	STY073	1.19	Thermal for Gen - min	7.64	Breaker Relay Reduction of Reach - max
Stockyards	STY075	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Swan Lake	SWN021	0.1	Primary Over-Voltage - min	3.61	Breaker Relay Reduction of Reach - max
Swan Lake	SWN022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Terminal	TER061	2.3	Primary Over-Voltage - min	8.8	Breaker Relay Reduction of Reach - max
Terminal	TER062	1.6	Primary Over-Voltage - min	7.33	Breaker Relay Reduction of Reach - max
Terminal	TER063	4.34	Thermal for Gen - min	10	Primary Over-Voltage - max
Terminal	TER064	3.28	Thermal for Gen - min	10	Primary Over-Voltage - max
Terminal	TER065	3.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Terminal	TER066	2.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Terminal	TER071	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Terminal	TER072	5.32	Thermal for Gen - min	10	Primary Over-Voltage - max
Terminal	TER073	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Terminal	TER074	2.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Terminal	TER075	0.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Terminal	TER076	3.81	Thermal for Gen - min	10	Primary Over-Voltage - max
Terminal	TER081	0.8	Primary Over-Voltage - min	6.69	Breaker Relay Reduction of Reach - max
Terminal	TER082	3.28	Thermal for Gen - min	10	Primary Over-Voltage - max
Terminal	TER083	1.4	Primary Over-Voltage - min	8.39	Breaker Relay Reduction of Reach - max
Terminal	TER084	2.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Terminal	TER085	3.51	Thermal for Gen - min	10	Primary Over-Voltage - max
Terminal	TER086	5.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Tanner's Lake	TLK023	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Tanner's Lake	TLK032	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Tanner's Lake	TLK034	1.06	Thermal for Gen - min	1.06	Thermal for Gen - max
Tanner's Lake	TLK061	0.9	Primary Over-Voltage - min	6.53	Breaker Relay Reduction of Reach - max
Tanner's Lake	TLK062	1.2	Primary Over-Voltage - min	4.34	Breaker Relay Reduction of Reach - max
Tanner's Lake	TLK064	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Tanner's Lake	TLK065	1.17	Thermal for Gen - min	1.17	Thermal for Gen - max
Tanner's Lake	TLK066	1.4	Primary Over-Voltage - min	9.44	Breaker Relay Reduction of Reach - max
Tanner's Lake	TLK067	0.2	Primary Over-Voltage - min	6.78	Breaker Relay Reduction of Reach - max
Tanner's Lake	TLK071	1.8	Primary Over-Voltage - min	7.29	Additional Element Fault Current - max
Tanner's Lake	TLK073	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Tanner's Lake	TLK075	2.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Tanner's Lake	TLK076	10	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Tanner's Lake	TLK077	1.5	Primary Over-Voltage - min	7.84	Breaker Relay Reduction of Reach - max
Tracy	TRA001	0.2	Primary Over-Voltage - min	2.07	Breaker Relay Reduction of Reach - max
Tracy	TRA002	0.2	Primary Over-Voltage - min	1.63	Thermal for Gen - max
Tracy Switching Station	TSS061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Twin Lake	TWL061	0.9	Primary Over-Voltage - min	6.06	Breaker Relay Reduction of Reach - max
Twin Lake	TWL062	1.22	Thermal for Gen - min	8.06	Breaker Relay Reduction of Reach - max
Twin Lake	TWL063	1.4	Primary Over-Voltage - min	7.62	Breaker Relay Reduction of Reach - max
Twin Lake	TWL064	1.23	Thermal for Gen - min	9.73	Breaker Relay Reduction of Reach - max
Twin Lake	TWL065	1.4	Primary Over-Voltage - min	9.34	Breaker Relay Reduction of Reach - max
Twin Lake	TWL066	1.17	Thermal for Gen - min	7.28	Additional Element Fault Current - max
Twin Lake	TWL067	1.16	Thermal for Gen - min	7.28	Additional Element Fault Current - max
Twin Lake	TWL068	1.6	Primary Over-Voltage - min	8.4	Breaker Relay Reduction of Reach - max
Twin Lake	TWL069	1.17	Thermal for Gen - min	6.84	Breaker Relay Reduction of Reach - max
Twin Lake	TWL071	0.6	Primary Over-Voltage - min	5.53	Breaker Relay Reduction of Reach - max
Twin Lake	TWL072	1.17	Thermal for Gen - min	6.87	Breaker Relay Reduction of Reach - max
Twin Lake	TWL073	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Twin Lake	TWL074	1.17	Thermal for Gen - min	9.27	Breaker Relay Reduction of Reach - max
Twin Lake	TWL075	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Twin Lake	TWL076	1.6	Primary Over-Voltage - min	8.46	Breaker Relay Reduction of Reach - max
Twin Lake	TWL077	1.17	Thermal for Gen - min	10	Primary Over-Voltage - max
Twin Lake	TWL078	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Twin Lake	TWL079	1.17	Thermal for Gen - min	6.78	Breaker Relay Reduction of Reach - max
Twin Lake	TWL081	0.9	Primary Over-Voltage - min	6.44	Breaker Relay Reduction of Reach - max
Twin Lake	TWL082	2.1	Primary Over-Voltage - min	7.55	Breaker Relay Reduction of Reach - max
Twin Lake	TWL083	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Twin Lake	TWL089	1.17	Thermal for Gen - min	8.44	Breaker Relay Reduction of Reach - max
Upper Levee	UPP061	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Upper Levee	UPP062	1.59	Additional Element Fault Current - min	5.6	Breaker Relay Reduction of Reach - max
Upper Levee	UPP063	0.6	Primary Over-Voltage - min	3.05	Breaker Relay Reduction of Reach - max
Upper Levee	UPP064	2.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Upper Levee	UPP065	4.68	Thermal for Gen - min	10	Primary Over-Voltage - max
Upper Levee	UPP066	1.4	Primary Over-Voltage - min	8.42	Breaker Relay Reduction of Reach - max
Upper Levee	UPP067	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Upper Levee	UPP068	1.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Upper Levee	UPP069	6.66	Thermal for Gen - min	10	Primary Over-Voltage - max
Upper Levee	UPP081	1.8	Primary Over-Voltage - min	9.64	Breaker Relay Reduction of Reach - max
Upper Levee	UPP082	1.3	Primary Over-Voltage - min	8.07	Breaker Relay Reduction of Reach - max
Upper Levee	UPP083	1.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Upper Levee	UPP084	1.8	Primary Over-Voltage - min	8.41	Breaker Relay Reduction of Reach - max
Upper Levee	UPP085	1.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Upper Levee	UPP086	2.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Upper Levee	UPP088	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Upper Levee	UPP089	1.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Vesili	VES021	0	Primary Voltage Deviation - min	0	Primary Voltage Deviation - max
Villard	VIL021	1.6	Primary Over-Voltage - min	2.74	Additional Element Fault Current - max
Viking	VKG061	1.5	Primary Over-Voltage - min	7.23	Breaker Relay Reduction of Reach - max
Viking	VKG065	1.4	Primary Over-Voltage - min	8.53	Breaker Relay Reduction of Reach - max
Viking	VKG071	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Viking	VKG072	1.4	Primary Over-Voltage - min	9.33	Breaker Relay Reduction of Reach - max
Vermillion	VMR061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Vermillion	VMR062	1.5	Primary Over-Voltage - min	4.8	Primary Over-Voltage - max
Vermillion	VMR063	2	Primary Over-Voltage - min	8.12	Additional Element Fault Current - max
Wabasha	WAB021	0.8	Primary Over-Voltage - min	6.32	Breaker Relay Reduction of Reach - max
Wabasha	WAB031	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wakefield	WAK321	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Waseca	WAS081	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Waseca	WAS091	2.05	Additional Element Fault Current - min	6.82	Breaker Relay Reduction of Reach - max
Waseca	WAS092	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Waseca	WAS231	14.05	Additional Element Fault Current - min	14.39	Additional Element Fault Current - max
Waterville	WAT001	0.2	Primary Over-Voltage - min	1.72	Additional Element Fault Current - max
Waterville	WAT021	0	Primary Voltage Deviation - min	0	Primary Voltage Deviation - max
Waterville	WAT081	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Waverly	WAV021	0.3	Primary Over-Voltage - min	2.68	Breaker Relay Reduction of Reach - max
Williams Brothers Pipeline	WBP061	1	Primary Over-Voltage - min	9.45	Breaker Relay Reduction of Reach - max
Williams Brothers Pipeline	WBP063	4.68	Thermal for Gen - min	10	Primary Over-Voltage - max
West Coon Rapids	WCR061	0.8	Primary Over-Voltage - min	4.2	Primary Over-Voltage - max
West Coon Rapids	WCR062	0.6	Primary Over-Voltage - min	3.2	Primary Over-Voltage - max
West Coon Rapids	WCR063	0.7	Primary Over-Voltage - min	2.7	Primary Over-Voltage - max
West Coon Rapids	WCR311	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
West Coon Rapids	WCR321	0.1	Primary Over-Voltage - min	1.22	Breaker Relay Reduction of Reach - max
West Coon Rapids	WCR322	0.6	Primary Over-Voltage - min	7.82	Breaker Relay Reduction of Reach - max
Waconia	WCS061	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Waconia	WCS064	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Waconia	WCS071	0	Primary Voltage Deviation - min	0	Primary Voltage Deviation - max
Waconia	WCS072	1.17	Thermal for Gen - min	9.93	Thermal for Gen - max
Woodbury	WDY311	0.1	Primary Over-Voltage - min	1.79	Breaker Relay Reduction of Reach - max
Woodbury	WDY312	2.5	Primary Over-Voltage - min	8.9	Breaker Relay Reduction of Reach - max
Woodbury	WDY321	1.2	Primary Over-Voltage - min	9.11	Breaker Relay Reduction of Reach - max
Woodbury	WDY322	2.9	Primary Over-Voltage - min	20	Primary Over-Voltage - max
West Byron	WEB021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
West Faribault	WEF061	1	Primary Over-Voltage - min	3.43	Additional Element Fault Current - max
West Faribault	WEF071	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
West Hastings	WEH021	0.6	Primary Over-Voltage - min	4.91	Breaker Relay Reduction of Reach - max
West Hastings	WEH022	1	Primary Over-Voltage - min	9.88	Breaker Relay Reduction of Reach - max
Wells Creek	WEL021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Western	WES061	1.7	Primary Over-Voltage - min	8.71	Breaker Relay Reduction of Reach - max
Western	WES062	0.4	Primary Over-Voltage - min	2.88	Breaker Relay Reduction of Reach - max
Western	WES063	2.4	Primary Over-Voltage - min	9.15	Breaker Relay Reduction of Reach - max
Western	WES064	0	Additional Element Fault Current - min	0	Breaker Relay Reduction of Reach - max
Western	WES065	0.2	Primary Over-Voltage - min	2.54	Breaker Relay Reduction of Reach - max
Western	WES071	2.1	Primary Over-Voltage - min	9.04	Breaker Relay Reduction of Reach - max
Western	WES072	1.6	Primary Over-Voltage - min	7.34	Breaker Relay Reduction of Reach - max
Western	WES073	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Western	WES074	1.3	Primary Over-Voltage - min	6.69	Breaker Relay Reduction of Reach - max
Western	WES075	1.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Western	WES076	1.7	Primary Over-Voltage - min	7.21	Breaker Relay Reduction of Reach - max
Wilson	WIL071	1	Primary Over-Voltage - min	6.38	Breaker Relay Reduction of Reach - max
Wilson	WIL072	2.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL073	1.5	Primary Over-Voltage - min	6.18	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Wilson	WIL074	2	Primary Over-Voltage - min	9.5	Breaker Relay Reduction of Reach - max
Wilson	WIL075	1.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL076	2.2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL077	2.3	Primary Over-Voltage - min	9.66	Breaker Relay Reduction of Reach - max
Wilson	WIL078	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wilson	WIL079	1.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL081	1.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL082	1.3	Primary Over-Voltage - min	6.54	Breaker Relay Reduction of Reach - max
Wilson	WIL083	1.4	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL084	1.5	Primary Over-Voltage - min	8.13	Breaker Relay Reduction of Reach - max
Wilson	WIL085	1.4	Primary Over-Voltage - min	8.83	Breaker Relay Reduction of Reach - max
Wilson	WIL086	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL087	1.8	Primary Over-Voltage - min	7.14	Breaker Relay Reduction of Reach - max
Wilson	WIL088	3.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL089	1.3	Primary Over-Voltage - min	7.68	Breaker Relay Reduction of Reach - max
Wilson	WIL091	1.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL092	1.1	Primary Over-Voltage - min	6.81	Breaker Relay Reduction of Reach - max
Wilson	WIL093	1.5	Primary Over-Voltage - min	8.71	Breaker Relay Reduction of Reach - max
Wilson	WIL094	2.3	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL095	2.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL096	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL097	1.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Wilson	WIL098	1.9	Primary Over-Voltage - min	6.53	Breaker Relay Reduction of Reach - max
Winona	WIN021	0.2	Primary Over-Voltage - min	1.5	Breaker Relay Reduction of Reach - max
Winona	WIN022	1.15	Thermal for Gen - min	8.23	Additional Element Fault Current - max
Winona	WIN023	1.06	Thermal for Gen - min	10	Primary Over-Voltage - max
Winona	WIN032	1.8	Primary Over-Voltage - min	6.87	Breaker Relay Reduction of Reach - max
Winona	WIN033	0	Additional Element Fault Current - min	0	Additional Element Fault Current - max
Winona	WIN034	2.96	Thermal for Gen - min	10	Primary Over-Voltage - max
Winona	WIN041	3.92	Thermal for Gen - min	10	Primary Over-Voltage - max
Winona	WIN042	1.06	Thermal for Gen - min	6.6	Breaker Relay Reduction of Reach - max
Winona	WIN043	0.1	Primary Over-Voltage - min	0.88	Breaker Relay Reduction of Reach - max
Watkins	WKN001	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wobegon Trail	WOB021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wobegon Trail	WOB022	0.3	Primary Over-Voltage - min	1.96	Breaker Relay Reduction of Reach - max
West River Road	WRR061	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
West River Road	WRR064	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
West River Road	WRR065	8.5	Primary Over-Voltage - min	10	Primary Over-Voltage - max
West River Road	WRR074	1.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
West River Road	WRR075	1.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
West River Road	WRR081	3.9	Primary Over-Voltage - min	10	Primary Over-Voltage - max
West River Road	WRR084	2.6	Primary Over-Voltage - min	10	Primary Over-Voltage - max
West River Road	WRR085	3.28	Thermal for Gen - min	10	Primary Over-Voltage - max
Winsted	WSD061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Westgate	WSG061	1.8	Primary Over-Voltage - min	8.94	Breaker Relay Reduction of Reach - max
Westgate	WSG062	1.7	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Westgate	WSG063	1.3	Primary Over-Voltage - min	9.24	Breaker Relay Reduction of Reach - max
Westgate	WSG064	1.3	Primary Over-Voltage - min	9.67	Breaker Relay Reduction of Reach - max
Westgate	WSG065	0.5	Primary Over-Voltage - min	4.94	Breaker Relay Reduction of Reach - max
Westgate	WSG066	0.9	Primary Over-Voltage - min	6.18	Breaker Relay Reduction of Reach - max
Westgate	WSG071	1.2	Primary Over-Voltage - min	9.43	Breaker Relay Reduction of Reach - max
Westgate	WSG072	4.99	Thermal for Gen - min	9.67	Thermal for Gen - max
Westgate	WSG073	1.4	Primary Over-Voltage - min	9.83	Thermal for Gen - max
Westgate	WSG074	1.2	Primary Over-Voltage - min	8.33	Breaker Relay Reduction of Reach - max
Westgate	WSG075	1.8	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Westgate	WSG076	0.6	Primary Over-Voltage - min	4.56	Breaker Relay Reduction of Reach - max
Westgate	WSG351	0.02	Additional Element Fault Current - min	1.04	Breaker Relay Reduction of Reach - max
Westgate	WSG352	0.4	Primary Over-Voltage - min	4.13	Breaker Relay Reduction of Reach - max
Westgate	WSG361	0	Breaker Relay Reduction of Reach - min	0	Breaker Relay Reduction of Reach - max
Westgate	WSG362	0.1	Primary Over-Voltage - min	5.28	Breaker Relay Reduction of Reach - max
Westport	WSP021	0.3	Primary Over-Voltage - min	0.61	Thermal for Gen - max
West Union	WSU021	0.21	Thermal for Gen - min	0.21	Thermal for Gen - max
Watab River	WTB021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Watertown	WTN061	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Watertown	WTN062	0.3	Primary Over-Voltage - min	2.6	Breaker Relay Reduction of Reach - max
West Waconia	WWK311	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
West Waconia	WWK321	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wyoming	WYO021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wyoming	WYO022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Wyoming	WYO031	0.8	Primary Over-Voltage - min	5.85	Breaker Relay Reduction of Reach - max
Wyoming	WYO032	0.9	Primary Over-Voltage - min	4.43	Breaker Relay Reduction of Reach - max
Wyoming	WYO033	1.1	Primary Over-Voltage - min	8.18	Breaker Relay Reduction of Reach - max
Crossroads	XRD061	1.6	Primary Over-Voltage - min	7.54	Breaker Relay Reduction of Reach - max
Crossroads	XRD062	1.7	Primary Over-Voltage - min	9.71	Breaker Relay Reduction of Reach - max

Substation	Feeder	Minimum Hosting Capacity (MW)	Min Limiting Factor	Maximum Hosting Capacity (MW)	Max Limiting Factor
Crossroads	XRD063	1.5	Primary Over-Voltage - min	8.2	Breaker Relay Reduction of Reach - max
Crossroads	XRD075	1.04	Thermal for Gen - min	5.33	Breaker Relay Reduction of Reach - max
Crossroads	XRD076	0.1	Primary Over-Voltage - min	1.28	Breaker Relay Reduction of Reach - max
Crossroads	XRD077	2	Primary Over-Voltage - min	10	Primary Over-Voltage - max
Young America	YAM021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Young America	YAM031	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Yellow Medicine	YLM211	0.1	Primary Over-Voltage - min	0.94	Breaker Relay Reduction of Reach - max
Yellow Medicine	YLM212	0.2	Primary Over-Voltage - min	1.08	Breaker Relay Reduction of Reach - max
Zumbro Falls	ZUF021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Zumbrota	ZUM021	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max
Zumbrota	ZUM022	0	Primary Over-Voltage - min	0	Primary Over-Voltage - max

Requirement	Source	Location Response is Addressed
a. Please provide additional details around the choice of the methodology option in the DRIVE tool.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section D2
b. Provide the assumptions utilized that are related to location of distributed energy resources (DER) to load (e.g., did Xcel assume that small-scale DER would be located close to load or in sections with low or no load?).	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section D2
c. Please clarify how assumptions regarding types of DER impacted the choice to use the small distributed methodology	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section D2
2) Assumptions a. Please provide an example of the process used for validation of the GIS data, and include several examples and explanations where data was modified.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section E and March 20, 2017 Comments in Docket 15-962
b. Please provide additional information regarding the validation of GIS data on any areas where the report identified a small feeder section, such as less than five feet, registered as overloaded or showed potentially high voltage.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section E and March 20, 2017 Comments in Docket 15-962
c. Please provide more details, including a specific instance or reference, where a secondary conductor with DER results in high voltage, including whether there is or is not an existing regulation condition.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section E and March 20, 2017 Comments in Docket 15-962
d. For capacitors, did Xcel consider a situation with peak load and all capacitors turned off, and includes low voltage violations? Please explain whether Xcel did or did not, and, if not, why not?	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section E
e. Please provide Xcel's definition of "peak load."	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
f. For loading levels, please explain the reasoning for assuming a 20% daytime minimum load.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section E
g. Please explain the process for collecting peak load information from non-SCADA substations, including translating that into feeder-by-feeder information.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section E
h. Please explain whether or not Xcel collects daytime minimum load, or whether its existing SCADA system is capable of collecting daytime minimum load information. If it is, please explain why Xcel chose to use 20% as opposed to the actual daytime minimum load.	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
i. For Load Allocation, please provide further explanation of how Xcel determined "appropriate load curves." For example, is this something specified within the DRIVE tool, or was it separately determined by Xcel?	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
j. For feeder topology, please explain if Xcel made assumptions regarding the phasing of the load.	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
k. For head-end voltage, please explain why Xcel utilized a 104% voltage level. Did Xcel assume use of tap changers or other voltage regulation capabilities for this assumption and model run, and can this be done in the future?	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
3) Thresholds a. For primary voltage deviation, please explain if Xcel assumed that all DER on a feeder would trip off-line at the same time?	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
b. Please explain Xcel's decision to not run the primary under voltage threshold.	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
4) Limitations a. For no automatic mitigations applied, please provide a description and use of the advanced inverter functions that Xcel currently uses.	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
5) Attachment A (the results) a. Does Xcel have the ability to identify which feeders have capacitor banks and other potential voltage controls which are set to default?	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
6) Others a. Provide Xcel's definition of Distributed Energy Resources.	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section B

Requirement	Source	Location Response is Addressed
b. Explain if Xcel assumes that DER can only reduce hosting capacity to a feeder, or can DER also add hosting capacity through storage or demand response?	2/21/2017 MPUC (IR 1)	2017 Hosting Report Section B
c. Explain whether Xcel considered any mitigations on the DER side, such as utilization of the DER's advanced inverter functionality, if available.	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
d. Explain the use of the interconnection process versus this hosting capacity report to maintain reliability.	2/21/2017 MPUC (IR 1)	March 20, 2017 Comments in Docket 15-962
Including impacts from existing distributed energy resources, as the Company suggested would be possible with the 2017 DRIVE Tool update	4/19/2017 ILSR	2017 Hosting Report Introduction
Primary Voltage Deviation should be changed from 2% to 3% and 5% for individual and aggregate systems respectively to match current practices.	4/20/2017 FE	2017 Hosting Report Section F
IREC recognizes that Xcel is still in the early stages of its hosting capacity efforts, but notes that the lack of inclusion of other types of DER limit the accuracy of the methodology and its usefulness in the various intended applications. It would be helpful to have a better understanding of when a broader range of DER, in particular energy storage, can be incorporated.	4/20/2017 IREC	2017 Hosting Report Introduction
IREC requests additional information regarding what exactly prevents the DRIVE tool from using a minimum load value recorded from SCADA as opposed to the conservative estimates produced by Xcel.	4/20/2017 IREC	May 5, 2017 Comments in Docket 15-962
IREC would like to understand whether peak hours are assumed or whether the actual feeder peak load hour is used, and how long before the peak hour and for how long after are the capacitor banks switched on.	4/20/2017 IREC	2017 Hosting Report Section E
IREC would benefit from better understanding any assumptions used for secondary conductors (e.g., size, material, length, etc.).	4/20/2017 IREC	2017 Hosting Report Section E
Xcel's description in its report and supplemental comments do not address how the DRIVE tool would treat pre-existing conditions, in particular voltage violations. Specifically, Xcel does not articulate if and how it would address the ability of DER to help resolve such violations or exacerbate them, or whether it would simply display that circuit as having no remaining hosting capacity. IREC requests additional information on how pre-existing violations are screened and handled.	4/20/2017 IREC	May 5, 2017 Comments in Docket 15-962

CERTIFICATE OF SERVICE

I, Carl Cronin, hereby certify that I have this day served copies of the foregoing document on the attached list of persons.

xx by depositing a true and correct copy thereof, properly enveloped with postage paid in the United States mail at Minneapolis, Minnesota

xx electronic filing

Docket Nos. E002/M-17-777
E002/M-15-962
Xcel Energy's Miscellaneous Electric Service List

Dated this 1st day of November 2017

/s/

____

Carl Cronin
Regulatory Administrator

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