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March 3, 2025

VIA E-FILING
Will Seuffert
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101-2147

Re: In the Matter of an Investigation into Self-Commitment and Self-Scheduling of Large Baseload Generation Facilities
Docket No. E999/CI-19-704
Annual Compliance Filing

Dear Mr. Seuffert:

Minnesota Power respectfully submits its annual compliance report analyzing the Company's 2024 self-commitment of its baseload generation facilities pursuant to the Minnesota Public Utilities Commission Orders in Docket Nos. E999/AA-18-373 and E999/CI-19-704.

This filing, as well as Attachments 1, 2 and 3 to the filing contain information Minnesota Power considers Trade Secret. The Company believes this filing comports with the Minnesota Public Utilities Commission's Notice relating to Revised Procedures for handling Trade Secret and Privileged Data, pursuant to Minn. Rule 7829.0500. As required by the revised procedures, a statement providing the justification for excising the trade secret data is attached to this letter.

Please contact me at (218) 591-4870 or avang@mnpower.com if you have any questions regarding this compliance filing.

Yours truly,

Ana Vang
Regulatory Compliance Specialist, Senior

AV:kb
Attach.

STATEMENT REGARDING JUSTIFICATION FOR EXCISING TRADE SECRET INFORMATION

Pursuant to the Commission's revised Procedures for Handling Trade Secret and Privileged Date in furtherance of the intent of Minn. Stat. § 13.37 and Minn. Rule 7829.0500, Minnesota Power has designated portions of its attached compliance filing as Trade Secret.

Minnesota Power has excised material from this Self-Commitment and Self-Scheduling of Large Baseload Generation Facilities compliance filing ("Report") because the format of the Report requires Minnesota Power to compile and provide information regarding its operating parameters, power supply, and fuel costs. This is highly confidential information relating to Company financial and planning information; Minnesota Power's competitors and vendors would acquire highly confidential commercial information about Minnesota Power if this information were publicly available. In addition, unauthorized disclosure of this information may violate certain federal securities regulations.

Minnesota Power follows strict internal procedures to maintain the secrecy of this information in order to capitalize on economic value of the information to Minnesota Power on behalf of its customers. Minnesota Power respectfully requests the opportunity to provide additional justification in the event of a challenge to the trade secret designation provided herein.

STATE OF MINNESOTA
BEFORE THE
MINNESOTA PUBLIC UTILITIES COMMISSION

In the Matter of an Investigation into Self-Commitment and Self-Scheduling of Large Baseload Generation Facilities	Docket No. E999/CI-19-704 **MINNESOTA POWER'S ANNUAL COMPLIANCE FILING**

I. OVERVIEW

Minnesota Power (or the "Company") submits the calendar year 2024 annual compliance filing in the above referenced docket in response to following orders issued by the Minnesota Public Utilities Commission ("Commission") in Docket No. E999/AA-18-373 and Docket No. E999/CI-19-704:

- Docket No. E999/AA-18-373, February 7, 2019 Order ("February 2019 Order");
- Docket No. E999/AA-18-373, November 13, 2019 Order ("November 2019 Order");
- Docket No. E999/CI-19-704, January 11, 2021 Order ("January 2021 Order");
- Docket No. E999/CI-19-704, December 1, 2021 Order ("December 2021 Order");
- Docket No. E999/CI-19-704, November 17, 2022 Order ("November 2022 Order");
- Docket No. E999/CI-19-704, November 8, 2023 Order ("November 2023 Order").

Hourly Data

Hourly data required from Order Point 10 of the November 2019 Order, as well as Order Point 5 from the January 2021 Order, are included in Attachment 1 for Boswell Unit 3 ("BEC3") and Attachment 2 for Boswell Unit 4 ("BEC4") for the period of January 1, 2024 through December 31, 2024. Attachments 1 and 2 have been designated Trade Secret in their entirety due to the information included.

Joint Ownership

BEC4 is a co-owned unit with WPPI Energy ("WPPI") and currently the operating agreement does not allow for a change in how the unit is operated without prior approval of both partners. However, as discussed below in the Economic Dispatch section, the Company continues to have discussions with WPPI on an economic dispatch transition and continues to work with Midcontinent Independent System Operator ("MISO") on transmission reliability needs.

II. ANNUAL REPORT

A. 2024 Self-Commitment Analysis

In prior years there was more unpredictability across the energy market causing stronger demand for BEC4 and BEC4 generation. In 2023 natural gas prices dropped leading to lower-priced power markets and less volatility. The mild winter in 2024 triggered even more decline in gas and energy prices, shaping how Boswell units would run the rest of the year. This decrease in volatility has led to a reduction in energy production from BEC3 and BEC4 generation, as they continue to be a critical capacity resource to meet MISO Resource Adequacy requirements.

Net Cost/Benefit Analysis

As directed by the Commission, Minnesota Power evaluated the financial impact of self-commitment for BEC3 and BEC4 for the period of January 1, 2024 through December 31, 2024. As shown in Table 1 below, Minnesota Power's self-commitment of the units resulted in a net benefit of **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]**. This number does not include reliability and other customer benefits from self-commitment. The analysis evaluated all the hours during the year where the unit had a commitment status of must run, and compared the fuel and variable Operations and Maintenance ("O&M") cost to operate versus the net energy payments Minnesota Power received from the MISO market during these same periods. BEC3 operated in an economic dispatch status for the majority of the 2024 calendar year. The information included in Table 1 for BEC3 represents the hours Minnesota Power placed the unit in a must run dispatch status. The net (cost)/benefit was calculated in accordance with Order Point 9 of the November 2019 Order. Per the Order Minnesota Power's analysis includes fuel costs and variable O&M as used in the offer curve compared to the day ahead and real time MISO energy payments.

Table 1: (Cost) / Benefit When Boswell Units are Self-Committed

	(Cost) / Benefit		
	All Hours	**On-Peak /2**	**Off-Peak /3**
	[TRADE SECRET DATA BEGINS		
BEC3 Hours with Cost /1	[redacted]		
BEC3 Hours with Benefit			
BEC3 (Cost) / Benefit			
BEC4 Hours with Cost			
BEC4 Hours with Benefit			
BEC4 (Cost) / Benefit			
Combined BEC3 and BEC4			
	TRADE SECRET DATA ENDS]		

/1 BEC3 was in economic dispatch for the majority of the year. Data included in the table represents hours when unit operated in must run dispatch.
/2 On-Peak: HE 7-22 Monday-Friday
/3 Off-Peak: HE 23-24, 1-6 Monday-Friday and HE 1-24 Saturday-Sunday

In accordance with Order Point 5.f, Table 2 below includes an analysis of all hours during the year where the unit had a commitment status of must run and compared the total production costs to the net payments Minnesota Power received from MISO. Total production costs as defined in the January 2021 Order includes unit fuel, variable O&M, and preventative maintenance. The net MISO payment includes the energy payment plus ancillary service and make-whole payments. It is important to note the preventative maintenance data included in Attachments 1 and 2 are the best information the Company was able to obtain utilizing its accounting and budget system. However, it is not inclusive of all preventative maintenance and could include predictive maintenance costs as well. Minnesota Power does not track generation maintenance costs by predictive, preventative, or corrective maintenance. Instead, the accounting for generation maintenance costs is tracked consistent with FERC requirements. It is also important to note that preventative maintenance is not utilized in the MISO offer curve.

Table 2 below captures the costs and/or benefits when the units are operating in a must run commitment status. Therefore, since BEC3 transitioned to economic dispatch in July 2021, Table 2 only captures the costs and/or benefits when BEC3 was operating in a must run status. The table includes the full year impact of operating BEC4 in a must run status. If BEC3 operated in a must run status for the full year, there would have been

approximately **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** in additional net benefit included in the table below for 2024.

Table 2: Net (Cost) / Benefit including Preventative, Ancillary Services and Make-Whole Payments

	(Cost) / Benefit
	[TRADE SECRET DATA BEGINS
BEC3 Net MISO Payment	[redacted]
BEC3 Production Costs	
BEC3 (Cost) / Benefit	
BEC4 Net MISO Payment	
BEC4 Production Costs	
BEC4 (Cost) / Benefit	
Combined BEC3 and BEC4 Benefit	
	TRADE SECRET DATA ENDS]

Net (Cost)/Benefit Analysis with Operational Dynamics Included

To provide additional information for the Commission and stakeholders, Minnesota Power augmented the net (cost)/benefit analysis shown in Table 1 above by incorporating additional BEC3 and BEC4 operational dynamics into the analysis. The intent of the exercise is to improve the net (cost)/benefit calculation by continuing to include costs that "hypothetically" could have been avoided if BEC3 and BEC4 were economically dispatched in 2024, then the enhancement is excluding costs that could not have been avoided because of plant operating constraints. For example, a coal unit could be economically dispatched by MISO on a Monday but be required to operate on Tuesday per its minimum run time requirements – this analysis takes this operational dynamic into consideration. Minnesota Power intentionally used the word "hypothetically" above, because key milestones, which are discussed later, need to be met prior to moving to economic dispatch for BEC4. Furthermore, this analysis did not capture changes in ancillary service revenue, changes to market prices if these units were offline for economics, or situations where the units were needed for reliability or for supplemental heat to prevent the power plant from freezing up. The analysis started with the workbook used in the net (cost)/benefit analysis shown in Table 1 and layered on when BEC3 and BEC4 would have hypothetically been dispatched by MISO economically based on actual

data such as hourly Locational Marginal Prices ("LMPs"), fuel costs, planned/forced/ economic outages, as well as reagent and wear and tear adders, along with factoring in minimum run times and minimum times offline.[1] The result is a more realistic representation of the costs/benefits calculation. The analysis included all hours during the year where the unit had a commitment status of must run.

As shown in Table 3 below, the net benefit is increased to **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** when compared to the net benefit shown in Table 1.

Table 3: Net (Cost)/Benefit with Operational Dynamics Included

	(Cost) / Benefit
	[TRADE SECRET DATA BEGINS
BEC3 /1	[redacted]
BEC4	
Total (Cost) / Benefit	
	TRADE SECRET DATA BEGINS]

/1 BEC3 was in economic dispatch for majority of 2024. The cost/benefit shown above is for the hours that BEC3 was put into must run in 2024.

B. Order Point 5.g Analysis

Minnesota Power provided, as part of Attachments 1 and 2, the number of times in the analysis that each unit incurred losses over a duration greater than its minimum de-commit time and the associated costs. BEC3 and BEC4 have a de-commit time of **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]**.

However, this analysis does not take into consideration that the minimum run time for both units is **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]**. Provided below, in the Economic Dispatch section, Minnesota Power includes a future economic dispatch production cost model which looks at the potential average annual savings when BEC4 transitions to economic dispatch for a portion of the year. This production cost model provides a more realistic savings potential since it is able to capture the operational limitations.

[1] A production cost model was used to determine when MISO might have dispatched BEC3 and BEC4 for economics using historical data for 2022.

C. Ancillary Services

Eligible generation has the opportunity to make ancillary services available to the MISO market and receive payment for these services. These ancillary service products are required to ensure energy is compensated financially for being able to respond to imbalances between generation and load. The Boswell facility received approximately **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** in revenue for providing several ancillary service products, as shown in Table 4 below. The majority of the ancillary service revenue came from providing regulation, which requires these units to increase or decrease generation within seconds to respond to small imbalances due to renewable generation and load variation. Regulation is a critical reliability service provided by these units, and it is important to note that Boswell can only provide these ancillary services if the units are online and generating at minimum levels.

Table 4: Monthly Revenue from Ancillary Service

	BEC3			BEC4		
	Regulation	Spinning Reserve	Supplemental Reserve	Regulation	Spinning Reserve	Supplemental Reserve
	[TRADE SECRET DATA BEGINS					
January 2024	[redacted]					
February 2024						
March 2024						
April 2024						
May 2024						
June 2024						
July 2024						
August 2024						
September 2024						
October 2024						
November 2024						
December 2024						
2024 Total						
Total Ancillary Service Revenue (January 1, 2024 – December 31, 2024)						[redacted]
						TRADE SECRET DATA ENDS]

D. Make Whole Payments

Resources that are dispatched economically by MISO in either the Day Ahead or Real Time markets are basically guaranteed recovery of their production costs (offer, start-up and no-load costs) by way of the market, either through the LMPs or with a Make Whole Payment. If the LMPs do not adequately compensate the units over the commitment

period, then MISO will provide a Make Whole Payment to the unit through the Day Ahead or Real Time Revenue Sufficiency Guarantee Make Whole Payment charge types. Additionally, if market conditions erode the margin that would have been earned in the Day Ahead Market due to a lower dispatch in the real time, the units might be eligible for a Price Volatility Make Whole Payment in the real time.

E. Capital Revenue Requirements

Capital Revenue Requirements is a financial estimate of the total amount of money Minnesota Power must collect from customers to pay all costs including a reasonable return on investment for the assets. The revenue requirement for BEC3 and BEC4 is based on the capital investment in the facility and the financial metrics of the company such as debt rate, return on equity, taxes, and depreciation. The estimated Capital Revenue Requirements for BEC3 and BEC4 as of December 31, 2024 were **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** respectively.

F. Average Heat Rate

Table 5 below shows the average heat rate at economic minimum and average heat rate at economic maximum for BEC3 and BEC4.

Table 5: Average Heat Rates

	Average Heat Rate at Economic Minimum (Btu/kWh)	Average Heat Rate at Economic Maximum (Btu/kWh)
	[TRADE SECRET DATA BEGINS	
BEC3	[redacted]	
BEC4		
		TRADE SECRET DATA ENDS]

G. Operation and Maintenance Costs

Fixed Operations and Maintenance

Fixed O&M costs are defined as direct O&M expenses not related to fuel, reagents, fuel handling equipment, incremental wear-and-tear, and ash handling costs. Table 6 below shows the fixed O&M costs attributed to BEC3 and BEC4.

Table 6: Fixed O&M

	BEC3	BEC4
	[TRADE SECRET DATA BEGINS	
January 2024	[redacted]	
February 2024		
March 2024		
April 2024		
May 2024		
June 2024		
July 2024		
August 2024		
September 2024		
October 2024		
November 2024		
December 2024		
2024 Fixed O&M Cost		
	TRADE SECRET DATA ENDS]	

Variable O&M

Minnesota Power defines variable O&M as the changes in reagents, fuel handling equipment and incremental wear-and-tear, and ash handling costs minus fly ash sales revenue. These costs will increase or decrease depending on the production level of the generating unit. Below are the variable O&M costs in $/MWh we used in our offer into the MISO Energy Market during 2024.

Table 7: Dispatch Variable O&M ($/MWh)

	1/1/2024-3/31/2024	4/1/2024-12/31/2024
	[TRADE SECRET DATA BEGINS	
BEC3	[redacted]	
BEC4		
	TRADE SECRET DATA ENDS]	

Preventative Maintenance

Minnesota Power does not track generation maintenance costs by predictive, preventative, or corrective maintenance. Instead, the accounting for generation maintenance costs is tracked consistent with FERC accounting rules.

In order to comply with Order Point 5.d of the January 2021 Order, the preventative maintenance data included in Attachments 1 and 2 is the best information the Company was able to obtain utilizing its accounting and budget system. However, is not inclusive of all preventative maintenance and could include predictive maintenance costs as well.

The methodology Minnesota Power used to determine the hourly rate was based on actual costs available divided by generation output. Costs on a $/MWh basis vary greatly based on production, outages, and shared resources. It is also important to note that preventative maintenance is not utilized in the MISO offer curve.

Table 8: Estimated Preventative Maintenance ($/MWh)

	[TRADE SECRET DATA BEGINS
BEC3	[redacted]
BEC4	
	TRADE SECRET DATA ENDS]

Preventative maintenance is a runtime or calendar-based activity recommended by the manufacturer or by experience where a maintenance technician has hands-on activity with the piece of equipment. This would include inspections, tests, repairs and replacement of components in critical equipment. It may also include lubrications and minor adjustments. If inspection turns into repair or replacement, it becomes a corrective work order. Preventative maintenance costs also fluctuate from year to year based on outage schedules.

Predictive maintenance is a program that uses diagnostic and performance data, maintenance histories, design data and operating history to determine the condition of equipment. It utilizes the latest in technology such as vibration, thermography, motor testing to monitor equipment while it is operating. These activities do not significantly change based on incremental changes in production.

H. Unit Fuel Cost

Fuel as used in the offer curve for dispatch in the MISO energy market is defined as the actual monthly average cost of inventory on hand for the generating station.

I. Annual and Avoided Carbon Dioxide Emissions

In accordance with Order Point 8.a. of the December 2021 Order, the 2024 total carbon dioxide emissions for BEC3 and BEC4 were 1,617,259 short tons and 2,688,734 short tons, respectively, excluding the BEC4 portion attributable to WPPI's 20 percent share.[2]

Based on the Minnesota Department of Commerce, Division of Energy Resources recommended calculation for avoided carbon dioxide emissions and in accordance with Order Point 7.a. of the November 2022 Order, the avoided 2024 carbon dioxide emissions for BEC3 were 33,972 short tons. Based on the calculation and since BEC4 still operates in a must run commitment status there was no avoided carbon dioxide emissions.

J. Equivalent Forced Outage Rate

In accordance with Order Point 8.d. of the December 2021 Order, the Equivalent Forced Outage Rate ("xEFORd") for BEC3 and BEC4 were **[TRADE SECRET BEGINS** [redacted] **TRADE SECRET ENDS]**, respectively. The monthly xEFORds for 2024 can be found in Attachments 1 and 2.

K. Wind Curtailment

The wind energy production and curtailment information required by Order Point 7.c. of the November 2022 Order can be found in Attachment 3.

[2] Reference emissions reported to EPA Clean Air Markets Program https://campd.epa.gov/

III. ECONOMIC DISPATCH

During 2024, BEC3 operated in an economic commitment dispatch status for the majority of the year. Similar to 2023, due to the continued high market prices BEC3 was consistently dispatched by MISO. As Minnesota Power continues to work through the milestones identified for BEC4, the Company is not recommending a transition to economic dispatch in 2025. Minnesota Power will continue to review the operations, energy price forecast, discussions with WPPI, timing of local and regional transmission upgrades and reliability enhancements at BEC, and timeline for future transition of BEC4 to economic dispatch.

In accordance with Order Point 10 in the December 2021 Order, Minnesota Power evaluated a must run dispatch status compared to economic dispatch operations over a time period of January 1, 2025 through December 31, 2027. Two operational scenarios were analyzed as outlined in Table 9 below. In the first scenario Minnesota Power analyzed a “worst case” scenario where the units were set to must run all year. The second scenario analyzed a “best case” scenario where the units were in economic dispatch. Due to the need for supplemental heat BEC4 was set to must run during the winter months of 2025, excluding November and December, and economic for all other months. Even though BEC3 has transitioned to economic dispatch, Minnesota Power is required to provide a similar worst case/best case analysis to evaluate the potential cost savings between must run and economic dispatch.

The Company has made significant progress in addressing the various milestones initially identified in the 2021 filing that need to be reached in order to transition BEC4 to economic operations. These milestones and associated cost, discussed below, were not taken into consideration in the best case/worst case analysis. If the potential cost of meeting these milestones were incorporated into the analysis, it would have an impact on the results.

Table 9: Operational Scenarios

	BEC3	BEC4
First Scenario	Must Run Status	Must Run Status
Second Scenario	2025: Economic Dispatch (All Year) 2026: Economic Dispatch (All Year) 2027: Economic Dispatch (All Year)	2025: Economic Dispatch (Apr-Dec) 2025: Economic Dispatch (All Year) 2026: Economic Dispatch (All Year)

Using a production cost model, a comparison of the second scenario to the first scenario provided an annual power supply cost savings of approximately **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** over the course of the identified time period for BEC3 and BEC4, respectively.

Additional Sensitivity Analysis

With the volatility in energy prices observed in recent years, Minnesota Power wanted to include a market price sensitivity analysis to understand the impact to the cost benefits of moving to economic dispatch. Minnesota Power analyzed the impact a +/- 25 percent energy market change, from the base case, could have on the BEC4 analysis discussed above. Comparing the second scenario to the first scenario the +/- 25 percent market sensitivity analysis showed a three-year annual average range of power supply cost savings of approximately **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** for BEC4.[3]

For BEC3 the market sensitivity analysis showed similar results to BEC4 under the -25 percent market sensitivity, in which the benefit to move to economic dispatch increased. However, when market prices increase under the +25 percent market sensitivity the benefit of moving to economic dispatch decreases due to the unit being dispatch by MISO similar to a must run unit. Comparing the second scenario to the first scenario the +/- 25 percent market sensitivity analysis showed a three-year annual average range of approximately **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** in power supply cost savings for BEC3.

[3] The low end of the range represents the +25 percent market price sensitivity and the high end of the range represents the -25 percent market price sensitivity.

This sensitivity analysis shows that the company will need to continue monitoring energy markets and take into consideration ancillary impacts (i.e. wear and tear, and fuel procurement cost impacts) when making future operating decisions at Boswell.

Economic Dispatch Milestones – In Progress

The milestones identified below are the remaining milestones Minnesota Power is continuing to work through in order to transition BEC4 to economic dispatch.

A. Joint Ownership

The terms of the 1990 Operations, Ownership and Power Sales Agreement between Minnesota Power and WPPI states, **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** The Company has ongoing discussions with co-owner, WPPI, on economic dispatch operations for BEC4.

One of the main areas the Company and WPPI continue to try to understand is market coordination and customer impact for a jointly owned unit. In the MISO Market, BEC4 is modeled as two individual, distinct generators and each ownership share has its own generator node. Under a must run dispatch, Minnesota Power coordinates with WPPI on the energy market parameters to ensure a consistent dispatch of BEC4 that optimizes the unit's economics. Under economic dispatch, there is a potential for only one generator node (either Minnesota Power or WPPI) to be dispatched. Minnesota Power has identified several MISO market items that will need to be addressed further with WPPI, including changes to the offer strategy, changes to how BEC4 is modeled in the MISO energy market and decide if re-registration is needed, and determine whether new MISO market coordination agreements will be needed between Minnesota Power and WPPI. Minnesota Power will continue to advance this work with WPPI in 2025.

B. Generating Facility Impacts

Auxiliary Heat

During winter operations and after the retirement of BEC1 and BEC2 in 2018, BEC3 and/or BEC4 provide heating steam and process steam (e.g. air preheating steam) to the entire Boswell facility. In order to ensure the Boswell facility maintains a protected temperature, currently, at least one of the Boswell units needs to be operating during the cold winter months. The heating season in Northern Minnesota runs from September through May with the critical heating months being December through February. Loss of heating steam for any reason in the December through February range needs to be corrected within 72 hours to prevent the plant from freezing.

A backup heat source at Boswell, consisting of two natural gas fired heating boilers and balance of plant systems and structures requires a three-year schedule for permitting, design, procurement, and construction. The Company has completed the study phase and expects the backup heat source to be available by end of the 2024-2025 heating season. As of the date of this filing the project is in the final construction and installation phase. The project is anticipated to be commissioned during Q1 of 2025 with start-up to follow.

Operating a backup heat source in the form of natural gas heating boilers will also change the Company's fuel procurement strategy and commitment for natural gas firm capacity. As BEC3 and BEC4 move to economic dispatch there would be an incremental cost to purchase firm natural gas transportation capacity. This would apply to both fuel for the heating boilers as well as fuel for start-up of the power boilers on a more frequent basis.

Economic Dispatch Milestones - Monitoring

Minnesota Power continues to monitor the milestones identified below as they could impact the economic operations at BEC3 and/or the timing of transitioning BEC4 to economic dispatch.

C. Market Readiness

The ability of MISO market tools to properly evaluate the need and duration of baseload generation facilities is a key component of being ready to transition BEC4 to economic

dispatch. Currently MISO's existing Day Ahead commitment process does not provide assurance that the units will be operated economically across multiple days. In particular, while the economics of a single day may not indicate economic dispatch for the Boswell units (which have relatively high startup costs and a relatively long lead time), the economics over two or more days are more likely to favor commitment. This leaves the individual utilities in a position of having to actively manage and create additional internal procedures for operating the units in the MISO market environment when MISO is determining whether to commit the units.

MISO has improved tools such as the Multi-Day Operating Margin and Maintenance Margin reports, which provide some insight into the balance of supply and demand in MISO that may help Market Participants forecast the market economics of their long-lead units across multiple days. The tools may assist Market Participants in determining whether to must run their units, making the units available for MISO dispatch across multiple days, but forecasts cannot provide assurance that the decision to must run or not will maximize the unit's economics. Minnesota Power is engaged in the MISO Reliability Imperative, particularly within the System Enhancement and Operations of the Future as it pertains to long lead units. Minnesota Power will continue to advocate through the MISO Stakeholder process to recognize the value of these generators with attributes that provide flexibility, system adequacy, and system stability in order to provide least cost supply for our customers.

The Company has developed short-term forecasting tools in addition to internal processes to aid in the management of economic dispatch in the MISO market. The Company would utilize the same processes and procedures to offer BEC4 into the MISO market under economic dispatch; however, having two units at the same site under economic dispatch adds additional layers of complexity that are still being evaluated and analyzed. Having BEC3 and BEC4 offline simultaneously limits Minnesota Power's capability to respond to any market or reliability events that could arise during the real time market. It could take Minnesota Power 22 to 24 hours to bring a generator online and dispatchable, if needed. Furthermore, additional processes need to be established if

both units dispatch economically as there are constraints to start both units at the same time.

In addition, the Company will continue to refine its processes and procedures for working with the market when the unit cycles on and offline more often due to economics. The experience gained on the BEC3 transition, while still limited at this time, will aid in the future transition for BEC4. The Company works closely with MISO to manage the economic dispatch of BEC3 on a daily basis; and based on daily operating and facility conditions, may need to move in and out of economic commitment status to manage all aspects of the plant.

Minnesota Power will continue to use its current planning process to help predict and plan expected mid-term and longer-term energy production at the facility. These projections help inform the Company regarding how these units are expected to operate for the upcoming year. The projections are also used to inform the Company's fuel procurement strategy and procurement of materials, such as reagents for the environmental controls. Outputs from the evaluation are then used to track and forecast BEC3 and BEC4 generation production.

D. Transmission Reliability

Currently Boswell provides essential reliability services that give the operational flexibility needed to ensure continuous reliable operations of the power system and energy supply to a unique geographic area. The energy and reliability needs of this area include both energy intensive large industrial loads and sprawling rural community areas. These two very different types of customers must be served while also balancing bulk regional power transfer impacts, particularly as regional renewable energy production varies on a minute-by-minute basis and the transmission grid operates with facilities coming in and out of service due to maintenance, storms and unexpected events. There are two main areas of concern for transmission system reliability that stem from the transition of both Boswell units to economic dispatch: (1) voltage support and system strength; and (2) regional voltage stability. The first concern, voltage support and system strength, is primarily related to whether or not there is at least one Boswell unit online at any given time. The

second concern, regional voltage stability, is primarily related to how much power is being produced by the Boswell units at any given time and the surrounding system conditions at the time. An overview of each of these concerns is provided briefly below.[4]

As the last remaining baseload generators operating in Northern Minnesota, the Boswell units provide voltage support and system strength on a continuous basis that support consistent and predictable system operations and properly functioning protection systems. Without the Boswell units online, the Northern Minnesota transmission system would operate for extended periods of time without any local generators online providing fault current and voltage regulation. This mode of operation would be unprecedented in the modern history of the Northern Minnesota transmission system and, if not adequately assessed and mitigated, would lead to a great deal of uncertainty and potential mis-operation in the transmission system and the lower-voltage distribution systems connected to it. Minnesota Power has undertaken several different types of analysis to understand the significance, complexity, and inter-relationships of voltage support and system strength impacts. Minnesota Power's analysis, including short circuit, transient stability, and motor starting analysis, was summarized in the technical report titled *Summary Report on System Strength & Voltage Support Impacts in Northeastern Minnesota* ("System Strength Study"), which was filed in this docket on July 22, 2022.[5]

Several Minnesota Power and MISO studies have also identified that there is a regional voltage stability concern associated with one or both Boswell units being offline under certain combinations of transmission system conditions. Minnesota Power continues to work with MISO to ensure that this voltage stability issue is understood, monitored, and managed effectively in MISO real-time operations, as well as being evaluated and planned for in MISO long-range transmission planning studies. Short periods have occurred where both Boswell units have been offline together because of a combination of planned and unplanned outages. Through close coordination with MISO and other impacted utilities, reliability has been maintained but only because of ideal timing of the

[4] For additional information, please see Appendix F in Minnesota Power's Application for Approval of its 2021-2035 Integrated Resource Plan in Docket No. E015/RP-21-33.
[5] Docket No. E999/CI-19-704.

planned activities. During all occurrences of simultaneous outages, a more conservative approach to operations has been requested by MISO to limit the potential for reliability issues to arise should another unplanned event occur. Because of these limited periods of operation without Boswell and Minnesota Power outreach, MISO understands the issue, and both MISO and Minnesota Power are monitoring and responding to real-time indicators associated with the voltage stability issue. Over time, additional tools and improvements may be developed to increase operational awareness and management of the issue. It is also important to note that the voltage stability concerns are primarily associated with system conditions that typically occur during winter months. With at least one Boswell unit expected to be running through the winter months in the near future, the near-term risk of encountering voltage stability issues is lessened. Therefore, for the time being, regional voltage stability concerns are not an obstacle for transitioning one or both Boswell units to economic dispatch, assuming that at least one unit continues to be available for dispatch to support transmission reliability. However, as discussed in the System Strength Study, without improvements to the transmission system to replace the voltage support and system strength provided by the Boswell units, long-term intentional operation of the transmission system without the BEC units – such as when both units would be offline due to economic operation – would result in an unacceptable level of reliability risk and uncertainty. Therefore, until the long-term voltage support solutions discussed below are completed, specifically the Riverton STATCOM and the HVDC Modernization Project, only one Boswell unit at a time should run on economic dispatch to avoid transmission system reliability impacts.

In the last year, projects identified to address these issues have advanced in development. Minnesota Power is moving forward with the development of a new STATCOM project[6] to provide steady state and dynamic voltage support to the local backbone 230 kV network, with a targeted in-service date in early 2028. In June 2023, Minnesota Power filed a combined Certificate of Need and Route Permit Application for the HVDC Modernization Project,[7] which was later approved in an October 2024 Order.

[6] See discussion of MPUC Project Tracking No. 2021-NE-N21 in *2023 Biennial Transmission Projects Report*, pages 92-94. *(*MPUC Docket No. E999/M-23-91)
[7] Dockets Nos. E015, ET2/CN-22-607 and ET2/TL-22-611

This project will implement grid-supporting voltage source converter ("VSC") HVDC technology. The new VSC HVDC converter station, which is targeted to be in-service no later than April 2030, will also contribute to the long-term need for steady state and dynamic voltage support on Minnesota Power's local 230 kV network by maintaining the connection between the HVDC System and the Minnesota Power Arrowhead 230/115 kV Substation. In August 2023, Minnesota Power and Great River Energy filed a combined Certificate of Need and Route Permit Application for the Northland Reliability Project,[8] which was approved in a February 2025 Order. The Northland Reliability Project was approved by MISO in July 2022 as part of the Long Range Transmission Plan ("LRTP") Tranche 1 portfolio of multi-value projects. As stated in the application, the "[Northland Reliability] Project is needed to maintain transmission system reliability and optimize regional transfer capability as coal-fired generation ceases operations in northern Minnesota and significant renewable generation comes online in the upper Midwest." The Northland Reliability Project is targeted to be in-service by June 2030. Minnesota Power continues to monitor the timing of these critical transmission upgrade projects as it considers making a decision on the timing of moving BEC4 to economic dispatch.

E. Environmental Emission Compliance

Boswell deploys advanced air quality control technology equipment on both BEC3 and BEC4 which is designed to significantly reduce pollutant emissions to ultra-low levels of nitrogen oxides, sulfur dioxide, particulate matter, and mercury. To meet the required permit limits under economic dispatch operations, emission controls need to normalize over an operating period, as start-up and shut down cycling can lead to higher emission rates than baseload operation and ultimately impact flexibility to respond while operating within allowed permit limits.

In order to operate within permit levels, BEC3 and BEC4 may periodically need to be offered using the must run dispatch status for approximately three to five days to ensure that proper margin to emission limits can be maintained for the next shut down/start-up

[8] Dockets Nos. E015, ET2/CN-22-416 and ET2/TL-22-415

cycle. Shorter runs could be accommodated; however, every third to fifth start-up may require a longer run time to maintain margin to comply with permit requirements.

With BEC3 being consistently dispatched by MISO since its transition to economic dispatch, similar to a must run unit, Minnesota Power has not gained operational experience on emission impacts. However, the Company will continue to closely monitor emissions impacts due to economic dispatch and adjust offer parameters to optimize flexibility and emission margin.

F. Generating Facility Impacts

BEC3 and BEC4 have been designed for consistent, round the clock operation at full load. The use of these Units for cycling can lead to component damage and reliability problems. According to EPRI ("Electric Power Research Institute") these reliability impacts have been seen in the form of accelerated damage to boilers from corrosion and thermal fatigue and turbine problems associated with water chemistry. Corrosion and thermal fatigue develop over long periods of time and cycling increases the rate at which this occurs. There are methods to minimize the rate at which thermal fatigue occurs such as decreasing the ramp rate of the unit and maximizing the warm up period during start-up. There are also chemistry additions, such as Anodamine, that can be injected into the boiler to reduce corrosion fatigue. Anodamine, a proprietary filming amine, was selected as a candidate to inhibit the corrosion of low-pressure steam turbine steels. Minnesota Power is injecting Anodamine on BEC3 and on BEC4 on a continuous basis. Boiler chemistry is also a component impacted by unit cycling. This impact can be seen in the form of generation holds until adequate boiler chemistry can be achieved or negative impacts to turbine components. There are ways to minimize the generation holds related to boiler chemistry through the use of a polisher. A polisher is a device used to filter water condensed from steam as part of the steam cycle. It is frequently filled with polymer resins which are used to remove or exchange ions such that the purity of the condensate is maintained at acceptable levels. BEC4 has a polisher available for its operation as needed and with increased use, the cost to operate and maintain the polisher will increase.

When loads change or units are cycled on and off the consequences are numerous with pulverizers going off and on, fans speeds going up and down, furnace temperatures and heat profiles are altered, changes to pollution control requirements, steam and flue gas velocities vary, and so on. All of these changes create stresses and systems can be unsteady resulting in reliability impacts. In order to manage units effectively, it's important to understand the critical risks, such as higher costs, increased probability of failure, and rate of equipment degradation. Past research done by EPRI has demonstrated that the detrimental effects of cycling operation might not show up in the short term and that unique unit characteristics (age, design, metallurgy, etc.) and operational regimes make it difficult to accurately quantify and predict cycling impacts. Plant design, cycling regime, equipment condition, changes in operating practices, and changes in fuel all make it unlikely that a one-time assessment will produce an accurate result that can be used in the long run. Continued, longer term evaluation of components and systems needs to be done to fully recognize and minimize these reliability impacts.

Boiler Chemistry

Boiler cycle water chemistry programs are designed to protect the boilers and turbines from deposits due to impurities in the feedwater and steam systems. By moving to economic dispatch, it is very likely that each of the Boswell units may experience more frequent starts, resulting in the inability to stabilize boiler chemistry before the unit is shut down. This could increase the level of deposits and shorten the interval between required boiler cleanings. The estimated cost of boiler cleaning including disposal is $1.5 million per boiler. Minnesota Power has implemented preventative chemical treatments on BEC3 and BEC4 to maximize the time between boiler cleaning cycles.

Cycle chemistry holds may be a barrier to quickly and reliably returning a unit to service. The more impurities that are present in the feedwater and steam systems, the longer the water lab holds take, and the longer it takes to get the unit to a dispatchable load range during a start-up. A potential solution is to evaluate re-piping Unit 3 to the Unit 4 polisher, which would likely be in the range of $1 million. At this time Minnesota Power has been unable to determine the need for this solution, given BEC3 has been operating similar to a must run unit since its change to economic dispatch.

A sustainable boiler chemistry program is necessary so the units are flexible to meet the customer energy needs when regional renewables are unavailable and protect the asset from physical degradation and loss of reliability that would jeopardize their ability to come on-line for either a hot or cold start.

Auxiliary Equipment

Auxiliary equipment such as large electric motors, coal pulverizers, large fans, boiler feed pumps and boiler circulating water pumps were designed to be operated in a baseload manner. During economic dispatch the equipment will very likely experience more frequent starts and stops. The Company will train operators for the frequent starts and stops and adjust Preventative Maintenance and Predictive Maintenance programs accordingly.

Published data indicates that plants that have moved from baseload operation to economic commitment on a seasonal or annual basis have experienced widely variable effects to their operations. The variability is related to frequency and number of starts, operating time while running, size and operating temperature/pressure. At this time, the Company is unable to know definitively what the effect of economic dispatch will have on operating costs.

To maintain reliable operations, the Company will re-evaluate capital and O&M expenses based on experience with a new operating profile. At this time, no changes have occurred related to maintenance practices, since the units continue to be operating similar to a must run unit.

G. Staffing

Offering BEC4 as an economic dispatch unit is not anticipated to have any impact on planned staffing levels at Boswell. The Company's current staffing methodology is to share human resources between BEC3 and BEC4 and Boswell headcount has been determined for both units operating simultaneously. There may be times when a specific position will not need to be replaced in the event of one or both units not being dispatched, and a scheduled employee is ill or requests vacation. The determination of filling that

vacated position for that day will be made at the time of the occurrence and dependent on other planned work for that day.

H. Fuel Procurement and Fuel Operations

The Company's fuel procurement process consists of three components: coal procurement, rail transportation, and inventory management. Current coal procurement practices are a key attribute to ensuring low-cost energy for Minnesota Power customers. The following outlines the considerations and consequences, regarding coal procurement practices, under a significant change in Boswell Energy Center operations.

Coal Commodity Impact

Minnesota Power has coal commitments under contract until **[TRADE SECRET DATA BEGINS [redacted] TRADE SECRET DATA ENDS]** as part of a layered purchase strategy designed to secure competitive pricing as well as guarantee a portion of forecasted need per year in supply availability.

Even with a reasonable preparation period, procuring competitively priced coal becomes challenging under the conditions of economic operations. Volume requirement uncertainty requires a conservative procurement approach to avoid potential liquidated damages due to over-commitment. Competitive commodity pricing is often directly proportional to higher volume commitments so, in turn, a conservative volume approach would likely cause pricing to be in line with higher market pricing versus a volume incentivized price point. There is also risk that coal mines will already be fully committed and no longer have immediately available supply by the time Minnesota Power is ready to enter into additional contracts, leaving the options of no supply, alternate mines with lower quality, and/or higher pricing, particularly if additional tonnages are needed within a current calendar year.

Rail Transportation Impact

Minnesota Power is a captive shipper on the BNSF railroad, meaning no other rail transportation provider can deliver coal to the Boswell Energy Center. Minnesota Power's rail transportation binding tonnage nomination is due several months prior to each effective contract year. Transportation needs can be a challenge to determine accurately

with economic operations, especially during a period of volatile energy markets. Generation forecast error could result in significant liquidated damages due to over-commitment. Conversely, under-commitment would result in low inventory levels requiring potential unit idling during strong energy price periods and ultimately purchasing energy at a higher cost within the energy market. Reducing transportation tonnage commitments in preparation for economic dispatch would also negatively impact transportation contract price negotiation as economies of scale will be lost.

Tariff rail transportation rates are an alternative to binding contract tonnages but, with respect to customers, is not a financially responsible option as tariff rates are **[TRADE SECRET DATA BEGINS** [redacted] **TRADE SECRET DATA ENDS]** than negotiated contracted rates and also do not provide delivery performance certainty from the railroad. As a captive shipper, there is no substitute transportation supplier available to mitigate current rail transportation disruption risk.

Inventory and Fuel Operation Impacts

The rail transportation contract has an obligation of ratable deliveries throughout the year. Economic operations will lead to wide physical inventory fluctuations by accepting deliveries when the units are at a low/no generation level and failing to deliver enough coal to keep inventory levels constant during high generation demand. Physical inventory levels would likely need to be maintained at a higher volume than current levels to handle generation volatility which equates to higher carrying costs and expense.

Inconsistent inventory levels translate to higher O&M costs for Fuel Operations by having to either push coal to or from the stockpile versus maintaining a consistent inventory level. Inventory management practices will need to be revised to ensure proper staffing and equipment capabilities to effectively mitigate increased operational costs of controlling wide inventory fluctuations.

Balancing coal commodity, rail transportation, coal inventory and operational risks are all challenges Minnesota Power is currently navigating with BEC3 on economic dispatch.

I. Fuel Adjustment Clause Impacts

Minnesota Power would like to bring awareness that a move to economic dispatch at both Boswell units could result in additional Fuel Adjustment Clause ("FAC") volatility. The Company has identified that procurement of coal can be a challenge when the energy markets change significantly throughout the year.

IV. OPERATING PROCEDURES AND PHYSICAL MODIFICATIONS TO UNITS

In July 2021, BEC3 transitioned to economic commitment dispatch status. In addition, Minnesota Power invested $4.0 million into BEC3 to significantly reduce the operational minimums of the unit from 175 MW to 75 MW, creating considerably more flexibility for the unit in its daily dispatch. This project was completed in November 2021.

In 2018, Minnesota Power reduced the operational minimums for BEC4 from approximately 300 MW to 210 MW. In December 2021, BEC4 was able to lower the Emergency Minimums from 210 MW to 185 MW. At this time there have been no other projects identified; however, Minnesota Power will continue to explore other opportunities.

V. COAL OPERATIONS

On February 1, 2021, Minnesota Power submitted its 2021-2035 Integrated Resource Plan[9] ("IRP") which announced its vision for a carbon-free future. As part of the approved IRP,[10] BEC3 will cease coal operations by 2030 and BEC4 will cease coal operations by 2035. On March, 1, 2025, Minnesota Power will submit its 2025 IRP, communicating its plans for replacing coal energy at BEC3 and BEC4. Minnesota Power will provide an update in next year's Self-Commitment and Self-Scheduling of Large Baseload Generation Facilities on any impacts the 2025 IRP Plan has on economic dispatch operations at BEC3 and BEC4.

VI. CONCLUSION

The Boswell Energy Center continued to be a valuable and reliable asset for Minnesota Power and its customers as the energy markets continued to experience pricing volatility driven by fuel prices, dispatchable generation retirements, and increasing intermittent renewables on the system. Although the Company does not have a firm date at this time for when BEC4 will transition to economic dispatch, Minnesota Power continues to

[9] Docket No. E015/RP-21-33
[10] January 9, 2023 Order.

address the remaining milestones while monitoring energy markets and customer impacts.

Dated: March 3, 2025

Respectfully Submitted,

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PUBLIC DOCUMENT
TRADE SECRET DATA
EXCISED IN ITS ENTIRETY

Attachment 1

PUBLIC DOCUMENT
TRADE SECRET DATA
EXCISED IN ITS ENTIRETY

Attachment 2

Minnesota Power
Wind Energy Purchase Agreement with
FPL Docket No. E015/M-05-975
Dated December 20, 2005

	Oliver County I			
	FPL Wind Energy in FAC (MWh)	Curtailments of Wind Energy MWh	Curtailment Payments by MP	Reason Codes
	[TRADE SECRET DATA BEGINS			
January 2024				2
February 2024				2
March 2024				2
April 2024				2
May 2024				2
June 2024				2
July 2024				2
August 2024				2
September 2024				2
October 2024				2
November 2024				2
December 2024				2
Total				

TRADE SECRET DATA ENDS]

1. Minnesota Power's refusal to accept Contract Energy at the Point of Delivery as a result of low load conditions that justify not accepting Contract Energy; or
2. The availability of less expensive energy from another source; or
3. Minnesota Power's election to use non-firm transmission services to deliver Contract Energy.

Minnesota Power
Wind Energy Purchase Agreement with
FPL Docket No. E015/M-05-975
Dated December 20, 2005

	Oliver County II			
	FPL Wind Energy in FAC (MWh)	Curtailments of Wind Energy MWh	Curtailment Payments by MP	Reason Codes
	[TRADE SECRET DATA BEGINS			
January 2024				2
February 2024				2
March 2024				2
April 2024				2
May 2024				2
June 2024				2
July 2024				2
August 2024				2
September 2024				2
October 2024				2
November 2024				2
December 2024				2
Total				

TRADE SECRET DATA ENDS]

1. Minnesota Power's refusal to accept Contract Energy at the Point of Delivery as a result of low load conditions that justify not accepting Contract Energy; or
2. The availability of less expensive energy from another source; or
3. Minnesota Power's election to use non-firm transmission services to deliver Contract Energy.

Minnesota Power
Bison Wind Energy Curtailment Reporting
Docket No. E015/M-09-285; Dated
Docket No. E015/M-11-234; Dated September 8, 2011
Docket No. E015/M-11-626; November 2, 2011

	Bison	
	Delivered MWh	Lost MWh
	[TRADE SECRET DATA BEGINS	
January 2024	[redacted]	
February 2024		
March 2024		
April 2024		
May 2024		
June 2024		
July 2024		
August 2024		
September 2024		
October 2024		
November 2024		
December 2024		
Total		

TRADE SECRET DATA ENDS]

Minnesota Power
Wind Energy Purchase Agreement with Nobles 2
Docket No. E015/M-18-545
Dated January 23, 2019

	Nobles 2		
	Nobles Wind Energy in FAC (MWh)	Curtailments of Wind Energy MWh	Curtailment Payments by MP
	[TRADE SECRET DATA BEGINS		
January 2024	[redacted]		
February 2024			
March 2024			
April 2024			
May 2024			
June 2024			
July 2024			
August 2024			
September 2024			
October 2024			
November 2024			
December 2024			
Total			

TRADE SECRET DATA ENDS]

STATE OF MINNESOTA)
) ss
COUNTY OF ST. LOUIS)

AFFIDAVIT OF SERVICE VIA ELECTRONIC FILING

Kristine Bergren of the City of Duluth, County of St. Louis, State of Minnesota, says that on the 3rd day of March, 2025, she served Minnesota Power's Annual Compliance Filing of its 2024 Report in **Docket No. E999/CI-19-704** on the Minnesota Public Utilities Commission and the Energy Resources Division of the Minnesota Department of Commerce via electronic filing. The persons on E-Docket's Official Service List for this Docket were served electronically.

Kristine Bergren