COMMERCE DEPARTMENT

February 28, 2019

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

RE: **Comments of the Minnesota Department of Commerce, Division of Energy Resources**
Docket No. E002/M-18-684

Dear Mr. Wolf:

Attached are the comments of the Minnesota Department of Commerce, Division of Energy Resources (Department) in the following matter:

*Northern States Power, d/b/a Xcel Energy's 2018 Distribution System Hosting Capacity Study.*

The report was filed on November 1, 2018, by:

Bria E. Shea
Director, Regulatory & Strategic Analysis
Northern States Power Company d/b/a/ Xcel Energy Services Inc.
414 Nicollet Mall
Minneapolis, MN 55401

The Department is available to respond to any questions the Minnesota Public Utilities Commission may have on this matter.

Sincerely,

/s/ MATTHEW LANDI
Rates Analyst

/s/ LISE TRUDEAU
Senior Engineering Specialist

ML/LT/jl
Attachment

COMMERCE DEPARTMENT

# Before the Minnesota Public Utilities Commission

## Comments of the Minnesota Department of Commerce Division of Energy Resources

Docket No. E002/M-18-684

## I. BACKGROUND

On November 1, 2018, Xcel Energy (Xcel or the Company) filed its 2018 Distribution System Hosting Capacity Report (the 2018 Report) as required by Minn. Stat. §216B.2425, subd. 8 (the Statute) and the Minnesota Public Utility Commission's (Commission) July 19, 2018 Order in Docket No. E002/M-17-777 (the Order).

Minn. Stat. §216B.2425, subd. 8, states:

> Subd. 8. Distribution study for distributed generation. Each entity subject to this section that is operating under a multiyear rate plan approved under section 216B.16, subdivision 19, 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 sub-division 2.

The relevant portions of the Order listed the following requirements for Xcel's 2018 Report:

> 2. Xcel's 2018 Hosting Capacity Report must 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.
>
> 3. Xcel's 2018 Hosting Capacity Report must be detailed enough to inform future distribution system planning efforts and upgrades necessary to facilitate the continued efficient integration of distributed generation.

4. Xcel must file 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 must explain in detail the basis for those concerns.

5. Xcel must provide the Hosting Capacity results in downloadable, MS-Excel or other spreadsheet file formats.

6. Xcel must provide information on the accuracy of the Hosting Capacity Report information; both estimates on the accuracy of the 2018 report and an analysis of the 2017 results compared to actual hosting capacity determined through any interconnection studies or other reasonable metric.

7. The Commission hereby requests that Xcel Energy address stakeholder recommendations in the Company's 2018 Hosting Capacity Report filing, including:

    a. consider the methodological options to both improve and measure accuracy of the hosting capacity analysis, including identification and analysis of industry best practices and an explanation of the Company's methodological choice;
    b. consider the feasibility and practicality of including the results of both the Small Distributed methodology and the Large Centralized methodology in future hosting capacity analyses;
    c. conduct a sensitivity analysis;
    d. explore a range of options for better presenting the public-facing results of the Hosting Capacity Analysis after consideration of, but not limited to, any security and privacy issues that may be implicated in providing more detailed information and what information might be useful to developers and stakeholders;
    e. provide an update in each report on the evolving capability of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs;

f. file more detailed data on load profile assumptions used in the analysis, including peak load (kW) by substation and feeder; and
g. file supplemental information that would result in a broader understanding of how to guide distribution upgrades for additional hosting capacity.

8. The hosting capacity report identified in Minn. Stat. § 216B.2425, subd. 8, may be filed separately from the Biennial Transmission Projects Report.

9. Xcel must file a Hosting Capacity Report on an annual basis by November 1 each year.

Further, on November 20, 2018, the Commission issued its Notice for Comment Period (Notice). The Notice requested comments on the Report regarding the following topics:

- Does Xcel Energy's 2018 Hosting Capacity Study achieve the requirements outlined in the Commission's July 19, 2018 Order[footnote omitted] and Minn. Stat. §216B.2425, subd. 8?
- Does the Hosting Capacity Study adequately address stakeholder recommendations [footnote omitted], or what modifications or clarifications are needed?
- Should the Hosting Capacity Study continue to be filed independently from the statute-required Biennial Grid Modernization Report or Integrated Distribution Plan in years in which they are required to be filed?
- Are there other issues or concerns related to this matter?

Since there are no specific rules for Minn. Stat. §216B.2425, subd. 8, the Minnesota Department of Commerce, Division of Energy Resources (Department) examined Xcel's 2018 Report according to the Statute and the Order. In addition, the Department offers the following comments as a response to the Commission's Notice.

## II. DEPARTMENT ANALYSIS

### *A. TOPIC #1*

As noted above, the first topic open for comment asks whether the 2018 Report achieves the requirements outlined by the Statute and the Order. The Department's analysis relies on the

Statute and the Order to determine the completeness of the 2018 Report in terms of serving the public-interest-oriented goals of the Statute and the Order.

*1. The Statute*

Minn. Stat. §216B.2425, subd. 8, as aforementioned, states that Xcel:

> *…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 sub-division 2. [emphasis added].

The Department views the statute as having two distinct requirements: (1) a substantive requirement, which is found in the *italicized* text above; and (2) a procedural requirement, which is found in the underlined text above.

Further, the completeness analysis of the substantive requirement of the Statute involves two components and requires answers to two questions:

> (1) Does the 2018 Report identify interconnection points on Xcel's distribution system for small-scale distributed generation resources, and;
> (2) Does it identify distribution upgrades that will help facilitate the development of distributed generation resources?

The Department concludes that the 2018 Report identifies a reasonable and sufficient amount of interconnection points on Xcel's distribution system[1] and identifies necessary distribution upgrades to support the continued development of distributed generation resources. The Department finds that the answer to both those questions is yes, and therefore concludes that the 2017 Report is complete as far as the substantive requirement of the Statute is concerned.

The completeness analysis of the procedural requirement of the Statute involves only one component and requires an answer to one question: was the 2018 Report included in the study that is required by the Statute under subdivision 2 (referring to the Biennial Transmission Projects Report[2])?

[1] Xcel identified and included 1,049 feeders in the 2018 Report, while excluding 120 feeders from the public "heat map" based on confidentiality and security concerns. 2018 Report, pages 29-30.
[2] Minn. Stat. §216B.2425, subd. 2. The biennial transmission report is filed every two years and was filed last year in Docket No. E002/M-17-377. The next biennial transmission report is expected to be filed on November 1, 2019.

While the answer is technically no, as it was filed in a separate regulatory proceeding, Order Point #8 of the Order permits Xcel to file the 2018 Report separate from the Biennial Transmission Projects Report. Order Point #8 was borne out of the Department's recommendation to retroactively permit the Hosting Capacity Report in Docket No. E002/M-17-777 (2017 Report) to be filed separately from the biennial transmission report and to apply to future hosting capacity report filings, including the 2018 Report. Thus, the Department concludes that the procedural requirement of the Statute is satisfied.

*2. The Order*

The Order created eight requirements for Xcel's next Hosting Capacity Report. They can be organized into two categories: (1) substantive requirements, and; (2) structural requirements. These categories are discussed below as the Department reviews each of these requirements to determine completeness.

*a) Substantive Requirements*

The Department views Order Points 2, 3, 6, and 7a-c and 7e-g as the substantive requirements of the Order regarding the actual content of the report.

*i. Order Point #2 Sufficient Detail as a Starting Point for Developers*

As noted above, Order Point #2 required that the 2018 Report to 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." In addition, this Order Point requires the information to be "sufficient to provide developers with a starting point for interconnection applications."

The 2018 Report contains detailed hosting capacity analysis (HCA) of most of Xcel's individual feeders, excluding only those feeders that are sensitive for privacy or security reasons, or feeders not owned by Xcel.[3] This detailed information on a per-feeder basis was also provided in a spreadsheet attached to the 2018 Report.

As discussed in Docket No. E002/M-17-777, there are four ways of performing a hosting capacity analysis, two of which are widely accepted by the industry: the Iterative Capacity Analysis (ICA) method and the "hybrid" method employed by the Electric Power Research Institute (EPRI) DRIVE tool.[4] The Company explained in the 2017 Report that the ICA method is an "intensive analysis that tried to precisely answer the specific level of DER that can be

[3] 2018 Report, pages 12-13 and 29-30.
[4] 2017 Report, page 8; 2018 Report, page 16.

accommodated at each node, through detailed power flow analysis that is similar to an interconnection engineering study."[5] The Company further explained in the 2017 Report that the DRIVE tool is less data intensive, but has proven to be reasonably accurate in steering DER interconnections to potential 'best' locations."[6]

In the 2018 Report, the Company provided additional information regarding a comparison of the ICA and hybrid methods. The Company explained that a California utility, San Diego Gas and Electric, undertook a study to compare the two methods and found there to be little difference between the results:[7]

> Key findings were that different hosting capacity methods can provide similar results; similar hosting capacity results can be derived more efficiently; hosting capacity methods will continue to evolve and improve. These findings demonstrate that the DRIVE hybrid method produces comparable results to one of the early leading industry approaches to hosting capacity that is significantly more labor intense to produce. We are confident that as DRIVE is refined through further improvements and modifications, the accuracy of the hybrid method will correspondingly also improve.

The Department appreciates that the Company continues to provide updates regarding the industry best practices for hosting capacity analysis. At this time, the Department concludes that the EPRI DRIVE tool is an appropriate and reasonable method for the Company to use in conducting hosting capacity analyses.

In terms of whether the use of the EPRI DRIVE tool specifically and the Company's 2018 Report generally are in compliance with Order Point #2, the Department reviewed the 2018 Report and observed that the Company made several improvements:[8]

> - *Application of Reverse Power Flow Threshold.* An enhancement in the DRIVE tool allowed us to implement the "Reverse Power Flow" threshold. Unlike the functionality in previous versions of the tool, this version reports any reverse power flow at the head-end of the feeder (substation feeder breaker). If reverse power flow is seen at that location, a violation occurs and hosting capacity is limited. This enhancement allows our hosting

[5] 2017 Report, page 8.
[6] *Id.*
[7] 2018 Report, page 17.
[8] 2018 Report, pages 1-2.

capacity analysis (HCA) to better align with the criteria we use in the interconnection process.

- *Adjustment of Voltage Deviation Threshold.* In previous years, we used the default setting of three percent with an assumed 60 percent loss of aggregate generation for a given feeder. In our current analysis, we changed the threshold to five percent with an assumed 100 percent loss of aggregate generation. This means that if a five percent voltage deviation occurs for a sudden loss of all generation on that feeder, hosting capacity is limited. This enhancement has minimal effect on the results, but better aligns with how we perform interconnection studies with multiple sources of distributed generation.[footnote omitted]
- *Inclusion of fuses for thermal violations.* Another enhancement to the DRIVE tool included the addition of thermal violations on three phase fuses. In some instances, hosting capacity can be limited by the protective fuses used to serve a given area. These areas are usually small and serve a small number of customers. Consequently, this enhancement has only had a minimal impact on the hosting capacity for small portions of the system.
- *Regulator bandwidth adjustment*. As described in our 2017 analysis, we corrected the default bandwidth of our regulators, which aligns with the simplified IEEE 1453 approach. Our regulators now have a 4.8 Volt bandwidth with a trigger occurring at 50 percent of that (2.4 Volts).
- *Removal of solar gardens from the analysis that are not in-servic*e. In an attempt to make our analysis more forward looking we included any solar gardens with signed Interconnection Agreements into our models for our 2017 analysis. Due to issues with some of those projects not being built on time, not proceeding, or troubles with accurately accounting for how facilities were going to be constructed in the field we did not continue that practice this year. Instead, we are only including solar gardens that were in-service as of August 14, 2018. We believe this will provide more accurate results that can be used in conjunction with the publicly updated interconnection queue to better understand the remaining hosting capacity capabilities of a given feeder.

The Department concludes that these changes appear to be reasonable improvements over the 2017 Report. In addition, the Company's stated methodology appears to be an earnest attempt to accurately estimate its distribution system in the hosting capacity analysis. The Company

used data from its Geographic Information System (GIS) to inform the 1,049 feeder models created in Synergi Electric, the distribution load-flow program used by the Company.[9] Once this data was inputted, the Company "ran a series of 'clean-up' scripts to provide model assumptions and address any common issues that may be present in the data" such as "setting the head-end voltage, setting the burial depths on underground cable, setting the height of overhead conductor above the ground, and placing equipment settings into capacitors, reclosers, and regulators, among other things."[10] Once the Company addressed all of the identified errors, it allocated the load to the feeder based on demand data and customer energy usage data. Before analyzing the models using DRIVE to determine the hosting capacity results, the Company ran a load-flow and performed a final check for any abnormalities on the feeder.[11]

The Company further explained that it used the "Large Centralized" method for allocating distributed energy resources (DERs) across a feeder, which is intended to match the large amount of community solar gardens (CSG) being implemented in Minnesota.[12] The Company explained that "[T]he Large Centralized methodology only focuses on installations on three phase lines, which generally have more capacity and better align with the types of installations [the Company] is seeing on [its] system."[13]

Using the various assumptions detailed on pages 10 through 13 of the 2018 Report and the criteria thresholds available to determine hosting capacity on a given piece of equipment as explained on pages 13 and 14 of the 2018 Report, the Company conducted its hosting capacity analysis.

In consideration of the Company's use of the EPRI DRIVE tool and its detailed methodology, the Department concludes that the Company is in compliance with Order Point #2, as Xcel provided "a reliable estimate of the available level of hosting capacity per feeder at the time of submittal of the report to the extent practicable" and that the "information provided is sufficient to provide developers with a starting point for interconnection applications."

*ii. Order Point #3: Sufficient Detail to Inform Planning Efforts*

As noted above, Order Point #3 required that the 2018 Report be detailed enough to inform future distribution system planning efforts and upgrades necessary to facilitate the continued efficient integration of distributed generation.

[9] 2018 Report, pages 7-8.
[10] 2018 Report, page 8.
[11] *Id.*
[12] 2018 Report, pages 8-9.
[13] *Id.*

The 2018 Report contains high-level information about the hosting capacity of most feeders in Xcel's distribution system. While not necessarily precise and becoming less representative over time as the actual distribution system changes, the hosting capacity study results are likely to be informative for future distribution system planning as it is generally helpful for interested stakeholders to determine the capacity available on the distribution system for distributed energy resources (DERs) and the various technical constraints that may be limiting capacity at individual feeders. This insight allows for more targeted DER siting and identifies system upgrades that may be needed in the future to enable a more efficient allocation of resources and the orderly integration of cost-effective DERs. Therefore, the Department concludes that the Company complied with Order Point 3.

*iii. Order Points #6 and #7a: Accuracy of the 2018 Report*

As noted above, Order Point #6 requires Xcel to provide information on the accuracy of the 2018 Report and a comparison of the 2017 Report results to actual hosting capacity determined through any interconnection studies or other reasonable metric. Additionally, Order Point #7a requires Xcel to consider options to improve and measure the accuracy of its hosting capacity analysis.

Section H of the 2018 Report contains a detailed explanation of the Company's attempt to measure the accuracy of the 2018 Report by first assessing the correlation of the results between the 2017 and 2018 Reports. The Company then correlated both the 2017 and 2018 results with interconnection screen results.

The Company began by comparing the 2018 results with its 2017 results. The Company explained that it performed 21 interconnection screens on large-scale distributed generation (DG), 17 of which proceeded to engineering study, and then recorded the corresponding hosting capacities from both the 2017 and 2018 hosting capacity analyses for those 17 interconnection screens.[14] In comparing the 2017 and 2018 results, the Company found that only three of the 17 locations had results that differed by more than 100 kW, and further, "in all of these instances, the limiting factor for the hosting capacity in the 2018 results was due to the Reverse Power Flow, which was not utilized in the 2017 analysis."[15] The Company stated that it believed that if the version of the DRIVE tool used in the 2017 analysis included the Reverse Power Flow threshold, the results would have been nearly identical between the 2017 and 2018 analyses.[16] The Company concluded that the 2017 and 2018 results were consistent between the two versions of the DRIVE tool used.[17]

[14] 2018 Report, pages 18-19.
[15] 2018 Report, page 19.
[16] *Id.*
[17] *Id.*

The Company then compared the 2017 and 2018 results to the screen results and found that "for the 21 locations, 18 of the screening results positively correlated with the 2017 hosting capacity results and 19 positively correlated with the 2018 results."[18] The Company explained that this means "if the project passed the Screen for 'X' amount of generation, there was at least that amount of hosting capacity at that location for our 2017/2018 reports."[19]

The Company determined that differences in Daytime Minimum Load (DML) values and potential islanding/reverse power flow issues were the causes for the three sites where screen results did not correlate with its 2017 hosting capacity analysis.[20] When the Company examined these three sites on a more detailed basis, and corrected the DML values and included the new threshold for Reverse Power Flow in the 2018 hosting capacity analysis, the three sites correlated with the screen results.

The Company explained that there was a 90 percent positive correlation rate between the 2018 results and the screen results, and that the only thing limiting a 100 percent correlation was estimating a default DML value as the percent of the peak feeder load, and further explained:[21]

> It is not currently practical to use actual DML values in our HCA. We do not currently maintain this information for all feeders on our system. In addition, and separate from the significant effort involved in gathering actual DML values for every feeder, incorporating the actual values into our annual HCA would be a significant work effort. We would need to build a second set of feeder models containing these values, run them through DRIVE— and bring together both sets of results to determine the final values. Considering the incremental benefit portrayed by our 2018 HCA accuracy analysis, we believe a reasonable course of action is to identify and examine the feasibility and impact of other potential process improvements, and continue working with EPRI to potentially address this gap in a more efficient way.

In consideration of the Company's efforts to measure the accuracy its hosting capacity analysis, the results of these efforts, and the Company's explanation regarding an improvement in measuring the accuracy of its hosting capacity analysis, the Department concludes that the current hosting capacity analysis methodology appears to be reasonably accurate and that improvements suggested by the Company to determine actual DML values are not a prudent

[18] *Id.*
[19] *Id.*
[20] Id.
[21] 2018 Report, page 20.

use of ratepayer resources. The Company's commitment to identify and examine the feasibility and impact of other potential process improvements, and to continue its partnership with EPRI, appear to be reasonable and appropriate options for improving and measuring the accuracy of the hosting capacity analysis. Accordingly, the Department concludes that the 2018 Report is in compliance with Order Points #6 and #7a.

*iv. Order Point #7b: EPRI DRIVE Tool Methodology*

As noted above, Order Point #7b requires Xcel to consider using both the Small Distributed and Large Centralized methodologies in future hosting capacity analyses.

Also noted above, the Company explained that it used the Large Centralized methodology as this methodology more accurately reflected the types of DER installations being added to the Company's system, and that using the Small Distributed Methodology would be appropriate for smaller scale PV installations.[22] The Company provided further reasons why it would be difficult to use the Small Distributed methodology, let alone to use both in conducting the hosting capacity analysis:[23]

> Additionally, the accuracy of the results using the Small Distributed Method are dependent on the inclusion of secondary voltage equipment data in the modeling, because most violations for small scale installations occur on the secondary voltage level from the service transformer to the customer's meter. Since the Company does not maintain detailed secondary information beyond the transformer in its systems necessary for this analysis, this method would have limited usefulness. Further, our understanding of the intent of this analysis is that it is to provide realistic hosting capacity results at the primary voltage level for small scale installations up to 1 MW, rather than to inform small "roof top" style installations of available hosting capacity at the secondary voltage level. If there is available hosting capacity on a particular feeder, is it is not necessarily indicative of whether upgrades are required for small secondary connected DER. Likewise, if a particular feeder does not have hosting capacity available on a feeder it does not necessarily mean that a small secondary connected installation will be prohibited from interconnecting.
>
> Analyzing hosting capacity is complex – and preparing two sets of results would further complicate and exacerbate the amount of

[22] 2018 Report, pages 8-9.
[23] 2018 Report, pages 9-10.

> work involved, particularly when one set of results would have questionable accuracy. While it is feasible to run the analysis with both the Large Centralized and Small Distributed Methods, there is significant extra work needed to process those results and map them. Furthermore, it would be necessary to include additional explanation to aid understanding and help stakeholders and report users recognize the differences and limitations, and to know how to best utilize the two sets of results. Before expanding the annual analysis, we believe it is important to help simplify the understanding of hosting capacity and not add further levels of analysis that might create confusion and provide limited value.

This discussion is helpful for the Commission and stakeholders in the consideration of which methodological choice is most appropriate for conducting the hosting capacity analysis. Until such a time that the Company maintains detailed secondary voltage equipment data beyond the transformer necessary for conducting the hosting capacity analysis using the Small Distribution methodology and, further, that small scale PV installations become more common, the Department concludes that it is appropriate for Xcel to use the Large Centralized methodology.

**The Department recommends that the Commission require Xcel to provide updates on the appropriateness of the methodological choice of the hosting capacity analysis, a discussion of the ability of the Company to obtain more detailed secondary voltage equipment data, and the types of DERs being interconnected in future reports. (Recommendation 1)**

The Department concludes that the Company has sufficiently complied with Order Point #7b.

*v. Order Point #7c: Conduct a Sensitivity Analysis*

As noted above, Order Point #7c requires Xcel to conduct a sensitivity analysis. The Company explained that it conducted a sensitivity analysis for variations in power factor for new generation and substation bus voltage.[24] These two variables were specifically identified in stakeholder comments in Docket No. E002/M-17-777.[25] Fresh Energy also expressed concern over Xcel's assumptions regarding conductor spacing.[26] Xcel addressed why they assumed conductor spacing to be the same for each voltage class on page 11 of the 2018 Report, and is quoted above in Section 2(a)(i) of these comments.

[24] 2018 Report, page 23.
[25] Fresh Energy Initial Comments in Docket No. E002/M-17-777, pages 6-7.
[26] *Id.,* page 7.

The Department reviewed the results of the Company's sensitivity analysis. For the Power Factor sensitivity analysis, the Company varied the power factor for all new distributed generation from unity to 0.98 leading to 0.95 leading.[27] The Company reported that the average hosting capacity gained by changing the power factor of new DER to 0.98 leading was 240 kW, and if it was changed to 0.95 leading, the average hosting capacity gained an average of 188 kW.[28] The Company noted, however, that "as more reactive power is needed for the non-unity power factors, the hosting capacity that is limited by 'thermal for generation' will continue to decrease" and that "there is a limit of reactive power support that can be supplied to the distribution system from the transmission system."[29] The Company concluded that "assuming a more leading power factor for all new potential installations in our HCA would definitely show more hosting capacity across our system. However, it would be less accurate, due to the limitations that exist."[30]

For the Bus Voltage sensitivity analysis, Xcel varied the standard bus voltage from 100 to 104 percent.[31] The Company found that the average hosting capacity gained by reducing the voltage by two percent was 260 kW, and that no additional gains were observed if the bus voltage was lowered to 100 percent.[32] The Company noted, however, the following:[33]

> It is important to understand that bus voltage is set higher to mitigate potential low voltage issues at the end of the feeder. If the bus voltage were to be lowered, it could lead to low voltage for customers during periods of high usage. It can also lead to the inability to switch load to a neighboring feeder during contingency or maintenance situations, because the neighboring feeder doesn't have enough voltage headroom to serve the additional load. Two of the five feeders [selected for use in the sensitivity analysis due to their broad representation of difference in Xcel's system] began exhibiting low voltage issues at 102 percent and four of the five had them at 100 percent. This affirms the point that setting the bus voltage lower has other ramifications that would make a real-life implementation impractical without a significant investment in systems and equipment to enable a new level of feeder voltage regulation.

[27] 2018 Report, page 24.
[28] *Id.*
[29] *Id.*
[30] 2018 Report, page 25.
[31] *Id.*
[32] *Id.*
[33] *Id.*

Xcel concluded that while theoretical hosting capacity gains could be made by adjusting these two variables, they appear to be relatively small and "can lead to other system issues such as the need for reactive power support, potential low voltages for customers, and loss of resilience to alternatively serve load during contingency situations."[34] Overall, the Company concluded that "while both of these analyses proved to have some significance, our conclusion is that the power factor and bus voltage decisions we have made to date are reasonable."[35]

The Department notes that the Company provided a caveat to the conclusion regarding lowering the bus voltage variable and practical implementation: the Company stated that "setting the bus voltage lower has other ramifications that would make a real-life implementation impractical *without a significant investment in systems and equipment to enable a new level of feeder voltage regulation*."[36] (emphasis added)

**The Department requests that Xcel provide additional information on translating the theoretical gains of hosting capacity demonstrated by the Company's bus voltage sensitivity analysis into actual gains of hosting capacity, which should include information on the technological options available to the Company, the estimated cost of such options, and whether these options are part of the Company's analysis in the Company's 2019-2028 Integrated Distribution Plan filed in Docket No. E002/CI-18-251. (Request 1)**

*vi. Order Point #7e: Update on EPRI DRIVE Capabilities*

As noted above, Order Point #7e requires Xcel to provide an update on the evolving capabilities of the EPRI DRIVE tool and whether it's capable of incorporating the technologies included in the broadened definition of DERs.

Sections B and C of the 2018 Report discuss Xcel's definition of DER and the incorporation of DERs (specifically energy storage) in their hosting capacity analysis and the evolving capabilities of the EPRI DRIVE tool, respectively.

Regarding the incorporation of energy storage in the hosting capacity analysis, the Company stated the following:[37]

> 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

[34] 2018 Report, page 26.
[35] *Id.*
[36] 2018 Report, page 25.
[37] 2018 Report, page 6.

> of our hosting capacity tool with regard to energy storage, and maximize its capabilities where we can.

Regarding the evolving capabilities of the EPRI DRIVE tool, the Company stated the following:[38]

> As we have done in past years, we have expanded and improved our 2018 report based on lessons-learned from our ongoing use of DRIVE, and updates EPRI has made to the DRIVE tool – confirming our confidence in the tool. Enhancements that EPRI has made to the DRIVE tool since our last report include the ability to:
>
> - Reverse Power Flow based on feeder head
> - Unintentional Islanding dependent on switch locations (note: this still takes considerable manual effort to accommodate for a system wide analysis)
> - Improved various usability issues (fixed bugs, updated code, etc.)
> - Added the user variable for range of acceptable thermal limits
> - Fuses now considered as limiting elements for thermal violations
>
> As noted earlier, our analysis considers DER that acts as a generation source to the system. DRIVE does have the ability to output load capacity and future releases of the tool are expected to have added functionality to better address what certain distributions of load, like EV's or storage, might do to a feeder. However, we have not run the analysis to look at load additions, which we see as more of a traditional distribution planning function rather than a part of a HCA.

In review of these two sections, the Department concludes that the Company has sufficiently complied with Order Point #7e. **The Department recommends that, for future reports, the Commission continue to require Xcel to provide an update on the evolving capabilities of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs. (Recommendation 2)**

*vii. Order Point #7f: Provide More Detailed Data on Load Profile Assumptions, Including Peak Load (kW) by Substation and Feeder*

[38] 2018 Report, page 7.

As noted above, Order Point #7f requires the Company to provide more detailed data on load profile assumptions, including peak load (kW) by substation and feeder.

On page 12 of the 2018 Report, the Company provided the following information in relation to Order Point #7f:

> *Loading Levels* – We populated each feeder model with non-coincident peak load information that was scaled down to 20 percent by the DRIVE tool to represent the Daytime Minimum Loading. These feeder peak loads could be for any time of the day and are not in relation to any type of load curve. 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. [footnote omitted] 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 and customer energy usage. These are the only load curves used in our process. When available, we also used demand data from primary metered customers. These factors are inputs to the Customer Management Module used within Synergi to allocate the peak load. Our load allocation methodology has evolved to this process from a process that only considered service transformer sizes. There is potential to further improve our load allocation method with Advanced Metering Infrastructure and the capabilities it has.

The Company described the process they used to collect or estimate peak load data, but they did not provide the data itself. If minimum daytime load data is not available, the Company should use the date and time for peak load indicated by their SCADA system and monthly

manual substation read process. The timing of the peak load should be used to refine assumptions for Daytime Minimum Load.

**The Department requests that Xcel discuss the practicability of using more detailed load profile data in their feeder model and to file the peak load data by substation and feeder in spreadsheet format, as an additional column in an amendment to Attachment A. (Request 2**)

*viii. Order Point #7g: Hosting Capacity Upgrades*

As noted above, Order Point #7g requires Xcel to provide supplemental information regarding how to guide distribution upgrades for additional hosting capacity.

On pages 15 and 16 of the 2018 Report, the Company provided the following information in relation to Order Point #7g:

> To the extent a feeder has constraints, we identify the primary constraint in the tabular study results provided with this report as Attachment A. [footnote omitted] Table 2 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 2 omitted]
>
> In terms of mitigating constraints, our standard approach is to first study using low-cost options such as adjusting the DER power factor, before considering higher-cost options such as reconductoring. However, 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, attempting to pre-identify absolute mitigations that would increase the hosting capacity of each feeder will not always efficiently match the specific needs of a particular DER installation.

> The National Renewable Energy Laboratory (NREL) has created a technical report [footnote omitted] that further outlines costs and methods to increase hosting capacity on feeders in the United States. Some of the key takeaways from that report include:
>
> - Feeder characteristics, distribution of DER, and size of DER can all create significant variability in hosting capacity and distribution upgrade costs.
> - In general, voltage constraints are lower cost to mitigate due to the ability to adjust inverter settings
> - Thermal overloads are generally more expensive to mitigate.
> - Upgrade costs can be minimized by guiding systems to better locations
>
> These takeaways align with our potential mitigation strategies and further reiterate the difficulty in providing more detailed feeder specific mitigations due to the variabilities across the system.

The Department appreciates that the Company furnished this additional information. However, the Department believes that more specific information could help provide a better understanding of the types of mitigation options available that would result in additional hosting capacity and the associated costs of implementing those options.

The Department's initial comments in Docket No. E002/M-17-777, noted that the following information would be helpful in evaluating the actual upgrades required to increase hosting capacity:

1. The frequency at which the constraints to individual feeders occur throughout the distribution system;
2. A range of potential costs for each of the mitigation options available for an individual feeder and a range of total costs;
3. How much additional hosting capacity could be obtained by implementing the identified mitigation options on a technical and economic basis (i.e. the technical potential of the mitigation options and the economic potential of the mitigation options); and
4. Whether there would be a cost-effective impact on the value of DERs if such mitigation options were pursued (i.e. do any of the mitigation options impact the value proposition of DERs and if so, what is that impact?)

The Department notes that the Company provided raw data related to item #1 in Attachment A to the 2018 Report. However, a more thoughtful analysis would best serve the record, such as

a summary table indicating the specific frequency of the limiting factors of the minimum and maximum hosting capacity values.

**The Department requests that the Company provide a discussion about the feasibility and value of providing the following information:**

1. **The frequency at which the constraints to individual feeders occur throughout the distribution system;**
2. **A range of potential costs for each of the mitigation options available for an individual feeder and a range of total costs;**
3. **How much additional hosting capacity could be obtained by implementing the identified mitigation options on a technical and economic basis (i.e. the technical potential of the mitigation options and the economic potential of the mitigation options); and**
4. **Whether there would be a cost-effective impact on the value of DERs if such mitigation options were pursued (i.e. do any of the mitigation options impact the value proposition of DERs and if so, what is that impact?) (Request 3**)

The Department also invites other stakeholders to provide any information or insight that they may have regarding these items and their ability to help facilitate additional DER integration.

### *b) STRUCTURAL REQUIREMENTS*

The structural requirements of the Order refer to the requirements for the presentation and timing of the report. The Department considers Order Points #4, #5, #7d, and #9 to be structural requirements. The Department notes that Order Point #8 isn't a requirement, but rather, permits Xcel to file the hosting capacity report separately from the Biennial Transmission Projects Report.

#### *i. Order Point #4: Hosting Capacity Map*

As noted above, Order Point #4 requires Xcel to provide a "color-coded, map-based representation of the available Hosting Capacity down to the feeder level." It also requires Xcel to provide all information that is consistent with what Xcel believes are legitimate security concerns, and explain in detail the basis for any such concerns.

Xcel updated the public-facing website the Company created to display the results of the 2017 Report. This website allows anyone to view an interactive, color-coded, map-based representation of the results of the 2018 Report.[39] In addition, the Company provided a

[39] The visual results of the 2018 Report are available at: https://www.xcelenergy.com/working_with_us/how_to_interconnect.

detailed explanation as to what feeders were excluded from the 2018 Report due to security concerns.[40] Therefore, the Department concludes that the Company complied with Order Point #4.

*ii. Order Point #5: Downloadable Data*

As noted above, Order Point #5 requires Xcel to provide the Hosting Capacity results in downloadable, MS-Excel or other spreadsheet file formats.

In Attachment A to the 2018 Report, the Company provided an MS-Excel spreadsheet of the Hosting Capacity results. This spreadsheet is publicly available on the Company's *How to Interconnect* website that also provides access to the visual results of the 2018 Report. Therefore, the Department concludes that the Company complied with Order Point #5.

*iii. Order Point #7d: Presentation of 2018 Report*

As noted above, Order Point #7d requires Xcel to explore options for better presenting results of the hosting capacity analysis in consideration of security and privacy issues and what information may be useful to developers and stakeholders.

Section K of 2018 Report on pages 26 through 30 contains information related to Order Point #7d. The Company stated that they have been meeting with various stakeholders to discuss the 2018 Report, including developers and other stakeholders as part of the Solar*Rewards Community (S*RC) Workgroup.

The Company also stated that the feedback they received from the workgroup in mid-2018 indicated that the hosting capacity map and the website were either not used or underutilized, that additional information contained in the map (such as information related to substation, feeder, and other equipment) would make the map more useful to developers, and more frequent updates would also be a benefit to developers.

As a result of the stakeholder feedback, Xcel considered two prominent areas that may help improve the value of the hosting capacity analysis for developers and other stakeholders: (1) more frequent updates of the map; and (2) adding more data to the HCA map.

Regarding item #1, the Company stated that in order to accomplish this task, it would have to undertake a complete hosting capacity analysis in order to update the map.[41] The Company concluded that the resources needed to accomplish this task would outweigh the benefit.

[40] 2018 Report, pages 22 – 24.
[41] 2018 Report, page 27.

Regarding item #2, the Company stated that they are encountering a usability issue for feeders that are close in proximity to another feeder that limits the provision of more detailed equipment-related information for users.[42] The Company concluded that they are continuing to examine options that would enable them to provide this information in a consistently usable format.

**The Department requests additional information regarding whether item #1 (more frequent map updates) is feasible:**

1. **Why would the Company need to undertake a complete hosting capacity analysis each time it wanted to provide an update?**
2. **Could an update be accomplished quarterly, or semi-annually?**
3. **Can the Company perform a targeted update to the hosting capacity analysis (such as areas of the distribution system that are experiencing higher levels of interconnection than others and/or may have a higher locational value for DERs)?**
4. **Is there a different hosting capacity analysis methodology that would be acceptable to the Commission and stakeholders that would make more frequent updates feasible?**
5. **What is the cost to conduct the hosting capacity analysis such that the Company determined that more frequent updates has a cost that outweighs the benefit? (Request 4)**

Such information would help provide the Commission and other stakeholders with more information as they consider whether the hosting capacity analysis should be updated more frequently.

The Department also requests more information related to item #2 (adding more data to the map). As indicated in Fresh Energy's initial comments on pages 5 and 6 (and specifically figure 2) in Docket No. E002/M-17-777, it appears that Southern California Edison's (SCE) hosting capacity map is indeed capable of providing more detailed information. The Department notes that the Interstate Renewable Energy Council (IREC) also suggested similar improvements on pages 15 through 17 of their initial comments in Docket No. E002/M-17-777.

**The Department requests that Xcel indicate:**

1. **Whether it is possible for Xcel to use the same (or similar) software that allows SCE to provide more detailed information.**
2. **Is the current software employed by Xcel to display the hosting capacity analysis able to provide such information?**

[42] 2018 Report, page 28.

3. **What options are available to the Company to better display the hosting capacity analysis and more detailed information that is valuable to developers and other stakeholders? (Request 5)**

More insight into at least these two areas can help the Commission and other stakeholders assess and evaluate potential presentation improvements to make the hosting capacity analysis a more valuable tool for developers. Improving the value to developers and other stakeholders interested in the efficient integration of DERs should be seen as a paramount goal as this analytical task evolves.

**The Department recommends that the Commission require Xcel to work with stakeholders to improve the value of the Company's hosting capacity analysis, including but not limited to the provision of more detailed substation, feeder, and other equipment data in the hosting capacity map. (Recommendation 3)**

*iv. Order Point #9: Filing Date*

As noted above, Order Point 9 requires Xcel to file a Hosting Capacity Report on an annual basis, by November 1 of each year.

The Company filed the 2018 Report on November 1, 2018. Therefore, the Department concludes that the Company complied with Order Point #9.

*3. Conclusion Regarding Completeness*

In review of the Statute and the Order, and for the reasons detailed above, the Department concludes that the Company complied with both the Statute and the Order.

*B. TOPIC #2*

As noted above, the Notice asks whether the 2018 Report adequately addressed stakeholder recommendations, and if not, to suggest modifications or clarifications.

The Department generally concludes that the Company was responsive to stakeholder recommendations and appreciates the Company's efforts to work with stakeholders to improve the hosting capacity analysis. As discussed above, however, the Department makes three recommendations to improve the hosting capacity analysis:

- require Xcel to continue to provide updates on the appropriateness of the methodological choice of the hosting capacity analysis, a discussion of the ability of the

Company to obtain more detailed secondary voltage equipment data, and the types of DERs being interconnected in future reports,

- require Xcel to continue to provide an update on the evolving capabilities of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs in future reports; and
- require Xcel to work with stakeholders to improve the value of the Company's hosting capacity analysis, including but not limited to the provision of more detailed substation, feeder, and other equipment data in the hosting capacity map.

The Department requests that stakeholders provide more information regarding whether the Company adequately responded to their recommendations and offer suggestions for improving the hosting capacity analysis.

*C. TOPIC #3*

As noted above, the Notice asks whether the hosting capacity study should continue to be filed independently from the Biennial Grid Modernization Report or the Integrated Distribution Plan in years in which they are required to be filed.

The Department believes it is appropriate that future hosting capacity studies continue to be filed separately. The issues contained in the hosting capacity study are relatively unique and require substantive consideration and evaluation separate and apart from related regulatory proceedings. Further, hosting capacity analysis continues to be a novel and emergent analytical task for utility distribution planning. To the Department's knowledge, Xcel is one of a handful of utilities in the country that conduct such analyses. Continuing to offer a separate regulatory forum for such discussions is a valuable opportunity for stakeholders to participate in this novel and emergent analytical task and potentially help inform and improve the integration of DERs in a technically sound and economically cost-effective manner that accrues benefits to Xcel's ratepayers.

*D. TOPIC #4*

As noted above, the Notice asks whether there are other issues or concerns related to this mater.

At this time, the Department does not have any other issues or concerns.

## III. CONCLUSION

The Department appreciates the opportunity to comment on the Company's 2018 Report and looks forward to working with all stakeholders to improve future HCAs.

The Department requests that the Company provide additional information in reply comments:

- The Department requests that Xcel provide additional information on translating the theoretical gains of hosting capacity demonstrated by the Company's bus voltage sensitivity analysis into actual gains of hosting capacity, which should include information on the technological options available to the Company, the estimated cost of such options, and whether these options are part of the Company's analysis in the Company's 2019-2028 Integrated Distribution Plan filed in Docket No. E002/CI-18-251. (Request 1)
- The Department requests that the Company discuss the practicability of using more detailed load profile data in their feeder model and to file the peak load data by substation and feeder in spreadsheet format, as an additional column in an amendment to Attachment A. (Request 2)
- The Department requests that the Company provide a discussion about the feasibility and value of providing the following information:
    - The frequency at which the constraints to individual feeders occur throughout the distribution system;
    - A range of potential costs for each of the mitigation options available for an individual feeder and a range of total costs;
    - How much additional hosting capacity could be obtained by implementing the identified mitigation options on a technical and economic basis (i.e. the technical potential of the mitigation options and the economic potential of the mitigation options); and
    - Whether there would be a cost-effective impact on the value of DERs if such mitigation options were pursued (i.e. do any of the mitigation options impact the value proposition of DERs and if so, what is that impact?) (Request 3)
- The Department requests additional information regarding whether item #1 (more frequent map updates) is feasible:
    - Why would the Company need to undertake a complete hosting capacity analysis each time it wanted to provide an update?
    - Could an update be accomplished quarterly, or semi-annually?
    - Can the Company perform a targeted update to the hosting capacity analysis (such as areas of the distribution system that are experiencing higher levels of interconnection than others and/or may have a higher locational value for DERs)?

  - Is there a different hosting capacity analysis methodology that would be acceptable to the Commission and stakeholders that would make more frequent updates feasible?
  - What is the cost to conduct the hosting capacity analysis such that the Company determined that more frequent updates has a cost that outweighs the benefit? (Request 4)
- The Department requests that Xcel indicate:
  - Whether it is possible for Xcel to use the same (or similar) software that allows SCE to provide more detailed information.
  - Is the current software employed by Xcel to display the hosting capacity analysis able to provide such information?
  - What options are available to the Company to better display the hosting capacity analysis and more detailed information that is valuable to developers and other stakeholders? (Request 5)

The Department recommends the following:

1. The Department recommends that the Commission require Xcel to provide updates on the appropriateness of the methodological choice of the hosting capacity analysis, a discussion of the ability of the Company to obtain more detailed secondary voltage equipment data, and the types of DERs being interconnected in future reports. (Recommendation 1)
2. The Department recommends that the Commission continue to require Xcel to provide an update on the evolving capabilities of the EPRI DRIVE tool and whether it is capable of incorporating the technologies included in the broadened definition of DERs (maintain Order Point #7e). (Recommendation 2)
3. The Department recommends that the Commission require Xcel to work with stakeholders to improve the value of the Company's hosting capacity analysis, including but not limited to the provision of more detailed substation, feeder, and other equipment data in the hosting capacity map. (Recommendation 3)

ML/LT/jl

# CERTIFICATE OF SERVICE

I, Sharon Ferguson, hereby certify that I have this day, served copies of the following document on the attached list of persons by electronic filing, certified mail, e-mail, or by depositing a true and correct copy thereof properly enveloped with postage paid in the United States Mail at St. Paul, Minnesota.

Minnesota Department of Commerce
Comments

Docket No. E002/M-18-684

Dated this 28th day of February 2019

/s/Sharon Ferguson

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