STATE OF MINNESOTA
OFFICE OF ADMINISTRATIVE HEARINGS

FOR THE PUBLIC UTILITIES COMMISSION

In the Matter of the Application of Minnesota Power for a Certificate of Need for the HVDC Modernization Project in Hermantown, Saint Louis County; In the Matter of the Application of Minnesota Power for a Route Permit for a High Voltage Transmission Line for the HVDC Modernization Project in Hermantown, Saint Louis County.	**OAH 5-2500-39600** **MPUC E-015/CN-22-607** **MPUC E-015/TL-22-611**

REBUTTAL TESTIMONY OF THOMAS DAGENAIS

I. INTRODUCTION

Q. Please state your name, employer, title, and business address.

A. My name is Tom Dagenais. I am employed by ATC Management, Inc., the corporate manager of American Transmission Company LLC (collectively, ATC). My job title is Director – System Planning and my business address is 2489 Rinden Road, Cottage Grove, Wisconsin.

Q. Are you the same Tom Dagenais who filed direct testimony in this proceeding on behalf of ATC in support of its Arrowhead Substation Alternative?

A. Yes.

Q. What is the purpose of your rebuttal testimony?

A. My rebuttal testimony responds to the direct testimony of MP witnesses Christian Winter and Daniel Gunderson concerning the Arrowhead Substation Alternative.[1]

Q. Are you sponsoring any exhibits in support of your testimony?

A. Yes. I am sponsoring the following exhibits:

- Rebuttal Schedule 1, which is MP's responses to Large Power Intervenor Information Requests 19 and 21;
- Rebuttal Schedule 2, which is a map depicting the location of the Arrowhead-Weston transmission line;
- Rebuttal Schedule 3, which is a report that ATC previously prepared concerning the benefits of the Arrowhead-Weston Transmission Line Project;
- Rebuttal Schedule 4, which is a document outlining the timeline for the annual MTEP study cycle;
- Rebuttal Schedule 5, which is MISO's list of active projects from the MTEP database (filtered to show only the HVDC Modernization Project);
- Rebuttal Schedule 6, which is MISO's list of transmission projects under evaluation in the current MTEP cycle as of Mar. 6, 2024 (filtered to show only the MP projects being evaluated);
- Rebuttal Schedule 7, which is MP's response to ATC Information Request No. 038;

[1] Unless otherwise noted, acronyms and capitalized defined terms used in my rebuttal testimony have the same meaning as they do in my direct testimony. Neither Minnesota Department of Commerce – Division of Energy Resources (DOC-DER) witness Michael Zajicek nor Large Power Intervenors (LPI) witness Kavita Maini offered a formal opinion on the Arrowhead Substation Alternative in their direct testimonies. To the extent either witness raises new issues with respect to ATC or the Arrowhead Substation Alternative in rebuttal testimony, ATC may seek the opportunity to respond.

- Rebuttal Schedule 8, which includes the system impact studies, facility study, and Facility Construction Agreement for MP's transmission service requests on the HVDC Line;
- Rebuttal Schedule 9, which is a copy of the current version of MISO's Transmission Planning Business Practice Manual (No. 020);
- Rebuttal Schedule 10, which is a map of conceptual long range transmission projects that MISO circulated in July 2020;
- Rebuttal Schedule 11, which is a March 23, 2021 MISO System Planning Committee Board of Directors presentation concerning LRTP Tranche 2;
- Rebuttal Schedule 12, which is a December 6, 2022 MISO System Planning Committee Board of Directors presentation concerning LRTP Tranche 2;
- Rebuttal Schedule 13, which includes excerpts from a July 26, 2023 presentation that MISO provided to transmission owners at a meeting concerning LRTP Tranche 2 in Eagan, Minnesota;
- Rebuttal Schedule 14, which is a slide deck that MISO published on March 4, 2024, outlining its initial proposed portfolio of LRTP Tranche 2 transmission projects;
- Rebuttal Schedule 15, which is a concept paper that Minnesota Power submitted to the Department of Energy for funding for the Project.

Q. Before delving into the details, can you please summarize your response to the arguments that MP has raised in opposition to the Arrowhead Substation Alternative?

A. I do not find the rationale behind MP's opposition to the Arrowhead Substation Alternative to be credible or persuasive. MP claims that the new system for its HVDC Line must be

designed "to deliver low-cost wind energy to Minnesota Power customers effectively, efficiently, and reliably, while being designed with future local and regional transmission needs in mind."[2] In my opinion, the Arrowhead Substation Alternative better achieves these objectives than MP's proposed point-of-interconnection for the Project (the new 345 kV St. Louis County Substation). Compared to MP's proposal, the Arrowhead Substation Alternative is a more cost-effective option for interconnecting the Project to the alternating current high voltage transmission system. It is more efficient in that it would result in lower system-wide electrical losses and utilizes existing transmission infrastructure, rather than requiring the construction of an entirely new substation. And it is more reliable because it would involve the installation of a second, parallel transformer to serve the Project. From this vantage point, the Arrowhead Substation Alternative presents the most prudent, cost-effective, and reliable means of interconnecting the Project to the high-voltage AC transmission system in Minnesota.

Much of MP's opposition to the Arrowhead Substation Alternative is rooted in the notion that it is too complex, would create greater benefits for Wisconsin than it would for Minnesota, and cannot accommodate potential future transmission expansion in the area. This is simply incorrect. The Arrowhead Substation Alternative would reduce—not complicate—transmission system operations by facilitating removal of the existing Arrowhead phase-shifting transformer and 345 kV capacitor banks; while MISO will need to study the Arrowhead Substation Alternative as part of the MTEP process, the same is true of MP's proposed point-of-interconnection, and ATC anticipates that this study

[2] Winter Direct, p. 15.

process can be concluded as early as the end of this year. The Arrowhead Substation Alternative would benefit both Wisconsin and Minnesota by creating a stronger regional transmission tie between the two states and providing additional reliability to MP's HVDC System. And it is more than adequate to support potential future transmission expansion in the area: even after this alternative is implemented, there will still be space to accommodate one additional 345 kV transmission line without the need to expand the current substation footprint. In sum, the Arrowhead Substation Alternative is a superior method of interconnecting the Project to the high-voltage transmission system. The Commission should approve the Project on the condition that MP implement the Arrowhead Substation Alternative in lieu of constructing the new 345 kV St. Louis County Substation.

II. THE REGIONAL TRANSMISSION SYSTEM

Q. Please describe how the transmission system operates to deliver power from electric generators to consumers within the MISO footprint.

A. Broadly speaking, the electric power system is comprised of three sectors: generation, transmission, and distribution. Electricity is generated at power plants (such as coal plants, natural gas plants, or wind or solar farms) and then transmitted long distances across the high-voltage transmission system, which is generally considered to include networked transmission facilities rated at 100 kilovolts (kV) or higher. Substations located throughout the transmission system step down, or reduce, the voltage of this electricity, at which point it flows across the local (i.e., lower voltage) distribution system for delivery to consumers.

Across 15 Midwestern states and Manitoba, Canada, the Midcontinent Independent System Operator, Inc. (MISO) is the regional grid operator, which means it is responsible for (among other things) managing the dispatch of electrical generation and the operation

of the high-voltage transmission system to reliably serve customers.[3] MISO's transmission owning members, such as ATC and MP, own the transmission lines that make up the bulk power system, but have transferred functional control over most (though not necessarily all) of their transmission facilities to MISO. MISO, in turn, uses a security constrained economic dispatch algorithm to dispatch electric generation and manage power flows across its footprint: generators submit offers to sell electricity into the market, and MISO uses an algorithm to dispatch this generation in a manner that results in the least cost to customers, while still maintaining the security and reliability of the transmission system.

The transmission network that MISO operates consists of thousands of miles of interconnected transmission lines that are owned by different transmission-owning members of MISO. As noted at page 39 of my direct testimony, the fundamental physical properties of electricity make it difficult to store power or direct it from one specific location to another on the alternating current (AC) transmission system; as such, electrons generated on one utility's system often flow to and through another utility's system.

Q. How does MP's 550 MW Square Butte HVDC Line (HVDC Line) operate in the context of this overarching system?

A. My understanding is that, when MP acquired the HVDC Line almost 15 years ago, it did not transfer full functional control of the HVDC Line to MISO. Instead, MP and MISO entered into an Agency Agreement that was subject to review and approval by the Federal Energy Regulatory Commission (FERC).[4] Under this agreement, MISO is responsible for

[3] As relevant here, MISO is also responsible for planning expansions to the regional transmission system through the MISO Transmission Expansion Plan (MTEP) process, which I discussed at pages 21-22 of my direct testimony and will discuss later in my rebuttal testimony.
[4] *See* Rebuttal Schedule 1; *In Re Midwest Independent Transmission System Operator, Inc. and ALLETE, Inc.*, 129 FERC ¶ 61,172 (Nov. 24, 2009).

(among other things) carrying out certain core transmission provider responsibilities related to the HVDC Line, such as providing point-to-point transmission service, processing requests for generators to interconnect to the HVDC Line, and acting as reliability coordinator. On the other hand, MP physically operates, repairs, and maintains the HVDC Line, subject to MISO's direction as set forth in the Agency Agreement and the MISO tariff.[5] Although the HVDC Line is not subject to MISO's full functional control, it is still subject MISO's open, transparent, and collaborative planning process for transmission planning activities, including for the HVDC Modernization Project.[6]

Q. Does the HVDC Line operate differently from other AC transmission facilities in the MISO footprint?

A. To some extent. The HVDC Line runs for approximately 465 miles between Center, North Dakota and Hermantown, Minnesota, transmitting power via direct current (DC) from one end of the line to the other. The HVDC Line is connected to the AC transmission system at either endpoint, where the converter stations convert electricity from direct to alternating current (AC) or vice-versa, but not anywhere in between; this allows MP to transfer electricity directly from North Dakota to northeastern Minnesota, without any flow moving onto the AC transmission system in between those two points. However, once the electricity from the HVDC Line is injected onto the AC transmission system in

[5] A copy of this agreement is publicly available on MISO's website as Rate Schedule 26 to the MISO Tariff. *See MISO,* Tariff (Rate Schedules) (last visited Feb. 27, 2024), *available at* http://tinyurl.com/2s4hcars. These kind of agency agreements for non-transferred transmission facilities are specifically contemplated under the MISO tariff.

[6] *In Re Midwest Independent Transmission System Operator, Inc. and ALLETE, Inc.*, 129 FERC ¶ 61,172, at ¶ 33 (Nov. 24, 2009) ("[T]he HVDC Line shall be treated like any other Non-Transferred Facility under the Owners Agreement and the Midwest ISO Tariff with respect to transmission planning . . . . [T]ransmission planning on the HVDC Line will be subject to the same open and transparent transmission planning process used for facilities under Midwest ISO's functional control.").

northeastern Minnesota, it becomes comingled with network flows of electricity from other sources.

Q. At pages 5–6 of Mr. Winter's direct testimony and pages 6–7 of Mr. Gunderson's direct testimony, MP discusses the configuration and purpose of MP and ATC's transmission systems in Minnesota and Wisconsin. How do you respond to MP's characterization of ATC and MP's respective systems?

A. I do not believe these characterizations are complete or accurate. Regarding ATC's system, MP claims that ATC's 345/230 kV Arrowhead Substation "was built to benefit the Wisconsin AC transmission system and Wisconsin electrical users"[7] and that the 345 kV Arrowhead-Weston transmission line[8] connected to that substation "is used almost exclusively to facilitate regional power transfers through Minnesota Power's transmission system to other utilities in Wisconsin."[9] Certainly, these facilities benefit Wisconsin by facilitating the import of low cost renewable power into the state. However, that is not their only purpose, as they also benefit Minnesota and the region generally. The Public Service Commission of Wisconsin recognized as much when it initially approved the Arrowhead-Weston 345 kV Project in 2001, noting that the principal purpose of the project was "to improve the reliability of the transmission system, both in Wisconsin and on a regional level" and that the project "will serve electric power users in this state and in the region."[10]

[7] Gunderson Direct, p. 7.
[8] Throughout my and MP's testimony, the Arrowhead–Weston 345 kV transmission line is sometimes referred to by different names. As shown on Rebuttal Schedule 2, it runs from ATC's 345/230 kV Arrowhead Substation in Hermantown, Minnesota, to Superior, Wisconsin, and then south through the 345 kV Stone Lake, Gardner Park, and Weston Substations. That portion of the line between the Arrowhead Substation and Superior is sometimes referred to as the Arrowhead-Superior transmission line. The entire line is also sometimes referred to as the Arrowhead–Stone Lake–Gardner Park 345 kV line.
[9] Winter Direct, p. 6.
[10] *See In Re Joint Application of Minnesota Power Co. and Wis. Pub. Serv. Corp.*, Docket No. 05-CE-113, 2001 Wisc. PUC LEXIS 81, *Final Decision* (Oct. 30, 2001).

A report that ATC published in 2009 noted that the Arrowhead–Weston project benefitted the upper Midwest by creating stronger regional connections, reducing customer costs, and delaying the need to construct new generation; MP's executives lauded the regional benefits of the Arrowhead-Weston Project, stating that it "improves system reliability across a broader area than simply its local area. Because of the interconnected electrical system, its benefits extend throughout the Midwest region."[11] Finally, in this proceeding, MP has acknowledged the regional benefits of the Arrowhead-Weston Project:

> [A]s a result of two contingency events on the regional transmission system in the late 1990s, it became apparent that the Minnesota/Wisconsin electric interface was a weak link in the regional system that needed to be addressed. In addition, regional studies conducted at the time showed that a high voltage line connecting Minnesota to Wisconsin was important to improving regional reliability.
>
> Resolving this weak link was important to Minnesota Power and its customers. Despite the fact that roughly 95 percent of the Arrowhead-Weston Project is in Wisconsin, Minnesota Power determined that it was appropriate to participate and sponsor the Minnesota portion of the Arrowhead-Weston Project to enhance service reliability to Minnesota Power's customers, and to the State and region.[12]

Given all this, it is disingenuous for MP to suggest that ATC's 345/230 kV Arrowhead Substation and the Arrowhead-Weston 345 kV line almost exclusively benefits the state of Wisconsin.

Q. What about MP's characterizations of its own transmission system in Minnesota?

A. MP repeatedly describes its 230 kV transmission system—which connects to ATC's 345/230 kV Arrowhead Substation—as a "local" transmission network that is primarily

[11] *See* Rebuttal Schedule 3, at 2, 11–12.
[12] *See Minnesota Power's Response to Route Alternative and Conditions Proposed to be Evaluated in the Environmental Assessment*, MPUC Docket Nos. E015/CN-22-607, E015/TL-22-611, at 2 (Sept. 29, 2003).

used to serve MP's customers, while characterizing ATC's 345 kV facilities as "regional" lines used to move power around the upper Midwest.[13] This is not accurate. Generally speaking, transmission facilities considered part of the regional grid and subject to MISO's control include any networked transmission facilities above 100 kV.[14] Transmission facilities rated at 230 kV are more prevalent in northern Minnesota and the Dakotas, whereas southern Minnesota, Wisconsin, Iowa, and Illinois have more 345 kV facilities and fewer 230 kV facilities.[15] ATC's Arrowhead 345/230 kV Substation "bridges the gap" between these different transmission systems, but *both* types of facilities are high voltage assets that can be and are used to facilitate power flows throughout the region. Simply because MP's 230 kV transmission facilities are of a lower voltage than ATC's 345 kV facilities does not mean that the former are "local" in nature, whereas the latter are "regional" in nature. These systems are interconnected, and regional power flows occur across both systems.

Q. At pages 3–4 of Mr. Gunderson's direct testimony and pages 14–15 of Mr. Winter's direct testimony, MP asserts that power transmitted across MP's HVDC Line is "primarily injected into Minnesota Power's transmission system in northeastern Minnesota to serve Minnesota Power's customers" and that MP's proposed configuration of the Project ensures that power transmitted over the HVDC system

[13] *See, e.g.*, Winter Direct, at 5–6, 8, 16, 20, 35–36, 62–63.
[14] *See* MISO Tariff: Rate Schedule 01 (Transmission Owners Agreement), Art. I, § I.T, *available at* https://tinyurl.com/2s4hcars. Similarly, the North American Electric Reliability Corporation (NERC) generally defines the "bulk electric system" to include transmission elements operated at 100 kV or higher. *See* NERC, *Glossary of Terms Used in NERC Reliability Standards*, at 7 (updated Dec. 1, 2023), *available at* https://tinyurl.com/5e93yr8p.
[15] *See, e.g.*, Rebuttal Schedule 10.

"is delivered directly to Minnesota Power's customers to the greatest extent practicable." How do you respond?

A. As I noted earlier, it is difficult to control or direct electric power on the AC transmission system, especially without the use of specialized equipment. While some of the power injected into the AC transmission system from the HVDC Line may be used to serve MP's customers, there is no way to guarantee that all of this power is consumed by those customers. Once electricity from the HVDC Line is injected onto the AC transmission system, it becomes comingled with electric power from other sources and is an inseparable part of network flows that can move through the state and the region. In other words, there is simply no guarantee that the power delivered over the HVDC Line is used exclusively to serve MP's customers.

Q. At pages 16–17 of Mr. Winter's direct testimony, MP asserts that "maintaining the existing point of interconnection for the HVDC System at the Minnesota Power Arrowhead 230 kV/115 kV Substation is as important as developing the HVDC converter stations with a 345 kV AC transmission voltage to ensure the HVDC System maintains its connection to Minnesota Power customers and does not create unintended consequences to other parts of the regional AC transmission system." How do you respond?

A. I disagree. First, MP's proposed configuration of the Project does not "maintain the existing point of interconnection for the HVDC System" at MP's 230/115 kV Arrowhead Substation. MP contemplated maintaining this existing connection as a potential alternative, but affirmatively rejected that approach:

> Minnesota Power considered interconnecting the new HVDC converters directly to the 230 kV system . . . . While this alternative would have a lower cost in the near term, the long-term cost would likely be significantly higher than developing an initial interconnection at 345 kV.
>
> As the regional transmission system continues to develop to support the clean energy transition, the near-term focus has been on developing a strong 345 kV backbone network . . . . As the use and significance of this existing HVDC system evolves over the life of the proposed VSC Converter Stations, it will become increasingly important for the HVDC system to be directly interconnected to the regional 345 kV network, rather than the underlying local 230 kV network. However, to move the point of interconnection from the 230 kV system to the 345 kV system at a later date would require an expensive replacement of the converter transformers to change the winding voltage on the AC-system side. Since the converter transformers are approximately 20 percent of the overall cost of the HVDC Converter Station itself, there would be a significant sunk cost at the time the transition from 230 kV to 345 kV is made. Therefore, alternative AC transmission voltages are not a cost-effective long-term alternative for the Project.[16]

MP's own Application undermines its assertion that its proposed configuration maintains the existing point of interconnection for the HVDC Line. In fact, MP's proposal would affirmatively *change* the point of interconnection for the HVDC Line from the existing 230/115 kV Arrowhead Substation to the new 345 kV St. Louis County Substation. While ATC is not contesting MP's decision to interconnect the Project to the AC system at 345 kV, it is important to note this is exactly the configuration that ATC has proposed. The difference is that ATC is proposing for MP to utilize ATC's existing 345/230 kV Arrowhead Substation, rather than constructing an entirely new substation less than a mile away. In this sense, the Arrowhead Substation Alternative effectively mimics MP's

[16] *See* Application, § 4.3.2.

proposed method of interconnection, but at a lower cost, with fewer impacts, and with improved reliability.

Second, I disagree with the notion that MP's proposed configuration is the only option that "ensure[s] the HVDC System maintains its connection to Minnesota Power customers." The Arrowhead Substation Alternative *would* maintain a connection between the HVDC Line and MP's customers, as shown on Schedule 3 to ATC witness Tobin Larsen's direct testimony. Under this alternative, the Project would interconnect to ATC's 345/230 kV Arrowhead Substation, which is directly connected to MP's 230/115 kV Arrowhead Substation. Power can flow through the HVDC Line, to ATC's substation, and then to MP's substation, where it can be used to serve MP's customers.

MP's opposition to this approach appears to be rooted in the fact that power from the HVDC Line would have to flow through non-MP owned transmission assets (i.e., the ATC 345/230 kV Arrowhead Substation) before it could be delivered to MP's customers. This is a red herring. Utilities regularly construct or procure power from generating resources that are not directly connected to their transmission or distribution systems to serve their customers. MP is no exception. For example, MP (through its affiliate, South Shore Energy, LLC) will own a 20 percent stake in the new Nemadji Trail Energy Center (NTEC), an approximately 560 MW combined-cycle natural gas plant being constructed in Superior, Wisconsin. Dairyland Power Cooperative and Basin Electric Cooperative are the other two owners, with a 50 and 30 percent ownership stake in the plant, respectively.[17]

[17] Dairyland Power Cooperative is a generation and transmission cooperative that provides wholesale bulk electric power to 24 member cooperatives and municipalities in western Wisconsin, southeastern Minnesota, northeastern Iowa, and northwestern Illinois. Basin Electric Cooperative is also a generation and transmission cooperative that provides wholesale bulk electric power to 141 rural member cooperatives located in Montana, the Dakotas, Minnesota, Iowa, Nebraska, Wyoming, Colorado, and New Mexico.

This new plant will interconnect to the high voltage transmission system in Superior, Wisconsin through an ATC-owned switching station, which will in turn be connected to ATC's 345 kV Arrowhead-Weston line—the same transmission line that terminates at ATC's 345/230 kV Arrowhead Substation in Hermantown, Minnesota. Power generated from NTEC can flow through the networked transmission system to serve the energy and capacity needs of MP's customers, even though the switching station and transmission line connecting the plant to MP's transmission system are entirely owned by ATC.

In other words, MP has made a substantial investment in NTEC to meet its customers' energy and capacity needs, even though that facility is not directly connected to MP's transmission system and its output must pass through ATC-owned transmission facilities before reaching MP's customers.[18] Conceptually, this arrangement is no different from the Arrowhead Substation Alternative: energy from the HVDC Line can flow through ATC's 345/230 kV Arrowhead Substation before entering MP's transmission network to serve the needs of MP's customers. This is how the networked transmission system works—there is nothing remarkable or out-of-the-ordinary about a utility serving its customers through the MISO market, including over another utility's transmission system, to meet customer needs. To the contrary, there are numerous examples of such arrangements throughout the ATC footprint and the country generally. If MP was willing to enter into such an arrangement vis-à-vis NTEC, there is simply no basis for it to oppose entering into a similar arrangement here for the HVDC Line, especially when the point-of-

[18] The same could be said of Basin Electric Cooperative, whose footprint stretches hundreds of miles across the upper Midwest, Great Plains, and Mountain West.

interconnection that ATC is proposing will reduce costs and impacts, while improving the overall reliability of the HVDC system.

Q. At page 17 of Mr. Winter's direct testimony, MP asserts that changing the point of interconnection for the HVDC Modernization Project "would lead to additional complexity and required coordination to implement major changes to the regional transmission system." Do you agree?

A. No. As I discuss above, there is nothing inherently complex or extraordinary about the Arrowhead Substation Alternative—transmission owners commonly interconnect their facilities to neighboring transmission owners to meet customer needs and improve system reliability. Moreover, the planning analysis that ATC conducted (as described in my direct testimony) demonstrates that the Arrowhead Substation Alternative performs as well or better than MP's proposal from a reliability perspective. ATC's proposal also presents a more streamlined approach to interconnecting the Project relative to MP's preferred configuration: the Arrowhead Substation Alternative does not require construction of an entirely new 345 kV Substation and will facilitate the removal of the Arrowhead phase-shifting transformer (PST) and 345 kV capacitor banks from the Arrowhead Substation, which will actually simplify—not complicate—the operation of the transmission system.

Q. At pages 37–41 of Mr. Winter's direct testimony, MP claims that the Arrowhead Substation Alternative "materially benefits ATC's regional 345 kV transmission system in Wisconsin in at least three ways that are not observed with Minnesota Power's proposed [] configuration." How do you respond?

A. I strongly disagree. Before getting into the details, I want to emphasize that ATC is a transmission-only utility whose sole purpose is to plan, construct, operate, maintain, and

protect the high-voltage transmission system in the states in which it operates, including Minnesota. ATC does not and cannot own any electric generating resources (i.e., power plants) or provide retail electric service to any end-use customers. ATC has committed all its networked high voltage transmission facilities to MISO's functional control. ATC does not stand to benefit from implementation of the Arrowhead Substation Alternative any more than MP or any other utility would. ATC has not developed this alternative to benefit Wisconsin customers at the expense of Minnesota customers, as MP seems to believe. ATC's sole interest in this proceeding is ensuring that existing transmission facilities (in this case, the existing 345/230 kV Arrowhead Substation) are leveraged to the greatest extent feasible for the benefit of the entire region.

Turning to specifics, MP first argues that the Arrowhead Substation Alternative "would result in a greater portion of the power delivered by the HVDC System flowing away from Minnesota Power's customers." I will address this argument in further detail later in my testimony. For now, I simply reiterate what I noted above: once power from the HVDC Line enters the AC transmission system, it becomes comingled with network flows of power that MISO dispatches across the region, including (for example) the output from NTEC, which will be used to serve MP's customers. MP has not (and cannot) claim that moving the point-of-interconnection for the Project to ATC's 345/230 kV Arrowhead Substation will somehow jeopardize its ability to meet customers' energy needs. While power may flow differently across the system depending on what alternative is implemented, neither alternative materially impacts the availability of electric supply to meet the needs of MP's customers.

MP next claims that ATC's Arrowhead Substation Alternative "would remove Minnesota Power's grid-supporting VSC HVDC Converter Station from its point of interconnection on Minnesota Power's 230 kV network" and would instead provide such support "to ATC's proposed point of interconnection on the regional 345 kV network." This assertion has no merit. First, consider the configuration of the existing system: there are currently 345 kV capacitor banks installed in ATC's 345/230 kV Arrowhead Substation, which MP asserts "provide value to the AC and DC transmission systems, whether or not the ATC Arrowhead Alternative is implemented."[19] When activated, these capacitor banks provide voltage support to the nearby 345 kV *and* 230 kV transmission system, notwithstanding the fact that they are located within ATC's Arrowhead Substation. Likewise, the upgraded converter stations will continue to provide voltage support to MP's 230 kV transmission system and other area voltages, even if it is interconnected to the ATC 345/230 kV Substation. In fact, as I discussed in my direct testimony, ATC's voltage stability analysis shows that interconnecting the Project at ATC's Arrowhead Substation provides greater voltage stability support for the system than MP's proposal.

Finally, MP claims that adding a second transformer to and removing the existing 230 kV phase-shifting transformer from ATC's 345/230 Arrowhead Substation would "greatly reduce impedance between the Minnesota Power 230 kV system and the ATC Wisconsin 345 kV network," drawing more power into Wisconsin and eliminating the ability to control and limit power flows through ATC's 345/230 kV Arrowhead Substation.[20] There are two points worth mentioning here. First, the reduced impedance

[19] Winter Direct, p. 64.
[20] Broadly speaking, impedance refers to the extent to which a circuit (i.e., transmission line) opposes or resists electrical current flowing across it.

associated with ATC's proposal also reduces electrical losses on the electrical system, as discussed in my direct testimony.[21] This means that, under ATC's proposal, less power is lost as waste heat and more power is available for customer consumption, relative to MP's proposal.

Second, the Arrowhead PST does not operate automatically to limit or otherwise control power flows through ATC's 345/230 kV Arrowhead Substation. As discussed in my direct testimony and Schedule 8 thereto, MISO dispatches power and operates the transmission system such that the Arrowhead PST is not needed to prevent voltage instability or address other reliability issues. Specifically, the manner in which MISO dispatches resources in real-time respects the control point, system operating limit, and interconnection reliability operating limit on the Arrowhead-Stone Lake 345 kV transmission line and the Minnesota-Wisconsin Export Interface (MWEX), which addresses the voltage stability issues that the Arrowhead PST was originally intended to prevent. The Arrowhead PST simply does not operate automatically to limit or control flows of power into Wisconsin, as MP suggests; rather, this is effectively built into the security constrained economic dispatch algorithm that MISO uses to operate the system.

III. THE MISO PLANNING PROCESS AND THE HVDC LINE

Q. Please describe how proposed transmission projects are reviewed and approved through the MISO Transmission Expansion Plan (MTEP) process.

A. As noted in my direct testimony, MISO prepares the regional transmission expansion plan on an annual basis, beginning June 1 of the year before the plan is released. A high level

[21] As power is transmitted across the transmission system, some of the electricity is lost as waste heat.

schedule for the entire process is included as Rebuttal Schedule 4 to my testimony. The process begins with the development or refinement of planning models in which new transmission projects will be studied: transmission owners provide MISO with their planning criteria and the models they used to develop new projects, and those models are subject to review and feedback from stakeholders (e.g., other transmission owners; transmission customers; state regulators; consumer advocates; etc.). By September 15 of the year before the plan is released, transmission owners submit new transmission projects for review and evaluation, specifying the type of project and the target Appendix for the project (i.e., A or B).[22] Shortly thereafter, MISO posts all proposed projects and power flow models. MISO and other stakeholders review those projects through a collaborative, open, and transparent process that lasts several months: stakeholders can submit comments and feedback on, and offer alternatives to, the transmission projects that have been proposed. MISO considers this feedback and then evaluates the proposed project within planning models that were developed earlier in the MTEP process. Beginning in the first quarter of the MTEP plan year, MISO holds several subregional planning meetings (SPMs) to present proposed projects, provide the results of its independent evaluation, and address feedback received from stakeholders, including with respect to any alternatives that have been proposed. MISO staff will then present a final list of MTEP projects that will be proposed for Board approval and a draft of the current cycle MTEP report. The MISO Board of Directors then decides whether to approve the set of projects at the end of the calendar year.

[22] As mentioned at page 34 of my direct testimony, Appendix A projects have been approved by MISO as the preferred solution to address a particular transmission issue. Appendix B projects are those that MISO has not formally approved through the stakeholder process but have been identified as a possible solution to address an identified need.

Q. Does the MISO Tariff require that proposed transmission projects be reviewed through an open and transparent stakeholder-based process?

A. Yes. Regardless of whether a facility has been or will be transferred to MISO's functional control, Attachment FF of the MISO Tariff—which establishes MISO's transmission expansion planning protocol—requires transmission owners to submit proposed projects for review through MISO's stakeholder review process. This stems from FERC Order 890, which requires regional transmission organizations like MISO to develop a plan for a coordinated and regional transmission planning process and requires transmission owning members of MISO to participate in that process.[23] When FERC approved the agency agreement between MP and MISO for the HVDC Line in 2009, it made clear that this facility is still subject to MISO's open, transparent, and collaborative MTEP planning process.[24]

Q. Has the HVDC Modernization Project been reviewed through the collaborative, stakeholder-based MTEP process?

A. To ATC's knowledge, no. As I mentioned in my direct testimony, the HVDC Modernization Project is currently listed in Appendix B of the MISO MTEP, meaning that it has not been formally approved by MISO.[25] The Project is also not included on MISO's list of MP-sponsored projects being reviewed as part of the current MTEP cycle.[26] MP has provided information regarding this Project to ATC in one-on-one discussions and to MISO during planning meetings for LRTP Tranche 2, as discussed in ATC witness Robert

[23] *See Preventing Undue Discrimination and Preference in Transmission Service*, 72 Fed. Reg. 12266, 12320-21 (Feb. 16, 2007), *codified at*
[24] *See* note 6.
[25] *See* Rebuttal Schedule 5.
[26] *See* Rebuttal Schedule 6.

McKee's rebuttal testimony. However, ATC reviewed documentation from the West Subregional Planning Meeting held during the current MTEP study cycle and there is no mention of the HVDC Modernization Project being evaluated or studied. In fact, there is no mention of the Project in documentation from MISO's West Subregional Planning Meetings and West Technical Study Task Force Meetings going back to 2021 and 2022, respectively. Based on this, it does not appear that MP has submitted the Project for review and approval through the MTEP process.

Q. But at pages 30–31 of Mr. Winter's direct testimony, MP asserts that it "has taken the necessary steps to advance the HVDC Modernization Project with MISO to meet its customers' needs while ATC has not taken any similar actions for the ATC Arrowhead Alternative." At pages 25–26 of Mr. Gunderson's direct testimony, MP likewise claims that the Arrowhead Substation Alternative "has not been studied or worked on in a broader planning setting with MISO or Minnesota Power." How do you respond to these assertions?

A. In my view, MP has this backwards. The Project has not yet been vetted through the open and transparent MTEP planning process. This is a critical point. That process provides stakeholders—including other transmission owners—with the opportunity to review and provide feedback on proposed transmission projects. It not only enables affected parties to give input on how a project could affect them or the reliable operation of the system generally, but also to suggest project modifications or potential alternatives. Fundamentally, this is MP's project—not ATC's. MP, not ATC, is responsible for ensuring the Project is properly vetted through the MTEP process. Had MP done this already, it would have triggered a formal stakeholder review process in which ATC could provide

feedback and input, including presenting the Arrowhead Substation Alternative that it has introduced here. Whether intentionally or unintentionally, MP has circumvented this process, leaving ATC with no choice but to intervene in these proceedings. This is a less than ideal situation for everyone involved, but MP's suggestion that the onus was on ATC to present the Arrowhead Substation Alternative for review in the MTEP study cycle is simply wrong.

Q. How then do you explain MP's assertion that, upon execution of a Facilities Construction Agreement with MISO, the Project "is ready to be recommended to the MISO Board for approval in the current MTEP cycle." (Winter Direct, at 31) What is your response?

A. As noted, to date, ATC is not aware of any discussions or meetings that have been held between MISO, MP, and other affected stakeholders as part of the MTEP process concerning the Project. I do not believe MISO will approve the Project as part of MTEP Appendix A until it is reviewed through this stakeholder process. In other words, if MP intends to move the Project to Appendix A of the MTEP this year, then the Project will be subject to further review and feedback from stakeholders, including ATC, during the current MTEP planning cycle.

Q. Please elaborate.

A. MP contends that the Project can be approved as part of the current MTEP planning cycle based on system impact studies (SIS) that MISO conducted in connection with MP's transmission service requests (TSRs) to increase the capacity of the HVDC Line from 550

MW to 900 MW.[27] Between 2019 and 2020, MP submitted to MISO two TSRs to reserve up to 200 MW and 150 MW, respectively, of additional firm transmission service on its HVDC Line. Because the existing capacity of the HVDC Line is 550 MW, physical upgrades—including the Project—are needed to increase its capacity to 900 MW to accommodate the new TSRs. MISO conducted two SISs (one for each TSR) to evaluate what impacts these requests would have on the reliable operation of the transmission system.[28] The models MISO used in the SISs assumed that the HVDC Line would be upgraded to accommodate the additional 350 MW of new TSRs but did not describe the nature or scope of those upgrades. MISO ultimately did not identify any transmission constraints associated with granting the TSRs. Several years later, in April 2023, MP prepared a Facilities Study to document the scope, estimated cost, and timing of upgrades that would be needed for the HVDC Line to accommodate the new TSRs.[29] The Facilities Study noted that these upgrades would include (among other things) the Project being reviewed in this proceeding, including replacement of the converter stations at either end of the HVDC Line and construction of the new 345 kV St. Louis County Substation.

To ATC's knowledge, this Facilities Study is the first time in either the TSR or MTEP process that MP indicated its intention to develop the new St. Louis County Substation as part of the Project. In other words, MISO did not actually analyze the impact of this new substation (or any other aspect of the Project) on the transmission system as part of the previously conducted SISs; it simply assumed that MP would implement some kind of upgrade to increase the HVDC Line's capacity to 900 MW to accommodate the

[27] *See* Rebuttal Schedule 7.
[28] *See* Rebuttal Schedule 8, at 1, 11.
[29] *See* Rebuttal Schedule 8, at 21.

TSRs. MP and MISO have now executed a Facilities Construction Agreement (FCA)[30] for the construction of network upgrades needed to increase the capacity of the HVDC Line—including the Project—and filed that agreement with FERC for approval. MP therefore claims that this "the Project has been fully assessed by MISO" and can be approved by the MISO Board of Directors in the current MTEP cycle.

Q. Do you agree with MP that the Project has been "fully assessed by MISO"?

A. No. As mentioned, when MISO conducted its system impact studies in 2019 and 2020, it assumed that there would be some kind of generic upgrade to the HVDC System to accommodate the TSRs, but did not actually model or evaluate the impact of the new 345 kV St. Louis County Substation (or any other aspect of the Project) on the larger transmission system. There is nothing in the SISs describing the new 345 kV St. Louis County Substation, its proposed electrical layout, or any other details concerning the Project. In other words, MISO analyzed the TSRs assuming that the HVDC System would be upgraded to increase its overall capacity but, based on the SISs, had no understanding of what those specific upgrades would look like; as a result, MISO did not actually study the Project—as MP has proposed in this proceeding—in the system impact studies it previously conducted. In fact, it was not until years later, in April 2023, that MP prepared and submitted to MISO the facilities study describing the Project and other upgrades to the HVDC Line that would be needed to increase its capacity to 900 MW.

Q. Was ATC aware of the system impact studies that MISO conducted in connection with MP's transmission service requests?

[30] *See* Rebuttal Schedule 8, at 43, 144.

A. To my knowledge, no. MISO will often develop Ad Hoc Study Groups to coordinate with and solicit feedback from other transmission owners who could be impacted by TSRs like those described above. However, neither MISO nor MP arranged any such study groups with ATC (or, to ATC's knowledge, other transmission owners), presumably because the SISs did not identify any constraints on any transmission facilities, including ATC's. From this perspective, it makes little sense for MP to claim that ATC has "bypass[ed] . . . the formal MISO process for the ATC Arrowhead Alternative to be evaluated as an alternative to the Project,"[31] given that ATC was not aware of the SISs MISO conducted for MP's transmission service requests and MP has not provided stakeholders with the opportunity to review the Project through the MTEP study process. ATC could not have "bypassed" a process that MP failed to initiate in the first place concerning its own Project.

Q. Will the Project be subject to further study as part of the MTEP process?

A. Yes. As shown on Rebuttal Schedule 5, the Project is currently listed in Appendix B to the active MTEP database as an "Other" type transmission project. Per Sections 2.3.2.1 of MISO's Transmission Planning Business Practice Manual (No. 020) (BPM), "Other" transmission projects are considered "bottom-up" transmission projects that may be needed to address (among other things) aging transmission infrastructure or to improve operational performance or address other operational issues.[32] As discussed in Section 4.1 and 4.3 of the MISO Transmission Planning BPM, these projects are subject to stakeholder review and feedback—including concerning potential alternatives—as part of the MTEP process before the MISO Board of Directors can approve such projects at the end of the current

[31] Winter Direct, p. 31.
[32] *See* Rebuttal Schedule 9, at 24–25.

MTEP cycle. Assuming the Project is reviewed as part of the current MTEP cycle, ATC would have until May 31 to submit the Arrowhead Substation Alternative to MISO for consideration, which MISO and other stakeholders will review and evaluate, including at upcoming subregional planning meetings between May and August.[33]

Q. MP also claims (Winter Direct, at 30–31) that MISO recently released a set of power flow models that "incorporate the HVDC Modernization Project configuration proposed by Minnesota Power." How do you respond?

A. While MISO may have included MP's proposed configuration of the Project in the base case models for LRTP Tranche 2, that is no substitute for ensuring the Project is reviewed through MISO's open and transparent MTEP process, which is the basis for all other regional planning model assumptions, such as LRTP models or generator interconnection study models. As I mentioned, to date, MP has failed to do this. It cannot now lean on MISO's inclusion of the Project in certain power flow models as some sort of tacit approval of the Project.

Q. Can you please explain LRTP Tranche 2 and MISO's ongoing planning efforts related to it?

A. As ATC witness Bob McKee explains in his direct testimony, MISO has been working with its members and stakeholders on developing a long-range transmission plan (LRTP) over the last several years. This multi-year process—which will proceed in several phases, or tranches—is intended to identify regional transmission projects that will support reliable operation of the electric grid as more fossil fuel-fired generation is retired and new

[33] The timeline for the current MTEP cycle is available on MISO's website. *See* MISO, *MISO Transmission Expansion Plan (MTEP)* (last visited Mar. 6, 2024), *available at* https://tinyurl.com/2xwppms8 (Upcoming MTEP Cycle (MTEP24) tab).

renewable resources (wind, solar, and batteries) come online. LRTP Tranche 1 was approved in 2022 and included 18 regional projects across the Midwest. The LRTP Tranche 2 study process began in the fourth quarter of 2022 and will also examine regional transmission projects for the Midwest. This portfolio is expected to be finalized with the MISO Board during the second half of this year.

Q. At pages 32–34, 66 of Mr. Winter's direct testimony, MP claims that if the Commission orders implementation of ATC's Arrowhead Substation Alternative, the draft Facilities Construction Agreement (FCA) between MISO and MP would have to be modified or cancelled, MP would need to cancel its existing transmission service requests (TSRs) for the HVDC Line, and MISO would have to conduct a new system impact study (SIS), creating a potential delay in the MISO study process of "over a year" that could have "cost and additional schedule implications for the Project." Do you agree with this assessment?

A. No. In my view, MP's scheduling concerns are overstated. As described above, assuming MP does seek to have the Project approved in MTEP Appendix A in the current study cycle, ATC and other stakeholders will have the opportunity provide input and feedback, including concerning potential alternatives such as the Arrowhead Substation Alternative.[34] MISO will then evaluate the feedback it has received, analyze the alternatives that have been submitted (including through detailed planning analysis), and recommend the best solution for inclusion in the current MTEP and approval by the MISO Board.[35] In other words, by the end of this planning year, MISO can review and approve

[34] As noted in Section 4.3.1.2 of the MISO Transmission Planning BPM, transmission alternatives to proposed MTEP project include "transmission expansion such as the upgrade of existing facilities." Rebuttal Schedule 9, at 81.
[35] Rebuttal Schedule 9, at 88.

for inclusion in the MTEP the Project as proposed by MP, or the Project as modified by the Arrowhead Substation Alternative. While approval of the Arrowhead Substation Alternative could impact the FCA that MP has executed with MISO, the FCA contains provisions by which the agreement could be amended, potentially without the need to conduct an additional system impact study, given that MISO will have already studied the Arrowhead Substation Alternative as part of the MTEP process.[36]

Q. Do you agree with MP's assertion that "ATC could have developed (or can, in the future, develop) its own project" and "a better approach would be for ATC to submit ideas to MISO for consideration in the ongoing LRTP Tranche 2 analysis." (Winter Direct, at 40; Gunderson Direct, at 9)

A. No. As noted above, MP is the Project sponsor. It was MP's responsibility to ensure the Project was appropriately vetted through MTEP so stakeholders like ATC could provide input and feedback, including regarding the Project's proposed point-of-interconnection. Had MP done so *before* filing its Application with the Commission, the issues that ATC is raising here could have been resolved through the MTEP stakeholder review process. MP cannot now claim that the Arrowhead Substation Alternative will delay implementation of the Project when it had ample opportunity for stakeholders like ATC to review and provide feedback on it as part of the MTEP process. MP's suggestion that ATC should submit the Arrowhead Substation Alternative to MISO for further review makes little sense. ATC does not and will not own the HVDC Line or any of the upgraded facilities (outside the ATC Arrowhead Substation) that will be required as part of the Project. Second, MP

[36] Rebuttal Schedule 9, at 50, 118 (FCA § 2.2.4).

simultaneously asserts that ATC should submit the Arrowhead Substation Alternative to MISO for review, while also claiming that this additional review will create scheduling delays for the Project. These arguments are internally inconsistent and make little practical sense.

Q. At pages 46–48 of Mr. Winter's direct testimony, MP claims that "[a]s a concept, the St. Louis County Substation is MISO's original idea" and that "the Company anticipates that the St. Louis County Substation would be necessary to support future AC transmission development." Do you agree with the way MP has characterized the relationship between its proposed 345/230 kV St. Louis County Substation and MISO's planning efforts?

A. MP is correct that MISO initially developed a concept for a new 345 kV substation in St. Louis County, Minnesota at the outset of the LRTP planning process. But it was and always has been just that—a concept. As shown on Rebuttal Schedule 10, the initial conceptual version of this substation—which MISO put forward in March 2020—was located a significant distance west of the new 345 kV St. Louis County Substation that MP has proposed in this proceeding. In March 2021 and December 2022, the System Planning Committee of the MISO Board of Directors were presented additional concepts for LRTP Tranche 2, again depicting a potential new substation well west of the St. Louis County Substation MP has proposed here.[37] A July 2023 presentation that MISO provided to transmission owners at an in-person meeting in Eagan, Minnesota depicted this potential new substation closer to MP's proposed iteration of the St. Louis County Substation, but

[37] *See* Rebuttal Schedule 11, at 8; Rebuttal Schedule 12, at 14.

specifically noted that it was a draft concept subject to change.[38] The bottom line is: throughout the LRTP Tranche 2 planning process, MISO has been very clear that the ideas and maps it presents are high level, general concepts outlining how the system could be expanded in the future. To my knowledge, MISO has not specifically advocated or endorsed an iteration of the 345 kV St. Louis County Substation, as MP has proposed it in this proceeding.

Q. Have there been any recent developments regarding the LRTP Tranche 2 portfolio concerning the conceptual 345 kV St. Louis County Substation?

A. Yes. On March 4, 2024, MISO released a slide deck with its initial draft portfolio of transmission projects for LRTP Tranche 2, which will be the subject of further discussion at an upcoming March 15 workshop.[39] The initial draft portfolio depicts no new LRTP Tranche 2 projects in northeastern Minnesota and, consequently, no proposal for a new 345 kV St. Louis County Substation in that area. While this plan is subject to change between now and when it goes before the MISO Board for approval (likely later this year), it shows that the development of the 345 kV St. Louis County Substation as part of LRTP Tranche 2 is not a foregone conclusion, as MP presumes.

Q. At pages 84–87 of Mr. Winter's direct testimony, MP asserts that ATC's 345/230 kV Arrowhead Substation "does not appear to have sufficient expansion capability to accommodate all of the potential long-term transmission concepts being entertained in the MISO LRTP study" and that the Arrowhead Substation Alternative "would

[38] *See* Rebuttal Schedule 13.
[39] *See* Rebuttal Schedule 14.

limit the possibility of utilizing the ATC Arrowhead 345 kV Substation for potential future regional transmission system improvements." Do you agree?

A. No. As ATC witness Tobin Larsen explains in his direct testimony, when the 345/230 kV Arrowhead Substation was initially constructed, it was designed to be expanded in the future, should the need arise. It is technically and physically capable of interconnecting both the Project and an additional 345 kV line that may be needed in the future, without expansion of the existing footprint. The Arrowhead Substation Alternative is the most prudent and reasonable option for interconnecting the Project to the transmission system, given known and reasonably forecasted future system needs.

While there are certainly instances in which new transmission projects will require development of new substation infrastructure, in this case, prudent planning dictates utilization of the existing 345/230 kV Arrowhead Substation to interconnect the Project. It was designed with future needs in mind, so that it could accommodate exactly the type of transmission expansion being contemplated in this proceeding. Those future needs are here now. It makes little sense to require customers to fund construction of an entirely new substation, less than a mile away, when they have previously been assigned the bill for including future expandability into the design of the existing Arrowhead Substation.

MP attempts to rationalize the proposed new St. Louis County Substation against the backdrop of ongoing LRTP Tranche 2 planning efforts. In principle, it makes sense to account for MISO's regional transmission plans when developing a project like this. But as part of the LRTP process, both MISO and participating transmission owners have emphasized the need to leverage existing transmission assets to the greatest extent feasible. In a report summarizing the LRTP Tranche 1 portfolio, MISO noted that "[a]s final

solutions were developed, the ability of those solutions to use existing system right of way was a key consideration" and that "[c]o-locating new facilities with existing transmission assets enables more efficient development of transmission projects and minimizes the environment and societal impacts of infrastructure investment needed to achieve the needs identified."[40] That is, utilizing existing infrastructure limits both the costs and impacts of the significant new infrastructure that will be needed to support the ongoing transformation of the grid. The Arrowhead Substation Alternative is consistent with this overarching principle.

It also reflects a more reasonable and prudent option for interconnecting the Project to the transmission system in light of known and reasonably foreseeable future needs. After the interconnection of the Project, there will be one open position in the Arrowhead substation for an additional 345 kV line. This is not inconsequential. Even one additional 345 kV transmission line in this area could be a significant regional transmission project and could interconnect to the existing substation without expanding its overall footprint. On the other hand, recent developments in the LRTP Tranche 2 planning process suggest that "upgrade[s] to [MP]'s existing HVDC System to potentially expand and adapt its purpose"[41] and a new 345 kV St. Louis County Substation may not even be implemented as part of MISO's overall regional transmission plan. In other words, it is the Arrowhead Substation Alternative—not MP's proposal—that is more aligned with MISO's regional planning efforts and long-term regional needs.

[40] *See* MISO, *MTEP21 Report Addendum: Long Range Transmission Planning Tranche 1 Executive Summary*, at 22, 72–73 (2022), *available at* https://tinyurl.com/mrxhys7y.
[41] Winter Direct, p. 50.

IV. MP'S OBJECTIONS TO THE ARROWHEAD SUBSTATION ALTERNATIVE

Q. At page 36 of your direct testimony, you testified that you did not find MP's rationale for rejecting the Arrowhead Substation alternative to be persuasive or reasonable. Has that opinion changed after reviewing the direct testimony that MP filed in this proceeding?

A. No.

A. The Existing Arrowhead PST and 345 kV Capacitor Banks

Q. At pages 60–61 of Mr. Winter's direct testimony, MP asserts that the Arrowhead PST "serves the purpose of controlling power flow as needed to address phase angle differences between the weakly-connected systems in northern Minnesota and northwestern Wisconsin" and that it continues to serve this purpose today. Do you agree?

A. No. While the Arrowhead PST was initially installed to help manage power flows and support voltage stability between the transmission systems in Wisconsin and Minnesota, there have been significant changes in the operation of the transmission system over the last 20 years that have rendered it obsolete. MP's description of the Arrowhead PST does not reflect the reality of how the Minnesota-Wisconsin transmission interface is operated today.

In the early 2000s when the Arrowhead-Weston 345 kV Project was initially being planned and reviewed, MISO was still in its infancy: MISO was initially organized in 1998, received FERC approval to operate as a regional transmission organization in 2001, and did not implement the existing wholesale energy markets until 2005. Before these energy markets became fully functional, individual transmission owners (like ATC) were

responsible for operating their transmission systems; as a transmission operator, ATC considered the Arrowhead PST necessary to help manage power flows and ensure voltage stability on the transmission system between Minnesota and Wisconsin.

That is no longer the case today. By the time the Arrowhead-Weston Project went into service in 2008, MISO had fully functioning wholesale energy markets and was better positioned to manage real-time operations in a manner that addressed the reliability issues the Arrowhead PST was originally designed to address. As explained in Schedule 8 to my direct testimony, in today's market, the Arrowhead PST does not operate automatically to control power flow between Minnesota and Wisconsin unless the fast or slow settings are exceeded. For west-to-east power flows, those settings are equal to the system operating limit ("SOL") on the Arrowhead-Stone Lake 345 kV line, which is the maximum amount of power flow allowable over that line under the worst single contingency, including a margin for reliability. MISO dispatches generation within the market while respecting the control point of this line, which is set to 98 percent of the SOL. Together, the SOL and control point help maintain voltage stability and prevent voltage collapse on the surrounding regional system, and MISO dispatches generation in the marketplace while respecting these limits; in other words, the manner in which MISO operates the transmission system effectively maintains compliance with the Arrowhead-Stone Lake 345 kV SOL, without the need to operate the Arrowhead PST.[42]

[42] Relatedly, the MISO market now also utilizes an online real-time study process known as real-time dynamic security assessment, which did not exist before approximately 2012. This tool monitors system voltage and dynamic stability on various areas of the transmission system—including MWEX and the Arrowhead-Stone Lake 345 kV line—in real time and identifies safe operating limits every five to 15 minutes. This provides MISO with real-time information on operating limits that need to be respected to maintain reliability on the system and further demonstrates that the Arrowhead PST has become obsolete.

MP claims that an existing operating guide for the Minnesota-Wisconsin Export Interface (MWEX) demonstrates that the Arrowhead PST "continues to be a critical component of maintaining the reliability of the regional transmission system."[43] This is not accurate. The operating guide **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/ CONFIDENTIAL ELECTRIC/ENERGY INFRASTRUCTURE INFORMATION ("CEII"):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]** Retiring the Arrowhead PST would have no impact on MISO's ability to reliably operate the system and would simplify system operations and the administration of this operating guide.

Q. At pages 59-62 and 66 of Mr. Winter's direct testimony, MP claims that the Arrowhead Substation Alternative would require removal of the Arrowhead phase-shifting transformer PST and capacitor banks, which "cannot be implemented without having been thoroughly studied and coordinated with MISO and other affected transmission owners" through (among other things) steady state, transient,

[43] Winter Direct, at 61; Winter Schedule 28 (MWEX Operating Guide). Operating guides are pre-existing procedures that are initiated under certain operating conditions to alleviate reliability issues, such as line overloads or abnormal voltages. MISO develops these operating guides in consultation with affected transmission owners. These guides are usually used as interim measures, not long-term reliability solutions, and add complexity to real-time system operations.

and voltage stability studies; MP asserts that, due to the need for these studies, "the Commission could not order the ATC Arrowhead Alternative without there being a significant risk of changes being identified after the Commission's decision." How do you respond?

A. As described in my direct testimony, ATC conducted steady state, transient, and voltage stability studies to compare the performance of the Arrowhead Substation Alternative to MP's proposed point-of-interconnection for the Project (i.e., the 345 kV St. Louis County Substation). Those studies demonstrate that, from a reliability perspective, ATC's proposal, with the Arrowhead PST and Arrowhead 345 kV capacitor banks removed from service, performs as well or better than MP's proposal. While additional MISO analysis will be needed as part of the MTEP process, I fully expect that MISO's ultimate conclusions regarding the need for the Arrowhead PST and the 345 kV capacitor banks will be consistent with ATC's findings. Finally, it is important to note that MISO typically does not model the operation of the Arrowhead PST in its regional planning studies; rather, MISO models the transmission system to respect the system operating limits over MWEX and the Arrowhead-Stone Lake 345 kV line without relying on the operation of the Arrowhead PST.[44] Given this, I do not agree with MP's assertion that there is a "significant risk of changes being identified after the Commission's decision" that would complicate or otherwise delay the Project. I fully expect that if and when MISO studies the Arrowhead Substation Alternative as part of the regional transmission planning process, it will find

[44] To ATC's knowledge, the only situation in which MISO analyzes the control settings on the Arrowhead PST is in the context of definitive planning phase (DPP) studies for new generator interconnection requests; even then, the purpose of this analysis is to ensure that ATC voltage stability criteria is being met. To ATC's knowledge, no other MISO studies simulate and utilize the Arrowhead PST's capability to regulate power flows on the system.

that this is an adequate and reliable means of interconnecting the Project to the transmission system.

B. MP's Power Flow Analysis Study for the Project

Q. At pages 63–65 of Mr. Winter's direct testimony, MP describes a "power flow analysis study" that it conducted to provide "a limited technical comparison" between the Arrowhead Substation Alternative and MP's proposed configuration of the Project. Have you reviewed the results of that study?

A. Yes.

Q. Let's discuss each of the "major findings" from that study that Mr. Winter discusses in his direct testimony. First, at page 63 of Mr. Winter's direct testimony, MP claims that "[t]here are substantive negative impacts to Minnesota Power customers if the ATC Arrowhead Alternative is implemented" because more power will flow from MP's HVDC System into Wisconsin, creating "a much closer relationship between Minnesota Power's HVDC System and ATC's Wisconsin 345 kV transmission system." Do you agree with this finding?

A. No. In reaching this conclusion, MP asserts that the Arrowhead Substation Alternative will result in "seven to 10 percent more of the power delivered by the HVDC System flow[ing] into Wisconsin and away from Minnesota Power's customers." ATC was unable to independently re-create the calculations that MP conducted to support this conclusion. But for several reasons, I do not consider it to be a valid criticism of the Arrowhead Substation Alternative.

First, MP conducted its steady state analysis of each alternative in three distinct study cases, each of which reflect conditions on the transmission system at a distinct point in time—the

2028 summer peak, summer shoulder, or winter peak.[45] Because each of these cases examines the system at a distinct point in time, they are not necessarily representative of how the system would operate at all points in time over the course of a year. While MP's analysis suggests that the Arrowhead Substation Alternative could result in additional power flow into Wisconsin, that will not necessarily be true under all operating scenarios and at all times. Indeed, in one of the cases that MP studied **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/CEII):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]**, there are greater power flows into Minnesota, from Wisconsin, with Arrowhead Substation Alternative in-service.

Second, the premise of MP's finding—that additional power flowing into Wisconsin negatively impacts MP's customers—is not valid. Generally speaking, increased power flows into Wisconsin indicate that there is a stronger regional tie between the Minnesota and Wisconsin systems, which benefits both states; power can be imported or exported depending on system needs and operating conditions, which can help maintain system reliability. In fact, this is one of the fundamental objectives of the regional planning process: creating stronger ties between regional transmission systems produces a better functioning bulk electric market that can more cost effectively meet customer demand and maintain reliability across the MISO footprint, especially as more intermittent renewable generation comes online. For example, on days when wind output from MP's wind resources may be low, a stronger regional tie enables the company to import additional power from NTEC or Wisconsin-based solar generation. The creation of a stronger regional

[45] These appear to be similar to the MP-supplied study cases that ATC used in its planning analysis.

transmission tie between Wisconsin and Minnesota is actually a benefit of the Arrowhead Substation Alternative—not a drawback.

Relatedly, one of the key benefits of the Project is its ability to implement bidirectional dispatch capability on the HVDC Line (i.e., to direct power flows west-to-east or east-to-west), which MP claims will enable it and the region "to continue to support its clean energy transition" and to provide "enhanced operational flexibility for both supporting transmission reliability and optimizing HVDC dispatch for market economics."[46] Utilizing this bidirectional dispatch capability would in some circumstances require moving power from Wisconsin (or other points east) into Minnesota. The initial concept paper that MP submitted to the Department of Energy for federal funding for the Project acknowledges as much, stating that "[m]odern HVDC technology at the converter stations would also enhance the HVDC dispatch capability and allow energy to flow in both west to east and east to west directions, adding new flexibility and optionality for the regional transmission system supporting ND, MN, WI and beyond."[47] This emphasizes my earlier point, which MP acknowledged in its concept paper to the DOE: the stronger transmission tie that the Arrowhead Substation Alternative creates between Wisconsin and Minnesota is a benefit to this proposal, not a disadvantage.

Third, to the extent MP is suggesting that the Arrowhead Substation Alternative results in less power available to serve its customers, that suggestion is wrong. As discussed earlier, once electricity from the HVDC Line is injected onto the AC transmission system, it becomes comingled with network flows of power from other sources. Regardless of

[46] *See* Application, §§ 3.1, 3.3.2.4.
[47] *See* Rebuttal Schedule 15.

where the electrons are coming from or which alternative is implemented, there will be an adequate supply of power on the transmission system to meet MP's customer demand. In fact, ATC's proposal arguably increases MP's access to regional power supplies to meet customer needs by facilitating a stronger transmission tie between Minnesota and Wisconsin.

Q. Second, at page 64 of Mr. Winter's direct testimony, MP claims that the Arrowhead Substation Alternative would cause power flow on the Arrowhead-Weston 345 kV transmission line to exceed 800 MVA. How do you respond?

A. I address this issue in the next section of my testimony. As I will discuss, from the perspective of ensuring reliable and efficient operation of the transmission system, there is simply no legitimate reason for the Commission to keep this 800 MVA limit in place. Regardless of which alternative the Commission selects, it should remove this limitation from the Arrowhead Substation and associated transmission facilities.

Q. Third, at page 64 of Mr. Winter's direct testimony, MP claims that the Arrowhead PST and 345 kV capacitor banks "provide value to the AC and DC transmission systems" and that the results of MP's study "are not conclusive on whether or not the Arrowhead capacitor banks are, in fact, needed under the ATC Arrowhead Alternative." Do you agree?

A. No. As discussed in my direct testimony, ATC's planning studies evaluated the performance of the Arrowhead Substation Alternative against MP's proposal; in modeling the Arrowhead Substation Alternative, ATC assumed that the Arrowhead PST and 345 kV capacitor banks would be retired. The results of these studies demonstrate that ATC's alternative performs as well or better than MP's preferred point-of-interconnection (i.e.,

through the 345 kV St. Louis County Substation). The initial purpose of the Arrowhead PST was to maintain voltage stability on the transmission system between Minnesota and Wisconsin. The voltage stability analysis that ATC conducted demonstrates that the Arrowhead Substation Alternative provides greater voltage support to the system than MP's proposal, even with the Arrowhead PST (and 345 kV capacitor banks) removed from the 345/230 kV Arrowhead Substation. Finally, as part of the LRTP Tranche 2 process, MISO itself has been considering removing and retiring the Arrowhead PST, which further demonstrates that it is not needed to maintain reliability on the regional system.[48]

The only empirical planning analysis that MP can cite to support its assertion that the Arrowhead PST and 345 kV capacitor banks "provide value" to the transmission system is on page 17 and 22 of the power flow analysis it submitted in this proceeding. (Winter Schedule 14) But as discussed below, this analysis does not show that the Arrowhead PST and/or 345 kV capacitor banks are needed to address or mitigate violations of relevant reliability criteria or planning standards.

Q. Do you have any other observations or comments regarding MP's power flow analysis?

A. Yes. First, MP only conducted a steady state analysis of each alternative, whereas ATC conducted steady state, dynamic stability, and voltage stability analyses for each alternative, consisting of over 75 distinct modeling runs across different scenarios. From

[48] A presentation that MISO gave to transmission owners in July 2023 notes that MISO was considering removing the Arrowhead PST as part of potential regional transmission projects that could be implemented in northeastern Minnesota. (*See* Rebuttal Schedule 13, at 23) Whether intentionally or not, MP neglected to mention this anywhere in its direct testimony, including in its discussion of the July 2023 meeting with MISO in Eagan, Minnesota. *See* Winter Direct, at 48–49.

this perspective, ATC's analysis generally reflects a more robust evaluation of the reliability impacts of each alternative.

Turning to the details, MP's steady state analysis **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/CEII):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]**

- At page 16 of Schedule 14 to Mr. Winter's direct testimony, MP notes that **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/CEII):** [redacted]

[49] This line generally runs northwest from the MP 230/115 kV Arrowhead Substation to the Forbes Substation in St. Louis County.

[50] A remedial action scheme is a process that detects predetermined system conditions and takes corrective actions—such as curtailing generation or demand or reconfiguring the system—to meet reliability standards or otherwise address reliability concerns.

[redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]**

- At page 17 of Schedule 14 to Mr. Winter's direct testimony, MP notes that **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/ CEII):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]** Given the foregoing, I do not agree with MP's conclusion that these overloads demonstrate "some value to retaining the [Arrowhead PST]" because MP has not demonstrated that the Arrowhead PST would need to operate automatically to remediate them. To the contrary, MISO could and would take action to re-dispatch generation within the marketplace to mitigate these thermal violations.

- On pages 17 and 18 of Schedule 14 to Mr. Winter's direct testimony, MP notes that **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/ CEII):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]** ATC's transformer emergency ratings are set at the level at which the transformer can operate for up to two hours. If facilities are loaded to greater than their normal rating but less than their emergency rating, then these loadings are not considered valid violations that require mitigation in a planning study; if the contingencies described here actually occurred, MISO would redispatch generation after the contingency to ensure that flow is reduced to less than the facilities' normal rating. Again, these findings do not support MP's conclusion that there is "some value" to retaining the Arrowhead PST.
- On page 20 of Schedule 14 to Mr. Winter's direct testimony, MP notes that, for the Arrowhead Substation Alternative, **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/CEII):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]** As noted earlier, if voltages are outside of their normal rating but within their emergency rating, then this is not a valid

violation that requires mitigation in a planning study. Keeping system equipment within normal ratings following a contingency would require a massive overbuild of the transmission system.

- On page 22 of Schedule 14 to Mr. Winter's direct testimony, MP notes that **[BEGIN HIGHLY CONFIDENTIAL TRADE SECRET/CEII):** [redacted] **END HIGHLY CONFIDENTIAL TRADE SECRET/ CEII)]** For these reasons, I disagree with MP's assertion that this finding demonstrates that there is value to retaining the Arrowhead 345 kV capacitor banks.

C. <u>The 800 MVA Limitation</u>

Q. At pages 41, 64, 68–69 of Mr. Winter's direct testimony, MP claims that the Arrowhead Substation Alternative would result in flows on the Arrowhead-Stone Lake 345 kV line "regularly exceed[ing] 800 MVA," which would "violate the condition that remains in place today on the ATC Arrowhead 345 kV/230 kV Substation." How do you respond?

A. MP spends considerable time explaining the historical rationale behind this limitation, citing several materials from the administrative record of the Minnesota EQB proceeding

authorizing construction of the Arrowhead-Weston 345 kV project. Based on these materials, MP asserts that the 800 MVA limitation "related to the power flow of the system and concerns of bulk power transport from North Dakota to Wisconsin."[51] I reviewed those materials. Taking them at face value, it appears that there was a concern from one EQB commissioner regarding the Arrowhead-Weston project's "potential use . . . for increasing bulk sales of electricity" from power plants that might be constructed outside of Minnesota due to the new line.[52] The specific concern was that development of these new power plants outside the state might lead to more in-state pollution (e.g., mercury deposition and greenhouse gas emission from coal plants).

Assuming this was the rationale for imposing the 800 MVA limitation, it demonstrates that there was no legitimate basis for imposing this limit, at least from the perspective of electric system planning. I understand the desire of Minnesota officials to limit the impact of upwind power plant emissions on state resources. However, over the last ten to 15 years, there has been a rapid increase in the retirement of coal-fired generation and a significant increase in the amount of renewable generation coming online. Market forces, concerns over climate change, and increasingly aggressive state renewable portfolio standards make it highly unlikely that any new coal generation will be constructed in the upper Midwest in the near future; in fact, out of dozens of proposed generator interconnection requests, there is currently only one small new coal generation facility in the entire MISO Generator Interconnection Queue, and this facility is in the early stages of the interconnection process, meaning it may not even be built. The 800 MVA limit that the

[51] Winter Direct, p. 68.
[52] *See* Winter Schedule 34.

Minnesota EQB initially imposed on the Arrowhead-Weston 345 kV line has outlived its initial purpose.

More importantly, whatever concerns officials had over air quality impacts from out-of-state generation when the Arrowhead-Weston line was initially permitted are wholly unrelated to maintaining system reliability or efficient operation of the bulk electric system. The only purpose the 800 MVA limit serves is to restrain the amount of electricity that can be transmitted across the Arrowhead-Weston 345 kV line, from Minnesota to Wisconsin. There is no reasonable engineering basis to keep this limit in place, and to ATC's knowledge, regulatory bodies in Minnesota and Wisconsin have not imposed similar restrictions on any other transmission lines connecting the two states; while MP argues that the Arrowhead Substation Alternative could cause an exceedance of the 800 MVA limit—which may be true, under certain system conditions—MP does not actually defend it.

Q. But at page 8 of Mr. Gunderson's direct testimony, MP asserts that "the flow on the Arrowhead-Weston line is maintained within the 800 MVA limitation through use of a phase-shifting transformer at ATC's 345/230 kV Substation." Is this correct?

A. No, it is not. The Arrowhead PST is not used to maintain compliance with the 800 MVA limit—these are two distinct issues. The existing transformer in the Arrowhead 345/230 kV Substation has a summer normal rating of 801 MVA; in other words, the capacity of the existing transformer inherently limits the ability to transmit more than 800 MVA across the Arrowhead-Weston 345 kV transmission line. As Mr. Winter acknowledged, "it is physically impossible for more than 801 MVA to flow on the transmission line into Wisconsin without overloading the transformers," which "[m]aintains compliance with"

the 800 MVA limit.[53] On the other hand, the Arrowhead PST was initially installed to maintain voltage stability on the transmission system between Minnesota and Wisconsin—not to comply with the 800 MVA limit.[54] And as I discussed earlier, the Arrowhead PST has since become obsolete for this originally intended purpose, given the manner in which MISO dispatches generation and operates the regional transmission system.

Q. Is ATC requesting that the Commission lift the 800 MVA limitation as part of this proceeding?

A. Yes. Regardless of which alternative the Commission ultimately selects, it should remove the 800 MVA limitation that the Minnesota EQB initially imposed when authorizing construction of the 345/230 kV Arrowhead Substation and Arrowhead-Weston Line. From a reliability and system planning perspective, it serves no legitimate purpose.[55]

D. Impacts on HVDC System Design & Procurement

Q. At pages 28–29 of Mr. Winter's direct testimony, Mr. Winter claims that, if the Commission orders implementation of the Arrowhead Substation Alternative, MP would have to update planning studies that it previously conducted for its configuration of the Project, which would take approximately 12 months and would delay the HVDC Supplier's detailed design activities by approximately 15 months. How do you respond?

[53] Winter Direct, p. 68.
[54] As shown in the Administrative Law Judge's January 29, 2001 report for the proceedings before the Minnesota EQB, installation of the Arrowhead PST was a matter of record and planned even before the 800 MVA limit was proposed and adopted at the EQB's March 15, 2001 open meeting. *See* Winter Schedule 32, at 4.
[55] While I am not an attorney, I also understand that this limit could be subject to legal challenges as an unlawful restriction on interstate commerce, which ATC's attorneys may address during briefing in this case.

A. Neither I nor anyone at ATC has been involved in the studies that MP or its HVDC supplier have conducted in connection with the Project, so I cannot speak to what measures MP would have to take to update those studies or how long that process would take if the Arrowhead Substation Alternative were implemented. That said, to the extent MP is attributing any of this delay to the additional planning studies that would need to be conducted in conjunction with MISO, those studies will need to occur regardless of which alternative is implemented and will likely occur this year, assuming the Project is targeted for inclusion in MTEP24 Appendix A; the existing MISO Tariff also has established procedures that can be used to expedite these studies, as I explained in my direct testimony.

More importantly, before filing its application in this matter, the onus was on MP to evaluate reasonable alternatives to its proposed configuration of the Project, including the proposed point-of-interconnection in Minnesota. While MP did consider interconnecting the Project to ATC's Arrowhead Substation, it acknowledges that it "dismiss[ed] what has become the ATC Arrowhead Alternative without the need to complete detailed studies or analytical modeling."[56] In my view, this was a mistake. Had MP conducted more detailed analysis of the Arrowhead Substation Alternative before filing its application, it would have realized—as ATC has demonstrated in this proceeding—that the Arrowhead Substation is a superior solution for interconnecting the Project to the AC transmission system in Minnesota, relative to MP's proposal. The fact that MP may need to conduct additional analysis if the Commission were to order implementation of the Arrowhead Substation Alternative is no justification for allowing

[56] Winter Direct, p. 57.

MP to proceed with their proposed method of interconnection, which—in my view—is inferior to the alternative that ATC has proposed. MP has also been aware of ATC's intervention and advocacy for the Arrowhead Substation Alternative in this proceeding since September 2023; if it is concerned about the impact that the Arrowhead Substation Alternative will have on the overall Project schedule, it should be considering this alternative as part of its detailed design study process in the event the Commission orders implementation of the Arrowhead Substation Alternative.

Q. At pages 70–79 of Mr. Winter's direct testimony, MP discusses the impact that the Arrowhead Substation Alternative could have on detailed design and procurement activities for both the HVDC and AC system design for the Project. Did you review this portion of Mr. Winter's testimony?

A. Yes.

Q. Do you have any comment on the scheduling concerns he discusses therein?

A. ATC witness Dustin Johanek provides a more detailed response to the concerns that MP raises concerning scheduling. I would note that (at least some of) MP's scheduling concerns are rooted in the notion that implementation of the Arrowhead Substation Alternative could require installation of a second phase shifting transformer. For all the reasons I discussed previously, I am confident that, if the Arrowhead Substation Alternative is implemented, the existing PST could be retired and there will be no need for a new one. Accordingly, there should be no scheduling delays associated with procuring a new phase-shifting transformer because it will not be needed as part of ATC's proposal.

E. Construction, Operation, and Maintenance Issues

Q. At pages 81–83 of Mr. Winter's direct testimony, MP claims that "Minnesota Power would lose direct control over a portion of the path of delivery from the HVDC System to its customers" if the Arrowhead Substation Alternative is adopted. What is your response?

A. Again, this is a non-issue. As I explained earlier, there is nothing inherently remarkable or problematic about a utility moving energy or capacity over third party's transmission assets to meet customer needs. The NTEC is a prime example—MP indirectly owns a 20 percent stake in that facility, which connects to the same ATC-owned transmission line that terminates at ATC's 345/230 kV Arrowhead Substation. MP will have no issues procuring energy and capacity from that facility to serve its customers as part of the normal course of business. The same is true here if the Commission ultimately decides to order implementation of the Arrowhead Substation Alternative.

Q. At page 83 of Mr. Winter's direct testimony and pages 27–29 of Mr. Gunderson's direct testimony, MP discusses the need to negotiate an updated transmission-to-transmission interconnection agreement with ATC if the Commission orders implementation of the Arrowhead Substation Alternative. How do you respond to this testimony?

A. As noted in ATC witness Bob McKee's rebuttal testimony, this concern is overstated. If the Arrowhead Substation Alternative is implemented, the parties can amend their existing transmission-to-transmission interconnection agreement, which will not have a material impact on the in-service date for the overall Project.

Q. At pages 83–84 of Mr. Winter's direct testimony, MP asserts that, if the Arrowhead Substation Alternative is implemented, there will be a "greater risk of HVDC System Operations being impacted by MWEX operations and restrictions." How do you respond?

A. In my view, this does not present a material risk to the construction or operation of the Project. MP does not provide any detail or explanation concerning *how* operation of the HVDC Line would be "impacted by MWEX operations and restrictions" or how those "operations and restrictions" would adversely impact its own operations or customers. In any event, the HVDC Line is not under MISO's functional control and there is presently nothing in the MWEX operating guide that would allow MISO to use the HVDC Line to manage flows over MWEX. Moreover, the analysis that ATC has conducted demonstrates that the Arrowhead Substation Alternative actually increases the ability of power to flow across the Arrowhead-Weston transmission line under system intact conditions and with the occurrence of the worst contingency. This actually *decreases* the risk that MWEX operations could restrict operation of the HVDC Line, relative to MP's proposed alternative.

Q. Does this conclude your pre-filed rebuttal testimony?

A. Yes.