minnesota power
AN ALLETE COMPANY

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August 31, 2012

VIA E-FILING
Dr. Burl W. Haar
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101-2417

Re: In the Matter of Minnesota Power's Boswell Energy Center Unit 4
Environmental Retrofit Project - Mercury Emission Reduction Plan Petition
Docket No. E015/M-12-920

Dear Dr. Haar:

Through the enclosed Petition, Minnesota Power submits to the Minnesota Public Utilities Commission and the Minnesota Pollution Control Agency its Boswell Energy Center Unit 4 ("BEC4") Mercury Emission Reduction Plan in compliance with Minn. Stat. § 216B.6851. Minnesota Power's Plan for BEC4 will cost-effectively achieve significant environmental benefits in BEC4's operation and help to ensure this core resource operates safely, reliably and compliantly on behalf of Minnesota Power's customers for years to come.

Retrofitting BEC4 to reduce mercury emissions and improving other aspects of its environmental performance as requested in this Petition will help to ensure BEC4 continues to deliver a large volume of essential energy to residents, communities and businesses in Northern Minnesota at a reasonable cost. At 585 MW of net capacity, BEC4 is the single largest base load generator in Minnesota Power's fleet, providing cost-effective and reliable power to Minnesota Power's customers. Because much of Minnesota Power's total energy supply is used by industrial customers that operate around the clock, the Company has a uniquely high load factor, requiring a power supply that is more steady than that of most utilities. Over half of the electricity Minnesota Power sells to retail customers is purchased by its 12 largest industrial customers. As well, Minnesota Power is anticipating significant customer growth in both energy and demand over the next decade. BEC4 has a key role in meeting present and future demand and energy needs on Minnesota Power's system.

Minnesota Power is required by Minnesota's Mercury Emission Reduction Act ("MERA") to file a 90 percent mercury reduction plan for BEC4 by July 1, 2015 and implement the plan by December 31, 2018. Under the project schedule outlined in this Petition, Minnesota

Power would be in compliance with MERA more than two years in advance of when required, providing significant environmental benefits to Northeastern Minnesota and the state as a whole.

Minnesota Power has been proceeding strategically and thoughtfully in determining the appropriate action for BEC4 compliance with MERA, the Environmental Protection Agency's recently finalized Mercury and Air Toxics Standard Rule and other existing and pending state and federal environmental regulations in order to make prudent investments in BEC4 on behalf of Minnesota Power's customers. Although several of the federal rulemakings affecting utility emissions are not yet final, Minnesota Power believes it now has sufficient information and access to proven environmental control technologies that will ensure Minnesota Power's compliance with current and future environmental regulations for BEC4 over the long term.

In accordance with Minn. Rule 7829.1300, Minnesota Power has included a Summary with this filing. As reflected in the attached Affidavit of Service, the Summary has been filed on the official general service list utilized by Minnesota Power as well as the 2010 Integrated Resource Plan service list.

Pursuant to the Commission's revised Procedures for Handling Trade Secret and Privileged Data in furtherance of the intent of Minn. Stat. § 13.37 and Minn. Rule 7829.0500, Minnesota Power has designated portions of the Appendix to the attached Petition as Trade Secret. Minnesota Power has removed certain information from the Report to prevent disclosure of the Company's information regarding its methods, techniques, and process for identifying, obtaining, managing, and comparing various resources. This is highly confidential information; Minnesota Power's competitors, as well as its potential suppliers, would gain a commercial advantage over Minnesota Power if this information were publicly available. Minnesota Power follows strict internal procedures to maintain the secrecy of this information in order to capitalize on the economic value of the information for Minnesota Power's customers. Public availability of this information could economically harm Minnesota Power and its customers in terms of energy supply provision or acquisition. Minnesota Power and its customers would suffer in providing resources to its retail load. Minnesota Power respectfully requests the opportunity to provide additional justification in the event of a challenge to the trade secret designation provided herein.

Please contact me at (218) 355-3601 with any questions related to this matter.

Yours truly,

Lori Hoyum

Lori Hoyum
Policy Manager

Enc.

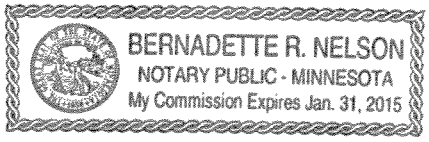
STATE OF MINNESOTA)
) ss
COUNTY OF ST. LOUIS)

AFFIDAVIT OF SERVICE VIA ELECTRONIC FILING

Jodi Nash of the City of Duluth, County of St. Louis, State of Minnesota, says that on the 31st day of August, 2012, she served Minnesota Power's Mercury Emission Reduction Plan Petition to the Minnesota Public Utilities Commission and the Energy Resources Division of the Minnesota Department of Commerce via electronic filing. The remaining parties on the attached service list were served the Summary as so indicated on the list.

Subscribed and sworn to before
me this 31st day of August, 2012.

Notary Public - Minnesota
My Commission Expires 1/31/2015



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STATE OF MINNESOTA
BEFORE THE
MINNESOTA PUBLIC UTILITIES COMMISSION

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In the Matter of Minnesota Power's Boswell Energy Center Unit 4 Environmental Retrofit Project	Docket No. E015/M-12-920 **MERCURY PLAN FILING**

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SUMMARY OF FILING

Minnesota Power submits to the Minnesota Public Utilities Commission and Minnesota Pollution Control Agency its mercury emission reduction plan filing for Boswell Energy Center Unit 4 ("BEC4") in compliance with Minn. Stat. § 216B.6851. Minnesota Power plans to execute an environmental retrofit project on BEC4 as a multi-pollutant solution for reducing mercury, particulate matter, sulfur dioxide, and other hazardous air pollutants being addressed by United States Environmental Protection Agency ("EPA") regulations while also reducing plant wastewater. Minnesota Power plans to install a semi-dry flue gas desulfurization system, fabric filter and powder activated carbon injection system to help achieve compliance with the Minnesota Emission Reduction Act ("MERA"), the EPA Mercury and Air Toxics Rule, and other enacted or pending federal and state environmental rulemakings regulating air and water emissions and solid byproducts from coal-fired power plants. Through multi-pollutant control technology, Minnesota Power will cost-effectively achieve the mercury emission reduction required by MERA while ensuring compliance with other regulatory programs over the long term.

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List of Acronyms, Terms and Description

Acronym	Term
AFR	Annual Electric Utility Forecast Report
AFUDC	Allowance for Funds Used During Construction
AQCS	Air Quality
AREA	Arrowhead Regional Emission Abatement Plan
BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
CCOFA	Closed Coupled Over-fire Air
BEC	Boswell Energy Center (Units 1, 2, 3 & 4)
BEC3	Boswell Energy Center Unit 3
BEC3 Plan	Boswell Energy Center Unit 3 Environmental Retrofit Plan
BEC4	Boswell Energy Center Unit 4
BEC4 Plan Petition	BEC4 Mercury Emission Reduction Plan Petition
BEC4 Project	BEC4 Environmental Retrofit Project
CAIR	Clean Air Interstate Rule
CCGT	Combined Cycle Gas Turbine
CCR	Coal Combustion Residuals Regulation (coal ash)
CDS	Circulating Dry Scrubber
Commission	Minnesota Public Utilities Commission
CO_2	Carbon Dioxide
CROW	Control Room Operator Window (MISO Outage Process)
CSAPR	Cross State Air Pollution Rule
DSM	Demand Side Management
EPA	United States Environmental Protection Agency
ESP	Electrostatic Precipitator
FF	Fabric Filter (also referred to as a baghouse)
FGD	Flue Gas Desulfurization
GHG	Greenhouse Gas
GW	Gigawatt
GWh	Gigawatt hour
HAP	Hazardous Air Pollutant(s)
HCl	Hydrochloric acid
HF	Hydrogen fluoride

Acronym	Term
Hg	Mercury
H_2SO_4	Sulfuric Acid
ICAP	Installed Capacity
ID	Induced draft fans
kW	Kilowatt
L&C	Load and capability
lb/MMBtu	One million British thermal units
lb/TBtu	Trillion British thermal units
LAER	Lowest Available Emission Rate
LNB/OFA	Low NO_x burners with over-fire air
MACT	Maximum Achievable Control Technology
MATS	Mercury and Air Toxics Standards
MERA	Minnesota Mercury Emissions Reduction Act
MISO	Midwest Independent Transmission System Operator
MPCA	Minnesota Pollution Control Agency
MW	Megawatt
MWh	Megawatt hour
NAAQS	National Ambient Air Quality Standards
ND	North Dakota
NSPS	New Source Performance Standards
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NSR	New Source Review
OPG	Ontario Power Generation
O&M	Operation and maintenance
PAC	Powder Activated Carbon (similar to Activated Carbon Injection (ACI))
Pb	Lead
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
PM10	Particulate Matter with a Diameter of 10 Micrometers or Less
ppm	Parts per million
PRB	Powder River Basin
PSD	Prevention of Significant Deterioration
PVRR	Present Value of Revenue Requirement

Acronym	Term
RACT	Reasonably Achieved Control Technology
RBLC	Central database of air pollution technology (RACT/BACT/LAER)
RCRA	Resource Conservation and Recovery Act
SC Aero	Simple Cycle Aero Derivative
SC CT	Simple Cycle Combustion Turbine
SC RICE	Simple Cycle Reciprocating Internal Combustion Engine
SCPC	Supercritical Pulverized Coal
SCR	Selective Catalytic Reduction
SDA	Spray Dry Absorber
SIP	State Implementation Plan(s)
SNCR	Selective Non-Catalytic Reduction
SOFA	Separated over-fire air
SO_2	Sulfur Dioxide
Stat.	Statute (Minnesota Statute(s))
Tailoring Rule	Title V Greenhouse Gas Tailoring Rule
THEC	Taconite Harbor Energy Center (Units 1, 2 & 3)
THEC3	Taconite Harbor Energy Center Unit 3
UCAP	Unforced Capacity
ug/m^3	Micrograms per Cubic Meter of Air
VFD	Variable Frequency Drives
Young 2	Square Butte's Milton R Young lignite coal generating station
WACC	Weighted Average Cost of Capital
WFGD	Wet Flue Gas Desulfurization
316(b)	Cooling water intake rule

TECHNOLOGY SPECIFIC

Acronym	Term	Description
FGD	Flue Gas Desulfurization	Used generically to reference all technologies removing SO_2 from the flue gas.
WFGD	Wet Flue Gas Desulfurization	This is a wet SO_2 removal system. BEC4 currently utilizes this technology for SO_2 removal.
SDFGD	Semi-dry Flue Gas Desulfurization	Used generically to reference all semi-dry technologies including *spray dry absorber*, *circulation dry scrubber* and *NID*.
-	Scrubber	Used generically to reference pollutant removal systems

Acronym	Term	Description
		including wet FGD, semi-dry FGD, dry sorbent injection, and wet particulate removal systems.
CDS	Circulating Dry Scrubber	A newer semi-dry technology that sprays lime and water into the flue gas separately which allows for better control for varying coal blends. Minnesota Power uses this term generically to reference all forms of this technology including NID.
-	NID	A form of the CDS technology.
SDA	Spray Dry Absorber	An older technology used with SDFGD systems that utilize a high speed nozzle to distribute a water/lime mixture into the flue gas.
-	Absorber Tower	This refers to the tower section in a WFGD that contains the lime sprays that remove the SO_2. This is the main component in a WFGD.
-	Vertical Reactor Tower	This refers to the tower section in a SDFGD that contains a mixture of lime and fly ash for the removal of SO_2. This is the main component in a SDFGD.

STATE OF MINNESOTA
BEFORE THE
MINNESOTA PUBLIC UTILITIES COMMISSION

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In the Matter of Minnesota Power's Boswell Energy Center Unit 4 Environmental Retrofit Project	Docket No. E015/M-12-920 **MERCURY PLAN FILING**

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I. INTRODUCTION

Minnesota Power respectfully submits its Mercury Emission Reduction Plan Petition ("BEC4 Plan Petition" or "Petition") to the Minnesota Public Utilities Commission ("Commission") and Minnesota Pollution Control Agency ("MPCA") seeking approval of its Boswell Energy Center Unit 4 ("BEC4") Environmental Retrofit Project ("BEC4 Project" or "Project") in compliance with Minn. Stat. § 216B.6851. Minnesota Power has been proceeding strategically and thoughtfully in determining the appropriate action for BEC4 compliance with Minnesota's Mercury Emission Reduction Act ("MERA") and other existing and pending state and federal environmental rulemakings in order to make prudent investments on behalf of Minnesota Power's customers. Although several of the federal rulemakings potentially affecting BEC4 are not yet final, Minnesota Power believes it now has sufficient information and access to proven environmental control technologies that will help to ensure Minnesota Power's compliance with current and pending environmental regulations over the long term for BEC4 through the plan proposed in this Petition.

At 585 MW of net capacity, BEC4 is the newest and single largest base load generator in Minnesota Power's fleet, providing cost-effective and reliable power to Minnesota Power's customers 24 hours a day, 7 days a week. Because more than 50 percent of Minnesota Power's total energy supply is used by its 12 largest industrial customers that operate around the clock, the Company has a uniquely high load factor, requiring a power supply that is more steady than that of most utilities. Retrofitting BEC4 to reduce mercury emissions by 90 percent, and improving other aspects of its environmental performance as requested in the Petition, will help ensure BEC4 continues to deliver a large volume of essential energy to residents, communities and businesses in Northeastern Minnesota at a reasonable cost.

As described in this Petition, Minnesota Power's long-term outlook for energy and capacity needs supports Minnesota Power's decision to move forward with the BEC4 Project. Minnesota Power is anticipating significant growth in both energy and demand over the next decade. BEC4 is a critical base load asset in Minnesota Power's long-term resource strategy as outlined in the Company's Commission accepted 2010 Integrated Resource Plan. The BEC4 Project is an economic, cost-effective plan for meeting customer energy needs and it allows BEC4 to remain a low cost and reliable generation asset capable of meeting those needs safely and reliably. For these reasons, Minnesota Power has already made significant investments in BEC4 to reduce NO_x emissions and replace the original turbine with a more efficient design that produces an additional 50 MW of emission-free capacity and energy. The proposed technology for the BEC4 retrofit is commercially available and has proven performance when installed on utility scale projects.

Minnesota Power has studied many options for meeting environmental regulations on BEC4 and its other units including those for mercury, oxides of nitrogen ("NO_x"), sulfur dioxide ("SO_2") and particulate matter ("PM"). Technology choices, economic projections, resource needs, customer cost impacts and project execution were key factors in this extensive assessment. Recognizing that the best alternative for any one pollutant may not provide the best overall solution for meeting other pollutant control requirements, Minnesota Power's goal was to choose a multi-pollutant control technology that cost-effectively optimizes the reductions for targeted pollutants while maintaining or enhancing unit efficiency. The BEC4 Project is a reasonable and cost-effective multi-pollutant solution to reducing mercury, SO_2, PM and other hazardous air pollutants identified by the United States Environmental Protection Agency ("EPA") while also significantly reducing wastewater from BEC4 operations.

Minnesota Power is required by MERA and the recent EPA-issued Mercury and Air Toxics Standard ("MATS") Rule to reduce mercury and other pollutants on BEC4 within a specific timeframe. MERA requires Minnesota Power to file a 90 percent mercury reduction plan for BEC4 by July 1, 2015 and implement the plan by December 31, 2018. Under the project schedule described herein, Minnesota Power will be in compliance with MERA more than two years in advance of when required, providing significant environmental benefits to Northeastern Minnesota and the state. The EPA's issuance of the MATS Rule for mercury

reduction and other air pollutants in December of 2011 was a key factor in the timing of submitting the BEC4 Plan Petition. With anticipated Commission approval of this Petition in 2013 and the granting of a one-year project implementation extension by the MPCA, Minnesota Power will comply with MATS and MERA timely.

By proactively managing the design, engineering and procurement of the project, Minnesota Power will be able to deliver an on-time, cost-effective multi-pollutant solution for BEC4. Among other measures that will be undertaken, to ensure successful construction, the Company will obtain competitive quotations for major purchases and award contracts to the lowest evaluated bidder(s), secure majority percent of the total cost of the BEC4 Project in fixed fee/lump sum contracts, utilize proven contractors with demonstrated bidding, construction management, and supplement its internal construction management team with a team from an external engineering/construction management company to provide additional support and expertise.

II. MINNESOTA STATUTORY BACKGROUND

A. Minnesota Power's BEC4 Mercury Emission Reduction Plan under MERA

1. Mercury Option under Minn. Stat. § 216B.6851

The Minnesota Mercury Emissions Reduction Act was signed into law on May 11, 2006. (Minn. Stat. § 216B.6851, subd. 5) The Act targeted six generating units at Minnesota's three largest coal-fired power plants.[1] The original legislation called for Minnesota Power to file with the Commission a 90 percent mercury reduction plan for one of its two wet-scrubbed units, Boswell Energy Center Unit 3 ("BEC3"), by December 31, 2007, with plan implementation by December 31, 2010. The mercury reduction plan for Minnesota Power's second unit, BEC4, was to be filed with the Commission by July 1, 2011, with plan implementation completed by December 31, 2014.[2]

A bill was signed into law on May 14, 2010 which extended the plan filing date for BEC4 to July 1, 2015 and its plan implementation date to December 31, 2018. The legislation also stipulated that Minnesota Power submit to the Commission and MPCA, beginning by July 1, 2011, a yearly report outlining its emission reduction analysis and potential plans for BEC4. On June 30, 2011, Minnesota Power submitted its 2011 Mercury Emission Reduction Plan Report to the Commission in compliance with MERA. The Report provided insight into Minnesota Power's planning and analysis process as it evaluates how best to achieve compliance with Minnesota's mercury reduction regulations at BEC4. On July 2, 2012, Minnesota Power submitted its 2012 Mercury Emission Reduction Plan Report updating the Commission, MPCA, and other stakeholders in compliance with Minn. Stat. § 216B.6851, subd. 5. Minnesota Power's 2011 and 2012 Mercury Emission Reduction Plan Reports are attached to this Petition as Exhibits 1 and 2, respectively.

2. Other Environmental Improvement Plans under Minn. Stat. §216B.686

In order to encourage utilities to address multiple emissions and recognizing the integrated nature of these emission reductions, MERA allows utilities required to submit

[1] Minnesota's three largest coal-fired power plants at the time the legislation was enacted were: Xcel Energy's Sherco and Allen S. King plants and Minnesota Power's BEC, also known as the Clay Boswell Plant.

[2] One year extensions on both the plan filing and implementation can be obtained with Commission approval. See Minn. Stat. §216B.685, subd. 4(b).

mercury emissions reduction plans to "also propose plans for investments and related expenses in pollution control equipment to be installed at facilities in Minnesota needed to comply with state or federal emission control statutes or regulations that became effective after December 31, 2004." Minn. Stat. § 216B.686, subd. 1(a). For this Petition, these statutes or regulations include plans that meet or exceed the MATS Rule regulating hazardous air pollutants emitted from coal-fired utility units greater than 25 MW; the Cross-State Air Pollutant Rule ("CSAPR") regulating emissions that contribute to ozone and/or fine particulate pollution in other states; and National Ambient Air Quality Standards ("NAAQS") established to protect human health ("primary standards") or public welfare ("secondary standards") and regulates a state's air quality related to ground level ozone, fine particulate matter ("$PM_{2.5}$"), SO_2 and NO_x. Accordingly, Minnesota Power's BEC4 Project is a comprehensive approach that includes the installation of cost-effective control technology that provides increased environmental and public health benefits while ensuring compliance with these and other regulatory programs over the long term. MATS, CSAPR, NAAQS and several other federal rulemakings regulating air and water emissions and solid byproduct from coal-fired power plants that have recently been, or may be enacted by 2019, are discussed in detail in Section IV.

3. MPCA's Review Requirements under MERA

The MPCA review requirements under Minn. Stats. §§ 216B.684 and 216B.686, subd.3 are as follows.

Minn. Stat. § 216B.684

(1) Assess whether Minnesota Power's Boswell 4 Plan meets Minn. Stat. § 216B.682, subd. 3 (Mercury Emissions Plans Generally).

(2) Evaluate the environmental and public health benefits, including benefits associated with mercury and non-mercury emission reductions.

(3) Assess the technical feasibility and cost effectiveness of the mercury reduction technologies.

(4) Advise the Commission of the appropriateness of Minnesota Power's Boswell 4 Plan.

Minn. Stat. § 216B.686, subd. 3

(1) Verification that the Boswell 4 Plan is being installed on facilities in Minnesota and will achieve the emission control of applicable state or federal emission control statutes or regulations under Minn. Stat. § 216B.686, subd 1 (Utility filing)

(2) A description of the Boswell 4 Plan environmental benefits.

(3) An assessment of the overall appropriateness of the Boswell 4 Plan.

4. Current Cost Recovery of Investments and Expenditures for the BEC4 Project

Minn. Stat. § 216B.683 and Minn. Stat. § 216B.1692, provide the ability for Minnesota Power to seek approval for current cost recovery of investments and expenditures related to compliance with MERA through an emission-reduction rate rider. A subsequent filing for cost recovery of investments and expenditures for the BEC4 Project will be submitted to the Commission for consideration and approval at a future date.[3]

B. Statutory Requirements Compliance Guide

The following chart lists individual statutory requirements for the plan proposed within this Petition and where they are addressed in this filing.

Statute	Requirements	Location
Minn. Stat. 216B.682	MERCURY EMISSIONS-REDUCTION PLANS	V, VII
Subdivision 3.	Mercury Emissions Plans Generally	--
(a)	In each plan submitted under this section, a utility shall present information assessing that plan's ability to optimize human health benefits and achieve cost efficiencies. Each plan must provide the cost, technical feasibility, and mercury emissions reduction expected for the utility's preferred technology option and each alternative considered. The utility shall demonstrate that it has considered achieving the mercury emissions reduction required under this section through multiple pollutant control technology.	V.A.3, V.C.3.a, V.C.3.c., V.C.3.d., V.C.3.e., VI, VIII
(b)	A plan submitted under this section may also:	--
(1)	provide measures to reduce the cost and maximize the flexibility of each option proposed or considered	V.A.3., VI.A., VIII

[3] Per Minn. Stat. §216B.1692, subd. 2., a public utility must submit its plan filing for its emissions-reduction project at least 60 days in advance of a petition seeking approval of cost recovery and establishment of a rider.

Statute	Requirements	Location
(2)	specify permit targets or conditions proposed by the public utility for each mercury emission-control option proposed or considered, including, but not limited to, numeric emission targets, percent removal expectations, emission control technology installation and operation requirements or work practice standards, and potential changes in the performance of the mercury emissions-reduction technology over time	V.C.3.e.
Minn. Stat. 216B.684	ENVIRONMENTAL ASSESSMENT OF MERCURY EMISSIONS-REDUCTION PLAN	--
	The Pollution Control Agency shall evaluate a utility's mercury emissions-reduction plans filed under sections 216B.682 and 216B.6851 and submit its evaluation to the Public Utilities Commission within 180 days of the date the plan is filed with the agency and commission. In its review, the agency shall (1) assess whether the utility's plan meets the requirements of section 216B.682 or 216B.6851, as applicable, (2) evaluate the environmental and public health benefits of each option proposed or considered by the utility, including benefits associated with reductions in pollutants other than mercury, (3) assess the technical feasibility and cost-effectiveness of technologies proposed or considered by the utility for achieving mercury emissions reduction, and (4) advise the commission of the appropriateness of the utility's plan. In preparing its assessment, the agency may request additional information from the utility, especially with regard to alternative technologies or configurations applicable to the specific unit, and the estimated costs of those alternatives.	II.A.3., III.F.
Minn. Stat. 216B.6851	UTILITY OPTION	--
Subdivision 1	Election	II.A.1.
Subdivision 2	Supplemental Unit	V.C.3.b.
Subdivision 3	Plan for 90% reduction required	II.A.1, V, V.C.3.c.
Subdivision 4	Alternative plans	VII
Subdivision 5	Early action; wet scrubbed units	--

Statute	Requirements	Location
(a)	The utility may have until July 1, 2015, to file its plans for reduction at its other wet scrubbed unit at the qualifying facility, and may have until December 31, 2018, to implement mercury emissions reduction at that unit.	II.A.1.
Subdivision 6	Agency review and commission approval	II.A.1., III.F.
(a)	The agency shall review the utility's plans as provided in section 216B.684.	II.A.3.
(b)	The Public Utilities Commission shall review and evaluate a utility's mercury emissions-reduction plans submitted under this section. In its review, the commission shall consider the environmental and public health benefits, the agency's determination of technical feasibility, competitiveness of customer rates, and cost-effectiveness of the utility's proposed mercury-control initiatives in light of the Pollution Control Agency's review under paragraph (a). Within 180 days of receiving the agency's report, the commission shall approve a utility's mercury emissions-reduction plan that the commission reasonably expects will come closest to achieving total mercury reductions at targeted and supplemental units owned by the utility equivalent to a goal of 90 percent reduction of mercury emissions at the utility's targeted units by December 31, 2018, in a manner that provides for increased environmental and public health benefits without imposing excessive costs on the utility's customers. If the commission is unable to approve the utility's 90 percent reduction plan filed under subdivision 3, the commission, in consultation with the Pollution Control Agency, shall order the utility to implement the most stringent mercury-control alternative proposed by the utility under this section that provides for increased environmental and public health benefits without imposing excessive costs on the utility's customers.	II.A.3., III.F.
(c)	At each targeted and supplemental unit included in a plan under this section, a utility shall propose to implement mercury emissions-control measures that will result in the greatest reduction of mercury emitted from that unit that is technically feasible without imposing excessive costs.	V

Statute	Requirements	Location
Minn. Stat. 216B.686	OTHER ENVIRONMENTAL IMPROVEMENT PLANS	II.A.2.
Subdivision 1	Utility filing	--
(a)	In order to encourage a utility to address multiple pollutants, a utility required to submit mercury-reduction plans under sections 216B.68 to 216B.688 may also propose plans for investments and related expenses in pollution control equipment to be installed at facilities in Minnesota needed to comply with state or federal emission-control statutes or regulations that became effective after December 31, 2004.	IV, V
(b)	For each plan, the utility must show that the investments in pollution control equipment to be installed at facilities in Minnesota under the plan will provide for increased environmental and public health benefits, do not impose excessive costs on the utility's customers, and will achieve at least the pollution control required by applicable state or federal regulations.	V.A.3., V.C.1.a., V.C.1.c., V.C.1.d.
Subdivision 2	Emissions-reduction riders	--
Subdivision 3	Agency Review	--
(1)	verification that the emissions-reduction project qualifies under subdivision 1	--
(2)	description of the projected environmental benefits of the proposed project	II.A.3, V.C.1.a., V.C.1.d.
(3)	its assessment of the appropriateness of the proposed plans	II.A.3.
Subdivision 4	Commission approval	II

III. PROCEDURAL MATTERS

Pursuant to Minn. Rule 7829.1300, Minnesota Power provides the following required general filing information.

A. Summary of Filing (Minn. Rule 7829.1300, subp. 1)

A one-paragraph summary accompanies this petition.

B. Service on Other Parties (Minn. Rule 7829.1300, subp. 2)

Pursuant to Minn. Stat. § 216.17, subd. 3 and Minn. Rules 7829.1300, subp. 2, Minnesota Power eFiles the BEC4 Plan Petition on the Department of Commerce - Division of Energy Resources ("the Department") and the Minnesota Office of the Attorney General – Antitrust and Utilities Division. Pursuant to Minn. Stat. § 216B.684 the MPCA is being served a copy. A summary of the filing prepared in accordance with Minn. Rules 7829.1300, subp. 1 is being served on Minnesota Power's general service list.

C. Name, Address and Telephone Number of Utility (Minn. Rule 7829.1300, subp. 4(A))

Minnesota Power
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(218) 722-2641

D. Name, Address and Telephone Number of Utility Attorney (Minn. Rule 7829.1300, subp. 4(B))

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E. Date of Filing and Date Proposed Rate Takes Effect (Minn. Rule 7829.1300, subp. 4(C))

This Petition is being filed on August 31, 2012. The proposed effective date of the BEC4 Environmental Retrofit Project Rider is the date of the Commission's Order.

F. Statute Controlling Schedule for Processing the Filing

This petition is made pursuant to Minn. Stat. § 216B.6851. Pursuant to Minn. Stat. § 216B.683, subd. 1(a), Minnesota Power may file for approval of its BEC4 Environmental Retrofit Project Rider under Minn. Stat. § 216B.1692, subd. 3. As provided under Minn. Stat. § 216B.1692, subds. 2 and 3, Minnesota Power will be filing a petition to recover the costs of the BEC4 Project not less than 60 days after submitting this petition. Under Minn. Stat. § 216B.1692, subd. 5(a), the Commission is required to wait until after receiving the MPCA's environmental assessment of Minnesota Power's BEC4 Plan Petition proposal before proceeding with written and oral comments. Also, under Minn. Stat. §§ 216B.6851, subd. 6(b) and 216B.686, subd. 4, within 180 days of receiving the MPCA's environmental assessment the Commission shall approve the petition and associated emissions reduction rider if the Commission finds the BEC4 Plan Petition meets applicable Mercury Act requirements. Finally, Minn. Stat. § 216B.16, subd. 1 requires 60 days notice to the Commission of a proposed rate change, after which time the proposed rate change takes effect unless suspended.

G. Utility Employee Responsible for Filing (Minn. Rule 7829.1300, subp. 4(E))

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H. Impact on Rates and Services (Minn. Rule 7829.1300, subp. 4(F))

The BEC4 Plan Petition will have no effect on Minnesota Power's base rates. Customer rate impact information is provided in Section VI.

I. Service List (Minn. Rule 7829.0700)

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IV. ENVIRONMENTAL CONSIDERATIONS

A. Assessment of Likely Federal Laws to be Enacted by 2019

Minnesota Power is closely following and assessing several federal rulemakings regulating air and water emissions and solid waste from coal-fired power plants that have recently been, or may be enacted by 2019. In addition to the MERA, these federal regulations will or could impact BEC4. In the following paragraphs, Minnesota Power describes the federal rulemakings it is following relative to BEC4 and its current assessment of their applicability to BEC4.

1. Air Regulations

Mercury and Air Toxics Standards

Under Section 112 of the Clean Air Act, the EPA is required to set emission standards for hazardous air pollutants ("HAPs") for certain source categories. The EPA published the final Mercury and Air Toxics Rule, also known as the MATS Rule, in the Federal Register on February 16, 2012, addressing such emissions from coal-fired utility units greater than 25 MW. There are currently 188 listed HAPs that the EPA is required to evaluate for establishment of Maximum Achievable Control Technology standards. In the final MATS Rule, the EPA established categories of HAPs, including mercury, trace metals other than mercury, acid gases, dioxin/furans, and organics other than dioxin/furans. The EPA also established emission limits for the first three categories of HAPs, and work practice standards for the remaining categories. Affected sources must be in compliance with the Rule by April 2015. States have the authority to grant sources a one-year extension in support of compliance implementation plans and the EPA is assessing other means for granting additional extensions when justified. In order for BEC4 to attain compliance with this regulation it will have to install additional emissions controls.

Cross-State Air Pollution Rule

On July 6, 2011, the EPA issued CSAPR, which went into effect on October 7, 2011. The final rule replaced the EPA's 2005 Clean Air Interstate Rule ("CAIR"). However, on December 30, 2011, the United States Court of Appeals for the District of Columbia Circuit issued a ruling staying implementation of CSAPR, pending judicial review, and ordered that

CAIR remain in place while CSAPR is stayed. On August 21, 2012, the District of Columbia Circuit Court of Appeals vacated the CSAPR, ordering that the CAIR remain in effect while a CSAPR replacement rule is promulgated. CSAPR would have required states in the CSAPR region to significantly reduce power plant emissions that contribute to ozone and/or fine particle pollution in other states. The CAIR carries similar mechanisms for compliance to the CSAPR. These regulations do not directly require the installation of controls. Instead, they require facilities to have sufficient emission allowances to cover their emissions on an annual basis. These allowances would be allocated to facilities from each state's budget annually and could also be bought and sold.

The CAIR regulations similarly require certain states to improve air quality by reducing power plant emissions that contribute to ozone and/or fine particle pollution in other states. Minnesota participation in CAIR was stayed by EPA administrative action while the EPA completed a review of air quality modeling issues in conjunction with the development of a final replacement rule. In its final determination, the EPA listed Minnesota as a CSAPR-affected state based on new 24-hour fine particulate NAAQS analysis. While CAIR remains in effect, Minnesota participation in CAIR will continue to be stayed. It continues to be uncertain if CSAPR-related emission restrictions will become effective for Minnesota utilities because of the August 21, 2012 DC Circuit Court of Appeals CSAPR vacatur decision and related legal challenges.

Since 2006, Minnesota Power has significantly reduced emissions at the Laskin, Taconite Harbor and Boswell generating units. Based on expected generation rates, these emission reductions would have satisfied Minnesota Power's NO_X and SO_2 emission compliance obligations with respect to the EPA-allocated CSAPR 2012 allowances budget for all units. Minnesota Power will continue to track EPA rulemaking activity related to any possible replacement for the recently vacated CSAPR.

National Ambient Air Quality Standards

National Ambient Air Quality Standards are established to protect human health ("primary standards") or public welfare ("secondary standards"). The EPA is required to review the NAAQS every five years. If the EPA determines that a state's air quality is not in

compliance with a NAAQS, the state is required to establish plans to reduce emissions to demonstrate attainment with that NAAQS. These state plans often include more stringent air emission limitations on sources of air pollutants than the NAAQS require. Four NAAQS have either recently been revised or are currently proposed for revision, as described below.

- Ozone NAAQS. The EPA has proposed to more stringently control emissions that result in ground level ozone. In January 2010, the EPA proposed to revise the 2008 primary ozone eight-hour standard and to adopt a secondary standard for the protection of sensitive vegetation from ozone-related damage. The EPA was scheduled to decide upon the 2008 eight-hour ozone standard in July 2011, but has since announced that it is deferring revision of this standard until 2013.

- Fine Particulate Matter NAAQS. The EPA finalized the NAAQS Fine Particulate Matter standards in September 2006. Since then, the EPA established a more stringent 24-hour average $PM_{2.5}$ standard and kept the annual average $PM_{2.5}$ standard and the 24-hour coarse particulate matter standard unchanged. The United States Court of Appeals for the District of Columbia Circuit has remanded the $PM_{2.5}$ standard to the EPA, requiring consideration of lower annual average standard values.

  The EPA proposed a new $PM_{2.5}$ standard on June 14, 2012 with a goal to finalize the standard by December 14, 2012. The EPA proposed adjusting the annual $PM_{2.5}$ standard from 15 ug/m^3 and is accepting comments on whether to set the new standard as 12 ug/m^3 or 13 ug/m^3. The current annual $PM_{2.5}$ standard of 15 ug/m^3 has been in place since 1997. The EPA is proposing to leave the existing 24-hour $PM_{2.5}$ of 35 ug/m^3 unchanged. The 24-hour standard has been in place since 2006. The EPA is also proposing a separate $PM_{2.5}$ secondary standard in the range of 28-30 deciviews to address visibility impairment. State attainment status determination will occur after the rule is finalized. It is not known when affected sources would have to take additional control measures if modeling demonstrates non-compliance at their property boundary.

- SO_2 and NO_2 NAAQS. During 2010, the EPA finalized new one-hour NAAQS for both SO_2 and nitrogen dioxide ("NO_2"). Ambient monitoring data indicates that Minnesota will likely be in compliance with these new standards; however, the one-hour SO_2

NAAQS also requires the EPA to evaluate modeling data to determine attainment. The EPA notified states that their State Implementation Plans ("SIP(s)") for attainment of the standard will be required to be submitted to the EPA for approval by June 2013 but will not be required to include the evaluation of modeling data to determine attainment. State Implementation Plans require inclusion of means to achieve one-hour NAAQS attainment by 2017.

In late 2011, the MPCA initiated modeling activities that included approximately 65 sources within Minnesota that emit greater than 100 tons of SO_2 per year. However, on April 12, 2012 the MPCA notified Minnesota Power that such modeling had been suspended as a result of the EPA's announcement that the June 2013 SIP submittals would no longer require modeling demonstrations for states such as Minnesota where ambient monitors indicate compliance with the new standard. The Agency is awaiting updated EPA guidance and will communicate with affected sources once the MPCA has more information on how the state will meet the EPA's SIP requirements. Currently, compliance with these new NAAQS is expected to be required as early as 2017.

NAAQS can impact BEC4 in two possible ways. First, if facility air dispersion modeling (triggered by a project or permit requirement) demonstrates the NAAQS are being exceeded at the overall Boswell facility ambient air boundary one or more emission sources at the Boswell facility would have to accept lower emission limits.

Second, if a county where a Minnesota Power facility is located goes into non-attainment, then existing facilities may have to install Reasonably Achievable Control Technology ("RACT") to control emissions.

Minnesota Power is confident the BEC4 Project, in conjunction with recently installed NO_x controls on that unit, are likely to be sufficient to address any NAAQS issues now and well into the future.

Regional Haze

The federal Regional Haze Rule requires states to submit SIPs to the EPA to address regional haze visibility impairment in 156 federally-protected parks and wilderness areas. Under the first phase of the Regional Haze Rule, certain large stationary sources, put in service between

1962 and 1977, with emissions contributing to visibility impairment, are required to install emission controls, known as Best Available Retrofit Technology ("BART"). Minnesota Power has two steam units, BEC3 and Taconite Harbor Energy Center Unit 3 ("THEC3"), which are subject to BART requirements. Every 10 years the MPCA must review the Regional Haze plan, and put in place additional requirements to achieve reasonable further progress towards reductions in PM, SO_2 and NO_x which contribute to haze. The next review of the Regional Haze Rule is expected to take place in 2018.

Even though BEC4 is not subject to Regional Haze requirements, the NOx controls already installed on BEC4, and the additional reductions in SO_2 and PM with the BEC4 Project will help to ensure compliance with NO_x, SO_2 and PM requirements well into the future.

Regulation of Greenhouse Gases

On May 13, 2010, the EPA issued the final Prevention of Significant Deterioration ("PSD") and Title V Greenhouse Gas Tailoring Rule ("Tailoring Rule"). The Tailoring Rule establishes permitting thresholds required to address greenhouse gas emissions for new facilities, at existing facilities that undergo major modifications, and at other facilities characterized as major sources under the Clean Air Act's Title V program. For Minnesota Power's existing facilities, the rule does not require amending existing Title V Operating Permits to include greenhouse gas ("GHG") requirements. GHG provisions may be added to Title V permits by the MPCA as permits are renewed or amended, as is applicable at the time In late 2010, the EPA issued guidance to permitting authorities and affected sources to facilitate incorporation of the Tailoring Rule permitting requirements into the Title V and PSD permitting programs. The guidance stated that the project-specific "top down" Best Available Control Technology ("BACT") determination process used for other pollutants will also be used to determine BACT for GHG emissions when required for new or for existing facilities that undergo major modifications.

If provisions of the Tailoring Rule are triggered by a facility, EPA has indicated that it may apply operational efficiency requirements as a means for containing or reducing carbon dioxide ("CO_2") emissions. Minnesota Power does not anticipate that BEC4 will be subject to requirements under these provisions, since no major modifications that would result in a

significant emissions increase (greater than 75,000 tons CO_2 per year) are planned by Minnesota Power for BEC4.

On March 28, 2012, the EPA announced its proposed rule to apply CO_2 emission New Source Performance Standards ("NSPS") to new fossil fuel-fired electric generating units. The new NSPS applies only to new or re-powered units, which does not apply to BEC4.

2. Water and Ash Management

Regulation of Coal Combustion Residuals

On June 18, 2010, the EPA proposed regulations for coal combustion residuals ("CCR" or "coal ash") generated by the electric utility sector. The proposal sought comments on three general regulatory approaches for coal ash including: regulation as a hazardous waste under Subtitle C of the Resource Conservation and Recovery Act ("RCRA"); regulation under Subtitle D of RCRA as a non-hazardous waste; and regulation under Subtitle D of RCRA, but only at the end of a current ash storage facility's (i.e., impoundment or landfill) useful life ("D-Prime" option). Minnesota Power generates fly ash and bottom ash at BEC that is currently managed in onsite impoundments (ash ponds and cells). It is now estimated that the final rule will be published in late-2012 or early 2013. Impacts to BEC4, if any, from an eventual final rule could occur beginning in the 2018 timeframe.

The Boswell ponds are regulated by the State of Minnesota's dam safety program and MPCA's water quality division in addition to federal EPA oversight. EPA's latest ash impoundment inspection at BEC on May 17, 2010, independently confirmed that the ponds are well managed and maintained. The existing on-site impoundments at BEC are well-built and well maintained, and in their current configuration, will provide ample, safe, environmentally protective ash storage capacity through the life of BEC, including for BEC4 itself. In fact, the BEC4 Project will beneficially transition BEC4's ash, the largest wet component of ash stored and transported to the pond system today, from wet slurry to dry transport. The transition to dry transport further enhances the handling and storage methods of this material, eliminates mixing

ash with slurry water, creates the potential for beneficial use fly ash sales in future years and better positions the Unit to meet future potentially more stringent ash designations.[4]

While various CCR regulation options are being considered at the federal level, Minnesota Power believes its current and planned ash management plans at BEC, well-regulated by the State of Minnesota, will address a majority of the proposed federal rules. Further, the BEC4 Project analysis, when stressed for a wide range of potential prospective ash costs, remains in the best interest of Minnesota Power customers.

Regulation of Water Effluent

On September 15, 2009, the EPA announced its decision to proceed with information collection and advance rulemaking to revise regulations of wastewater discharges from power plants and the treatment technologies available to reduce pollutant discharges (40 CFR 423). EPA plans to propose a water effluent rulemaking for the steam electric power generating industry in November 2012 and take final action by April 2014.

The BEC ash storage system is comprised of distinct and separate wet and dry handling areas serving all four BEC units, with BEC4 comprising about half of the ash handling and storage systems. Today, BEC4 captures particulates, mercury and sulfur dioxide in its wet scrubber and the resulting ash/recycled water mixture is slurried into the BEC4 ash pond for ash/water separation and ultimate ash storage. Similarly, bottom ash from BEC4 is currently slurried into the Units 1-4 bottom ash pond, and after gravitational clarification, a portion of bottom ash conveyance water is routed to the central wastewater treatment facility. The BEC4 Project will eliminate water contact with fly ash, allowing the entire BEC facility to handle and store dry fly ash. Thus, wastewater from BEC4 operations will be significantly reduced as a result of the Project, consequently reducing the future impact of a water effluent rule on the Unit.

The BEC4 fly ash pond is currently a closed-loop system with no outfall; however, after extensive recycling, and as ash pond capacity is reduced over the long term, the final remaining wastewater in the BEC4 pond will either be reused in an evaporative process or dewatered prior to final pond closure or repurposing. While this action is not projected to be necessary for

[4] Minnesota Power has begun a process to bring dry ash from BEC3 to market for beneficial use, and intends to consider similar plans for BEC4.

decades, any wastewater treatment, for interim operations or final closure, would be treated to meet all applicable water quality standards at that time and be subject to 40 CFR 423. Minnesota Power's ash management plans associated with the BEC3 Plan[5] contemplated these future wastewater treatment needs for the entire facility.

316(b) Proposed rule – Standards to Protect Aquatic Ecosystems

On April 20, 2011, the EPA published a new proposed cooling water intake Rule, commonly known as "316(b)," for existing power plants and manufacturing facilities to be implemented through National Pollutant Discharge Elimination System permits.

Clean Water Act Section 316(b) requires that the location, design, construction and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact. The proposed new Rule is aimed at reducing fish impingement and fish entrainment at cooling water systems. Affected facilities will be required to reduce fish impingement by either monitoring to show specified fish and shellfish mortality standards have been met or demonstrating that the intake velocity meets specified design criteria. Entrainment technology determination will rely on state permit writers' best professional judgment, after taking into consideration a suite of site-specific factors. Technologies to meet the impingement requirements will have to be implemented as soon as possible, but no later than within 8 years of issuance of the final rule, originally expected in 2012 and recently delayed until July 2013. Where required on Minnesota Power units, expected impingement technology would likely be installed in the 2014-2016 timeframe, with any required entrainment technology installed in the 2017-2020 timeframe.

Since BEC4 is equipped with a cooling tower system to cool the circulating water, which is considered a best technology available, impacts of the 316(b) Rule on BEC4 are expected to be negligible. Any impacts on BEC4 will likely be determined by specifics of the final rule and completion of either field measurement studies and/or engineering assessments.

5 See Docket No. E-015/M-06-1501.

V. PROPOSED EMISSIONS REDUCTION PLAN

A. Description of Planned Project

1. Background Information on BEC4

BEC4 is located in Cohasset, Minnesota and was placed into service in 1980. BEC4 employs 75 full-time Minnesota Power employees. Its boiler is a tangentially-fired steam generator. BEC4, until recently, operated with a gross generation capability of 585 MW with 535 MW available as net output due to 50 MW of existing station service required to operate auxiliary equipment. In 2010, Minnesota Power replaced the original turbine with a more efficient design that is able to operate at over 635 MW gross capability and 585 MW net capability without consuming additional fuel. Turbine upgrades to increase generating efficiency on existing generating units that do not require additional fuel are among the most cost-effective methods for increasing Minnesota Power's reliable energy supply without increasing emissions. In essence, Minnesota Power added 50 MW of zero emission, dispatchable, capacity and energy as a result of this efficiency improvement project.

From 1980 to 2011 Minnesota Power burned low mercury, low sulfur Montana Powder River Basin ("PRB") coal at BEC. Over time, Minnesota Power has been diversifying its coal portfolio, optimizing various factors including having fuel quality that is compatible with the existing boiler design while minimizing emissions, ensuring unit availability, obtaining consistency in the fuel supply, and improving delivered fuel cost outcomes for customers. The characteristics of various types of coal can appear very similar, yet have very different combustion results due to trace element differences. This variability can have a major impact on base line emissions, thus coal test burns are essential in determining the suitability of a new coal mix. Both computer modeling and actual test burns of coal are conducted at BEC prior to selecting new fuels. Test burns helped indicate the performance of the unit, based on the fuel supply, providing insights into any concerns such as boiler fouling, flue gas and steam temperatures, and emissions. Based on the testing done, Minnesota Power began burning a new blend of coal from Wyoming and Montana at BEC in January 2011.

2. Existing Emission Control Equipment

BEC4 was originally constructed with first generation low NO_x Burners and close coupled over-fire air [6] and, what was in 1980 a state-of-the-art wet spray tower absorber/particulate removal system. This system removes more than 85 percent of the SO_2 and over 97.5 percent of the Unit's PM. More recent investments made in emission reduction at BEC4 have resulted in continued improvements in emission reduction as described in the following paragraphs

NOx Control

In late 2008, Minnesota Power installed Selective Non-Catalytic Reduction ("SNCR") technology for the removal of NO_x at BEC4. The SNCR system utilizes NALCO Mobotec's Rotamix technology. Boiler injection ports are used to deliver urea[7] into the boiler to chemically transform NO_x emissions into nitrogen gas and water vapor. In 2010, Minnesota Power increased its effectiveness in preventing the formation of NO_x with the replacement of BEC4's first generation low NO_x burners with state-of-the-art low NO_x burners and separated over-fire air technology that is widely used in coal-fired utility boilers to minimize the creation of NO_x in the coal combustion process. These NO_x controls provide approximately a 55 percent annual reduction in NO_x emissions.

[6] Close coupled over-fire air ("CCOFA") is a type of over-fire air system used for NOx emission reduction. CCOFA systems are typically implemented by adding air injectors immediately above the existing furnace burners. This was an early technology used for NOx control. As technology improved, it worked better to stage the flame even farther by adding the over fire air even higher in the boiler. The staging of the combustion air lowers the flame temperature and since NO_x is formed in higher temperatures, less NO_x is formed. Separated over-fire air ("SOFA"), installed on BEC4 in 2010, is an example of this newer technology. With SOFA, the air ports are located higher in the boiler resulting in a greater separation from the combustion zone (cooler temperatures produce less NO_x) and more effective NO_x reduction.

[7] In most commercial SNCR systems, either ammonia or urea is used as the reagent. A reagent is a substance used in a chemical reaction to detect, measure, examine, or produce other substances. Ammonia may be injected in either anhydrous or aqueous form, and urea, as an aqueous solution.

Mercury, PM and SO_2 Control

BEC4 currently utilizes a scrubber with a wet particulate removal system for PM control coupled with a spray tower absorber for SO_2 control. Additionally, even though the existing scrubber is not designed for mercury control, Minnesota Power is receiving a limited amount of mercury emission reduction through the scrubber as a co-benefit.

A small portion of BEC4's flue gas (approximately 2 to 5 percent) bypasses the scrubber. This bypass stream is treated by an electrostatic precipitator ("ESP") for PM control before being blended with the remainder of the flue gas, where it acts to reheat the flue gas treated by the scrubber. This process results in keeping the flue gas dry as it exits the spray tower absorber and passes through the induced draft ("ID") fans, duct work, and finally through the stack. Dry flue gas is critical because moist gas will adversely impact downstream equipment.

3. Description of Environmental Control Equipment to be Installed on BEC4 as part of this Project

Minnesota Power provides the following description of its planned environmental control technology and expected emission reductions resulting from technology installation as requested in Minn. Stat. §§ 216B.682, subd. 3, 216B.6851, subd. 3, 216B.686, subd. 1 and 216B.1692, subd. 3(a). As proposed, the BEC4 Project will utilize commercially-available, state-of-the-art, multi-pollutant technology designed not only to meet MERA requirements, but also achieve the necessary mercury, PM and hydrogen chloride emission reductions mandated under the MATS Rule. Thorough engineering analysis of this environmental control technology has shown that the proposed BEC4 Project will be a practical and cost-effective solution for BEC4 given its size, baseload use and the other environmental requirements that must be addressed in the coming years.

Table 1 lists the successive engineering studies Minnesota Power pursued on BEC4 as it thoughtfully assessed an optimal approach to the Unit's multi-emission retrofit.

Table 1. Engineering Studies

Study	Year	Firm
Feasibility Study NO_x, SO_x, PM, Hg	2007	Burns & McDonnell
Study to Retrofit Existing Scrubber	2008	Burns & McDonnell
Second Opinion Study on Overall Project Design	2009	Black & Veatch

In 2007, Minnesota Power contracted with the engineering firm Burns & McDonnell to conduct a feasibility study to initially look at the options available to reduce NO_x, SO_2, PM and mercury at BEC4. Based on the results of the initial study, Minnesota Power again contracted with Burns & McDonnell in 2008 to conduct a cost estimate study that provided more detail and insight on available options for retrofitting the existing environmental controls on BEC4. This second study confirmed that potential control technologies applied to BEC4 must be analyzed as an overall system to determine the cost per pollutant reduced. With emission reduction retrofits, there is generally a substantial co-benefit between the pollutants that are captured by each technology, and thus it is important to understand how the technologies will work together in order to optimize their selection.

Through these investigations, Burns & McDonnell evaluated combining use of the existing wet scrubber with the use of a fabric filter and a powdered activated carbon injection system because that combination showed the best potential of achieving the required mercury emission reduction. The study results indicated, however, that installation of this equipment would compromise performance of the existing BEC4 absorber tower used for SO_2 removal. The alkaline fly ash that is currently captured and subsequently utilized in the absorber towers for SO_2 emission reduction on BEC4 today would no longer be available once a fabric filter is added for PM and mercury control.[8]

In 2009, Minnesota Power contracted with the engineering firm Black & Veatch to obtain a second opinion of available options and costs associated with an environmental retrofit on BEC4. The results of this work identified very similar costs to the earlier Burns and McDonnell study. However, Black & Veatch identified Circulating Dry Scrubber ("CDS") technology as an additional available option that would have long-term benefits for Minnesota Power and its customers. Benefits associated with installation of a CDS system include high mercury and SO_2 removal efficiency; integral sulfur trioxide, hydrochloric acid ("HCl"), hydrofluoric acid,

[8] For SO_2 removal, the alkaline fly ash is used as an effective replacement for lime which is typically used to remove SO_2 in a wet scrubbing system. If a fabric filter is required for mercury capture, the fly ash would no longer be available and a lime/limestone system would have to be added. An attempt to wet the ash captured by the fabric filter was not considered because using wet ash in the spray tower absorber could result in re-emission of the mercury that was captured in the fabric filter by the powdered activated carbon.

mercury, heavy metals, dioxins and furans, and $PM_{2.5}$ emissions reduction; lower capital cost, and lower operational and maintenance costs when compared to wet flue gas desulfurization systems.

The evolution of state and federal regulations occurred in parallel path to these studies and these developments were taken into account in project planning. Based on the outcome of these various engineering studies, Minnesota Power proposes to install a proven, utility scale, commercially available CDS system for the removal of SO_2, PM and mercury, as part of the BEC4 Project. The CDS technology will also further reduce emissions of acid gases, including HCl and trace metals. And, similar to the BEC3 Environmental Improvement Plan ("BEC3 Plan"), Minnesota Power proposes to install a powdered activated carbon ("PAC") injection system to capture flue gas mercury, and a fabric filter incorporated with the CDS technology to control PM and help optimize mercury removal performance.

Circulating Dry Scrubber (CDS)

A CDS is a type of semi-dry flue gas desulfurization system. In a CDS system, flue gas enters a vertical reactor tower before exiting to a fabric filter where additional emission capture and collection takes place. Flue gas enters at the base of the vertical reactor tower and flows upward through what is called a "venturi," mixing with the fluidized bed[9] which is comprised of a mixture of dry lime and fly ash. The intensive gas-solid mixing occurring at this point in the CDS process promotes reaction of sulfur oxides in the flue gas with the dry lime particles. Water is introduced separately above the venturi section for flue gas humidification to enhance the reactivity of the lime and physical absorption for more effective SO_2 removal. PAC is injected into the vertical reactor tower for the purpose of capturing mercury and is collected along with the PM in the fabric filter. Introducing the PAC prior to the flue gas entering the fabric filter allows for the necessary reaction time to maximize mercury removal.

[9] A fluidized bed is a layer of small solid particles suspended and kept in motion by an upward flow of a fluid (as a gas). The fluidized bed acts as a reactor for the flue gas to make contact with the reagent.

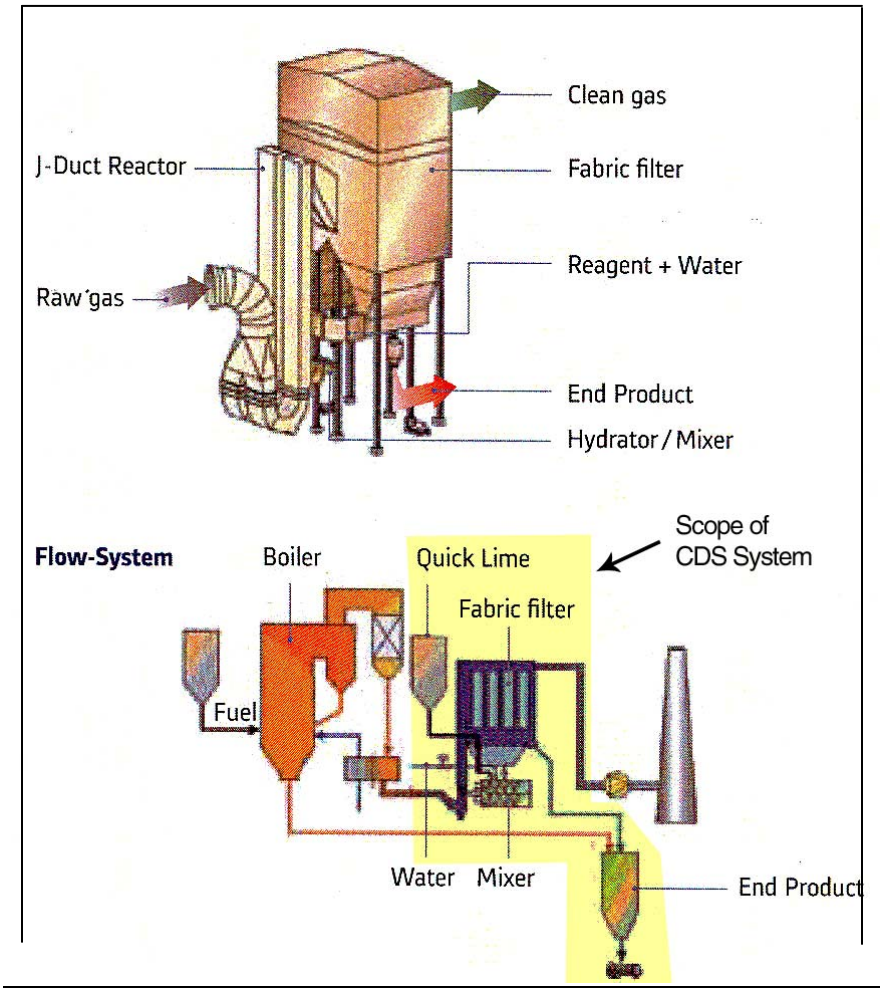

Figure 1. CDS Flow Process Diagram

Powdered Activated Carbon (PAC)

PAC systems are a proven power plant mercury reduction technology that are able to achieve very high removal efficiencies (i.e., 90 percent). PAC is used to remove mercury from the flue gas. The injected carbon compound adsorbs[10] the vaporized mercury from the flue gas and combines the mercury with carbon and fly ash particulate. The particulates are then captured by a fabric filter.

Minnesota Power expects it will achieve an approximately 90 percent mercury removal at BEC4 using PAC in combination with a fabric filter and that this use of multiple emission control technologies to reduce mercury is consistent with the intent of Minn. Stat. § 216B.682, subd. 3(a) to "demonstrate that [Minnesota Power] has considered achieving the mercury

[10] Absorption is the process where one substance has fully entered into or is taken into the other substance.

emissions reduction required...through multiple pollutant control technology." The Fabric Filter section provides additional detail on expected mercury emission reduction.

Fabric Filter

The fabric filter, also commonly referred to as a "bag house," is integral in optimizing mercury removal. When used in combination with PAC, a fabric filter is the most effective mechanism for capturing mercury. The fly ash and PAC form a cake on the filter bags. The mercury particles in the flue gas are forced to pass through the caked bags to exit the stack. This provides the necessary residence time for the PAC to contact the mercury particles. The mercury particles adhere to the fly ash and PAC matter instead of exiting the stack.

Fabric filters use fiberglass or other fabric bag materials to collect total filterable PM, fly ash and mercury-laden carbon. The unique concept of combining use of the fabric filter with a CDS system is that a portion of the fly ash is recirculated to an absorber tower to assist in SO_2 removal. As the filters continue to collect additional fly ash, a portion is sent to storage/disposal. The system operates with a controlled loading of fly ash to optimize its performance.

Byproduct Ash Handling System ("Ash System")

Conversion of BEC4 to a CDS system will change the way waste fly ash is currently managed in the existing Boswell ash disposal system. The BEC4 dry fly ash will be transported pneumatically from the BEC4 CDS to a newly constructed BEC4 fly ash silo, then transported to the ash disposal area via truck for deposition with dry coal combustion residuals ("CCRs") from Units 1, 2, and 3. Additional handling and storage capability to the Unit 1, 2, & 3 ash disposal infrastructure, which is currently designed to accommodate dry fly ash from Boswell Units 1, 2, and 3, is necessary to accommodate the increased volume of fly ash generated by the BEC4 CDS. The necessary upgrades include expansion of the bottom ash foundation base layer in the pond disposal area, larger final cover construction projects, an increased stormwater sedimentation pond, access ramp and haul road improvements, and additional equipment to transport and store the additional fly ash.

Conversion to dry handling also effectively positions BEC4 to accommodate upcoming regulatory changes associated with both the CCR and Steam Electric Effluent Guidelines ("SEEG") EPA rulemakings. Dry handling of fly ash and FGD solids will likely be required by

either the CCR or SEEG Rules. Additionally, the CDS system is a net consumer of water/wastewater, which will result in a no net wastewater discharge for BEC4. This water-consumptive property has obvious benefits in a regulatory future where stringent metals- or salts-based limits for wastewater discharges might otherwise require additional capital and O&M investments in the future. Additionally, internal wastewater recycling and consumption may benefit other Boswell Units, which may be able to divert wastewater streams to a retrofitted BEC4 instead of treating and discharging it.

B. Priority Ranking and Order, Planned Schedule and Activities Involved

1. Priority Ranking and Order of Projects

Minn. Stat. § 216B.1692, subd. 2, requires Minnesota Power to provide its analysis, considerations, general rationale and conclusions regarding project priority ranking and order. Minnesota Power is taking a similar approach to project priority ranking and order with the BEC4 Project as was approved by the Commission in October 2007 for its BEC3 Plan. BEC3, Minnesota Power's other generating facility subject to MERA, installed the required environmental control technology during the 2007-2009 timeframe as part of its Commission approved BEC3 Plan.

Minnesota Power is proposing a single emissions-reduction project at one generating facility, i.e., BEC4, so setting a priority ranking among projects and determining an order for project completion is not applicable. That is, Minnesota Power considers its BEC4 Project to be a single project under Minn. Stat § 216B.1692, subd. 2(1, 3 & 6) with both mercury and non-mercury components. Minn. Stat. §§ 216B.6851, subd. 1, 216B.686, subd. 1.

2. Preliminary Schedule for Construction Assuming Granting of Fourth Year to Complete Project

For a single project of this magnitude within the existing footprint, with the unit operating and serving customers concurrently, Minnesota Power must carefully coordinate installation of the individual components. In addition, due to the integrated nature of the entire project, there is a need to provide considerable upfront time for conceptual engineering, final design, procurement and construction. Equipment and labor resource (e.g., skilled craft, engineering) availability were strategically considered in developing a schedule. Similarly,

effort was made to schedule the required outage(s) at the optimal time for customers in order to minimize replacement energy costs and associated operation and maintenance costs. Final tie-in of the entire BEC4 Project will occur during a single scheduled maintenance outage. Minnesota Power plans to begin onsite construction for the BEC4 Project in spring 2013, assuming receipt of construction permits, with in-service expected by year-end 2015. Pursuant to Minn. Stat. §§ 216B.6851, subd. 5, 216B.1692, subds. 2(2) and 3(a)(2 & 3), the following tables present the projected schedules for implementation activities, and air and water permitting:

Table 2. Project Implementation Activity

Activity – Project Implementation	Timeline
Phase 1 – Conceptual Engineering Target Procurement Activities – Environmental Equipment	Apr 2012 – Dec 2012
Phase 2 – Final Design & Procurement Fabricate/Deliver – Fabric Filter/CDS	Jul 2012 – May 2015
Phase 3 – Construction Site Preparation Pile/Pile cap construction Construction – Civil & Foundations Construction – CDS/Fabric Filter and Ash Silo Construction – Electrical and Controls	 Apr 2013 – Jul 2013 Jul 2013 – Nov 2013 Apr 2013 – Sep 2014 Apr 2014 – Jul 2015 Nov 2014 – Jul 2015
Phase 4 – Start-Up Checkout & Commission for Tuning Final Plant Start-Up and Tuning	 Apr 2015 – Oct 2015 Oct 2015 – Jan 2016

Table 3. Air Permitting Activity

Activity – Air Permit Amendment	Timeline
Combined Federal/State Title V Operating and Construction Permit Amendment Application Submittal	September 2012
MPCA Reviews Permit Application (assuming 150-day legislative goal to permit issuance)	Through December 2012 / January 2013
Permit Issuance	March 2013

Table 4. Wetlands/Water Permitting Activity

Activity – Wetlands/Water	Timeline
Combined Federal/State/Local Permit Application Submittal	September 2012
Itasca County Soil Water Conservation District (SWCD) Approval	October 2012
US Army Corp of Engineer Approval Public Notice and Review	January 2013
Department of Natural Resources (DNR) Approval	March 2013

3. Blackwater Lake

Following analysis from three feasibility/technology selection studies which identified CDS as the least cost multi-emission control technology applicable for BEC4, Minnesota Power is now evaluating different CDS layouts and site arrangements which minimize environmental impacts while balancing project construction cost, unit efficiency, constructability and long term access for maintenance.

Wetland and public water impacts from CDS siting near Blackwater Lake could affect the Project permitting timeline. As a result, Minnesota Power has already engaged local governing units in consultation about the Project and are working collectively with them to address local impacts in a timely manner. Adjusting the shoreline through lake filling could trigger the need for additional environmental permitting steps, including a combined local/state/federal wetlands permit.

In evaluating the various options to site the BEC4 CDS, two possible options emerged – a north option and a west option. The most cost effective and efficient siting option for the CDS, and basis for the BEC4 Project, is the "west option." It leads to the closest siting of the CDS to the BEC4 boiler building, therefore creating the most efficient ductwork arrangement and least

cost, while requiring about an acre of shoreland adjustment through lake fill. By comparison, as Minnesota Power considered the "north" option, it found significantly more ductwork, more extensive above ground and underground site utility relocations and reduced unit efficiency. Additionally, this north option would create considerable construction difficulties due to existing infrastructure on the north option area. Cranes and other equipment used for erecting the CDS and related equipment would be required to be larger in size and scale to work in the congested north option area, due to existing rail, road and employee traffic interferences in operating all four Boswell units concurrently during construction.

4. Special Equipment Ordering (Manufacturing of Specialized Equipment)

The CDS system to be purchased for BEC4 will be specially designed for the Unit. Most CDS systems that have been installed in the United States have been for units of 400 MW or less and unit retrofits with CDS up to 1,300 MW are underway. The CDS is comprised of a vertical reactor tower, fabric filter, fly ash recirculation system and lime storage and handling.

The overall timeline for engineering, design and procurement of the CDS equipment is estimated to be one and a half to two years plus two and a half to three years of construction. Engineering and design of the equipment will be performed early in the schedule. Materials and equipment used in manufacturing will then be purchased by the vendor as soon as is feasible.

It is common for utility-scale equipment vendors to require established payment schedules and penalties for cancellation of an order at specified points in the manufacturing process. This is typically a negotiated item of the contract. Minnesota Power is committed on behalf of its customers to negotiate and enforce the most favorable performance and contractual terms.

Minnesota Power plans to secure favorable terms in the CDS contract from its supplier to address performance and operating cost risks. These include enforceable performance guarantees on chemical consumption, overall system reliability guarantees and emission rate guarantees.

5. Construction

The proposed schedule, as outlined in Table 2 on page 29, enables Minnesota Power to prudently engineer design packages, which will be followed by competitive bidding for major fabrication and erection services. Construction of a project of this scope and size will require utilizing the fourth year extension EPA has made available under the MATS Rule.

Construction oversight will be accomplished by a blended team of Minnesota Power and Burns & McDonnell engineers, who together will enforce the CDS, construction packages and auxiliary equipment vendor contracts to a successful project completion. The Burns & McDonnell project managers assigned to the BEC4 Project possess direct, relevant experience having just completed a similar CDS construction for another US utility. Further, Minnesota Power is planning to secure a third party consultant to provide a prudency review of all project activities. Many of the preceding construction management enhancement measures were initiated on and are being utilized successfully in Minnesota Power's Bison wind project construction and they will be utilized on BEC4 Project construction.

6. Start-Up, Cut-Over and Tuning

During the final phase of construction, BEC4 operations and maintenance staff will begin training in preparation for the transition to the new CDS system. Employees will assist with the startup and check out of the various systems that make up the CDS as part of their training. The start-up process is projected to occur between April 2015 and October 2015 during which time each system will be completely checked out to ensure the control systems are functioning properly, and subsequently turned over to BEC4 operations staff. Minnesota Power's current staffing levels are expected to be sufficient to reliably operate and maintain the new CDS system.

An outage is currently scheduled for the fall of 2015 to tie in the duct work to the new CDS system. The outage is anticipated to last six to eight weeks. Once BEC4 is started up after the outage, it will be operating with the new CDS system and tuning will begin. Tuning of the equipment to meet operational and emission performance guarantees is estimated to take from one to three months. Once tuning of the equipment is complete, formal acceptance testing will be conducted at which time the CDS vendor is required to prove it has met all emission reduction and related guarantees.

This schedule ensures the ability to fully comply with EPA regulations in April 2016 when the MATS rule goes into effect, assuming Minnesota Power is granted a one-year extension from the MPCA.

7. BEC4 Outage and Replacement Energy

A BEC4 outage request has been submitted to the Midwest Independent Transmission System Operator ("MISO") for the period from October 3, 2015 through November 29, 2015. MISO generation owners must submit their planned maintenance outage schedules for coal-fired facilities 10 MW and above to MISO at least two years prior to the start of the outage. Minnesota Power's outage request was submitted in compliance with this criterion. The purpose of this outage will be to "tie in" the duct work and cutover to the new CDS system. Minnesota Power has communicated the planned outage to MISO by submitting a request for the outage. The Company's request has been received and is being reviewed by MISO. MISO is expected to inform Minnesota Power whether this study shows Minnesota Power can perform this major outage at the scheduled time, depending on system reliability effects. With the number of coal-fired units within the MISO footprint impacted by the MATS Rule, MISO is currently reviewing how it manages its generation outage scheduling. Minnesota Power is closely monitoring MISO's progress to make sure the Company is ready to take any additional action necessary related to its outage request. In the interim, Minnesota Power and MISO will continue to communicate regarding this outage up until unit outage commencement. Once the outage begins, Minnesota Power would communicate any outage duration changes to MISO in order to keep the end-date current.

In previous Dockets[11] related to the fuel adjustment clause, Minnesota Power has described its phased strategy for purchasing replacement energy associated with scheduled generator outages, i.e., purchasing some portion of the energy needed months ahead of the outage and then purchasing incremental amounts for outage coverage through additional strategic purchases as it gets closer to the actual outage timeframe. This iterative approach, which is being deployed for the upcoming BEC4 outage, uses energy market knowledge in an

[11] Refer to Docket No. E999/AA-11-792 for Minnesota Power's Energy Source Procurement and Dispatching Policies.

effort to acquire the lowest priced available energy to meet customer needs during an outage period.

In addition to employing the above-discussed, phased strategy, Minnesota Power will further seek to minimize replacement energy costs by performing routine maintenance activities in parallel with the BEC4 Project cutover outage to tie in the new facilities. The cutover outage has been requested for the fall timeframe, when power prices are typically lower. Unit load variation is expected during the commissioning process as systems are integrated and commissioned and protective tests are completed to assure long term reliability and performance. The balance of plant or general maintenance activities, which will be accounted for separately from the BEC4 Project costs, are being coordinated integrally with the overall outage schedule.

8. WPPI Energy's 20 Percent Ownership

BEC4 is jointly owned by Minnesota Power and WPPI Energy (formerly Wisconsin Public Power, Inc.). Since 1990, WPPI Energy has owned 20 percent of BEC4 which currently equates to 117 MW.[12] As co-owner of BEC4, WPPI Energy will pay a proportionate share of the required capital and operations and maintenance ("O&M") associated with the BEC4 Project. Minnesota Power and WPPI Energy have worked collaboratively throughout the development of the companies' environmental compliance plans and respective regulatory filings.

Wisconsin utilities are required by statute to obtain a Certificate of Authority from the Public Service Commission of Wisconsin ("PSCW") prior to the construction of certain replacements, modifications or additions at their generating facilities. WPPI Energy is expected to submit an application for a Certificate of Authority for the BEC4 Project within 30 days of Minnesota Power filing this petition. A decision by the PSCW is anticipated in the spring of 2013.

[12] See Docket No. E015/PA-90-153.

C. Analysis and Considerations

1. Emission Reductions, Cost-effectiveness and Environmental/Health Benefits

a. Emission Reductions

Table 5 reflects expected mercury, PM and SO_2 emission reductions to be derived from the BEC4 Project as directed under Minn. Stat. §§ 216B.682, subd. 3(a), 216B.1692, subd. 3(a)(8). Minnesota Power expects it will achieve approximately 90 percent mercury removal at BEC4 using PAC in combination with the fabric filter. Co-benefit emission reductions for SO_2 and PM, along with mercury, are based on expected performance of the CDS technology as guaranteed by the vendors. Because the Project's technology is demonstrated and performance guarantees exist, Minnesota Power does not anticipate any problems in achieving the stated emission reductions. The table summarizes expected annual reductions following implementation of the BEC4 Project as follows:

Table 5. Expected Annual Reductions

Boswell Unit 4	**Hg (lbs/year)**	**PM (tons/year)**	**SO_2 (tons/year)**
Before BEC4 Project (Baseline) [a]	228	1,275	1,061
After BEC4 Project [b]	26	259	647
Emissions Decrease	202	1016	414
Percent of Expected Annual Reduction			
Percent Reduction	89%[c]	80%	39%

a. Baseline emissions are defined as the average annual emissions data reported as part of the MPCA Annual Emissions Inventory for 2011, representing typical operation at BEC4. Data presented includes emissions from both coal combustion and natural gas used for start-up. Beginning in January 2011, Minnesota Power began burning a lower sulfur blend of coal on BEC4. The BEC4 Project emissions reductions from uncontrolled potential were based on combustion of coal blends with a potential worst-case fuel sulfur content of 0.69%. Conversely, net emission reductions from 2011 actual emissions were based on the lower sulfur coal actually combusted during 2011 which averaged approximately 0.29% fuel sulfur content. The combustion of lower sulfur coal during the 2011 baseline year yields a smaller post-project SO_2 emissions reduction than would have been calculated had BEC4 not electively combusted lower sulfur coal blends during the baseline period. The calculation is therefore artificially deflated. If reductions were calculated from other baseline years of higher fuel-sulfur combustion prior to 2011, the percentage reduction in SO_2 tonnage as a result of the project would have been much higher.

b. Emissions following implementation of the BEC4 Project are calculated by multiplying the actual 2011 annual baseline coal plus natural gas heat input (43,137,381 mmBtu/yr) by the proposed emission rate for each pollutant. The 2011 heat input is expected to be generically representative of future heat inputs. The emission rates utilized from the CDS vendor guarantees are as follows: SO_2 – 0.030 lbs/mmBtu, PM – 0.012 lbs/mmBtu, and Hg 0.60 lb/Tbtu. Natural gas emission factors were not calculated separately for purposes of this analysis, so future emissions represent a true worst case scenario, assuming all heat input is coal-based.

c. See Table 8 for uncontrolled emission reduction figures. The BEC4 Project is projected to reduce mercury emissions by 90% from uncontrolled.

Table 6 shows the baseline emission rates at BEC4 and emission rates that would result from Minnesota Power's BEC4 Project compared to recent BACT determinations for similar plants. Minn. Stat. § 216B.1692, subd. 2(5). Although BEC4 is not required to meet BACT, Minnesota Power is providing this comparison to illustrate the level of environmental benefit that will be achieved by the BEC4 Project. All applicable proposed emission rates are equivalent to or very close to the lowest value in the EPA's RACT/BACT/LAER [13] Clearinghouse ("RBLC") database. [14]

Table 6. Baseline Emission Rates at BEC4

Boswell Unit 4	Hg		PM	SO2
	(lbs/TBtu)	(lb/GW- H)	(lbs./MMBtu)	(lbs/MMBtu)
Baseline Emission Rate	5.283[b]	0.0489	0.06	0.049
Recent BACT Determinations[a]	1.4 – 1.7	0.012 – 0.100	0.012-0.030	0.06 – 0.09
Post-Project Emission Rate Guarantee	0.60	0.0056	0.012	0.030

a. Recent BACT determination emission rates are established based on EPA's RACT/BACT/LAER Clearinghouse data and equipment capabilities for similarly sized, configured, and controlled pulverized coal boilers.

b. The current uncontrolled design mercury is 6.016/TBtu based on expected potential coal composition.

[13] The terms "RACT," "BACT," and "LAER" are acronyms for different program requirements under the New Source Review ("NSR") program which mandates that new or majorly modified facilities obtain NSR permits preventing air pollution by process changes or installation of control equipment.

[14] RBLC is a central database of air pollution technology information including but not limited to past RACT, BACT, and LAER decisions. Data in the RBLC are not limited to sources subject to RACT, BACT, and LAER requirements. Noteworthy prevention and control technology decisions and information are included even if they are not related to past RACT, BACT, or LAER decisions. The information is compiled by EPA from State and local permitting agencies as BACT and LAER (and sometimes RACT) are determined on a case-by-case basis, usually by State or local permitting agencies.

As previously mentioned, the requirements driving the BEC4 Project include the federal MATS Rule and Minnesota's mercury reduction statute. Table 7 shows these standards compared to the baseline and expected post-project emission rates.

Table 7. Standards Comparisons

Boswell Unit 4	Hg (lbs/TBtu)	PM (lbs/MMBtu)	SO_2[a] (lbs/MMBtu
Baseline Emission Rate	5.283	0.06	0.049
Proposed Post-Project Emission Rate Guarantee	0.60	0.012	0.030
MATS Standard	1.2	0.030	0.20
Minnesota Mercury Reduction Goal	Up to 90%	-	-

a. Note that under the MATS regulation, SO_2 is an alternate parameter for the HC1 standard, for which the BEC4 Project will also meet requirements

b. Supplemental units

Minnesota Power has the option to count the mercury reductions at supplemental units toward the ultimate 90 percent goal for BEC4. Minn. Stat. § 216B.6851, subds 2 and 3. Currently, Minnesota Power may consider the two units at Taconite Harbor Energy Center ("THEC") as supplemental following their mercury reduction retrofits as part of the Commission-approved Arrowhead Regional Emission Abatement ("AREA") Plan. Given that BEC3 has achieved and actually exceeded a 90 percent mercury removal rate and that BEC4 is expected to achieve about 90 percent mercury reduction, Minnesota Power does not expect to use supplemental unit mercury removal to meet its goal under MERA.

c. Cost-effectiveness

The cost effectiveness of the BEC4 Project was analyzed on two dimensions. First, various retrofit plans for BEC4 were evaluated considering the available retrofit technologies to determine the least cost alternative to meet the MERA and MATS requirements. As a further cost-effectiveness analysis, BEC4 with the least cost alternative installed (the proposed Project that is the subject of this Petition) was compared to other resource alternatives to BEC4 which are discussed in Section VII.

Based on MPCA guidance, Minnesota Power allocated the full cost of the fabric filter to mercury control along with the PAC costs. The associated costs of Minnesota Power's BEC4 Project related to emission reduction of mercury and PM are shown in Table 8 and Table 9.[15]

Table 8. Gross Emission Reduction

Gross Emission Reduction							
Pollutant Controlled	**Boswell 4 Retrofit Plan Equipment Proposed**	**Total Capital Cost ($)**	**Annual O&M Cost ($/year)**	**Total Annualized Cost ($/yr)**	**Baseline Emission Reduction (unit/yr)**	**Cost / Reduction**	
						Value	**Units**
Mercury	PAC System + Fabric Filter	$309,100,000	$3,600,000	$38,931,080	285 lbs	$136,600	$/lb/yr
PM	Fabric Filter	--	--	--	247,210 tons	--	--
SO_2	CDS & Fabric Filter	$122,400,000	$10,800,000	$27,851,785	40,850 tons	$682	$/ton/yr
Total		$431,500,000	$14,400,000				

[15] See Footnote 'a.' for Table 5.

Table 9. Net Emission Reduction

Net Emission Reduction							
Pollutant Controlled	**Boswell 4 Retrofit Plan Equipment Proposed**	**Total Capital Cost ($)**	**Annual O&M Cost ($/year)**	**Total Annualized Cost ($/yr)**	**Emission Reduction (unit/yr)**	**Cost / Reduction**	
						Value	**Units**
Mercury	PAC System + Fabric Filter	$309,100,000	$3,600,000	$38,931,080	202 lbs	$192,728	$/lb/yr
PM	Fabric Filter	--	--	--	1,016 tons	--	--
SO_2	CDS & Fabric Filter	$122,400,000	$10,800,000	$27,851,785	414 tons	$67,275	$/ton/yr
Total		$431,500,000	$14,400,000				

Gross emissions reductions, shown in Table 8, reflect reductions from an uncontrolled state.[16] Net emissions reductions reflect emissions reductions, shown in Table 9, from the 2011 baseline with existing control equipment currently installed. See Table 5[a] regarding coal blends and their impact on emission reduction achieved with proposed CDS technology. Additionally, it should be noted that:

- The total annual cost was calculated as follows: Capital costs were levelized by applying an 11.05 percent capital recovery factor over a 24-year period which is the anticipated remaining life of BEC4 beginning in 2012. O&M annual costs were levelized over this same 24-year period by a factor of 1.3265 using a 8.18 percent discount rate and 3.0 percent inflation rate,
- This analysis assumes particulate matter removal will result from the fabric filter as a co-benefit; however, 100 percent of the capital and O&M costs associated with the fabric filter have been attributed to the removal of mercury per MPCA guidance,
- Total capital cost reflects the total project cost, gross of WPPI Energy's 20 percent ownership share, and excludes approximately $3.8 million of Allowance for Funds Used During Construction ("AFUDC").

[16] The term "uncontrolled" in relation to emissions means measurement based on the inherent properties of the expected design fuels only. There is no emission reduction control technology impacting emission levels in an uncontrolled state.

- The cost per ton of incremental SO_2 removed from the BEC4 Project is higher than what was experienced by Minnesota Power when implementing MERA on BEC3 as BEC4 is already controlled for SO_2 emissions at a higher level than was BEC3 at the time of the implementation of the BEC3 Plan. Additionally, the cost used in calculating this SO_2 rate on BEC4 includes costs to replace certain control equipment that is already installed to meet currently permitted SO_2 emissions levels. The need for replacement is due to the combined design considerations of MERA and MATS Rule requirements for mercury control and applications on SO_2 removal systems.

In Table 10 below, from a cost effectiveness standpoint, Minnesota Power compared the $136,600/lb removal for mercury and PM on a gross emission reduction basis to the other alternatives it analyzed for mercury removal. As noted in Table 10, only Alternative D was eligible for full consideration and comparison with Minnesota Power's proposed BEC4 Project since only Alternative D could meet all other state and federal regulatory requirements. As noted, Alternative D has a removal cost of $151,183/lb gross compared to the less expensive BEC4 Project cost of $136,600/lb.

Table 10. Alternative Approaches Considered by Minnesota Power to Address Mercury

		Alternatives			
	Proposal	A[a]	B[a]	C[a]	D
	Install FF, halogenated PAC @ high injection rate[b]	Halogenated PAC/CaBr2 injection w/ existing scrubber	Install FF, no PAC	Install CDS, non-halogenated PAC	Install FF, halogenated PAC @ low injection rate[b]
% control	90%	65 to 75%[c]	25 to 30%	<80%	80%
Mercury emitted, lb/yr	32				64
Mercury removed, lb/yr	285	-	-	-	254
Capital cost	$309,100,000	-	-	-	$309,100,000
Annual operating cost	$3,600,000	-	-	-	$3,200,000
Levelized annual cost of mercury control	$38,931,080	-	-	-	$38,400,464
$/lb. mercury removed, annual[d]	$136,600	-	-	-	$151,183
Carbon injection rate, lb/mmacf	2.5	-	-	-	~1.25

a. Alternatives not considered further due to not meeting minimum requirements for MATS and/or other regulatory requirements
b. Cost estimates do not include modifications to existing scrubber or new semi-dry FGD required for SO_2 control
c. Based on full scale testing of various reagents as outlined in Minnesota Power's 2011 Mercury Emission Reduction Plan Report for BEC4[17]
d. Based on gross emission reductions (removal from uncontrolled emissions)

In addition to the proposed mercury removal plan described in this section, Minnesota Power is required to submit a mercury emissions reduction alternative (Minn. Stat. § 216B.6851, subd. 4). The alternative mercury plan must come as near as technically possible to achieving 90 percent mercury reduction at a lesser cost. Table 10 also summarizes the approaches Minnesota Power considered specifically to address the alternative mercury plan as required. As part of the review of alternatives to address mercury emissions, ultimate consideration was only given to those approaches that were technologically proven through full scale performance testing, were commercially available at utility scale andwould also ensure compliance with other regulatory programs, such as MATS. Assuming uncontrolled mercury for BEC4 equates to an emission rate of 6.0 lb/TBtu, a control efficiency of at least 80 percent would be required to meet MATS mercury limit of 1.2 lb/TBtu. Also, since BEC4 currently does not meet MATS particulate limit,

[17] Docket No. E015/M-11-712

any mercury solution must also achieve a reduction in particulate emissions. Alternatives A, B and C were ultimately eliminated from further consideration, as explained in more detail below.

Alternative A utilizes injection of halogenated activated carbon along with a solution of calcium bromide in conjunction with the existing wet venturi and FGD scrubber. Many trials of full scale testing of this option were conducted in 2011 and outlined in Exhibit 1. Results were promising with mercury removals of 65-75 percent and even 90 percent for short periods. However, based on the testing, a 90 percent removal could not remain compliant with opacity standards. The likely average removal over time would be significantly less than that required to meet the MATS mercury limit. In addition, this approach alone would not address the particulate matter limit which is contained in the MATS Rule and would create unacceptable opacity standard environmental compliance limitations. For these reasons, Alternative A was eliminated and not considered further.

Alternative B consists of the installation of a fabric filter without the addition of PAC injection system. As described earlier in this document, a CDS system will also be a necessary component of the overall control installation to address SO_2. Studies have shown that fabric filters alone can be effective at removing some of the mercury, even without the addition of mercury sorbent. The range of effectiveness of a fabric filter alone to capture mercury is quite large, depending on several factors. A review of available data of the CDS technology did not reveal any mercury emissions information. Mercury emissions information does exist for another semi-dry FGD technology called a spray dryer absorber which also incorporates a fabric filter. A review of available data indicates this technology results in typical mercury removal rates of 25 to 30 percent.[18] Alternative B was removed from further consideration because this technology would likely not allow BEC4 to meet the mercury requirements under the MATS Rule.

Alternative C utilizes the CDS and fabric filter technology as in the proposed BEC4 Project, however, substitutes non-halogenated carbon for the halogenated carbon for a lower operating cost. The levelized annual cost of the project is somewhat lower due to the reduced O&M cost associated with the non-halogenated carbon usage. Discussions with CDS suppliers[19]

[18] Based upon professional judgment of air quality engineers at Burns & McDonnell.
[19] Minnesota Power contacted all major CDS providers in consultation.

indicates this option would not likely be able to consistently meet the 80 percent removal required to meet the MATS Rule and would not be willing to guarantee mercury removal. For these reasons, this option has been eliminated for further consideration.

Alternative D utilizes the same CDS and fabric filter technology and injection of halogenated activated carbon as is proposed in the BEC4 Project, but the halogenated activated carbon is injected at a low rate. The levelized annual cost of the project is somewhat lower due to the reduced O&M cost associated with the halogenated carbon usage (see Table 10). However, the cost per pound of mercury removed is actually higher, since less mercury is captured, and the carbon cost is only a small fraction of the overall levelized annual cost of the mercury control system. For this reason, the desire to meet the goal of the Minnesota Statute without the need for supplemental unit mercury contributions, and to have a compliance margin under MATS, Minnesota Power recommends the proposed mercury solution be chosen instead of Alternative D.

d. Environmental/Health Benefits

Pursuant to Minn. Stat. §§ 216B.682, subd. 3(a) and 216B.686, subd. 1(b), Minnesota Power provides the following information assessing the increased environmental and human health benefits from the BEC4 Project. Evaluations of recent federal programs including MATS and CSAPR have calculated benefit/cost ratios indicating the environmental and health benefits of those programs outweigh the control costs. In December 2011, the EPA published its regulatory impacts analysis of the MATS Rule. This study stated the overall benefits of MATS would outweigh its costs by between 3 to 1 or 9 to 1 depending on the benefit estimate and discount rate used.[20] As demonstrated in Section V.C.1.c. (Cost-effectiveness), the 10 percent incremental difference between the control efficiency of at least 80 percent required to meet MATS mercury and the goal of 90 percent mercury emission reduction under MERA, increases the cost-effectiveness of the proposed mercury control solution.

As EPA and others have pointed out, the vast majority of the benefits from implementing the MATS Rule come from EPA's predicted health benefits of reduced fine particulate matter rather than from reductions in air toxics emissions. Fine particle reductions result from decreased

[20] Ref RIA http://www.epa.gov/ttn/ecas/regdata/RIAs/matsriafinal.pdf page 20

emissions of electric utility SO_2, and NO_x as a co-benefit from air toxics removal and from other precursors to fine particle formation that do not typically source from electric utility operations, such as carbonaceous material and organics. Although Minnesota Power may not agree with every assumption used in EPA's cost/benefit analysis, Minnesota Power accepts EPA analysis that the MATS Rule benefits from particulate matter reductions exceed the costs for MATS Rule related control measures.

In its review of Minnesota Power's previous plans and filings (AREA Plan, BEC3 Plan), the MPCA stated that most notable to the State of Minnesota are the benefits associated with reduced mercury emissions and reduced visibility impairment from fine particle formation. It is not possible to quantify or monetize all the environmental and health benefits associated with lowering the ambient levels of mercury and PM, but the same benefits as previously recognized by the MPCA in emission reduction plans should be applicable to Minnesota Power's BEC4 Project.

Reduced Emissions of Mercury.

The accumulation of mercury in fish tissue is a pervasive issue in Minnesota as well as many other states and countries. There are multiple factors involved with the process where mercury released to the environment is assimilated into fish tissue. Power plant mercury stack emissions in Minnesota are estimated by the MPCA to be a 1 percent to 3 percent contributor to Minnesota background mercury. Reducing stack mercury emissions brings overall benefits by helping reduce the availability of mercury before it is assimilated into the food chain. Sulfates in sediments are part of the mercury bioaccumulation cycle because conditions created by sulfate reducing bacteria can increase the methylation of mercury. It is the methyl mercury form that is able to bio-accumulate in fish so, in cases where the amount of sulfate limits methyl mercury production in sediments, reducing sulfates might help reduce mercury in fish. Power plants have already reduced their sulfates by more than half since 1980 and additional reductions would occur under CSAPR and Regional Haze Rule compliance. While the actual benefit from additional reduced power plant SO_2 emissions is uncertain, the BEC4 Project offers improvements to the environment by reducing mercury stack emissions and further reducing SO_2 emissions that may be contributing to mercury methylation.

Reduced Contribution to Regional Haze.

Fine particles are the primary cause of regional haze, which obscures the visibility of distant objects as well as the brightness and clarity of vistas. Most fine particles are already removed before reaching the power plant stacks, but fine particles can also be produced in the atmosphere from gaseous sulfur dioxide and oxides of nitrogen emitted from power plants. Consequently, particulate and SO_2 emission reductions at BEC4 through the Project will contribute to visibility improvements within Minnesota Power's region. That region is affected by federal rules tied to visibility in the nearby Boundary Waters Canoe Area Wilderness, Voyageurs National Park and Isle Royale National Park. Given the close relationship between visibility and the proximity of emission sources, the BEC4 Project's emission reductions are likely to deliver measurable visibility benefits at these nearby Class 1 Wilderness areas.

Summary

Overall, using recently developed quantifiable information, and considering unquantifiable benefits, Minnesota Power believes that the environmental and health benefits associated with the BEC4 Project are in the public interest.

e. Technical Feasibility and Operation Issues

CDS technology is relatively new to the U.S. market, but has been growing in demand over the past five years. Multiple installations of CDS systems are in operation or under construction with sizes up to 1,300 MW. CDS systems are popular in Europe and have been efficiently operating there for many years. The CDS has achieved SO_2 emission removal levels of 90 – 98 percent, in addition to the removal of acid gas constituents addressed by the MATS Rule.

Advantages of a CDS System

CDS systems are flexible in operation, which will allow BEC4 to use a wider range of coal blends. CDS is a simple process that is generally low maintenance. CDS equipment reliability has been increased by eliminating parts that require frequent maintenance which are found in typical wet flue gas desulfurization systems. Because CDS is a dry system, the absorber material can be constructed of unlined carbon steel rather than lined or alloy steel needed with a

wet FGD, reducing construction and sourcing costs. The flue gas is not saturated with water, and there is no liquid waste stream. Water streams from BEC that need to be treated may be used in the CDS, therefore reducing or eliminating the need for water disposal and treatment. The water used in the CDS evaporates into the flue gas for the purpose of cooling the flue gas to a temperature at which the CDS system can operate most efficiently.

The CDS system will completely replace the existing BEC4 wet FGD and ESP systems (which will be abandoned in place and retired from rate base for rate making purposes). The existing systems are unable to be incorporated with new equipment needed to meet MATS regulations and therefore new equipment needs to be installed. Because the new system will be semi-dry, the existing stack and ID fans will be utilized. However, new variable frequency drives ("VFD") will be installed on the ID fans to improve efficiency. The existing low NO_x burners, SOFA and SNCR equipment will not be affected by the new CDS system.

Sorbents

Minnesota Power plans on utilizing two different sorbents. Pebble lime will be delivered by truck to the site and placed into a storage silo. The pebble lime will be hydrated and used in the removal of SO_2. BEC4 will also have the capability to receive lime in hydrated form directly from suppliers by truck or rail.

PAC will be utilized in the removal of mercury. The PAC will be delivered by truck to a silo and injected into the flue gas via blowers. PAC can be delivered either brominated or non-brominated. BEC4 is expected to use brominated PAC. The benefit in using brominated PAC is that it helps in the oxidation of mercury, which aids in the removal process.

Unit Reliability and Dispatch

As with any equipment in a power plant, the largest potential impact on unit operation in terms of reliability and dispatch is the impact on ability to follow load changes and operate within a load range. This is particularly important in today's energy market, as more intermittent generating sources are added to the system. When dispatch requires a change in generation operating level, all components need to be able to properly react. In the case of environmental control equipment, this means the ability to react to load change while maintaining compliance. Vendors were asked to provide performance guarantees over an operating load range and meet

guarantees over a long-term emission test. The installed system will be required to meet a 180-day reliability test in which it maintains 99 percent reliability while not affecting unit performance.

Station Service

Each vendor was required to provide electrical load information. CDS technology has substantially less equipment than the existing wet system; therefore, the electrical loads are anticipated to be equal to or lower than the current station service requirements with the new CDS than with the existing wet system, likely increasing unit efficiency post-Project. The ID fans are one of the largest electrical loads. The electrical load from the ID fans is a function of pressure drop through the entire system and can only be estimated after final vendor selection and detailed duct design has been completed.

CDS Vendor Performance Guarantee

Minnesota Power has requested that each CDS vendor that submitted a proposal meet a given limit for emission levels. Table 11 below lists the emission guarantees specified by Minnesota Power to each bidding vendor. The guarantees are based on MATS limits, and MERA goals, as well as expected or typical equipment performance and Minnesota Power compliance objectives. In addition to emission rate guarantees, vendors were asked to specify additional operational guarantees. The values for the operational parameters were not specified by Minnesota Power. Key parameters included in the list were pressure drop, fabric filter bag life, byproduct ash production, and consumption of water, compressed air, lime and activated carbon. These parameters will factor in to vendor selection and could affect the overall capital costs, future O&M costs and any additional equipment or upgrades that may be needed to accommodate the new equipment. The exact emission and operational guarantees cannot be finalized until the final vendor selection process is completed.

Table 11. Emission Guarantees

Pollutant	Emission Guarantees
SO_2	≤ 0.030 lb/MMBtu
PMtotal	≤ 0.020 lb/MMBtu
PMfilt	≤ 0.012 lb/MMBtu
HCl	≤ 0.0010 lb/MMBtu
Lead	≥ 98% removal
HF	≥ 90% removal
H_2SO_4	≤1 ppm
Hg	≤ 0.60 lb/TBtu
Opacity	≤ 5%

f. Overall Appropriateness

Minnesota Power's Project is an appropriate emission reduction investment that will enable the continued provision of environmentally compliant and cost-effective energy to customers from BEC4 and it should be approved. Minn. Stat. §§ 216B.684, 216B.686, subd. 3(a)(3). The basis for the Project's approval is summarized below:

Emission Control Regulation Compliance

Under Minn. Stat. § 216B.6851, subd. 3, Minnesota Power must file a plan designed to achieve total mercury reductions equivalent to a goal of 90 percent from BEC4. Minn. Stat. § 216B.6851, subd. 5(a) requires Minnesota Power to file its plan for mercury emission reduction at BEC4 no later than July 1, 2015, with implementation of this plan to occur no later than December 31, 2018. In order to encourage a utility to address multiple pollutants, MERA allows utilities required to submit mercury emission reduction plans to also propose plans for environmental retrofits that meet or exceed new state or federal emission control regulations. Minnesota Power has studied many options for meeting federal air, water and solid waste regulations potentially impacting BEC4 that have recently been, or may be enacted by 2019. Recognizing that the best alternative for any one pollutant may not provide the best overall solution for meeting other pollutant control requirements, Minnesota Power's focus has been to identify multi-emission reduction technology that will cost-effectively optimize the reductions for all pollutants at BEC4 in total. Therefore, Minnesota Power's BEC4 Project is a comprehensive approach that achieves the mercury emissions reduction required while ensuring compliance with other regulatory programs over the long term. More detailed information on these regulatory programs is provided in Section IV of this document.

- Mercury and Air Toxics Standards (MATS). Under Section 112 of the Clean Air Act, the EPA is required to set emission standards for HAPs for certain source categories. In the final MATS rule addressing utility HAPs emissions, the EPA established emission limits for mercury, trace metals other than mercury (for which PM is a surrogate), and HCl. The overall solution Minnesota Power has proposed for BEC4 will address mercury, PM, and improve performance for HCl.
- Cross-State Air Pollution Rule (CSAPR). In 2011, EPA promulgated a final Rule requiring facilities to have sufficient allowances to cover emissions of SO_2 and NO_x on an annual basis. Although Minnesota Power's analysis indicates the Company currently would have enough allowances to cover emissions from its fleet under CSAPR, any regulation developed by EPA to replace the recently vacated CSAPR could result in increased or reduced allowance allocations in the future. Improved SO_2 emissions control performance achieved through the proposed project will reduce dependence on allowances for future compliance.
- National Ambient Air Quality Standards (NAAQS). As EPA reviews the ambient standards on a routine basis, they are sometimes adjusted, and often made more restrictive. Recent examples include the 2010 SO_2 and NO_2 NAAQS, and the recently proposed $PM_{2.5}$ NAAQS. These NAAQS could also result in more stringent emission limits on Minnesota Power's steam generating facilities, possibly resulting in additional control measures on some of its units. The proposed project will reduce emissions of SO_2 from BEC4, improving performance relative to the SO_2 NAAQS.

Significant Emission Control Achieved in a Cost-Effective Manner

Minnesota Power's BEC4 Project cost-effectively improves the Unit's environmental performance to remain in compliance with state and federal regulations. As stated previously, the Project is shown to be cost-effective in the following ways:

- Minnesota Power anticipates a reduction of SO_2 emissions of 39 percent, a reduction of PM emissions of 80 percent, and a reduction in mercury emissions of up to 90 percent,
- Mercury removal will be accomplished through the proposed project at $136,600/lb versus the $151,183/lb cost of the viable alternative,

- According to EPA, MATS implementation has a range of benefits from 3 to 1 or 9 to 1 depending on benefit estimate and discount rate used,
- As cited in Section VII, retrofitting BEC4 under Minnesota Power's proposed plan will save customers between $210 million and $373 million over gas resource replacement alternatives.

g. Inclusion of Energy Conservation Projects

In addition to the benefits of reduced emissions from the BEC4 environmental retrofit, Minnesota Power anticipates obtaining significant energy efficiency benefits with the Project. Minnesota Power's conservation program experts are part of the Project's cross-functional team and will be involved throughout the planning and implementation phases to help identify and quantify energy efficiency opportunities. As is seen with customer projects, involving conservation program experts in the early planning phases helps to ensure the most effective efficiencies are identified and included in the decision-making process. This is in line with Minnesota Power's planning principles to use cost-effective technology to greatly reduce emissions, improve efficiency and keep its largest and newest baseload plants operating for many more years on behalf of customers. Similar to the analysis for customer energy conservation projects, energy efficiency and payback are important criteria used in prioritizing Company projects and the BEC4 Project is no exception.

VI. SUMMARY OF INVESTMENTS, EXPENDITURES AND CUSTOMER IMPACTS

A. Estimated Capital Investment

1. Project Costs

Pursuant to Minn. Stat. § 216B.682, subd. 3(a), Minnesota Power provides the BEC4 Project total capital cost, which is estimated at approximately $350 million. The total capital cost reflects Minnesota Power's 80 percent[21] ownership interest in the equipment and facilities that comprise the BEC4 Project. The Project cost estimates have been developed based on consulting engineers' like-kind project experience and vendor proposals, as well as Minnesota Power engineering resources and experience. Minnesota Power and its contractors will be responsible for project management, permitting, licensing and approvals, site preparation, balance of plant construction, and ancillary facilities. Table 12 reflects the project cost breakdown:

Table 12. Project Cost Breakdown – Minnesota Power's Share[21]

	Capital (000s)	Annual Incremental O&M (000s)
CDS/ Fabric Filter	$ 251,800	$ 9,100
PAC System	$ 9,200	$ 300
Ductwork	$ 34,900	$ –
Ash Handling Systems	$ 53,900	$ 3,100
Total	**$ 349,800**	**$ 12,500**

Minnesota Power anticipates incremental O&M expense for the BEC4 Project to be approximately $12.5 million in for the period ending June 30, 2017 as shown in Table 12. This cost is an estimate and is based upon the cost to operate similar facilities, as well as estimates provided by CDS vendors.

As discussed in Section V, Minnesota Power is evaluating differing CDS layouts and siting arrangements to not only minimize the environmental impact to Blackwater Lake, but also attempt to minimize major additional construction expenses while providing the best possible layout for technology operation and maintenance. Despite the environmental impacts and

[21] Net of WPPI's 20% ownership interest in BEC4 as discussed on page 34. Amounts include approximately $3.8 million of AFUDC. Annual incremental O&M amounts are reflected consistent with the periods utilized for calculation of customer impacts.

associated permitting considerations with shoreland adjustment with filling in approximately an acre of the Lake, there is still a clear, compelling technical, logistical and financial advantage to siting the CDS utilizing the west option. Siting on the north location (north option) would require a significant amount of additional ductwork, aboveground and underground utility relocations, and potential additional ID fans, lowering unit efficiency. Minnesota Power solicited CDS bids from a variety of potential suppliers, and received five qualified, competitive bids. Site layout requirements, as it relates to constructability, impact on Blackwater Lake and unit efficiency were all considered carefully. In the end, Minnesota Power will select the lowest overall cost supplies while minimizing environmental siting impact. Also, by considering siting on the north location, the Company would experience considerable additional construction difficulties due to existing infrastructure at BEC. Due to the requirement of additional equipment, materials and construction difficulties, siting on the north option is estimated to cost approximately an additional $35 million.

Bidding and Cost Controls

Minnesota Power will employ multiple steps during the BEC4 Project to help ensure the lowest overall cost for the retrofit. The Company will use its purchasing procedures to obtain competitive quotations for major purchases and award contracts to bidder(s) based on the best overall economic value for its customers. Contractors for the BEC4 Project will be selected on a competitive bid basis and must have demonstrated competency in completing similar major construction projects in an industrial utility environment safely, on-schedule and with a cost consistent with engineering estimates and current market conditions.

Through its bidding and contracting process, Minnesota Power expects to secure a majority of the total cost of the BEC4 Project in fixed fee/lump sum contracts that are competitively bid. Lump sum pricing will be established for those items where scope can be defined in detail. Project schedules are developed to provide adequate time for development of thorough engineering design drawings, specifications, and contract documents defining in detail the scope of work required under the contract. Unit pricing will be established for items where the actual quantities required to complete the work are subject to some variation and cost reimbursable pricing will be established for those items beyond the contractor's control, where detailed definition of the scope is not possible or when conditions under which the work must be

performed are uncertain or subject to significant variation. Work performed on a cost reimbursable basis will be monitored closely to ensure that the contractor is achieving good production consistent with safe work practices and that billings reflect the actual amount of labor and equipment utilized to perform the work.

Minnesota Power is assembling a blended project management team comprised of experienced engineers who recently completed a CDS installation at another US utility. The team has full support of ALLETE risk management services to inform and advise in a wide variety of considerations ranging from due diligence, hedging considerations, contract provision review and corporate oversight.

Minnesota Power is implementing a variety of measures to minimize changes in construction contract values and believes that changes in contract values can best be managed by working with contractors who have demonstrated competence in bidding, managing and implementing utility construction; are reasonable in requests for change orders; and are genuinely interested in securing repeat business. Minnesota Power requires all contractors to submit hourly billing rates for labor and equipment applicable to change order work as an integral part of their response to requests for proposals. These billing rates are considered in the evaluation and award of contracts. As the firm price contracts are awarded through the bidding process, the BEC4 Project cost estimate will continue to become more precise.

In addition to the potential for project scope and schedule changes to impact the Project, Minnesota Power acknowledges that material escalation and fuel price volatility could impact the Project cost and has accounted for reasonable increases; however, larger than anticipated escalation of material and fuel could result in increased costs beyond those already factored into the Project estimate. Through the negotiation process Minnesota Power will work to "lock in" portions of the Project costs to minimize exposure to commodity or delivery cost risk. Minnesota Power will be initiating competitive bidding for the remaining components of the BEC4 Project and will award contracts in parallel with receipt of all needed regulatory approvals. This will allow Minnesota Power to secure pricing and terms on certain materials and services to further reduce the overall risk of increased project costs.

2. Project Controls

Minnesota Power will also use its effective project management and quality assurance/quality control programs for the BEC4 Project. Minnesota Power assigns qualified employees to inspect and monitor construction quality on the job site. These employees include technicians, construction inspectors, surveyors, and registered professional engineers. Minnesota Power provides an on-site construction manager responsible for quality control and administration of the construction contracts, in addition to retaining the services of local engineering and testing firms. Minnesota Power also plans to supplement its internal construction management team with a team from an external engineering/construction management company. The engineering/construction management company will provide additional support and expertise in managing the construction of a project of this magnitude. This will allow Minnesota Power to provide its insight and experience as well as give employees an opportunity to develop their knowledge through working with outside expertise, maximizing the value to employees and the Company. Using this construction management structure will aid the Company in controlling scope changes and the costs associated with those changes.

3. Operational and Construction Logistics

Minnesota Power customers will require on-going full load production output from BEC4, as well as from the other three Boswell units, while the emission reduction construction activities for BEC4 occur at the facility. The sustained operating requirement for all of BEC while the BEC4 Project is executed is a very complex undertaking. Minnesota Power has successful experience managing this type of situation as evidenced with the BEC3 retrofit which occurred between 2007-2009. Minnesota Power will strive to effectively meet that goal while keeping workers and contractors safe, meeting environmental permit requirements during construction, minimizing the possibility of inadvertent unit outages for any of BEC's four units, and managing overall project costs and schedule.

To facilitate meeting the previously discussed goals, while working in a constrained location for construction, Minnesota Power will leverage the common facilities installed and used during the course of the BEC3 retrofit project such as the pedestrian bridge, fabrication tables, information/logistics center, contractor parking spaces and materials receiving areas. The reuse of these common facilities will help to eliminate rail, road and foot traffic safety concerns

due to the expected high volume of foot and vehicle traffic during the construction phase. Additionally, the reuse of these facilities strengthens the Company's ability to control costs and security at the job site, assist in contractor performance monitoring and helps to ensure material deliveries are received and tracked properly.

B. Estimated Customer Impact

Assuming current cost recovery for the BEC4 Project begins July 2013, Table 13 below summarizes the estimated rate impacts by customer class relative to the 2010 average rates approved in Minnesota Power's last rate case (Docket No. E015/GR-09-1151). For the average residential customer, the rate impact for the first twelve months of current cost recovery of the BEC4 Project would be approximately $1.15 per month or a 1.56 percent rate increase. For the twelve months ending June 30, 2017 this impact will increase to $4.33 per month or a 5.88 percent rate increase. For Large Power customers, the estimated rate impact for the first twelve months of current cost recovery of the BEC4 Project would be approximately 0.124¢ per kWh of energy or an increase of 2.37 percent. The estimated rate impact per kWh for the twelve months ending June 30, 2017 would be approximately 0.466¢ per kWh or an increase of 8.91 percent.

As part of a power sales agreement to Basin Electric Power Cooperative ("Basin"), Minnesota Power is allowed to collect costs from Basin associated with new emission control additions to BEC4 over a specified period. Minnesota Power is passing the benefits of this agreement directly to customers through crediting the jurisdictional revenue requirements by Basin's specified share of the costs for a portion of the contract.

Table 13. Estimated Customer Impact

	Estimated Rate Impact			
12 months ending 6/30	**2014**	**2015**	**2016**	**2017**
MN Juris Rev Req.	11,668,092	23,847,704	33,850,464	44,017,253
Rate Class Impacts (Note 1)				
Residential				
Avg Current Rate (¢/kWh)	8.963	8.963	8.963	8.963
Increase (¢/kWh)	0.140	0.286	0.405	0.527
Increase (%)	1.56	3.19	4.52	5.88
Avg Impact ($/mth)	1.15	2.35	3.32	4.33
General Service				
Avg Current Rate (¢/kWh)	8.957	8.957	8.957	8.957
Increase (¢/kWh)	0.140	0.286	0.405	0.527
Increase (%)	1.56	3.19	4.52	5.88
Avg Impact ($/mth)	4.01	8.18	11.59	15.08
Large Light & Power				
Avg Current Rate (¢/kWh)	7.050	7.050	7.050	7.050
Increase (¢/kWh)	0.140	0.286	0.405	0.527
Increase (%)	1.99	4.06	5.74	7.48
Avg Impact ($/mth)	259.65	530.43	751.13	977.40
Large Power				
Avg Current Rate (¢/kWh)	5.228	5.228	5.228	5.228
Increase (¢/kWh)	0.124	0.253	0.359	0.466
Increase (%)	2.37	4.84	6.87	8.91
Avg Impact ($/mth)	66,042	134,747	191,203	248,191
Municipal Pumping				
Avg Current Rate (¢/kWh)	8.121	8.121	8.121	8.121
Increase (¢/kWh)	0.140	0.286	0.405	0.527
Increase (%)	1.72	3.52	4.99	6.49
Avg Impact ($/mth)	27.69	56.57	80.11	104.24
Lighting				
Avg Current Rate (¢/kWh)	14.643	14.643	14.643	14.643
Increase (¢/kWh)	0.140	0.286	0.405	0.527
Increase (%)	0.96	1.95	2.77	3.60
Avg Impact ($/mth)	1.06	2.17	3.07	4.00

Note: 1. Average current rate based on Final 2010 TY General Rates in 2009 Rate Case with riders (E015/GR-09-1151)

VII. EMISSION REDUCTION ALTERNATIVES CONSIDERATION AND FINDINGS

The energy and capacity provided from BEC4, the largest generating resource in Minnesota Power's fleet, is an essential component of Minnesota Power's customers' supply. BEC4 generates a very large quantity of reliable energy at a reasonable cost 24 hours a day and is a baseload resource for the region's energy intensive requirements. In light of environmental rules anticipated to affect BEC4, Minnesota Power diligently worked to identify environmental compliance alternatives and ultimately determined that retrofitting BEC4 as proposed in this filing was the best option to pursue to meet the upcoming compliance requirements for the federal MATS and state MERA requirements. The analysis of other resource alternatives described in this section, and fully outlined in Appendix A, confirmed that BEC4 is needed for serving Minnesota Power customers over the long term and that the BEC4 Project is the most reasonable and cost-effective way to meet the Unit's environmental compliance requirements.

After determining that the BEC4 Project was the best retrofit design for ensuring environmental compliance on the Unit, three alternative environmental compliance paths involving either the timing of the BEC4 retrofit or the complete replacement of BEC4 were analyzed:

a) **Implement the BEC4 Project**: As described in this Petition, execute an environmental retrofit for air emission control technology at BEC4 by 2016 to significantly reduce hazardous air pollutants and keep the energy and capacity available for Minnesota Power's supply requirements.

b) **Delay the BEC4 Project:** Implement a temporary unit shutdown for BEC4 until 2020 and build a 213 MW natural gas combustion turbine in the interim to help with replacement power needs.

   The delay would postpone the cost of the environmental retrofit for Minnesota Power customers by approximately 5 years and expedite a natural gas resource build to protect customers from extreme amounts of market purchase exposure during the BEC4 shutdown. This compliance path would prove to be ultimately beneficial if the EPA MATS Rule was expected to dissolve or be significantly delayed for BEC4, bringing

benefits to customers as the capital costs of a BEC4 Project are pushed out or removed completely.

There is no indication of a delay or dissolution of the MATS Rule and this option would ultimately create a significant reliance on the regional market for replacement power purchases, at levels of almost 30 percent of expected energy supply requirements (much higher than typical market utilization of 15-20 percent). Minnesota Power does not believe the level of market volatility introduced by this option is a sound choice for customers.

After initial evaluation, the delay option was ultimately not included in the final consideration of viable alternative options for the BEC4 Project.

c) **Shut-Down and Replace BEC4:** Allow another reasonable generating resource option to replace BEC4 in 2016 and retire the BEC4 facility.

The retirement of BEC4 would include associated closure costs such as the remaining plant balance of this large facility and the construction of new generating resource(s) to provide the needed replacement energy and capacity requirements.

Minnesota Power screened a wide range of replacement alternatives to determine reasonable resource options to compare with retaining BEC4 and executing the proposed Retrofit Project.[22] The lowest cost alternatives included several natural gas generating resource options. Minnesota Power identified two natural gas alternatives to consider as part of its evaluation of the BEC4 Project's cost effectiveness:

1) "Direct" replacement: implementing a 1x1 combined cycle (approximately 400 MW) unit, plus a small bank of reciprocating engines (55 MW) in combination with wholesale market purchases (20 MW).

   This alternative would add assets to Minnesota Power's supply that would replace BEC4 energy and capacity requirements.

[22] Appendix A provides a full description of the screening process utilized to find reasonable generating resource replacement options to BEC4. Appendix A – Attachment 1 specifically addresses the screening options.

2) "Ownership Share" replacement: execute a strategy to procure an approximate 60 percent share of a larger 2x1 combined cycle unit (typically 800 MW) to replace the BEC4 resource.

   By considering this option, Minnesota Power ensured that it considered the lowest cost natural gas technology, as a combined cycle unit is a more efficient generating station and, in a larger size, can offer lower cost energy on a per megawatt-hour basis.

   Deploying this replacement option assumes Minnesota Power can find a counterparty to invest in the remaining share of the 800 MW unit in the same timeframe.

To verify whether the BEC4 Project was the best compliance alternative for its customers, Minnesota Power examined these two alternative paths in detail to determine if they were reasonable to pursue. As discussed above, the delay of the BEC4 Project was deemed unreasonable to warrant continued evaluation largely due to the added cost burden and market risk it created for customers. Therefore, the remaining alternative paths included the consideration of a BEC4 shutdown and two possible natural gas replacement options. Minnesota Power conducted a detailed comparison of the natural gas alternatives against BEC4 with the proposed retrofit Project implemented in a rigorous planning process to evaluate the best option for Minnesota Power's customers over the long term planning horizon. The retrofit option was found to provide the best environmental and economic benefits for customers.

Each of the natural gas alternatives were evaluated and compared against the alternative of BEC4 with Project implementation under a range of planning sensitivities.[23] The results showed the BEC4 Project provided a range of benefits for Minnesota Power customers over the two natural gas replacement options, spanning from $210 million to $373 million of savings over the study period.

[23] Minnesota Power utilized the Strategist modeling package to conduct its comparative analysis between the options. More details of the results from the comparative analysis are discussed in Appendix A.

As an extension of the comparative analysis, the BEC4 Project and replacement options were then stressed under varying industry conditions to validate the robustness of the BEC4 Project decision for Minnesota Power customers. Single variables that are critical to the electric industry (such as natural gas and coal pricing) were increased and decreased, and power supply costs were compared between the BEC4 Project and natural gas replacement alternatives. Variables were stressed as part of the analysis to ensure and confirm that the BEC4 Project was still the most reasonable and lowest cost option for customers under varying conditions.

The sensitivity analysis identified that the BEC4 Project is the best decision for Minnesota Power customers over a majority of the sixteen sensitivities evaluated as shown in Appendix A pages 18 and 19. The relative cost of the BEC4 Project is highly sensitive to gas price volatility and potential future carbon regulation. Even though a low gas sensitivity indicates the potential for customer benefit with the natural gas resource alternatives when compared to the BEC4 Project, the benefit in this sensitivity analysis is driven by an assumption of sustained, long-term low natural gas pricing at Henry Hub of $2/MMBtu in 2012 and $4/MMBtu in 2035 that is 50 percent below even the current, record low outlooks. While Minnesota Power included this sensitivity to validate this book-end condition for natural gas prices, it does not believe there is a high probability of sustained natural gas production at the levels in the "Minus 50% Natural Gas" sensitivity.

Due to the magnitude of BEC4 Project and its significance for Minnesota Power customers, a third party was enlisted to provide an independent review of the alternatives for meeting environmental compliance at BEC4. Pace Global Inc.'s analysis confirmed Minnesota Power's position that pursuing an environmental retrofit at BEC4 and completing it by 2016 was in the best interest of Minnesota Power's customers over a significant range of plausible industry futures.

Further support for the decision to move forward with the BEC4 Project resulted from Minnesota Power's recent baseload diversification study that was accepted by the Commission at its August 9, 2012 hearing. A rigorous system-wide analysis, including BEC4 and all Minnesota Power coal-fired units, was conducted as part of Minnesota Power's baseload diversification

study and was discussed in Minnesota Power's Baseload Diversification Report.[24] The results indicated moving forward with an air emission environmental retrofit on BEC4 would be in the best interest of customers.[25]

With all internal and independent third party evaluations identifying the significant customer benefit available with the implementation of the BEC4 Project and continuing to include BEC4 as a key part of its power supply, Minnesota Power is confident that pursuing the BEC4 Project is in the best interest of its customers.

[24] Minnesota Power's Baseload Diversification Report was filed with the Commission on February 6, 2012 and accepted by the Commission at its August 9, 2012 hearing. See Docket No. E-015/RP-09-1088.

[25] The value of BEC4 continuing in Minnesota Power's fleet was recognized and echoed in the comments on the Baseload Diversification Study by the Division of Energy Resources, page 23 of their comments indicate "…initial Department analysis determined that, at the expected level of environmental compliance costs, retiring BEC4 is not a cost-effective option."

VIII. EMISSION REDUCTION ALTERNATIVES CONSIDERED BUT NOT PURSUED

A. Installing New or Refurbishing Existing Emission Control Technology

As previously stated, Minnesota Power is closely following pending federal rules regulating various air pollutants, in addition to mercury, emitted by coal-fired power plants that may be enacted by 2019. It is important for Minnesota Power to avoid decisions that would result in mercury (or any other) emission reduction equipment being installed and then removed prematurely in order to accommodate the subsequent addition of reduction technology for other pollutants. By considering other potential emissions reductions beyond mercury, Minnesota Power can ensure the mercury emission reduction investment for BEC4 fits well technically with a multi-emission reduction/environmental improvement installation. Minnesota Power evaluated the following five options as part of its analysis of the most cost effective emission control technology for achieving compliance with all required federal and state regulations; however, they were not pursued for the reasons stated.

The studies discussed in this section of the filing began in 2009 and were completed by May 2010 and were completed by Burns & McDonnell. It is important to note that at the time these particular studies were conducted CAIR had been stayed and no new regulation had been proposed to replace it. The focus of the studies was to ensure Minnesota Power would be able to meet all existing and anticipated future requirements for air pollutants. Therefore, many of these options include the use of selective catalytic reduction ("SCR") technology for NO_x control and may differ only in the timing of installing the SCR. Since the time of the studies, new regulations for air pollutants have been enacted such as CSAPR and MATS (though as previously noted CSAPR came under a vacature ruling in August 2012). As a result of early and voluntary NO_x controls at BEC4, BEC4 currently meets NO_x emission levels for existing and pending regulations, eliminating the need to consider a SCR at this time; however, installation of a SCR is discussed in the following options since it was evaluated as part of the studies. Although a SCR was evaluated as part of the studies, the associated costs with construction of a SCR, which are similar for each option, were excluded from consideration when comparing the options. A SCR could be installed at any time in all of the options considered, including the proposed BEC4 Project, therefore, the SCR costs were excluded and the decision to evaluate the options further was based on other project-based costs and factors.

Table 14. Options Considered but not Pursued

Option	Description	Commercial Operation Date
1	New Wet FGD, ID Fans, SCR, FF, PAC	2016
2	New Wet FGD, ID Fans, FF, PAC and future SCR in place of original FGD	2016/2019
3	Upgrade original FGD, new ID Fans, FF, PAC	2016
4	New SCR only	2016
5	New FF, PAC, modify original FGD, ultra low PRB coal	2015

Option 1:

Description: This option included installation of a new wet FGD system, new ID fans, SCR system, fabric filter and powder activated carbon injection system. The projected timeframe for commercial operation of Option 1 was December 2016. The fabric filter and new FGD system were to be located east of the existing chimney. The SCR system was to be located west of the existing air quality control system ("AQCS") building.

Discussion**:** This option would meet the current MATS requirements and would provide BACT level reduction of NOx, SO_2, PM, and mercury. This option would require new ID fans, a substantial amount of ductwork to connect the new fabric filter, wet FGD and ID fans into the existing plant and chimney, as well as substantial and difficult ductwork to connect a SCR on the west side of the building. This option forces Minnesota Power to overcome substantial site constraints including demolition and relocation of the administrative building and warehouse at the facility and opening an area to the west of the plant into the lake for the SCR. This option is likely to help in meeting anticipated CCR rules in that the fly ash would be dry; however, the wet FGD would still produce a wet slurry.

Conclusion: This option will not be considered further due to the high cost, site constraints caused by the large footprint, high annual O&M requirements, lower efficiency, and the inability to fully comply with potential future CCR regulations due to the wet FGD slurry.

Option 2:

Description: This option included installation of a new wet FGD system, new ID fans, fabric filter, and powdered activated carbon injection system and future SCR installation. The

projected timeframe for commercial operation of Option 2 was December 2016. Installation and commercial operation of the SCR system was to be delayed until July 2019 to allow for demolition of the abandoned existing FGD to provide an area for construction and placement of the SCR. This simplified construction and eliminated the need to reclaim wetlands to allow for construction. The fabric filter and new FGD system were to be located east of the existing chimney.

Discussion: This option is similar to Option 1; however, installation of a SCR was delayed to the timeframe of 2017-2019 with the SCR being constructed in the location of the existing abandoned wet FGD. This option was evaluated due to site constraints.

As with Option 1, current MATS requirements and BACT level reduction of NO_x, SO_2, PM and mercury are met with Option 2. This option would require new ID fans, a substantial amount of ductwork to connect the new fabric filter, wet FGD and ID fans into the existing plant and chimney, but provides a simpler solution for connecting the ductwork to the SCR with the demo of the existing FGD. Option 2 still faced substantial site constraints including demo and relocation of the administrative building and warehouse at BEC. This option is likely to help in meeting anticipated CCR rules in that the fly ash would be dry; however, the FGD would still produce a wet slurry.

Conclusion: This option was not considered further due to the high cost, site constraints caused by the large footprint, high annual O&M requirements, lower efficiency, and the inability to fully comply with potential future CCR regulations due to the wet FGD slurry.

Option 3:

Description: The existing FGD system would be upgraded to meet current technology removal efficiencies. New ID fans, a SCR system, fabric filter, and activated carbon injection system would be installed as part of this project. The projected timeframe for commercial operation of Option 3 was December 2016. The fabric filter would be located east of the existing chimney and the SCR system was to be located west of the existing AQCS building.

Discussion: As with Option 1, this option would meet the current MATS requirements and provide BACT level reduction of NO_x, SO_2, PM and mercury. This is the most expensive option because it requires major modifications to the existing FGD system, installation of new ID fans,

a large amount of ductwork to connect a new fabric filter ahead of the FGD as well as the difficult ductwork to connect in a SCR due to the tight site constraints. Additionally, this option would require a number of outages to tie in the new and/or upgraded components. This option is likely to help in meeting future CCR rules in that the fly ash would be dry; however, the FGD would still produce a wet slurry.

Conclusion: This option was not considered further due to the high cost to retrofit a 30-year old scrubber that would be more expensive and less efficient to operate than the proposed CDS system, site constraints caused by the large footprint, high annual O&M requirements, and the inability to fully comply with potential future CCR regulations due to the wet FGD slurry.

Option 4

Description: This option only installed a SCR system with a projected commercial operation date of October 2016. The SCR system was to be located west of the existing AQCS building.

Discussion: This option considered only the installation of a SCR and left the new wet FGD system, new ID fans, fabric filter, and powdered activated carbon injection system for a future timeframe yet to be determined.

Conclusion: This option was not considered further because BEC4 meets the NO_x levels specified by the MATS Rule through installation of LNB and OFA, SNCR and would not meet the required PM and mercury compliance limits.

Option 5:

Description: This option includes installation of a fabric filter and a powdered activated carbon injection system. The existing FGD system would be modified from operating with fly ash to a forced oxidized limestone system, existing venturis would be removed and existing ID fans would be equipped with new VFD. The projected commercial operation date was December 2015. The fabric filter was to be located west of the existing AQCS Building.

Discussion: This option would provide for installation of the minimum amount of environmental control technology required in order to meet MATS.[26] This would meet the PM requirements, as

[26] Based on the final MATS Rule released in December 2011.

well as mercury. Although this option currently meets the SO_2 requirements, it requires ultra low sulfur coal and takes away any flexibility in burning lower cost coal blends and lessens the likelihood of meeting future SO_2 NAAQS. This could risk putting the Unit at a high operating cost, potentially impacting its cost competitiveness. Although this option would be likely to help in meeting anticipated CCR rules in that the fly ash would be dry, the FGD would still produce a wet slurry.

Conclusion: This option was not considered because of the high annual O&M costs, lower efficiency, and reliance on the existing wet FGD/venture particulate removal system that has been in service for more than 30 years and its associated age related operational risks over the long term. Additionally, this would remove future flexibility for utilizing any other PRB coals. Finally, any future NAAQS or regional haze requirements potentially would not be met with this option.

BEC4 is in a unique position with the existing wet particulate removal system combined with the spray tower absorber for SO_2 capture that has worked well in utilizing the alkaline properties in the fly ash for SO_2 removal. This emission control technology is not commonly used by other utilities. This leads to high capital costs to modify the existing FGD to operate on lime instead of fly ash. This would be higher than costs incurred if there was a more traditional PM removal system with a lime-based spray tower absorber. Minnesota Power has benefited over the years in using this particular system in that it allowed BEC4 to operate and meet customer electrical demands with a high level of SO_2 capture since 1980, producing low emission energy at a very low relative cost.

The current regulations for meeting MERA as well as MATS, leaves Minnesota Power no other option than to install a fabric filter system. However, the installation of a fabric filter completely changes the operation of the existing spray tower absorber by removing the fly ash that has currently been utilized for SO_2 capture. Any modification to the existing FGD that does not include completely replacing or substantially upgrading the components would result in Minnesota Power not being able to maintain low levels of SO_2 emissions. The Wyoming and Montana coal blend currently being burned on BEC4 has lower sulfur content and, consequently, less SO_2 emissions than the Montana PRB low sulfur coal traditionally burned on BEC4. Modifications to the existing scrubber would force Minnesota Power to limit fuel choices to the

ultra low sulfur fuels that in the future could result in increased fuel costs. Replacing the scrubber with a CDS system will allow Minnesota Power to maintain the low SO_2 emissions even with burning higher sulfur fuels and provide flexibility in fuel choices allowing for more competitive fuel supply options. Also note that upgrading the existing scrubber to provide the same flexibility as in Option 3 is a higher cost than the CDS option and will have substantially higher O&M costs into the future.

B. Do Nothing – Allow Facility to Continue with No Environmental Control Equipment Installed

Minnesota Power has a long history of environmental stewardship. In more recent years, the Company has combined this stewardship with power supply principles of creating more diverse, flexible and efficient resource options for its customers. This overall approach has been reflected in Minnesota Power's integrated resource plans and resource related petitions previously approved by the Commission, including recently approved wind and hydro resource filings.

Moving forward with a 'do nothing' alternative for BEC4 is not consistent with Minnesota Power's power supply principles, or its values. It could potentially be viewed as a good short-term solution, but it is not a good long-term solution in the best interest of Minnesota Power's customers. Therefore, 'Do nothing' was not considered as a viable alternative.

C. Closure or Repowering of Facility with Natural Gas

As an alternative to installing required additional emission reduction technology on BEC4, the costs, operational impact and other factors associated with retiring and replacing BEC4 with cleaner fuels was evaluated. Replacing BEC4 with a natural gas resource or combination of resources is an alternative to installing new emission controls, since natural gas generation results in emission of less mercury, SO_2, PM and other pollutants to an extent comparable to coal unit emission control retrofit equipment. In Section VII and Appendix A, Minnesota Power discusses its analysis and findings related to closure and replacement of BEC4.

A conversion of the existing steam production infrastructure to natural gas (the most price comparable fuel source to coal today) was not identified as a viable option for BEC4. The efficiency of the resulting natural gas boiler that would be available after a conversion of BEC4

infrastructure would not be comparable to available natural gas only technologies and ultimately results in a non-viable option for a large coal-fired generating resource such as BEC4. Minnesota Power focused its evaluation on more plausible and reasonable natural gas alternatives as described in Section VII and Appendix A.

IX. PROJECT COMMUNICATION AND FILING

Minnesota Power will provide ongoing communication with the Commission, the Department and other stakeholders prior to and upon approval and throughout Project construction. Minnesota Power will supplement the record with several additional updates related to the BEC4 Project in addition to future rider filings that include an annual factor filing, an in-service filing, and rider true-up filings. Minnesota Power voluntarily commits to providing the following updates related to achieved project milestones as part of the comment process or through additional filings:

- Milestones achieved with the air and wetland/water permitting,
- WPPI Energy's progress in obtaining its Certificate of Authority from the Public Service Commission of Wisconsin,
- Delivery of CDS technology and fabric filter to the project site and
- Installation of CDS and fabric filter is complete.

Minnesota Power also will submit annual reports to the Commission on the achievement of its mercury, SO_2, and PM reduction progress once commissioning and tuning is completed.

X. THE BEC4 PROJECT IS IN THE PUBLIC INTEREST

At 585 MW of net capacity, BEC4 is the newest and single largest base load generator in Minnesota Power's fleet, providing cost-effective and reliable power to Minnesota Power's customer 24 hours a day, 7 days a week. Because more than 50 percent of Minnesota Power's total energy supply is used by its 12 largest industrial customers that operate around the clock, the Company has a uniquely high load factor, requiring a power supply that is more steady than that of most utilities. Retrofitting BEC4 to reduce mercury emissions by 90 percent, and improving other aspects of environmental performance as requested in the Petition, is in the public interest as it will help to ensure BEC4 continues to deliver a large volume of essential energy to residents, communities and businesses in Northeastern Minnesota at a reasonable cost.

The EPA's issuance of the MATS Rule for mercury reduction and other air pollutants in December of 2011 was a key factor in the timing of submitting the BEC4 Plan Petition. With Commission approval of the Project in 2013 and the granting of a one-year extension for completion by the MPCA, Minnesota Power will comply with MATS within the allocated EPA timeframe. There are approximately 61 gigawatts ("GW") of generation that will require some action to comply with the EPA regulations within the MISO footprint. Nation-wide estimates project that 93-248GW[27] of coal will require environmental control upgrades to come into compliance with EPA regulations or be shutdown. The timing of the BEC4 Project will benefit customers in that it will allow Minnesota Power to get ahead of other utilities in securing competitive pricing, technology selection, requesting necessary outage(s) from MISO, and contracting with skilled trades to construct the Project. Under the current BEC4 Project schedule, Minnesota Power would be in compliance with MERA more than two years in advance, providing significant environmental benefits to the region well in advance of when required by Minnesota law.

The benefit of the BEC4 Project is that it not only brings Minnesota Power into compliance with MERA, but also provides a multi-pollutant solution to meet MATS and many of the other enacted or pending EPA rulemakings while also ensuring compliance with other regulatory programs over the long term. The comprehensive approach to emission reduction

[27] Measured in wet FGD equivalent GW. See May 2012 "Supply Chain Outage Analysis of MISO Coal Retrofits for MATS" prepared for MISO by The Brattle Group.

proposed with Minnesota Power's BEC4 Project will address mercury, PM, and improve performance for HCl which is required under the MATS Rule. Additionally, improved SO_2 emissions control performance achieved will reduce dependence on allowances for compliance. This will benefit Minnesota Power customers if current court challenges to CSAPR and/or changes in regulation result in reduced allowance SO_2 allocations in the future. Furthermore, as EPA reviews the NAAQS on a routine basis, they are sometimes adjusted, and often made more restrictive. Adjustments to these NAAQS could result in more stringent emission limits on Minnesota Power's steam generating facilities, possibly resulting in additional control measures on some of its units. Emissions of SO_2 from BEC4 will be reduced through the Project, improving performance compared to future SO_2 NAAQS standards.

Minnesota Power's long-term outlook for energy and capacity needs supports Minnesota Power's decision to move forward with the BEC4 Project. Minnesota Power is projecting significant growth in both demand and energy over the next decade. Planned additions by large retail customers and wholesale contract extensions out through 2019 keep Minnesota Power's long-term load growth projections[28] at an average 1.5 percent.[29]

Minnesota Power uses the MISO Module E Load and Capability ("L&C") calculation[30] as one measure to assess future resource need and overall resource adequacy. The MISO L&C calculation takes into consideration Minnesota Power's load forecast, expected demand side resources, firm and participation purchases and sales, accredited generating capability and MISO's currently required 12 percent planning reserves. The result of the L&C calculation is a capacity surplus (or deficit) projection for each planning season. Minnesota Power is expecting a need for capacity in the 2020 timeframe which is when the currently executed 250 MW Manitoba Hydro Power Purchase Agreement is implemented. The important contribution of

[28] Minnesota Power's June 2012 Annual Electric Utility Forecast Report ("AFR") was used for the evaluation of the BEC4 Project. The AFR contained several long-term scenarios for Minnesota Power's energy and demand requirements. The "Wholesale and Industrial Customer Addition Forecast Scenario," which contains the addition of the Essar taconite pellet facility in Nashwauk, Minnesota, was utilized as the expected outlook for the analysis.

[29] This projection also assumes that Minnesota Power continues to achieve its 1.5 percent energy conservation obligation. Beginning in 2020, Minnesota Power's system load forecast projects a more typical 1 percent system growth rate to extend the outlook to 2035.

[30] The MISO Resource Adequacy Program identifies how capacity resources are tested to determine their installed capacity values. These values are then utilized to estimate what capacity is available to serve load on an annual basis. Minnesota Power does not utilize the Unforced Capacity (UCAP) method for long term planning as this method does not properly account for long term operational characteristics of generating resources.

BEC4 in meeting future demand requirements of Minnesota Power's customers[31] is clearly shown in Figure 2.

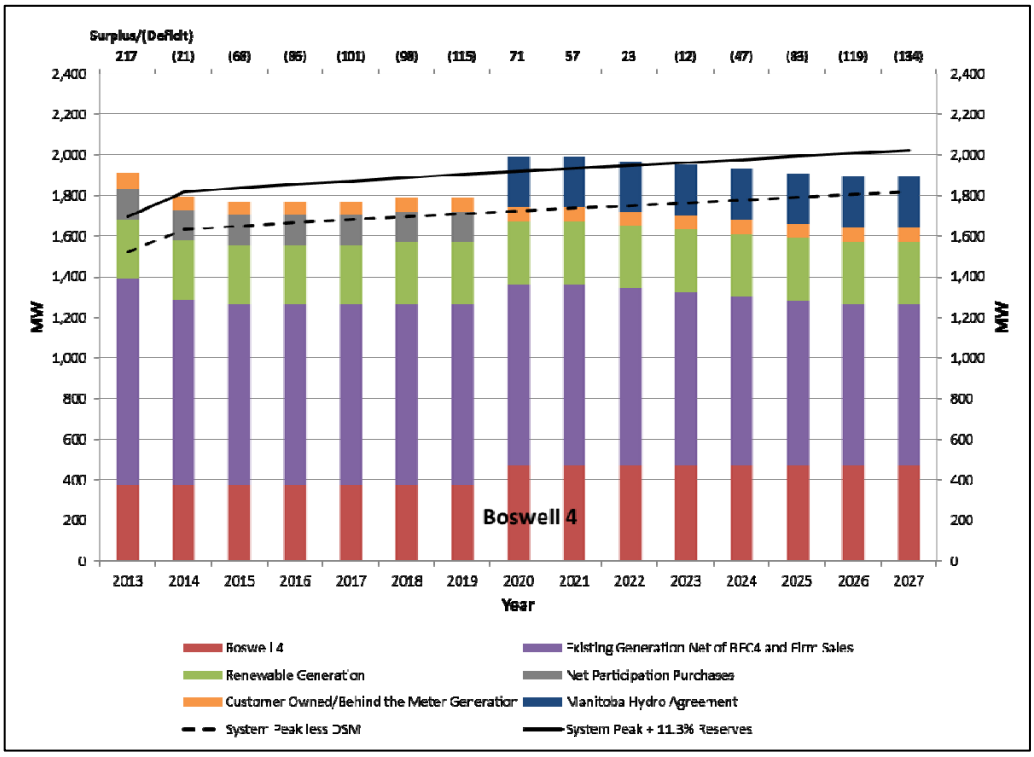

Figure 2. Demand Requirements under the Wholesale Industrial Customer Scenario

[31] The 100 MW increase in capacity at BEC4 in 2020 is due to the expiration of the 100 MW power sale to Basin Electric Power Cooperative.

Figure 3 is Minnesota Power's energy need outlook which also shows the critical part BEC4 has in meeting the future energy requirements of customers.

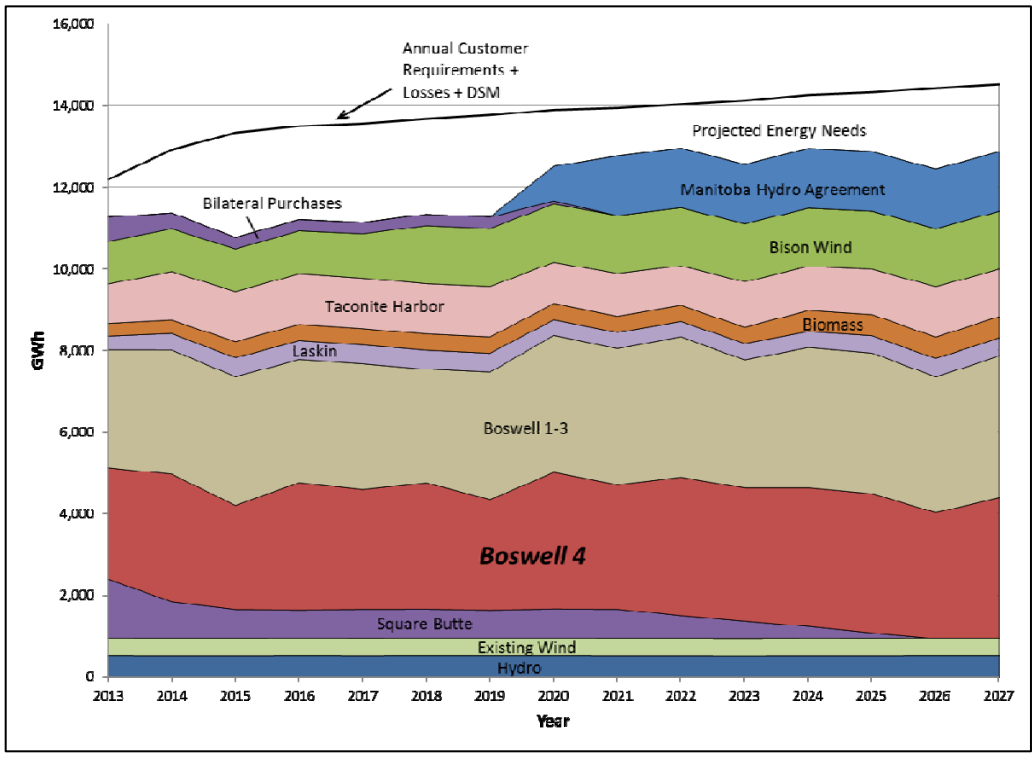

Figure 3. Energy Outlook – Wholesale Industrial Customer Scenario

The BEC4 Plan Petition used significant planning analysis to quantify the impact and benefit of the BEC4 Project and show the BEC4 Project is the lowest cost plan for customers over a wide-range of assumptions when compared to other alternatives. As described in this Petition, Minnesota Power evaluated the BEC4 Project against two possible natural gas replacement options and a BEC4 shutdown scenario under a range of planning sensitivities. The results showed that the BEC4 Project provided a decisive range ($210 million to $373 million) of financial benefits for Minnesota Power customers over the two natural gas replacement options and a BEC4 shutdown scenario. Based on these findings and the other justification provided in this section, Minnesota Power is confident that moving forward with the BEC4 Project is in the best interest of its customers.

The BEC4 Project is an economic cost-effective method for meeting customer energy needs and it allows BEC4 to remain a low cost and reliable generation asset capable of meeting the demands of Minnesota Power's system safely and reliably. BEC4 is a critical base load asset

within Minnesota Power's long-term resource strategy as outlined in the Company's integrated resource planning process. For this reason, Minnesota Power has already made significant investments in BEC4. In 2010, Minnesota Power increased its effectiveness in preventing the formation of NO_x with the replacement of the first generation low NO_x burners with state-of-the-art low NO_x burners and separated over-fire air technology that is widely used in coal-fired utility boilers to minimize the creation of NO_x in the coal combustion process. These NO_x controls provide approximately a 55 percent annual reduction in NO_x emissions. During the same timeframe Minnesota Power replaced the original turbine with a more efficient design that added 50 MW of zero emission, dispatchable, capacity and energy without consuming additional fuel. Turbine upgrades to increase generating output on existing generating units that do not require additional fuel are among the most cost-effective methods for increasing Minnesota Power's reliable energy supply without increasing criteria pollutant emissions.

The proposed multi-pollution solution CDS technology described in this Petition has proven performance when installed on utility scale projects and has several maintenance cost and environmental advantages over other FGD systems. Advantages include: generally low maintenance due to its simple system; increased equipment reliability due to the elimination of parts that require frequent maintenance which are found in typical wet FGD system; no liquid waste stream; and water streams from BEC that need to be treated may be used in the CDS, therefore reducing or eliminating the need for water disposal and treatment.

By proactively managing the research, design, engineering and procurement of the BEC4 Project, Minnesota Power is able to deliver an on-time, cost-effective multi-pollutant solution. The Company will utilize its purchasing procedures to obtain competitive quotations for major purchases and award contracts to bidder(s) based on the best overall economic value for its customers, secure a majority of the total cost of the BEC4 Project in fixed fee/lump sum contracts that are competitively bid, implement measures to minimize changes in construction contract values, work with contractors who have demonstrated competence in bidding, managing and implementing utility construction and are genuinely interested in securing repeat business, and supplement its internal construction management team with a team from an external engineering/construction management company to provide additional support and expertise.

Additionally, the reuse of common facilities installed and used during the course of its last major Boswell facility project strengthens the Company's ability to control costs and security at the job site, assist in contractor performance monitoring and help to ensure material deliveries are received and tracked properly.

Minnesota Power will also utilize its effective project governance and quality assurance/quality control programs by assigning qualified employees to inspect and monitor construction quality on the job site including an on-site construction manager responsible for quality control and administration of the construction contracts. Minnesota Power also plans to supplement its internal construction management team with a team from an external engineering/construction management company that will provide additional support and expertise in managing the construction of a project the magnitude of the BEC4 Project.

The BEC4 Project provides environmental benefits by reducing emission reduction levels of mercury, SO_2 and PM as shown in Figure 4,[32] as well as reducing the waste water discharged at BEC, positioning Minnesota Power well to meet current and future environmental requirements. The expected environmental benefits from the BEC4 Project are based on current EPA modeling techniques. Minnesota Power's BEC4 Project cost-effectively provides significant emission reductions and environmental/health benefits that exceed costs.

The expected improvement in air quality is illustrated in Figure 4 through the comparison of pre-Project to post-Project annual emissions for mercury, PM and SO_2.

[32] The BEC4 Project will also reduce emissions of fine particulate matter ("$PM_{2.5}$").

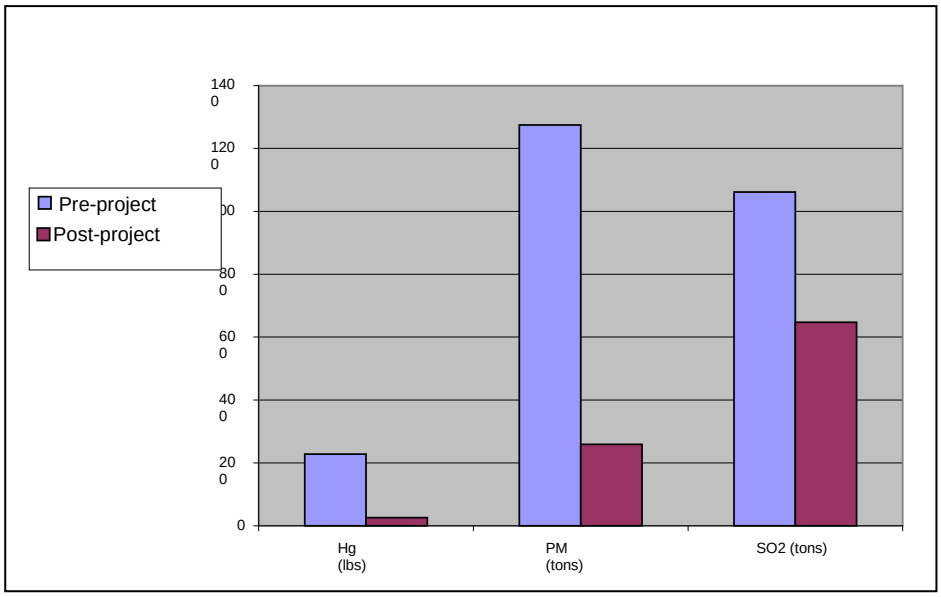

Figure 4. BEC4 Annual Emissions

Furthermore, Minnesota Power has been taking significant steps over the past five years to reduce the carbon concentration on the system as part of its larger integrated resource plan strategy. Specific actions already taken include:

- Phasing out of Minnesota Power's ownership share of Square Butte's Young 2 coal fired facility in the 2012 thru 2025 time period.
- Adding 400 MW of wind generation to its power supply by end of 2012 including Oliver County I, II, Taconite Ridge, and Bison 1, 2, and 3 projects.
- Purchasing 250 MW of hydro generation from Manitoba Hydro starting in 2020.

Moving forward with the BEC4 Project would continue to improve the air quality in northern Minnesota, aligning well with Minnesota Power's history of environmental stewardship.

XI. CONCLUSION

Minnesota Power respectfully requests that the Commission approve the BEC4 Project in compliance with MERA. BEC4 is and will continue to be an essential component of Minnesota Power's long-term resource strategy, especially with significant growth projected in customer energy and demand requirements over the next decade. The BEC4 Project is a prudent investment on behalf of Minnesota Power's customers that will reduce mercury emissions, provide a multi-pollutant solution to meet MATS and other existing and pending state and federal environmental regulations and significantly reduce wastewater production from BEC4. The BEC4 Project is a cost-effective plan to help ensure BEC4 continues to meet customer resource needs safely and reliably. Minnesota Power looks forward to working with the Commission and other interested stakeholders to implement the BEC4 Project.

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Respectfully submitted,

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