MINNESOTA
PUBLIC UTILITIES COMMISSION

Staff Briefing Papers

Meeting Date	November 14, 2019	Agenda Item 2**
Company	All Electric Utilities	
Docket No.	**E-999/CI-16-521** **E-999/CI-01-1023**	
	In the Matter of Updating the Generic Standards for the Interconnection and Operation of Distributed Generation Facilities Established under Minn. Stat. 216B.1611	
Issues	Should the Commission approve, modify or remand to the Technical Subgroup the proposed statewide Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (TIIR) and associated implementation plan?	
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✓ **Relevant Documents**	**Date**
MN PUC, Phase II Meeting Agenda and Slides	Aug. 20, 2019
MN PUC, Attachment: Draft Technical Interconnection and Interoperability Requirements	Aug. 23, 2019
Initial Comments	
Minnesota Rural Electric Association	Sept. 24, 2019
Department of Commerce – Division of Energy Resources	Sept. 24, 2019
Otter Tail Power	Sept. 24, 2019
Xcel Energy	Sept. 24, 2019

✓ **Relevant Documents**	**Date**
Dakota Electric Association	Sept. 24, 2019
Interstate Renewable Energy Council and Fresh Energy	Sept. 24, 2019
Minnesota Power	Sept. 24, 2019
Reply Comments	
Minnesota Rural Electric Association	Oct. 11, 2019
Department of Commerce – Division of Energy Resources	Oct. 11, 2019
Otter Tail Power	Oct. 11, 2019
Xcel Energy	Oct. 11, 2019
Dakota Electric Association	Oct. 11, 2019
Interstate Renewable Energy Council and Fresh Energy	Oct. 11, 2019
Xcel Energy – Late Filed Comments	Oct. 25, 2019

Table of Contents

I. Statement of the Issues

Draft TIIR
Should the Commission approve, modify or remand to the Technical Subgroup the proposed statewide Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (TIIR) and associated implementation plan?

Interim Implementation
Is the language in the Technical Subgroup's recommended Draft TIIR sufficient and appropriate on implementation of the statewide technical requirements in the interim as IEEE 1547-2018 implementation to UL 1741 certified equipment is complete (anticipated in 2021)?What, if anything else, should the Commission address related to interim implementation?

Utility-Specific Technical Specification Manuals
Is the language in the Technical Subgroup's recommended draft sufficient and appropriate on the scope of an individual utility's Technical Specification Manual (TSM) and the Commission's oversight? What, if anything else, should the Commission address related to the rate-regulated utilities' TSMs?

II. Background

Minn. Stat. §216B.1611 directs the Commission to initiate proceedings to establish, by order, generic standards for utility tariffs for the interconnection and parallel operation of distributed generation.

On September 28, 2004, the Commission issued its Order Establishing Standards as directed by Minn. Stat. §216B.1611. The Order includes Attachment 2 "Distributed Generation Interconnection Requirements"[1] which are currently in effect as the statewide technical requirements for distributed generation. The Draft TIIR[2] up for consideration in the current docket is proposed to replace Attachment 2.

On January 24, 2017, the Commission issued its Order Establishing Workgroup and Process to Update and Improve Statewide Interconnection Standards in the current docket. The update includes two phases: 1) transition Minnesota's distributed generation interconnection process to one based upon the FERC Small Generation Interconnection Procedures (SGIP) and Agreement (SGIA)[3]; and 2) update Minnesota's distributed generation interconnection technical requirements. These standards apply to all distributed generation, including storage, which is no more than 10 MW and

[1] MN PUC, Order Establishing Standards (September 28, 2004), Docket No. E999/CI-01-1023, Attachment 2, pp. 1-29 (pdf pp. 51-79)
[2] MN PUC, Draft Technical Interconnection and Interoperability Requirements, Docket No. E999/CI-16-521, e-filed separately as an Attachment to the August 23, 2019 Notice of Comment in this docket.
[3] Phase I was completed with the Commission's *Order Establishing the Updated Interconnection Process and Standard Interconnection Agreement* (August 13, 2018) and *Order Approving Tariffs with Modifications and Requiring Compliance Filings* (April 19, 2019). The newly revised, statewide Minnesota Distributed Energy Resource Interconnection Process and Agreement (MN DIP and MN DIA) went into effect on June 17, 2019.

operated in parallel with a Minnesota utility's electric distribution grid pursuant to Minn. Stat. §216B.1611. The Order also established Commissioner Matt Schuerger as Lead Commissioner.

On December 15, 2017, the Commission sought input on the scope and process for the Phase II update of statewide interconnection technical requirements. Several utilities jointly offered a Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (TIIR) proposal to serve as the starting point for discussion.[4] The DGWG- identified membership of the TSG included[5]:

Jeff Schoenecker/Craig Turner, Dakota Electric	Tam Kemabonta/Professor Mahmoud Kabalan	Dean Pawlowski, Otter Tail Power
Lise Trudeau, Dept of Commerce	Robert Jagusch, MMUA	Patrick Dalton/John Harlander/Alan Urban, Xcel Energy
Mike McCarty/Katie Bell, EFCA	Kevin McLean/Jenna Warmuth, MN Power	Natalie McIntire, Wind on the Wires
Brian Lydic/Sky Stanfield, IREC	Kristi Robinson, MREA	Laura Hannah, Fresh Energy

On March 12, 2018, the Commission, with the Organization of MISO States, hosted an IEEE 1547 Workshop featuring National Renewable Energy Laboratory, Institute of Electric and Electronic Engineers (IEEE), Electric Power Research Institute, and North American Electric Reliability Corporation representatives. TSG members participated in this workshop.

On April 6, 2018, IEEE 1547-2018 was published with significant revisions to the technical interconnection and interoperability requirements.

Between March 2018 and September 2018, the Commission convened seven web meeting discussions and sought feedback on the Draft TIIR following the outline provided in the December 15, 2017 Notice. The TSG added two additional web meetings for further needed discussion.

On September 21, 2018, the Technical Subgroup (TSG) met in person to reconcile and prioritize feedback from the first seven TSG meetings. The TSG also chose a writing subgroup comprised of Dakota Electric Association, Fresh Energy, Interstate Renewable Energy Council, Minnesota Rural Electric Cooperative Association, and Xcel Energy representatives to attempt to reconcile these suggestions in the Draft TIIR.

[4] Xcel Energy on behalf of "Minnesota Regulated Utilities", which included Otter Tail Power, Minnesota Power and Dakota Electric Association, filed the draft on January 17, 2018.

[5] Other participants: Commissioner Matt Schuerger, Michelle Rosier/Cezar Panait, MN PUC. Michael Coddington/Michael Ingram, NREL; Tom Key/Jens Boemer/Nadav Enbar, EPRI; Pam Johnson, Solar Energy Innovator Fellow. Technical assistance is not a participant or party to the docket and does not advocate for specific outcomes in the proceeding. The role of technical assistance is to support Commission staff in the process for these proceedings, and to provide an objective source of information or data, as requested, by Commission staff to understand areas of disagreement amongst participants.

Between April 2019 and July 2019, the Writing Subgroup offered three rounds of feedback incorporation to the Writing Subgroup's updated Draft TIIR[6] for the DGWG, shared with both Participants and Observers.

On August 9, 2019, the TSG met to discuss the attached further updated Draft TIIR before it was issued for public comment with this notice. Continued consideration was flagged for this comment period on the following: interim implementation issues and the interplay between the TIIR and utility-specific TSMs; including scope and Commission oversight of rate-regulated utilities. The Phase II Technical Subgroup's meeting agendas and slides from March 2018 through August 2019 are compiled and electronically filed in this docket.[7] The current membership of the TSG includes:

Craig Turner, Dakota Electric	Robert Jagusch, MMUA	Alan Urban/John Harlander, Xcel Energy
Lise Trudeau, Dept of Commerce	Cody Gustafson/Jenna Warmuth, MN Power	Allen Gleckner, Fresh Energy
Brian Lydic/Sky Stanfield, IREC	Kristi Robinson, MREA	
Professor Mahmoud Kabalan	Dean Pawlowski, Otter Tail Power	

On August 23, 2019, the Commission issued a notice of comment seeking input on the three topics identified in the statement of the issue above: 1) adoption of updated statewide technical requirements (i.e. Draft TIIR); 2) Interim implementation considerations; and 3) scope and role of the Commission related to utility-specific Technical Specification Manuals (TSMs).

On September 24, 2019, the following provided initial comment: Department of Commerce – Division of Energy Resources (Department), Minnesota Rural Electric Association (MREA), Otter Tail Power Company, Xcel Energy, Dakota Electric Association, Minnesota Power, and, filing jointly, Interstate Renewable Energy Council and Fresh Energy. Minnesota Solar Energy Industry Association (MNSEIA) did not file comments, but was an active participant in the Phase II Technical Subgroup; including providing written comments for consideration at the TSG Meeting #10.

On October 11, 2019, the same parties, except Minnesota Power, provided reply comments.

On October 25, 2019, Xcel Energy filed late-filed supplemental comments suggesting three additional changes to the Draft TIIR if the other parties in the docket were in support.

[6] Phase II Sub Work Group filed an updated draft TIIR on April 10, 2018 in this docket.
[7] MN PUC, Phase II Meeting Agenda and Slides e-filed in this docket on August 20, 2019.

III. Parties' Comments

A. Should the Commission approve or remand the TIIR as submitted by the TSG?

The parties dedicated significant effort into discussing, modifying and ultimately proposing the Draft TIIR for Commission consideration. Below is a summary of positions on the Draft TIIR:

Party	Position
MREA	"The Minnesota DER TIIR is a technically sound document that places the State of Minnesota in a great position for future DER interconnections. MREA looks forward to the implementation of the new technical requirements for the interconnection of DER to the distribution system."[8]
Dakota Electric	"Over the past three years many people have contributed their time and talents to help shape these documents. This process, while long and labor intensive, has been very educational for the Dakota Electric engineering staff. Dakota Electric is in support of the TIIR document produced through this process."[9]
Minnesota Power	"Minnesota Power is fully supportive of the Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (Minnesota DER TIIR) as submitted by the Distributed Generation Workgroup's Technical Subgroup."[10]
Otter Tail Power	"We believe that this document provides common technical standards that can be used throughout the state of Minnesota and support the approval of this document."[11]
Xcel Energy	"[W]e commend Commission Staff for spearheading the successful process that resulted in broad agreement on the content of the first version of the Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (TIIR). Parties have considered a range of issues at the Distributed Generation Workgroup ("Workgroup" or "DGWG") and this resulted in robust discussion, exchange of ideas, collaboration, and considerable consensus."[12]
IREC-Fresh Energy	"Our organizations greatly appreciate the Commission's commitment to this process of updating Minnesota's interconnection rules and requirements and also appreciate the hard work and collaboration of all of the Workgroup members through this process. In light of the substantial time and resources that went into developing the draft TIIR and the urgency to get updated technical standards in place, IREC and Fresh Energy support the Commission adopting the TIIR as submitted, with two specific modifications identified below."[13]

[8] MREA Initial, p. 3
[9] Dakota Electric Initial, p. 1
[10] Minnesota Power Initial, p. 2
[11] Otter Tail Power Initial, p. 1
[12] Xcel Energy Reply, p. 1
[13] IREC and Fresh Energy, pp. 1-2

Party	Position
Department	"The Department recommends that the Commission approve the TIIR."[14]

All parties commented in support of the Commission adopting the draft the State of Minnesota Technical Interconnection and Interoperability Requirements (Draft TIIR); however, several requested modifications prior to approval. The proposed modifications are described below. **(Decision Option 1 or 2)**

Proposed Changes to the Draft TIIR

Below staff summarizes only the proposed changes to the TIIR the Commission is being asked to adopt with this decision.[15] No party objects to the following correction or clarification to definitions and titles:

- Section 3.2 Definitions, Energy Storage System Control Mode (**Decision Option 2.a**)

  "The function that manages the real and reactive power flow from or to a ~~DER~~ ESS in response to certain parameters, (such as time, price signals, frequency or external signals, etc.)."

- Section 3.2 Definitions, Minnesota Technical Requirements (**Decision Option 2.b**)

  The term including all of the DER technical interconnection requirement documents for the state of Minnesota; including: 1) when an application was submitted before the effective date of the MN DIP and therefore is not subject to the MN DIP, the MN Technical Requirements shall mean Attachment 2 Distributed Generation Interconnection Requirements established in the Commission's September 28, 2004 Order in E-999/CI-01-1023) and 2) when an application is subject to the MN DIP, the MN Technical Requirements shall mean ~~until superseded and upon Commission approval of updated Minnesota DER Technical Interconnection and Interoperability Requirements in E-999/CI-16-521~~ this document – the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR) - as adopted and amended over time by Commission order.

- Section 5.4 Title (**Decision Option 2.c**):

  "Voltage and ~~Reactive~~ Active Power Control"

That said, MREA, Dakota Electric, Minnesota Power, and Otter Tail Power recommended adoption of the Draft TIIR as filed (**Decision Option 1**). IREC and Fresh Energy support **Decision Options 2.a-c**. The Department recommended adoption with only the change in **Decision Option 2.b**. Xcel Energy recommended adoption with **Decision Options 2.b-c.**

[14] Department Reply, p. 1
[15] See **Attachment A** for a summary of the party comments related to topics for possible consideration in future revisions of the TIIR.

In late-filed comments, Xcel Energy propose three additional modifications to the Draft TIIR; including correcting a reference and two footnotes clarifying sentences in Section 7 Protection Requirements.[16] (**Decision Option 3a-c)**

IREC and Fresh Energy propose the Commission approve the modified Draft TIIR, and reconvene the DGWG to discuss, among other topics, the creation of an interim implementation guidance document (discussed below).

B. Interim Implementation

In addition to the transition from the existing 2004 Minnesota Technical Requirements to the Commission's adoption of a TIIR, there is an additional transition to full implementation of the TIIR due to the timing of "readily available" UL 1741 equipment certified to IEEE 1547-2018.

IREC and Fresh Energy suggest the TIIR is "overly vague on two important points" related to this transition period language: 1) if there will be agreement on what constitutes "readily available"; and 2) which sections of the TIIR require "equipment that conforms with IEEE 1547-2018 advanced functionalities.[17] IREC and Fresh Energy propose modifying the TIIR Section describing the transition period (**Decision Option 3**):

> Section 1.6 Transition Period
>
> All requirements of the TIIR are immediately applicable unless requiring equipment that conforms with IEEE 1547-2018 advanced functionalities.
>
> Area EPS Operators cannot require the use of certified equipment that meets the requirements of IEEE 1547-2018 until ~~such time the equipment is readily available~~ three months after the UL 1741 future effective date for incorporating changes related to IEEE Std 1547-2018 and IEEE Std 1547.1-2020. At such time certified equipment first becomes available, the Area EPS Operator and DER Owner may mutually agree to utilize the certified equipment and functionalities in conformance with the requirements of IEEE 1547-2018. ~~At such time when certified equipment is readily available[ftn] available~~ Three months after the UL 1741 future effective date for incorporating changes related to IEEE Std 1547-2018 and IEEE Std 1547.1-2020., the entire TIIR shall be applicable.
>
> [Ftn]: Refer to UL 1741 for timeline of readily available certified equipment that meets the requirements of IEEE 1547-2018.

IREC and Fresh Energy explain why they recommend "readily available" be replaced with "three months after the UL 1741 future effective date"[18]:

> The future effective date is likely to be 18 months after UL 1741 is adopted, and adding three months provides a buffer which allows a little room for error. We believe this should

[16] Xcel Energy, Late-Filed Supplemental Comments, pp. 1-2.
[17] IREC – Fresh Energy, Initial, pp. 15-17; Reply, p. 6
[18] IREC and Fresh Energy, Initial, p. 16

> provide sufficient time for manufacturers and sales channels to make the products available and reduce confusion about old equipment.

Xcel Energy, alternatively, recommends the DGWG monitor and discuss this issue[19]:

> The Company does not oppose a clearly defined date that the full TIIR is to go into effect. However, any dates should consider other contingencies… Once [a date] is reflected in the TIIR, Xcel Energy would no longer be able to accept new applications or new installations that have non-compliant equipment. This issue should be monitored and discussed in the Workgroup after UL 1741 adopts IEEE 1547.1.

MREA agrees with Xcel Energy, and further recommends[20] (**Decision Option 4**):

> It would be preferable to assign the DER Technical Committee the responsibility for determining the changeover date once the updated UL 1741 certification is fully developed and a clearer picture of availability of equipment is known. This provides flexibility for Minnesota to adapt to issues that may arise in the future.

Regarding which TIIR Sections require IEEE 1547-2018 certified equipment, in Reply, IREC and Fresh Energy propose the Commission "[r]econvene the DGWG to draft a guidance document to accompany the TIIR which clarifies what provisions are in place in the interim period until newly certified equipment is available…" and offer a starting point for the proposed guidance document.[21] Summarizing outreach to the utilities to clarify how the TIIR would be applied in the interim[22]:

> … [W]e have reached out to the utilities and understand that their thinking was likely to rely on the existing 2005 technical requirements and/or IEEE 1547- 2003, but they did not have specific references prepared. While we agree that continuing existing practice for this transition period would likely provide the best continuity for interconnecting customers, we think it needs to be clear exactly where an existing practice applies, and if so, what is the exact practice that applies.

IREC and Fresh Energy suggest if the DGWG reaches consensus on the interim guidance document it should be filed in the docket, published on the Commission's webpage, and go into effect along with the TIIR. If consensus is not reached, each utility should adopt their preferred version of the guidance along with their TSM.[23] (**Decision Option 6**)

[19] Xcel Reply, p. 9
[20] MREA Reply, p. 1
[21] IREC – Fresh Energy Reply, Attachment 1
[22] IREC-Fresh Energy Reply, p. 4
[23] IREC-Fresh Energy Reply, p. 5

Related Revisions to the MN DIP and/or Utility Tariffs

In addition to updating the definition of "Minnesota Technical Requirements" in TIIR Sec. 3.2 (**Decision Option 2.b)**, Xcel Energy proposes to modify their existing Distributed Generation tariff (Sec. 10; Sheet No. 73) as follows (**Decision Option 7.a**):

> The ~~"Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (MN Technical Requirements)"~~ "State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR)" are referenced in the MN DIP and MN DIA but are not tariffed.
>
> As used in this tariff, when an application is subject to the MN DIP, the terms "Minnesota Technical Requirements" and "MN Technical Requirements" shall mean the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR). When an application was submitted before the effective date of the MN DIP and therefore is not subject to the MN DIP, these terms shall mean the "State of Minnesota Distributed Generation Interconnection Requirements" (at Sheet Nos. 10-135 through 10-159.6).

Additionally, Xcel proposes replacing the Company's tariffed version of MN DIP Attachment 4[24] with the following:[25] (**Decision Option 7.b**)

> The Minnesota Technical Requirements (State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR)), as modified over time as authorized by written order of the Minnesota Public Utilities Commission shall be used in conjunction with the Minnesota Interconnection Process (MN DIP) and Minnesota Interconnection Agreement (MN DIA) for Distributed Energy Resources.

Staff Analysis

Staff recommends adoption of **Decision Options 2.a and 2.c** as non-controversial modifications which improve the accuracy and readability of the TIIR. Staff recommends the Commission request input from the other parties on the late-filed modifications suggested by Xcel Energy, but believe these edits are also non-controversial and beneficial to the Draft TIIR (**Decision Option 3a-c**.)

Staff asks the Commission and parties to consider **Decision Options 2.b**. and **7a-b.** carefully. If Xcel's proposed changes to the MN Technical Requirements definition and reference in the Company's tariff was solely about matching titles, it would be easier to simply change the name of the Draft TIIR being adopted; however, Xcel catches an important clarification which is the terms Minnesota (or MN) Technical Requirements refer to different technical requirements based on whether the interconnection qualifies under MN DIP or the state's previous interconnection standards. Similarly, staff questions if, prior to full implementation of the TIIR,

[24] Xcel Ratebook, Section 10, Sheet Nos. 229-230. See **Attachment B** to these papers for a copy of MN DIP Attachment 4.
[25] Xcel Energy Initial, pp. 4-5

interconnections are responsible to achieve the technical requirements outlined in MN DIP Att. 4 and either the state's 2004 technical requirements or the TIIR (if adopted by the Commission). Or, if, as it appears in Xcel Energy's proposal, all interconnection applications approved under MN DIP will be able to achieve the TIIR when fully implemented.

MN DIP Att. 4 serves in the interim between the existing technical requirements and the Draft TIIR and states:

> Prior to Commission approval of the update of Minnesota Technical Requirements (anticipated in February 2019), the existing Minnesota Technical Requirements and the following standards shall be used in conjunction with the Minnesota Interconnection Process (MN DIP) and Minnesota Interconnection Agreement (MN DIA) for Distributed Energy Resources.(ftn) Once approved, the Minnesota DER Technical Interconnection and Interoperability Requirements will supersede this attachment.
> ….
> (ftn) This is an interim document while the Commission updates the Minnesota Distributed Energy Resource Interconnection and Interoperability Technical Requirements which includes alignment with the anticipated final IEEE 1547-2018 revision. For the transition period between Minnesota's existing statewide interconnection standards and the updated standards, both inverters certified to existing 1547.1 and 1547.1a-2015 (most current version); as well as, certified inverters per the expected revised 1547.1 standard should be acceptable.

Staff interprets the above interim language in the MN DIP to grant the Commission flexibility in determining when the TIIR goes into effect –both interim and full - and which interconnections under the MN DIP will be held to the 2004 Minnesota Technical Requirements and MN DIP Att. 4 compared to which will be required to comply with the TIIR – either fully or with support of the MN DIP Attachment 4.

Xcel's proposed revision to the definition of Minnesota (MN) Technical Requirements would require interconnections that applied beginning in June 2019 to comply with the TIIR. Staff notes that the TIIR recognizes IEEE 1547-2018, but it also includes UL 1741 in its References; and states: "At the time an interconnection application is submitted, the Area EPS Operator and the DER Operator shall use the most recent applicable technical reference."[26] Staff is unclear if this Draft TIIR language without MN DIP Att. 4 is sufficient to recognize some UL 1741 certified inverters installed in this interim period may be able to comply with some, but not all of IEEE 1547-2018.[27]

Staff notes it may be appropriate to recognize that these "applications subject to the MN DIP" approved in the interim of equipment certified to IEEE 1547-2018 may not be able to comply with the TIIR when IEEE 1547-2018 relevant sections go into effect. Below are two visuals that shows staff's understanding of Xcel Energy's proposal and, secondly, staff's understanding of the role of

[26] Draft TIIR, Section 2: References, pp. 8-9
[27] Staff notes: The Electric Power Research Institute provided a chart identifying the differences in inverters certified under different standards. See MN PUC, Phase II Meeting Agenda and Slides, e-filed on Aug. 20, 2019, pdf pg. 581 (TSG In Person Meeting, Sept 21, 2018) and 621 (TSG Meeting #9, May 31, 2019).

MN DIP Attachment 4 as an interim resource during the transition period from the 2004 Minnesota Technical Requirements to the TIIR:

Figure 1: Xcel Proposal

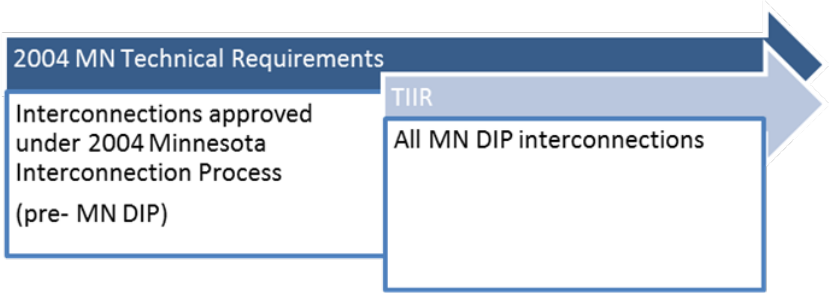
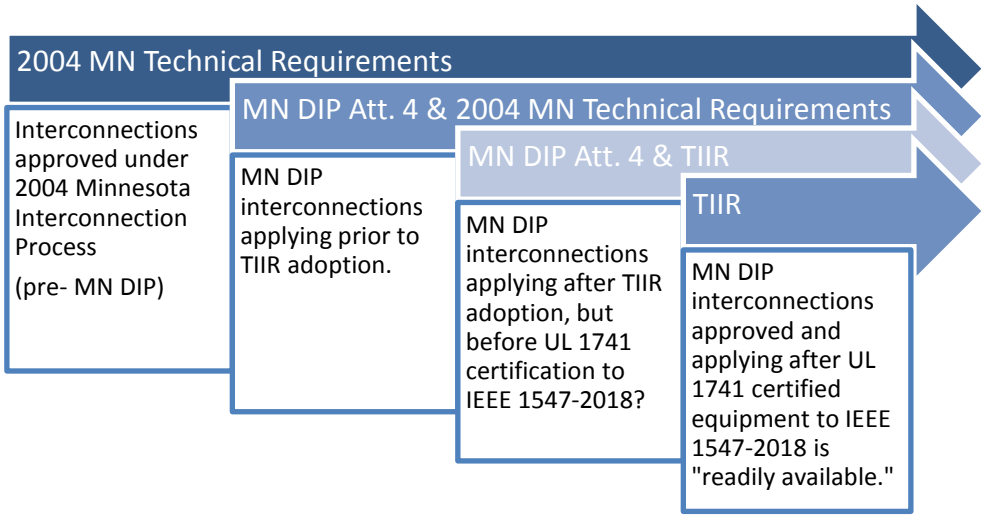


Figure 2: Staff Understanding of MN DIP Attachment 4



Staff does not disagree with Xcel's proposed modification to MN DIP Attachment 4; however, questions whether it is premature and if it could be done as part of the at least annual review envisioned by the Commission's August 13, 2018 Order adopting the MN DIP.[28] MN DIP Att. 4 provides the references IREC and Fresh Energy flag need to be clear during this interim period; however, it does not go as far as making explicit which Draft TIIR Sections will go into effect only after equipment certified to IEEE 1547-2018 is "readily available" which they propose be outlined in a companion guidance document to be developed.

Regardless of how the Commission chooses to address applicability timing of the TIIR and the role of MN DIP Attachment 4, other utilities should examine if modifications are needed in their tariffs.

Staff appreciates IREC and Fresh Energy drawing attention to the ambiguity in the language about the transition period; however, from staff's perspective the three month wait period is somewhat arbitrary. Staff supports MREA's position that the Commission engage the Distributed Generation

[28] MN PUC, Order Establishing Updated Interconnection Process and Standard Interconnection Agreement (August 13, 2018), Docket No. E-999/CI-16-521, Order Point 21, p. 32

Workgroup (DGWG) in determining when IEEE 1547-2018 "certified equipment is readily available" and suggests the Commission could delegate to the Executive Secretary authority to provide notice at such time and could address the MN DIP Attachment 4 at that time (**Decision Option 4**).

C. Utility Technical Specifications Manuals (TSMs)

Role and Scope of the TSMs

A significant shift from the 2004 Minnesota Technical Requirements to the Draft TIIR is the new role and scope of individual utility's Technical Specifications Manuals (TSMs.) The TIIR describes the role and scope of the TSMs[29]:

> Where industry standards exist, the TSM shall align with the applicable standards including IEEE 1547. The TSM also lists the Area EPS Operator specific requirements and provides further detail in areas where no common statewide or national industry standards exist[30]. In addition to allowing for differences in distribution electric and information systems design and operation, the Area EPS Operator's TSM allows for expedited adoption of new industry standards and best practices as they become available without creating conditions where the statewide interconnection standards and national standards become out-of-sync.

In addition to this description, the Draft TIIR Section 1.4 Coordination with Area EPS Operator's Specific Technical Standards further describes the TSMs stating in part[31]:

> The following is a brief listing of some of the areas which further technical guidance is to be provided within the Area EPS Operator's TSM.
>
> 1) Project Coordination Information
> 2) Protection system requirements for the DER interconnection
> 3) Operational standards and requirements
> 4) DER monitoring and communication requirements
> 5) Metering requirements in support of specific rates and operational needs
>
> The Area EPS Operator's TSM documents are to be designed to provide utility specific details aligned with the TIIR requirements. The Area EPS Operators' TSM document shall be limited to detailing requirements which are in support of the requirements contained within the TIIR and MN DIP. Additional requirements not contemplated by the TIIR may be mutually agreed upon between the Parties in an interconnection or operating agreement.

[29] Draft TIIR, Section 1.1, p. 2
[30] From the TIIR: "For example, industry standards do not define conditions or size thresholds for when metering, interoperability, protection, or other requirements shall be applied. Also, interconnection standards only address the electrical an interoperability interface between the Local EPS and Area EPS."
[31] Draft TIIR, Section 1.4, p. 5

IREC and Fresh Energy agreed to the creation of the TSMs, but "would have preferred to resolve many, if not most, of the technical requirements in the TIIR so that there was clarity and consistency across the state…"[32] Specifically, they outline two primary concerns with the creation of the TSMs[33]:

> Very significant technical requirements that can impact project costs and timing are not in the TIIR and instead have been left to utility discretion to adopt in their TSMs… [and the] … process of creating multiple TSMs also means there will be less scrutiny and thorough justification of the technical requirements that are imbedded within.

In addition to the list noted in TIIR Section 1.4 of areas of further guidance in the TSMs, Dakota Electric on behalf of the utilities proposed to the TSG the following as an outline of the TSMs[34]:

Jun 2019 DRAFT – Utility TSM Outline

1	Introduction	
2	Performance Category Assignment	Normal performance category, Assignment of abnormal performance category
3	Reactive Power Capability and Voltage/Power Control Performance	Voltage and reactive power control, Voltage and active power control
4	Response to Abnormal Conditions	Voltage ride-through and tripping, Frequency ride-through and tripping
5	Protection Requirements	AC disconnect, Protection
6	Signage and Labeling	Residential roof top, Residential ground mount, Large scale
7	Metering Requirements	Meter socket placement and type, Location and access of metering
8	Interoperability	Local DER communication interface, Cyber security
9	Energy Storage	Considerations not covered by industry standards
10	Test and Verification Requirements	Procedure, Documentation, Failure protocol, Testing procedure
11	Power Quality	Operations on start-up and shutdown, Resolving power quality issues found after interconnection, Normal operating bounds of expected power quality.
12	Modifications to Existing DER system	Process for notification of ESS Control Modes
13	Required Documentation	Information required on one-line diagram, Site diagram, Nameplate capacity documentation

8/1/2019 Source: Craig Turner, DEA. TSM-Technical Specification Manual_draft Outline June 2019.docx 16

IREC and Fresh Energy suggest the Commission's Order clearly define the scope of the TSMs and "recommend the Commission require that [the above June 2019 DRAFT – Utility TSM Outline] be followed by each utility"[35] and "… that the TIIR is the controlling technical document for the state of Minnesota and preempts anything in an individual utility's TSM unless expressly noted in the TIIR."[36] Xcel Energy points to TIIR Section 1.4 as sufficiently addressing this issue and suggests no clarification in the Order is required.[37]

[32] IREC and Fresh Energy Reply, p. 2
[33] IREC and Fresh Energy Initial, p. 3
[34] MN PUC, Phase II TSG Meeting #10 (August 9, 2019), Slide 16, as e-filed on August 20, 2019, pdf pg. 620
[35] IREC and Fresh Energy Initial, p. 5
[36] IREC and Fresh Energy Initial, p. 5
[37] Xcel Reply, p. 4

Otter Tail Power notes[38]:

> … [T]he TSM document needs to remain flexible to accommodate each utility's system and differences in those systems between utilities, while also allowing the flexibility to accommodate innovative, developing or other new ways to implement Distributed Energy Resources (DER) going forward.

IREC and Fresh Energy "urge the Commission to recognize that while the TIIR is an admirable effort, it does not achieve the goal of establishing statewide technical requirements so long as the TSMs contain numerous important, and disparate, technical requirements."[39]

Should the TSMs be Filed and Reviewed at the Commission?

The Draft TIIR includes Annex A which provides a link to utility webpage(s) containing their TSM; further, the Draft TIIR includes a place to list all four rate-regulated utilities' TSMs.[40] The Draft TIIR is silent on the frequency, display, notification and applicability of changes to a utility's TSMs.

Throughout Phase II, the TSG was not in agreement on the appropriate role of Commission oversight of the utility-specific TSMs. The Department observes[41]:

> … parties differed in their approach to utility-specific Technical Specification Manuals (TSMs), and whether the TSMs should be informational filing or subject to Commission approval.

Staff summarizes the differences:

Party	Position	Decision Option
MREA	"MREA cautions the Commission from placing too much oversight on the regulated utilities' TSM documents."[42] Supports language in the Draft TIIR. [link to utility's TSM webpage listed in the TIIR, no additional filing at the Commission]	**Decision Option 8**
Dakota Electric	"If the process to modify the utilities TSM document requires an extensive, time consuming process to obtain approval of changes to their TSM document, this would become a disincentive for the utility to embrace changes to their TSM document… Dakota Electric would instead recommend the use of an informational filing each time a regulated utility's TSM is updated… due to the size of the	**Decision Option 9**

[38] Otter Tail Power Reply, p. 2
[39] IREC and Fresh Energy Initial, p. 17
[40] Draft TIIR, Annex A, p. 40
[41] Department Reply, p. 3
[42] MREA Initial, p. 3

Party	Position	Decision Option
	TSM documents… informational notice to the utility's web site, where the TSM is required to be available."[43]	
Minnesota Power	Supports language in the Draft TIIR[44]	**Decision Option 8**
Otter Tail	"…Otter Tail proposes to file its TSM for informational purposes… [and]… changes to the TSM be filed with the Commission no more than every six months… any oversight above and beyond this could curtail the development of [DER] because the utility would need to wait for the necessary approvals prior to implementing a change to their TSM."[45]	**Decision Option 10**
Xcel Energy	Supports language in the Draft TIIR[46]	**Decision Option 8**
IREC-Fresh Energy	The TSMs should be filed with the Commission along with a clearly defined process for objections [30 days] and updates [filed clean and red-lined and subject to 30-day objection and petition at any time]… "This process will provide a streamlined pathway for TSMs to go into effect, allows for stakeholders to object to problematic provisions and does not foreclose later review of TSM provisions as circumstances change with technology and customer/industry experience with the process."[47]	**Decision Option 11**
Department	"Department understands Minnesota rules to generally require the annual filing of the TSM, and to provide some guidance regarding the standards that are contained in the TSM [per Minn. Rules pt. 8735.0800 Schedule E]. The Department recommends that the Commission require utilities to file their TSM on an annual basis with their other reporting requirements contained in Minnesota rules."[48]	**Decision Option 12**

MREA, Minnesota Power and Xcel agree that the TIIR sufficiently addresses the TSMs, and no further Commission oversight or notification is needed. Dakota Electric and Otter Tail Power offer several ways to allow for Commission informational notification when a TSM is changed. Utilities uniformly agree that the Commission should not have a review and approval process for utility-specific TSMs. Dakota Electric summarizes why[49]:

> If instead, the Commission decides to tightly regulate the development and modification of a TSM document, with the intent to help avoid unreasonable standards, then the

[43] Dakota Electric Initial, pp. 5-6
[44] Minnesota Power Initial
[45] Otter Tail Power Initial, pp. 2-3
[46] Xcel Energy Initial, p. 2
[47] IREC and Fresh Energy Initial, pp. 3-5 and Reply, Attachment 2 at Proposed Decision Option 2.
[48] Department Reply, p. 3
[49] Dakota Electric Initial, p. 5

> updating process for each regulated utility would be long and require many hours of work. This would become a disincentive for a utility to modify their TSM document once approved.

Dakota Electric offers how utilities may approach TSM development[50]:

> As one utility develops a more efficient method to resolve an issue, the other utilities will learn from each other through a comparison process… [T]o avoid increased labor costs, utilities are naturally encouraged to keep their TSM document standards as similar to the neighboring utilities as possible and not have unique requirements.

MREA agrees with Dakota Electric noting[51]:

> As electric cooperatives learn from each other and other electric utilities on how certain types of DER systems are best interconnected, the TSM document should be updated for the betterment of the utility, the installer and the membership.

Dakota Electric also suggests: "If the TSM standard is unreasonable and the utility is unwilling to adjust their standard, then a complaint to the PUC would be the next step."[52] IREC and Fresh Energy agree with the utilities that keeping the TSMs up-to-date is important; however, they do not support relying on individual complaint process to resolve concerns that might affect many projects.[53]

Instead, IREC and Fresh Energy suggest proposed changes to a utility's TSM be subject to a 30-day period for review and possible objection before going into effect. If objections are raised, the Commission would determine whether or not to resolve the concern prior to implementation. IREC and Fresh Energy claim[54]:

> This process is efficient and not unduly burdensome: it will incentivize utilities to work with the DER community on significant changes before they are proposed and ensure that the Commission has a chance to resolve disputes before they have the potential to impose costly or burdensome constraints on new projects.

Xcel Energy offers context for why the utilities are not supportive of IREC and Fresh Energy's proposal for a regulatory processes for the TSM or inclusion of the TSM in tariff[55]:

- The TSM must be able to reflect the range of existing technologies, emerging technologies; as well as, customer load types;

[50] Dakota Electric Initial, pp. 4-5
[51] MREA Initial, p. 3
[52] Dakota Electric Initial, p. 5
[53] IREC and Fresh Energy Reply, p. 2
[54] IREC and Fresh Energy Reply, p. 3
[55] Xcel Energy Reply, pp. 3-4

- The TSM must be able to address DER settings, within the TIIR defined ranges, in view of evolving grid technologies and optimized integration of DER specific to the utility;
- Grid management efforts are the sole responsibility of the utility and may not be given due consideration by stakeholders.

Lastly, the Department recommends the Commission "require utilities to file their Technical Specification Manuals as part of their annual reporting under Minn. Rules 7835" (i.e. as part of the Schedule E filed in utility's -9 reports each year.) (**Decision Option 12**)

Minn. Rules pt. 7835.0800 Schedule E states:

> Schedule E must contain the utility's safety standards, required operating procedures for interconnected operations, and the functions to be performed by a control and protective apparatus. These standards and procedures must not be more restricted than the standards contained in the electrical code under part 7835.2100 or the interconnection standards distributed to customers under part 7835.4750. The utility may include in schedule E suggested types of equipment to perform the specified functions. No standard or procedure may be established to discourage cogeneration or small power production.

Xcel Energy disagrees with the Department's recommendation that the TSM is part of Schedule E; noting that Minn. Rules 7835.4750 describes the interconnection standards to be distributed to customers as the "… currently effective interconnection standards established by subsequent commission order." Xcel appears to equate the Department's position with requiring Schedule E to be tariffed, and pivots from the TSM to the TIIR and notes that if the Commission required the TIIR to be filed in utility tariffs that could be done via Schedule E every January 1st consistent with Minn. Rules 7835.0300. Xcel reiterates Dakota Electric's description of shared learning and suggests "… consideration should be given in the Workgroup with the potential for utility adoption in subsequent revisions of TSMs."[56]

Staff Analysis

There is a balance that needs to be struck between the flexibility and transparency offered by utilities maintaining an electronically-accessible single Technical Specification Manual (TSM) on their webpage and the appropriate role of Commission oversight as evidenced by the record.

Staff offers some perspective on the current process related to emerging technical issues not addressed in the existing 2004 Minnesota Technical Requirements. Over the past several years, as Distributed Energy Resources have developed in Minnesota, so too have utility technical requirements despite no update to the statewide technical requirements since 2004. This led to a proliferation of interconnection technical requirements in program tariffs; e.g. metering requirements and Community Solar Garden-specific interconnection application review timelines. Outside of tariffs, with the emergence of 1 MW solar projects in Xcel Energy's Community Solar Garden program, the Company provided an informational filing related to changes in technical review for rapid voltage change and flicker per the Commission's Order. Another example is the

[56] Xcel Energy Reply, pp. 2-4

creation of operating agreements for storage interconnections modeled after examples from the Company's Colorado operations. A current issue of concern to developers has been raised related to open phase, single phase testing and grounding transformer requirements.

The Department suggests including the TSM as part of a utility's annual distributed generation filings which are subject to objection or petition.[57] If the Department intends for the Schedule E filing to be tariffed, then this option would also require clean and red-lined version when changes occur. If not tariffed, the TSM could change without Commission notification during the year and may be submitted in its updated form the next year without red-line notice of changes unless the Commission provides direction.

Alternatively, IREC and Fresh Energy establish a specific process by Order for Commission review that is similar to a streamlined Commission review and rate approval process (negative check off with a Notice approving rates) for annual updates to utility's distributed generation standard offer rates (-9 filings).[58] The differences with the Department's proposal is IRECE and Fresh Energy propose: 1) to delay in the TSM effective dates pending review period; 2) does not limit the frequency of the filing and review period (Department proposal is an annual filing vs. every time the utility updates the TSM), and 3) where the TSM filing occurs (-9 dockets or another docket). Both the Department and IREC and Fresh Energy's approaches appear to recognize, if TSM filings are required, the appropriate Commission oversight would be to accept - not adopt or approve - the utility's TSMs.

Staff agrees with the Department that Schedule E is an appropriate place for TSMs to be filed with the Commission if that is the Commission's prerogative. Staff would clarify that rather than viewing the TSM as the "interconnection standards distributed to customers under Minn. Rules pt. 7835.4750" as Xcel suggests, the TSM could fit under Schedule E as "… standards and procedures [which] must not be more restricted than the standards contained in the … interconnection standards distributed to customers under part 7835.4750." The TSM would still be distributed to the customers, along with the MN DIP, MN DIA (if appropriate) and TIIR.

Schedules A, B, G are filed each year with a rate-regulated utility's cogeneration and small power production tariff and subject to Commission review; however, not included in the utility's ratebook with the updated tariff sheets. Similarly, Schedule E does not need to be included in a utility's ratebook if, like the utilities suggest, there is a good reason not to include it there. In other words, the Commission has interpreted Minn. Rules. 7835.0300 at "[t]he tariff for generating utilities must contain schedules A to G.." as the tariff filing; rather than the tariff sheets included in the utility's rate book in the past and could do so with Schedule E.

Additionally, the Commission may wish to consider whether to require "utilities" as proposed in the Department's recommendation or whether to limit this filing requirement to "rate-regulated utilities." Minn. Rules Ch. 7835 does not apply to cooperative and municipal utilities that have

[57] Example: dispute on trade secret designation of avoided cost information in the current annual DG filing docket (E-999/PR-19-9)
[58] MN PUC, Order Approving Fees and Setting Filing Requirements (October 17, 2017), Docket No. E-999/CI-15-755, Order Point 4, p. 5.

adopted their own rules and jurisdiction for Minn. Stat. 216B.164. That said, Minn. Stat. 216B.1611; Subd. 3(2) requires cooperative and municipal utilities "to adopt a distributed generation tariff that address the issues included in the commission's order." Staff offers **Decision Option 13** for the Commission's consideration to make clear the issue of access to the TSM for potential interconnection customers regardless of if Minn. Rule 7835.4750 applies to the utility.

Lastly, IREC and Fresh Energy request additional transparency on the likely scope of the utility-specific TSMs, but Xcel Energy point to Draft TIIR Section 1.4 as addressing TSM scope and relation to the TIIR. Staff suggests including the Jun 2019 Draft – Utility TSM Outline - created and in use by the utilities - as an annex in the Draft TIIR footnoted in Section 1.4 of what is anticipated[59] to be included in a utility's TSM (**Decision Option 15)**:

> The following is a brief listing of some of the areas which further technical guidance is to be provided within the Area EPS Operator's TSM. [*add footnote*]
>
> Footnote: See Annex C for an anticipated list of additional topics in a TSM.

D. Future TIIR Revisions

Commission Process

All parties see value in the Commission continuing to convene either the full DGWG or a technical subgroup to consider future revisions to the TIIR; however, they vary on the process and frequency of the convening to update the TIIR. Several other parties offer more details:

Party	Position
MREA	"MREA envisions the DER Technical Committee would address the need for modification to the TIIR and then would recommend to the Commission specific changes to the Minnesota DER TIIR."[60]
Dakota Electric	Standing Technical Committee, consisting of technical individuals representing the stakeholders, reviews written proposals for changes to the TIIR, incorporates changes into the TIIR document, then release the updated TIIR for larger group discussion and review, and ultimately through Commission process for approval or rejection (no more than annually)
Otter Tail	"Because of the evolving nature of DER, we would be supportive of the Workgroup to continue to be a forum in which an open dialogue can occur as items arise."[61]
Xcel Energy	Cities Commission's August 13, 2018 Order providing that the DGWG address ongoing implementation and technical issues, and suggests applying that to the TIIR as well. [62]

[59] Staff notes anticipation neither requires nor limits TSM topics.
[60] MREA Reply, p. 1
[61] Otter Tail Power Reply, p. 3
[62] Xcel Reply, pp. 1-2

Party	Position
IREC-Fresh Energy	"IREC and Fresh Energy strongly support the idea of having a continuing formal Workgroup and have seen these used with some success in various states."[63] The Commission should reconvene the DGWG to: 1) discuss an interim guidance document (in short order); 2) discuss and establish next steps based on a Commission review of TSMs to identify consistency that could be moved to the TIIR and evaluate inconsistencies to determine if they are justified based on utility distinctions (a year after TSMs are filed); 3) review Revision Request Forms submitted; and 5) discuss and eventually resolve five outstanding issues.[64]
Department	"The Department recommends that a Technical group be established to review and recommend changes to the TIIR for the DG community and ultimately the Commission. Changes to the TIIR, including specific language revisions, could be proposed and reviewed on an annual basis. The Department does not recommend a more frequent revision process as consistency and experience should be gained prior to revisions."

Xcel Energy suggests the Commission's August 13, 2018 Order Establishing Updated Interconnection Process and Standard Interconnection Agreement in this docket addresses the process for future TIIR revisions:

> 21. The Commission delegates to its Executive Secretary the authority to establish and maintain an ongoing Distributed Generation Workgroup to meet annually, or more frequently as needed, to review implementation and technical issues that arise with implementation of the MN DIP, MN DIA, or emerging DER technology. Updates to the MN DIP and/or MN DIA may be accomplished by Commission order in response to a petition.

Parties seem to agree that the TSG process served its purpose well, but Dakota Electric Association and IREC and Fresh Energy both suggest a more formal process for proposing future changes to the TIIR. Dakota Electric's proposal[65]:

1) Create a technical body (review group) that will take the proposed modifications and identify which ones need to be addressed;
2) Identify a process to periodically develop TIIR revisions and seek Commission approval;
3) Allow for stakeholders to identify issues within the existing TIIR document;
4) Require the entity reporting the issue to also provide a detailed written solution proposal.

Dakota Electric notes this process would help the review group fully understand the scope of the proposal and creates a foundation for TIIR enhancements. IREC and Fresh Energy's proposal differs slightly by not limiting the frequency/timeframe of reconvening a broader Workgroup and establishing a Revision Request Form[66] to standardize and facilitate the collection of requests for

[63] IREC and Fresh Energy Reply, pp. 6-7
[64] IREC-Fresh Energy Reply, pp. 6-7 and Attachment 2. Five outstanding topics are outlined in **Attachment A** to these briefing papers.
[65] Dakota Electric Reply, pp. 2-3
[66] IREC and Fresh Energy Initial, Attachment A

changes to future iterations of the MN DIP, DIA and TIIR – and, they suggest, the TSMs.[67] **(Decision Option 14.b)**

Xcel agrees with Dakota Electric that requests to modify the TIIR identify the issue and a proposed solution, but does not support the Commission establishing a Revision Request Form as suggested by IREC and Fresh Energy[68]:

> Parties do not need to use a prescribed form to convey this basic information. Parties are free to use the IREC-designed form without the need for a Commission order.

TSM Conformance with TIIR **(Decision Option 14.a)**

In addition to the 30-day review period for a utility's TSM, IREC and Fresh Energy propose the Commission adopt a TIIR conformance review of utilities' TSMs. IREC and Fresh Energy propose[69]:

1) Commission staff or another neutral party create a report based on a review of the TSMs to identify which technical requirements are: (a) consistent across the utilities that could be moved into the TIIR and (b) currently inconsistent but warrant evaluation as to whether the differences are truly justified based on actual technical distinctions with utility systems;
2) Submit the report to the DGWG for discussion to try to achieve a consistent set of technical requirements.

No other party had the opportunity in written comments to address this proposal for a Commission-led review. MREA and Dakota Electric both describe a similar review utilities plan to do; including learning from each other[70] and when there is consistent requirements suggesting them for inclusion in a future revision of the TIIR.[71]

Staff Analysis

The Technical Subgroup, as part of the Distributed Generation Workgroup, has done an admirable job in this inaugural update of the statewide Minnesota Technical Requirements, and should remain the Commission's resource for discussion of DER interconnection and interoperability technical requirements. As Dakota Electric and MREA acknowledge, the TSMs provide important learning opportunities for utilities – and, staff would add, for stakeholders and the Commission too. Staff recommends the Commission allow the TSG, as part of the DGWG, to continue to lead in the review and development of technical requirements.

Voltage Reporting **(Decision Option 14.c)**

[67] IREC and Fresh Energy Initial, pp. 6-7
[68] Xcel Reply, p. 4
[69] IREC and Fresh Energy Reply, Attachment 2
[70] MREA Initial, p. 3
[71] Dakota Electric Initial, pp. 4-6

IREC and Fresh Energy propose a voltage reporting process[72] due to consumer protection concerns related with the Draft TIIR Section 5.4 enabling Voltage and Active Power Control (volt-watt), which is disabled by default in IEEE 1547-2018. The voltage reporting and a metric to determine maximum energy loss are based on discussions in California and work done by the National Renewable Energy Laboratories; however, it has not been discussed by the TSG to-date. IREC and Fresh Energy raise concerns that because voltage can vary locally it can be challenging to predict; further, impacts may vary over time with changes to distribution circuits (e.g. increased penetration of DER), utility voltage regulation practices or poor DER installation practices.[73] The Draft TIIR proposes to set the high voltage at the upper end of the range of normal steady state voltages allowed under ANSI C84.1.

> Section 5.4 Voltage and Active Power Control (volt-watt)
>
> The voltage-active power function may reduce DER energy production during times of abnormally high voltage. The extent of that reduction of production is dependent on the specific setting of the function, as well as actual steady-state voltage observed over time at the DER location. Deviation in the voltage parameters settings from the default, such as setting a voltage parameter to a lower value, may exacerbate the possible energy production reduction.
>
> In the circumstance where a DER Operator's production is being impacted by the Area EPS voltage, the DER Operator should notify the Area EPS Operator of the voltage concern[74]. The Area EPS Operator shall investigate the cause of abnormal voltage. If the abnormal voltage is originating from the Area EPS, the Area EPS Operator may need to modify equipment or settings. The Area EPS Operator may also need to work with other electric services to bring voltage within ANSI C84.1 Range A. If the abnormal voltage is originating from the DER Operator's premise, the DER Operator is responsible for mitigating the root cause.[75]…

Xcel Energy and Otter Tail Power do not support IREC and Fresh Energy's voltage reporting proposal. Xcel suggests the complaint process described in TIIR Section 5.4 is sufficient.[76] Otter Tail Power notes the voltage reporting proposal would require Advanced Metering Infrastructure (AMI), and suggests it would be beneficial to understand what the issue of concern is to determine the appropriate information provide.[77] IREC and Fresh Energy note inverter or DER-level data could be substituted for AMI voltage data.[78]

Staff Analysis

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[72] IREC and Fresh Energy Initial, Attachment B
[73] IREC and Fresh Energy Initial, pp. 13-14
[74] From Draft TIIR: For example, DER with the PCC located near the substation with a high source voltage may require upward adjustment of the V_1 parameter to avoid significant production impacts.
[75] From Draft TIIR: All parties should attempt, with a good-faith effort, to resolve voltage concerns in the process identified in TIIR Section 5.3. Any voltage concern disputes not resolved are to follow the dispute resolution process in MN DIP Section 5.3 and MN DIA Article 10.
[76] Xcel Reply, pp. 8-9
[77] Otter Tail Power Reply, p. 2
[78] IREC and Fresh Energy Initial p. 14

The Commission and the DGWG have time to flesh out the details of enabling volt-watt at the upper end of ANSI C84.1 Range A since certified equipment is not anticipated until 2021. Staff believes additional consideration is warranted, and as Otter Tail notes it would be more beneficial to understand the issues of concern, rather than adopt a voltage reporting process where some utilities cannot – or would not need to – comply.

The utilities acknowledge measuring voltage throughout the distribution system is not possible with current grid technology[79] and that AMI would be needed as an argument against IREC and Fresh Energy's voltage reporting proposal. In utility service quality reporting, voltage issues are primarily identified as proposed in the Draft TIIR – by a customer complaint followed by a utility investigation. Utilities are not required to report voltage levels for all feeders in service quality; thus, no one has certainty about how often and to what extent volt-watt, once enabled, would be triggered.

Staff are not technical experts on this matter, and the issue of volt-watt was discussed at the TSG.[80] Staff's understanding is utilities report setting head-end voltage (at the substation) higher than the ANSI Range A to ensure voltage levels at the end of feeders is within range. Often, the closer to the substation the more DER hosting capacity is available; which is why the MN DIP Fast Track process takes into consideration proximity to a substation when determining the size eligibility for consideration by Initial Review screens versus a full interconnection study.[81] If a volt-watt enabled DER is located too near a substation with head end voltage above Range A – say before customer load where the voltage level usually applies – the DER may face significant curtailment from high voltage. Staff is unclear how the utilities intend to address this concern, but locating DER further away from the substation is not necessarily the best solution. Utility-owned line voltage regulators can assist in ensuring voltage is in the appropriate range throughout the utility system; however, how inverter voltage regulation and this equipment work together was part of the rationale against moving from constant power factor to a voltage-reactive power control mode (volt-var.) Staff offers **Decision Option 16.f** to direct the DGWG's TSG to continue to flesh out details of enabling volt-watt prior to statewide implementation anticipated in 2021.

Near Term Topics for Future TIIR Revisions (**Decision Option 16a-e)**
To distinguish between immediate considerations for the Commission, staff includes decision options to direct the DGWG to take up the specific topics identified by IREC and Fresh Energy, but summarizes the record on these potential future topics in **Attachment A** to these briefing papers.

[79] See Xcel Energy, Volume 2B in Docket No. 19-564 for discussion of the Company's Advanced Grid Intelligence and Security proposal which includes discussion of visibility and control of voltage.

[80] TSG Meeting #3 (June 8, 2018). In addition to the agenda and slides filed in the current docket (August 20, 2019), the Commission's webpage lists the materials provided by TSG participants:
https://mn.gov/puc/utilities/interconnection/

[81] MN DIP Section 3.1.1 Fast Track Process Applicability

IV. Decision Options

Adoption of the Statewide Technical Interconnection and Interoperability Requirements (TIIR)

1. Adopt the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR) as filed on August 23, 2019. (*MREA, Dakota Electric, Minnesota Power, Otter Tail Power*)

2. Adopt the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR) as filed on August 23, 2019 with the following modifications:

   a. Definition of ESS Control Mode (Sec. 3.2): (*IREC-Fresh Energy)*
   "The function that manages the real and reactive power flow from or to a ~~DER~~ ESS in response to certain parameters, (such as time, price signals, frequency or external signals, etc.)."

   b. Definition of Minnesota Technical Requirements (Sec. 3.2) (*Xcel Energy, Department, IREC-Fresh Energy)*

   The term including all of the DER technical interconnection requirement documents for the state of Minnesota; including: 1) when an application was submitted before the effective date of the MN DIP and therefore is not subject to the MN DIP, the MN Technical Requirements shall mean Attachment 2 Distributed Generation Interconnection Requirements established in the Commission's September 28, 2004 Order in E-999/CI-01-1023) and 2) when an application is subject to the MN DIP, the MN Technical Requirements shall mean ~~until superseded and upon Commission approval of updated Minnesota DER Technical Interconnection and Interoperability Requirements in E-999/CI-16-521~~ this document – the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR) - as adopted and amended over time by Commission order.

   c. Section 5.4 Title: (*IREC-Fresh Energy, Xcel Energy)*
   "Voltage and ~~Reactive~~ Active Power Control"

3. Further modify the Draft TIIR as follows prior to adoption (*Xcel Late-Filed*):

   a. Section 2 References

   IEEE Std C62.92.2-2017, IEEE Guide for the Application of Neutral Grounding in Electric Utility Systems, Part II – Grounding of Synchronous Generator Systems ~~and Part VI – Systems Supplied by Current-Regulated Sources~~

   IEEE Std C62.92.6-2017, IEEE Guide for the Application of Neutral Grounding in Electric Utility Systems, Part VI

   b. Add the following footnote to this sentence in Section 7.2 [Protection] Requirements:

   "All equipment providing relay functions shall meet or exceed ANSI/IEEE Standards for protective relays, or standards applicable for the installation voltage, unless otherwise specified by the Area EPS Operator's TSM." *[insert footnote]*

Footnote: Inverters certified to UL 1741 may contain protective functions that do not require equivalent external protective relays to meet IEEE 1547 requirements.

c. Add the following footnote to this sentence in Section 7.4 Additional Protection:

"Medium and large DER installations may require more sensitive and faster protection to minimize potential damage and ensure safety." *[insert footnote]*

Footnote: Ride-through capabilities for bulk power system support should be considered before setting protective tripping times that conflict with BPS support.

4. Further modify the Draft TIIR at Section 1.6 Transition Period as follows prior to adoption: (*IREC with Staff Correction)*

Area EPS Operators cannot require the use of certified equipment that meets the requirements of IEEE 1547-2018 until ~~such time the equipment is readily available~~ three months after the UL 1741 future effective date for incorporating changes related to IEEE Std 1547-2018 and IEEE Std 1547.1-2020. At such time certified equipment first becomes available, the Area EPS Operator and DER Owner may mutually agree to utilize the certified equipment and functionalities in conformance with the requirements of IEEE 1547-2018. ~~At such time when certified equipment is readily available[ftn] available~~ Three months after the UL 1741 future effective date for incorporating changes related to IEEE Std 1547-2018 and IEEE Std 1547.1-2020., the entire TIIR shall be applicable.

OR

5. Request input from the Technical Subgroup (TSG) of the Distributed Generation Workgroup as to when IEEE 1547-2018 certified equipment is "readily available" and delegate to the Executive Secretary the authority to notice when the full TIIR goes into effect in consultation with the TSG. (*Staff modification to MREA*)

Actions Related to the Adoption of the TIIR

6. Reconvene the Distributed Generation Workgroup to draft a guidance document to accompany the TIIR which clarifies what provisions are in place in the interim period until newly certified equipment is available. The DGWG should complete its work and finalize the document by the publication date of the TIIR. The addendum shall be: (*IREC and Fresh Energy*)

a) Filed in this docket and published by the Executive Secretary along with the TIIR on its website if consensus is reached. Or,
b) Included with the utility TSMs when they are submitted by each utility if DGWG consensus is not reached.

7. Approve Xcel's proposed modification to the Company's tariffs as follows:

a. Amend Sec. 10, Sheet No. 73:

The ~~"Minnesota Distributed Energy Resource Technical Interconnection and Interoperability Requirements (MN Technical Requirements)"~~ "State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR)" are referenced in the MN DIP and MN DIA but are not tariffed.

As used in this tariff, when an application is subject to the MN DIP, the terms "Minnesota Technical Requirements" and "MN Technical Requirements" shall mean the State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR). When an application was submitted before the effective date of the MN DIP and therefore is not subject to the MN DIP, these terms shall mean the "State of Minnesota Distributed Generation Interconnection Requirements" (at Sheet Nos. 10-135 through 10-159.6).

b. Replace the MN DIP Attachment 4 language at Sec. 10; Sheet Nos. 229-230 with the following:

The Minnesota Technical Requirements (State of Minnesota Technical Interconnection and Interoperability Requirements (TIIR)), as modified over time as authorized by written order of the Minnesota Public Utilities Commission shall be used in conjunction with the Minnesota Interconnection Process (MN DIP) and Minnesota Interconnection Agreement (MN DIA) for Distributed Energy Resources.

Commission Process for Utility-Specific Technical Specification Manuals

8. Take no action on requiring informational filings of rate-regulated utilities' Technical Specification Manuals. (*MREA, Minnesota Power, Xcel Energy*)

OR

9. Direct [rate-regulated] utilities to file informational notice with the webpage link each time their Technical Specification Manual is updated. (*Dakota Electric Association)*

OR

10. Direct [rate-regulated] utilities to file a copy of their TSMs and re-file any time there is a change to the TSM which shall not occur more frequently than every six months (*Otter Tail Power*)

OR

11. Adopt the following approval [acceptance] procedures (*IREC and Fresh Energy)*:

a. Each utility's TSM shall be filed in this docket within 60-days of the Commission's order.

b. After the TSMs are filed, objections may be filed with the Commission within a 30-day period. Any such objection should clearly identify what provisions are being objected to, why, and identify a preferred alternative approach if possible. If no such objections are received, the TSMs shall go into effect automatically (i.e. 30 days after being filed). If objections are received, the Commission shall make a formal determination on the objections before the challenged TSM can go into effect. A TSM going into effect after the 30-day period with no objection does not waive or nullify future objections to the provision contained in that TSM.

AND/OR

12. Require rate-regulated utilities to file their Technical Specification Manuals as part of their annual reporting under Minnesota Rules 7835 in Schedule E (Minn. Rules 7835.0400). (*Department*)

13. Find it necessary for potential interconnection customers to be able to access the utility's safety standards, required operating procedures for interconnected operations, and the functions to be performed by any control and protective apparatus. These standards and procedures must not be more restrictive than the standards contained in the State of Minnesota Technical Interconnection and Interoperability Requirements. The utility may include suggested types of equipment to perform the specified functions. No standard or procedure may be established to discourage cogeneration or small power production. (*Staff proposal based on the language in Minn. Rule 7835.0800 Schedule E*)

Commission Process for Future TIIR Revisions

14. Adopt the following TIIR conformance procedures (*IREC-Fresh Energy)*:

    a. Commission staff (or another neutral party as determined by the Executive Secretary) shall conduct a review of the TSMs to identify (1) what technical requirements are consistent across the utilities that could be moved into the TIIR and (2) what technical requirements are currently inconsistent but warrant evaluation as to whether the differences are truly justified based on actual technical distinctions with utility systems. This review and accompanying report documenting the review, shall be conducted one year after the TSMs are first filed. The Executive Secretary shall convene the Distributed Generation Workgroup following the filing of the report to discuss and establish next steps.

    b. The Revision Request Form is adopted and should be made available on the interconnection page of the Commission's website.1 The Executive Secretary shall use these Request Forms to help determine when the DG Workgroup should be convened and what issues to cover.

    c. The Executive Secretary shall establish a voltage reporting process. At a minimum, the utilities shall file a report on voltage-based energy production impacts reported by DER operators using the elements defined in Appendix B to IREC and Fresh Energy's Comments. The reports shall be filed yearly for up to five years, the Executive Secretary may decide to increase the frequency of the reports, to extend the number of years which they shall be filed for, or change the formatting as is appropriate to accomplish the goal of ensuring the Commission has adequate information to understand how the new voltage regulation requirements are impacting DER customers.

15. Further amend the Draft TIIR at Section 1.4 as follows and include the Jun 2019 Draft – Utility TSM Outline as Annex C prior to adoption: (*Staff proposal)*

    The following is a brief listing of some of the areas which further technical guidance is to be provided within the Area EPS Operator's TSM.[*add footnote*]

    Footnote: See Annex C for an anticipated list of additional topics in a TSM.

16. The Commission recommends the following items for discussion and eventual resolution through the Distributed Generation Workgroup (*IREC-Fresh Energy*):

    a. Energy storage control modes and harmonizing the language and structure of the energy storage requirements in the operating agreements,

    b. Determine explicit treatment of Distributed Energy Resources using Power Control Systems for maximum capacity and export control in the Minnesota Distributed Energy Resources Interconnection Process (MN DIP) and the Technical Interconnection and Interoperability Requirements document.

    c. Evaluation of Voltage-Reactive Power Regulation (Volt-Var) in the Technical Interconnection and Interoperability Requirements.

    d. Harmonize the language and structure of the voltage regulation considerations in the operating agreements to the extent possible.

    e. Harmonize the language and structure of the communications operating agreements so as to not unduly burden DER operators.

17. The Commission may consider revisions to the TIIR to address these or any other issues upon petition. *(IREC-Fresh Energy)*

18. Delegate authority to the Executive Secretary to issue by Notice a clean copy of the statewide TIIR reflecting this Order.

Staff Recommends: 2a, 2c, 3a-c, 5, 6, 9, 12, 13, 15, 16a-f, 18.

Party Comments on Future Topics
(**Decision Options 16a-e**)

IREC and Fresh Energy point to the following five topics as requiring additional consideration to ensure that interconnection applicants understand what exactly is being agreed to and what is required to comply with the TIIR. Dakota Electric summarizes the TSG Writing Subgroup's challenge on these topics of determining "how far the initial TIIR standard should go in developing new technical standards and when the TIIR should be silent on technical issues and wait for the national standards to be developed."[82]

A. Energy Storage Systems (TIIR Section 10) **(Decision Option 16.a)**

IREC and Fresh Energy suggest operating agreement requirements and interconnection application review standards related to energy storage systems (ESS) are topics that need to be addressed in short order by the TSG and TIIR. Specifically, they argue that TIIR Section 10.2 Energy Storage System Control Modes[83] which requires the ESS control modes be reviewed and approved by the utility and documented in the customer's operating agreement "should be considered a temporary measure that is re-evaluated in the near future"; further noting:[84]

> IREC and FE believe energy storage system control mode review, approval and security requirements proposed in the TIIR may be unduly restrictive in the long-term.... While this conservative approach may appear prudent from an engineering perspective, we do not believe that this approach is necessary to protect the safety and reliability of the grid and believe it will impede customers' ability to operate their storage system in the most economical and/or grid beneficial manner.

In addition to re-evaluating how TIIR Section 10.2 treats energy storage systems various control modes, IREC and Fresh Energy requests the Commission consider standardizing operating agreement language for energy storage control modes per TIIR Section 10.2(iii):

> The ESS Control Mode(s) reviewed and approved should be documented in an operating agreement. The operating agreement should also list the ESS Control Mode(s) that is being utilized. Area EPS Operator shall be notified of changes to ESS Control Mode(s). The changes and notification to the Area EPS Operator shall follow all applicable agreements and requirements as documented in the TSM.

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[82] Dakota Electric Reply, p. 2
[83] Draft TIIR, Section 10.2, pp. 29-30
[84] IREC and Fresh Energy, pp. 8-9

Dakota Electric Association highlights the TIIR addresses the nascent stages of ESS standards and maintains flexibility to "… make sure that the technical requirements do not unduly constrain the application of energy storage" and cites, in part[85]:

> TIIR Section 10.1 [Energy Storage] Introduction[86]
>
> … The absence of guidance on ESS best practices and standards at a national level makes it likely that this section will require future revision sooner than other sections in the document. The intent of this document is to adopt standards as they become available. The approach taken for ESS in the TIIR is to define functional requirements, leaving implementation, testing, and verification for definition in individual Area EPS Operator's TSM. As was the case with inverter-based DER prior to IEEE 1547 in 2003, the types and use cases associated with ESS will continue to rapidly shift until standards and certifications are developed. Based on these factors, the Area EPS Operator shall specify any additional ESS requirements in the Area EPS Operator's TSM. …

Dakota Electric suggests[87]:

> .. [O]ne of the first areas for improving the technical standards for energy storage would be in the development of standard operating mode terminology and development of a few standard use cases. Starting with a few common operating modes and use cases would help focus the discussions on applicable technical standards.

B. *Power Control Systems and Maximum Capacity and Limited Export (TIIR Section 11)* **(Decision Option 16.b)**

Significant DGWG and TSG effort went into considering a DER's maximum capacity when limited below the nameplate rating.[88] The issue of capacity can impact all DER types, but is of particular importance for energy storage systems, and may have impacts on interconnection review and program eligibility. Two sections of the Draft TIIR address limited maximum capacity and limited export distinguishing between Simplified DERs (20 kW and below) and all other DERs.

[85] Dakota Electric Reply, p. 3
[86] Draft TIIR, Section 10.1, p. 29
[87] Dakota Electric Reply, p. 4
[88] TSG Meeting #4 (July 20, 2018 and August 3, 2018), In-Person TSG Meeting (September 21, 2018). A meeting summary of the In-Person TSG meeting is included in the Commission's TSG Agendas and Slides packet (pdf pp. 527-536)

Draft TIIR Section 11.2, in part[89]:

> For inverter-based DER systems 20 kW or less in Nameplate Rating, the Power Control limited capacity shall be implemented through utilizing the IEEE 1547 configuration settings. …
>
> For rotating machines or inverter-based DER systems larger than 20 kW in Nameplate Rating, the DER Operator shall submit details of the proposed Power Control limiting method for maximum capacity limiting, along with settings, if applicable. The Area EPS Operator shall review and either approve the proposed Power Control method and settings or provide a response as to why the method does not provide adequate control. The DER system should use the IEEE 1547 configuration settings as the preferred means of Power Control limited capacity.

Draft TIIR Section 11.3 Power Control Limited Export and Power Control Limited Import, in part[90]:

> … Power Control limiting for inverter-based DER systems with a Nameplate Rating of 20kW or less shall use a certified control system tested to UL 1741[91]. For these smaller systems, the DER Owner shall submit proposed settings to the Area EPS Operator for review and approval. For DER systems with a Nameplate Rating larger than 20 kW using a certified control system tested to UL 1741, the DER Operator shall provide test results showing the magnitude and duration of power import or export. …

IREC and Fresh Energy believe this approach leads to "extremely conservative assumptions" and Minnesota can learn from other states' (California, New York and Hawaii) experience, and describe what needs to further considered[92]:

> The configuration setting for power will generally limit output power at the inverter's terminals. In essence, it re-configures the inverter to a power value lower than nameplate. While this may be useful in some scenarios, it does not address the ability of Power Control Systems (PCS) to manage export while supporting local loads. A PCS would allow the inverter(s) on site to output full power when loads (possibly including energy storage) can consume the power. The PCS can, at the same time, ensure export to the grid remains below a certain power level. PCS are a low-cost option for managing PV system output, load and storage in order to meet export restrictions, though they can introduce inadvertent export.

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[89] Draft TIIR, Section 11.2, p. 32
[90] Draft TIIR, Section 11.3, p. 32
[91] From Draft TIIR: Testing to the UL Certification Requirement Decision on Power Control Systems may be used in the interim.
[92] IREC and Fresh Energy Initial, p. 10

IREC and Fresh Energy requests the Commission direct the DGWG to[93]:

> Determine explicit treatment of Distributed Energy Resources using Power Control Systems for maximum capacity and export control in the Minnesota Distributed Energy Resources Interconnection Process (MN DIP) and the Technical Interconnection and Interoperability Requirements document.

Xcel Energy supports this recommendation.[94]

C. Voltage Regulation (TIIR Section 5) (**Decision Option 16.c)**

The existing statewide technical requirements require a DER''s normal operation near unity power factor (+/- 98%) unless mutually agreement between 90% lagging and 95% leading.[95] In some cases, utilities have allowed normal operation below .98 CPF; however, there are some limits to reducing the CPF requirement and maintaining voltage for all customers.

Draft TIIR Section 5.3 Voltage and Reactive Power Control[96]:

> As defined by IEEE 1547 Clause 5.3.1, the Area EPS Operator specifies a reactive power control mode. Unless otherwise specified in the Area EPS Operator's TSM or specified in the Interconnection Agreement, the DER shall be installed with constant power factor mode enabled with 0.98 power factor, absorbing reactive power

IREC and Fresh Energy recognize CPF as an "acceptable first step" but "support utilizing the volt-var mode (voltage-reactive power mode) in the future." IREC and Fresh Energy recommends[97]:

> The Commission should require the Workgroup to fully evaluate volt-var within the next two years and should revisit and update the TIIR accordingly.

Xcel Energy does not object to this issue going to the Workgroup in this timeframe, but does not agree that the Commission needs to order this.[98] The parties agree that utilization of voltage-reactive power mode (volt-var) is an emerging topic in the industry and real world experience of utilities and collection of additional information will help determine the most beneficial default voltage regulation function and settings in future TIIR revisions.

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[93] IREC and Fresh Energy Initial, p. 10 and Reply, Attachment 2
[94] Xcel Reply, p. 6
[95] MN PUC, Order Establishing Standards (September 28, 2004), Docket No. E999/CI-01-1023, Attachment 2, 4.(A)iii(3), p. 10.
[96] Draft TIIR, Section 5.3, p. 21
[97] IREC & Fresh Energy Initial, p. 12
[98] Xcel Reply, p. 6

D. *Voltage Regulation and Operating Agreements* **(Decision Option 16.d)**

IREC and Fresh Energy point to Draft TIIR Section 5.2 as incorporating new reactive power capability required by IEEE 1547-2018 at the utility's discretion, and cautions[99]:

> … Some assurance that the DER customer is not unduly affected by the control is necessary. For example, the range or degree to which the utility can require changes in the voltage regulation setting should be limited in the operating agreement so as to not create too much economic uncertainty for the project owner and/or impose too much of a logistical burden where no communications exist.

IREC and Fresh Energy requests:

> The Commission should ensure that utilities and stakeholders work to harmonize the language and structure of these considerations in the operating agreements to the extent possible.

Xcel suggests this topic is premature, and should occur when discussing voltage-reactive power [control] mode (volt-var) as a default setting. In the meantime, Xcel points to IEEE 1547-2018; Clauses 5.2 and 5.3 to suggest[100]:

> IEEE 1547-2018 gives the DER Operator a reactive power range they can include in their design so as to avoid curtailment of real power, and limits the reactive power range that the Area EPS Operator can request of the DER when the default constant power factor mode is used.

E. *Communications (or Interoperability) and Operating Agreements (TIIR Section 9)* **(Decision Option 16.e)**

Draft TIIR Section 9.2 Monitoring, Control and Information to Exchange incorporates interoperability (communication (read) and control (write)) capabilities from IEEE 1547-2018, and states in part[101]:

> Writing of information by the Area EPS Operator through the Local DER Communication Interface, shall follow agreements governing Area EPS Operator control of the DER operating state control modes and parameters.

[99] IREC and Fresh Energy Initial, pp. 12-13
[100] Xcel Reply, p. 7
[101] Draft TIIR, Section 9.2, pp. 27-28

IREC and Fresh Energy argue[102]:

> While control of the DER's various settings may be beneficial for maintaining power quality, safety and reliability of the grid, the utility's changes to these settings may negatively affect the DER in terms of power production or ability to serve load.

IREC and Fresh Energy request[103]:

> … [T]he Commission should make it a priority to ensure that utilities and stakeholders work to harmonize the language and structure of these considerations in the operating agreements. The potential for conflict will most likely arise when the IEEE 1547-2018 functions are actually in place and operational, which gives the parties until about mid-2021 to work on more concrete language for the operating agreements.

Xcel does not support, noting[104]:

> The terms of MN DIA Attachment 5[105] allow the Area EPS Operator to provide requirements that must be met by the Interconnection Customer prior to initiating parallel operation, and therefore allows appropriate flexibility to address different types of communication and interoperability issues as appropriate to the type of DER installation being utilized.

In general, MREA suggests "… these new proposed topics be directed towards the proposed DER Technical Committee for future inclusion into the Minnesota DER TIIR."[106] Otter Tail Power agrees: "Because of the evolving nature of DER, we would be supportive of the Workgroup to continue to be a forum in which an open dialogue can occur as items arise." [107]

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[102] IREC and Fresh Energy Initial, p. 14
[103] IREC and Fresh Energy Initial, p. 15
[104] Xcel Energy Reply, p. 9
[105] Staff Note: Minnesota Distributed Energy Resource Interconnection Agreement, Attachment 5: Additional Operating and Maintenance Requirements for the Area EPS Operator's Distribution System and Affected Systems Needed to Support the Interconnection Customer's Needs states: " The Area EPS Operator shall also provide requirements that must be met by the Interconnection Customer prior to initiating parallel operation with the Area EPS Operator's Distribution System. Additional operating and maintenance requirements for an Affected System needed to support the Interconnection Customer's needs may be addressed in a separate agreement as described in Article 5.3."
[106] MREA Reply, p. 1
[107] Otter Tail Power Reply, p. 3

Attachment 4: Certification Codes and Standards

Prior to Commission approval of the update of Minnesota Technical Requirements (anticipated in February 2019), the existing Minnesota Technical Requirements and the following standards shall be used in conjunction with the Minnesota Interconnection Process (MN DIP) and Minnesota Interconnection Agreement (MN DIA) for Distributed Energy Resources.[14] Once approved, the Minnesota DER Technical Interconnection and Interoperability Requirements will supersede this attachment.

When the stated version of the following standards is superseded by an approved revision then that revision shall apply.

IEEE 1547-2003 IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE 1547a-2014 IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems – Amendment 1

IEEE 1547.1-2005 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

IEEE 1547.1a-2015 (Amendment to IEEE Std 1547.1 – 2005) IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems – Amendment 1

UL 1741 Inverters, Converters, Controllers, and Interconnection System Equipment for Use in Distributed Energy Resources (2010)

NFPA 70 (2017), National Electrical Code

IEEE Std C37.90.1(2012) (Revision of IEEE Std C37.90.1-2002), IEEE Standard for Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems Associated with Electric Power Apparatus

IEEE Std C37.90.2 (2004) (Revision of IEEE Std C37.90.2-1995), IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

[14] This is an interim document while the Commission updates the Minnesota Distributed Energy Resource Interconnection and Interoperability Technical Requirements which includes alignment with the anticipated final IEEE 1547-2018 revision. For the transition period between Minnesota's existing statewide interconnection standards and the updated standards, both inverters certified to existing 1547.1 and 1547.1a-2015 (most current version); as well as, certified inverters per the expected revised 1547.1 standard should be acceptable.

IEEE Std C37.108-20021989 (Revision of C37.108-19892002), IEEE Guide for the Protection of Network Transformers

IEEE Std C57.12.44-2014 (Revision of IEEE Std C57.12.44-2005), IEEE Standard Requirements for Secondary Network Protectors

IEEE Std C62.41.2-2002, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits

IEEE Std C62.41.2-2002_Cor 1-2012 (Corrigendum to IEEE Std C62.41.2-2002) - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits Corrigendum 1: Deletion of Table A.2 and Associated Text

IEEE Std C62.45-2002 (Revision of IEEE Std C62.45-1992) - IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits

ANSI C84.1-(2016) Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)

IEEE Standards Dictionary Online, [Online]

NEMA MG 1-2016, Motors and Generators

IEEE Std 519-2014, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.