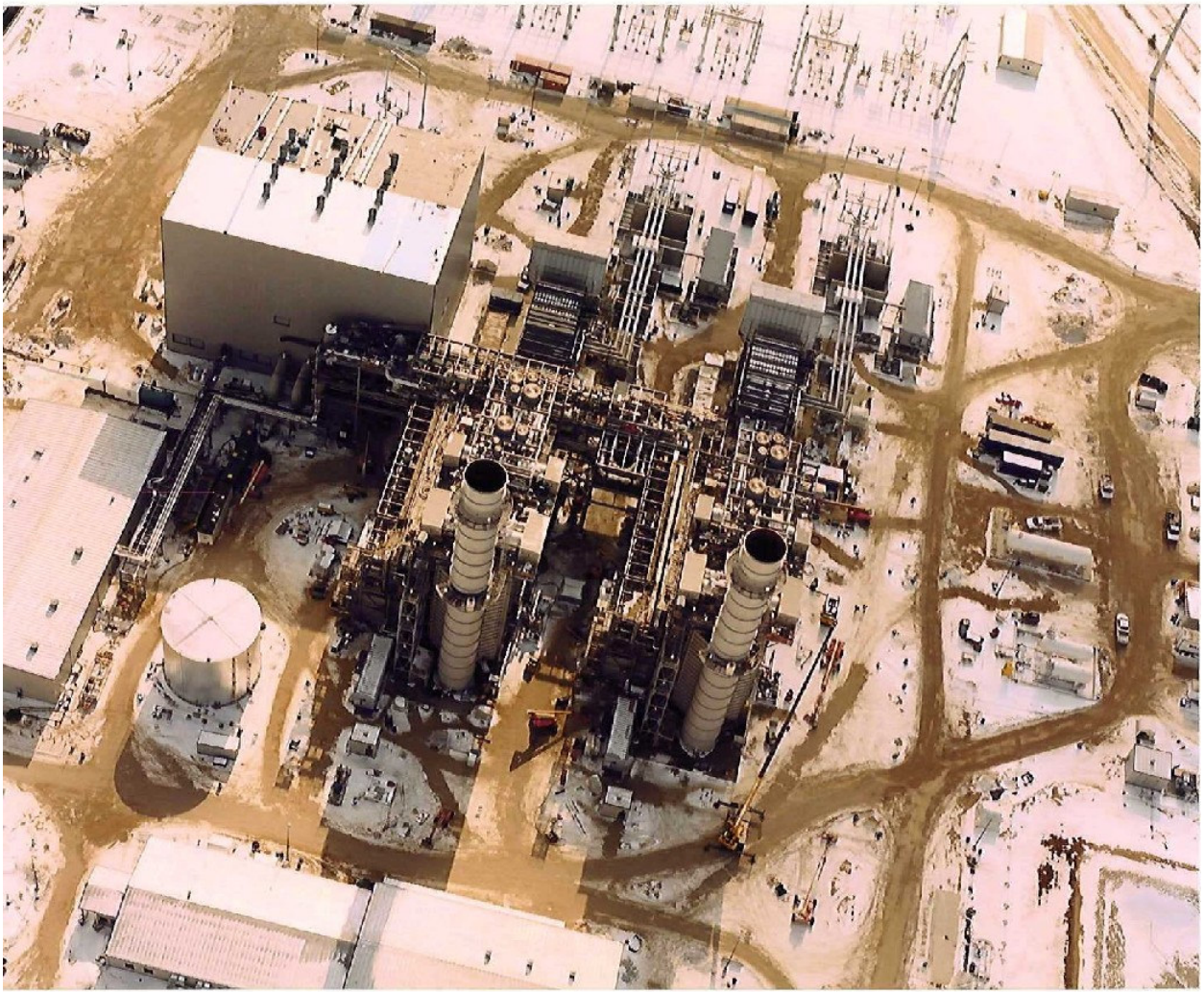
ENVIRONMENTAL ASSESSMENT

CALPINE MANKATO ENERGY CENTER POWER GENERATING PLANT
MANKATO, MINNESOTA ENVIRONMENTAL QUALITY BOARD

LARGE ELECTRIC POWER GENERATING PLANT
HIGH VOLTAGE TRANSMISSION LINE PROJECT

EQB DOCKET NUMBER 04-76-PPS-CALPINE MANKATO ENERGY CENTER



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July 2004

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OVERVIEW

The Project. Calpine Corporation is planning to build the Mankato Energy Center Large Electric Power Generating Plant in Blue Earth County near Mankato, Minnesota. Calpine intends to install two combined cycle, natural gas-fired combustion turbines that will be capable of generating approximately 650 megawatts of power in summer and 730 megawatts in winter. These turbines will be used to generate electricity for baseload and during periods of peak demand.

In conjunction with installation of the two new turbines, Xcel Energy is proposing to construct the necessary transmission facilities to convey the electricity to the transmission grid. Xcel proposes to construct a new triple circuit high voltage transmission line – two 115 kilovolt lines and a 345 kV line – to connect the Mankato Energy Center Plant with a nearby Wilmarth substation about 900 feet west of the proposed Plant.

In addition, Calpine has proposed to construct a new natural gas pipeline 20 inches in diameter about three and one-half miles long to bring fuel to the Plant. The pipeline will connect to an existing pipeline owned by Northern Natural Gas Company that runs through Blue Earth County three miles to the east of the proposed Mankato Energy Center Plant.

Certificate of Need. Mankato Energy Center does not require a Certificate of Need for one of the turbines and associated facilities, as this is covered under an Xcel purchase power agreement approved by the PUC in 2003. Mankato Energy Center is required to obtain a Certificate of Need from the Minnesota Public Utilities Commission ("PUC") for installation of the second turbine. Minn. Stat. § 216B.243. A new power plant with a capacity of 50 megawatts or more is a "large energy facility" under the definition in section 216B.2421, subd. 2(1). A Certificate of Need is not required for the new transmission lines because the lines are not long enough to fall under PUC jurisdiction. A Certificate of Need is not required for the pipeline because it does not meet the distance requirement either. Minn. Stat. § 216B.2421, subd. 2(5).

Calpine applied to the PUC for a Certificate of Need on March 2, 2004. The PUC found the application to be substantially complete on March 23, 2004. Under rules adopted by the Environmental Quality Board, the EQB is required to conduct environmental review of a proposed large energy facility during the Certificate of Need proceeding. Minn. Rules part 4410.7020. The environmental review looks at the potential impacts of the proposed project and various options.

Permits. In addition to a Certificate of Need, Calpine is required to obtain a Site Permit from the Environmental Quality Board identifying the location upon which the new facility can be built. Minn. Stat. § 116C.57, subd. 1. A Route Permit is also required from the EQB for the new transmission lines, notwithstanding that a Certificate of Need is not required. Minn. Stat. § 116C.57, subd. 2. The Route Permit establishes the route that the new transmission line will follow. Finally, Calpine is required to obtain a Pipeline Routing Permit from the EQB for the new pipeline. Minn. Stat. § 116I.015. The Pipeline Routing Permit establishes the route for the pipeline and imposes certain conditions designed to minimize the impact of the pipeline construction on landowners and the environment.

Environmental Assessment. As part of its review of an application for a Site Permit or a Route Permit for the kind of project proposed here, the EQB is required to prepare a document called an Environmental Assessment. Minn. Stat. § 116C.575, subd. 5. In the Environmental Assessment, the EQB evaluates the potential impacts of the project at the sites and routes proposed by the applicant and at possible alternative sites and routes that are identified and discusses ways to mitigate these potential impacts. The public is given an opportunity to participate in the development of the scoping decision, which identifies the alternatives and impacts that will be evaluated in the Environmental Assessment.

When an applicant for a certificate of need also applies for permits from the EQB, the EQB can combine the environmental review that is required into one document that looks at the factors to be determined by the Public Utilities Commission, such as what kind of facility to construct, with the site-specific issues evaluated by the EQB in determining what site or route to approve. Minn. Rules part 4410.7060. That is what was done in this case. The EQB is preparing one document called an Environmental Assessment that will satisfy both requirements. The PUC and the EQB will both rely on the same Environmental Assessment in reaching their final decisions.

Major Decisions. The first decision that will be made in this matter is a decision by the Public Utilities Commission whether there is a need for additional electric power. In the course of deciding whether additional electric power is needed, the Public Utilities Commission must also determine the size and type of any new facility to be constructed to meet the need that is found.

If the Public Utilities Commission determines that there is a need for additional power, it will issue a certificate of need for a particular size and type of facility. The EQB, then, must determine the appropriate location for this new facility. The only site under review in this proceeding is the Mankato site proposed by Calpine . If the PUC issues a certificate of need for a natural gas turbine, the Mankato Plant will be the location where they are installed.

The EQB could include conditions in any Site Permit it issues for construction of the Mankato Energy Center Plant if certain conditions are necessary and appropriate. Also, the other permits that Calpine is required to obtain, such as an air permit from the Pollution Control Agency, will include pertinent conditions designed to minimize the environmental impacts of the facility. However, no other location for this type of facility is under consideration at this time.

If a certificate of need is issued for the new combustion turbine, the EQB will also have to determine a route for the new triple-circuit (115/115/345 kV) transmission line that Xcel has proposed to construct from the Plant to the substation to the west. No alternative HVTL routes, besides the route proposed by Xcel, are under review and discussed in this document. This is due to the short distance between the proposed Mankato Energy Center plant and the Wilmarth substation.

Calpine will also have to build a new natural gas pipeline for this project. While the pipeline is a significant feature of the overall project, and a permit will be required from the EQB establishing the route for the pipeline, preparation of a separate environmental review document on the pipeline is not required.

Public Hearing. The Public Utilities Commission is required to hold a public hearing on the application for a certificate of need. Minn. Stat. § 216B.243, subd. 4. The Environmental Quality Board is also required to hold a public hearing on the applications for the site permit and the transmission line route permit. Minn. Stat. § 116C.575, subd. 6.

The hearings are scheduled for July 12 and 13, 2004, in Mankato. Administrative Law Judge Allen Klein of the Office of Administrative Hearings will preside at the hearing. Interested persons will have an opportunity at the hearing to ask questions about the project and to make comments that will become part of the administrative records for both agencies. As part of the hearing, Judge Klein will set a date for receipt of written comments.

Upon close of the record, Judge Klein will write a report and make a recommendation to the Public Utilities Commission on Calpine's request for a certificate of need. The PUC will schedule the matter in due course for a final decision.

Judge Klein will also write a second report and make a recommendation to the EQB on which specific site and specific route to approve. The final decision on the issuance of the permits will be made by the full EQB Board. It is anticipated that this matter will come before the EQB Board for a final decision at its monthly meeting on September 16, 2004.

1.0 INTRODUCTION

Calpine Corporation, through a wholly-owned subsidiary called Mankato Energy Center, LLC, ("MEC"), is proposing to build a Large Electric Power Generating Plant ("LEPGP") in Blue Earth County near Mankato, Minnesota, called the Mankato Energy Center[1]. This project will consist of two combined cycle natural gas combustion turbines that will be used to generate base-load electric power for Xcel Energy and electricity during periods of peak demand. Calpine is a large multi-national firm specializing in supplying natural gas, constructing pipelines and building gas-fired electric power plants. The project will have the capacity to generate about 650 megawatts of electricity in the summer.

The proposed LEPGP project is to be located immediately north of Mankato City limits north of Highway 14 and west of 3rd Avenue. The parcel has been annexed by the city of Mankato and is currently zoned industrial. The site and surrounding area contain a significant amount of utility-related features including a natural gas pipeline easement, a petroleum product pipeline easement, an electric utility substation, and an electric transmission line corridor. The area surrounding the site primarily contains industrial facilities and land uses, some agricultural land and a few farmsteads.

Three high voltage transmission lines ("HVTL") will also be constructed from the proposed power plant to Xcel Energy's existing Wilmarth substation. These connections will consist of two 115-kilovolt lines double-circuited on one set of poles and one 345-kilovolt line on its own set of poles (**Figure 8**). These transmission lines will be approximately 800 to 900 feet long.

[1] Site Permit Application, Mankato Energy Center, Docket No. 04-76-PPS CALPINE, Wenck Associates, March 3, 2004

Xcel Energy is responsible for construction of these lines and will apply to the EQB for a permit designating routes for these lines. Although the application has not yet been submitted to the EQB, technical information on the proposed lines and structures has been submitted by Xcel Energy in order to address the proposed transmission lines in this Environmental Assessment.
In association with the construction of its power plant, MEC is proposing to install a 20-inch outside diameter, underground, natural gas pipeline from to the Northern Natural Gas ("NNG") mainline that runs through Blue Earth County east of the proposed power plant. The length of the pipeline will be approximately 3.5 miles and will have an operating pressure of approximately 550 pounds per square inch ("PSI").

1.1 CERTIFICATE OF NEED

A certificate of need[2] from the Minnesota Public Utilities Commission is required to build a power plant with a generating capacity in excess of 50 megawatts. Minn. Stat. § 216B.243. However, MEC was selected by Xcel Energy as part of a bidding process approved by the PUC to provide up to 290 MW of baseload capacity and 85 MW of peaking capacity under a power purchase agreement between MEC and Xcel. That portion of the plant is exempt from a separate certificate of need requirement. Minn. Stat. § 216B.2422, subd. 5(c).

The additional power to be generated from this facility (approximately 355 MW) will be available for the merchant power market. A certificate of need is required for this part of the proposed facility.

1.2 SITE AND ROUTE PERMITS

In 1973 the Minnesota Legislature passed the Power Plant Siting Act (Minnesota Statues 116C.51-116C.69) requiring that any person who wants to build a large electric power generating plant ("LEPGP") or high voltage transmission line ("HVTL") is first required to obtain approval from the Minnesota Environmental Quality Board ("EQB") for a specific site for the plant or specific route for the transmission line. These rules are now found at Minnesota Rules Chapter 4400. Consistent with state policy, the rules are intended to locate large electric generating plants, associated facilities and transmission lines in an orderly manner while minimizing adverse human and environmental impacts.

MEC is required to obtain a Site Permit from the EQB identifying the location upon which the new facility can be built. Xcel is required to obtain a Route Permit from the EQB for the new high voltage transmission lines between the LEPGP and the adjacent Wilmarth substation. The Route Permit establishes the precise route that the new transmission lines will follow. Finally, MEC is required to obtain a Pipeline Routing Permit from the EQB for the new pipeline per Minn. Stat. § 116I.015. The Pipeline Routing Permit establishes the exact route for the pipeline and imposes certain conditions designed to minimize the impact of the pipeline construction on landowners and the environment.

[2] Certificate of Need Application for Mankato Energy Center, Docket No. IP6345/CN-03-1884, Wenck Associates, March 2, 2004

1.3 ENVIRONMENTAL REVIEW

The EQB is required to prepare a document called an Environmental Report when a certificate of need for a large energy project is applied for. Minn. Rules part 4410.7020. In the Environmental Report, the EQB evaluates the human and environmental impacts of a project of the type proposed and of various alternatives to the proposed project. Minn. Rules part 4410.7035. The certificate of need process is the only time when issues of size and type of the facility, and the no-build alternative, are considered.

As part of its review of an application for a Site Permit or a Route Permit for large energy projects, the EQB is required to prepare a document called an Environmental Assessment. Minn. Stat. § 116C.575, subd. 5. The EA will contain information on potential human and environmental impacts associated with the proposed project. The EA shall address required methods to mitigate such impacts for all of the sites and routes considered. In the EA, the EQB evaluates the potential impacts of the project at the sites and routes proposed by the applicant and at possible alternative sites and routes that are identified. It also discusses ways to mitigate these potential impacts.

When an applicant for a certificate of need also applies for permits from the EQB, the EQB can combine the environmental review that is required into one document that looks at the factors to be determined by the PUC, such as what kind of facility to construct, with the site-specific issues evaluated by the EQB in determining what site or route to approve. Minnesota Rules part 4410.7060. In such event, the EQB prepares one document called an Environmental Assessment A that will satisfy the environmental review requirements of both agencies. That is what the EQB has elected to do in this proceeding.

In accordance with the rules applicable to this proceeding, the EQB held a public information meeting in Mankato on April 21, 2004. This meeting was intended to provide the public with an opportunity to learn about the proposed project, to suggest alternatives to be addressed, and to identify concerns that should be considered by the EQB staff in preparing an EA. Public comments on the scope of the EA were accepted until May 10, 2004. After consideration of the public comments, the Chair of the EQB issued an EA Scoping Order on May 20, 2004 (**Appendix A**).

1.4 PUBLIC HEARING

The Public Utilities Commission and the Environmental Quality Board are both required to hold a public hearing as part of their consideration of applications for a certificate of need and permits for proposed large energy facilities. Both agencies can elect to combine the proceedings and hold a joint hearing. Minn. Stat. § 216B.243, subd. 4. Both the PUC and the EQB have decided to hold a joint hearing in this matter.

The hearing is scheduled for July 12 and 13 in Mankato, Minnesota. Administrative Law Judge Allen Klein of the Office of Administrative Hearings will preside at the hearing. Interested persons will have an opportunity at the hearing to ask questions about the project and to make comments that will become part of the administrative records for both agencies. As part of the hearing, Judge Klein will set a date for receipt of written comments.

Upon close of the record, Judge Klein will write a report and make a recommendation to the PUC on MEC's request for a certificate of need. The PUC will schedule the matter in due course for a final decision.

Judge Klein will also write a second report and make a recommendation to the EQB on which specific site and specific route to approve. The final decision on the issuance of the permits will be made by the EQB Board. It is anticipated that this matter will come before the EQB Board for a final decision at its monthly meeting on September 16, 2004.

Much of the information contained within this document was provided by the applicant or the applicant's representatives (Wenck Associates Inc.) in the form of: (1) the Application for Certificate of Need for the Mankato Energy Center Large Electric Power Generating Plant Project, (2) the Applications for a Site Permit and Transmission Line Route, Mankato Energy Center Project, (3) Correspondence with Xcel Energy on the High Voltage Transmission Line , and (4) public comments received from interested citizens and environmental groups, the Minnesota Project, the City of Mankato, Blue Earth County and Calpine Corporation.

Additional sources of information relevant to this project are listed below:

- Minnesota Environmental Quality Board (http://www.eqb.state.mn.us/) or (http://www.eqb.state.mn.us/EnergyFacilities/index.html)
- Minnesota Public Utilities Commission (http://www.puc.state.mn.us/electric/index.htm)
- Minnesota Pollution Control Agency (http://www.pca.state.mn.us/)
- Minnesota Department of Natural Resources (http://www.dnr.state.mn.us/index.html)
- Minnesota Department of Health (http://www.health.state.mn.us/)
- U. S. Environmental Protection Agency (http://www.epa.gov/)
- Electric Power Research Institute (http://www.epri.com/default.asp)
- City of Mankato (http://www.ci.mankato.mn.us/)
- U. S. Department of Agriculture Natural Resources Conservation (http://soils.usda.gov/about/)
- Minnesota Geological Survey (http://www.geo.umn.edu/mgs/)
- Department of Administration, State Demographic Center (http://www.demography.state.mn.us/)
- Federal Emergency Management Agency (http://www.fema.gov/)
- U. S. Department of Energy, Energy Information Administration (http://eia.doe.gov/)

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2.0 PROJECT DESCRIPTION

2.1 LARGE ELECTRIC POWER GENERATING PLANT (LEPGP)

Mankato Energy Center proposes to build a power plant (the "Facility") capable of producing approximately 655 megawatts of electricity (at summer ambient conditions) using natural gas-fired combustion turbines in a combined cycle configuration. Low sulfur distillate oil will be used as a back-up fuel to ensure uninterrupted operation of the Facility. The Facility will be designed to include two combustion turbine generators, two heat recovery steam generators equipped with natural gas-fired duct burners, one steam turbine generator with associated heat rejection system, and various appurtenant machinery and equipment required for a safe and efficient operating power plant. A simplified process flow diagram for the combined cycle turbines associated with the Facility is shown in **Figure 3**.

Cooling and process water will be supplied by treated wastewater effluent taken from the municipal wastewater treatment system, located approximately one mile due south of the Facility site on the east bank of the Minnesota River. The municipal wastewater will be treated prior to delivery to the Facility at a new treatment facility that is anticipated to be located on land adjacent to the existing municipal treatment plant. Cooling water and low-volume wastewater will be discharged to the Minnesota River in accordance with applicable discharge limits.

The Facility will be connected by pipeline to the Northern Natural Gas pipeline located approximately 3.2 miles east from the Facility site. The Facility will access the transmission grid via Xcel Energy's Wilmarth Substation located approximately 1,000 feet west of the site with two parallel 115 kilovolt ("kV") and one 345 kV transmission lines.

2.1.1 OWNERSHIP

The proposed Facility will be built, owned, and operated by Mankato Energy Center, LLC ("MEC"), a wholly owned subsidiary of Calpine Corporation ("Calpine"), an independent power producer. The EQB permits will be issued to MEC.

The following person should be contacted regarding any information presented in this application:

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2.1.2 SITE LOCATION

The proposed Facility site is located just north of the Mankato city limits in Lime Township in Blue Earth County, in the southwest ¼ of Section 31, Township 109N, Range 26W. The site is located within an area zoned for industrial use. It is situated on the southern portion of an old limestone quarry that has been mined to completion and currently serves as a demolition waste landfill and composting facility owned and operated by the Southern Minnesota Construction Company, Inc. ("SMC"). The site is approximately 25 acres in size. The Facility location is shown in **Figures 1 and 2**.

2.2 ENGINEERING DESCRIPTION OF OVERALL FACILITY

The Facility will be a combined cycle combustion turbine power electricity generating facility fueled primarily by natural gas. The Facility will have the capacity to generate approximately 655 MW of electricity, at summer ambient conditions, and transmit that electricity to a part of the electrical grid owned by Xcel and controlled by the Midwest Independent System Operator ("MISO").

The Facility will receive natural gas from a local area pipeline (primary fuel supply), distillate oil (secondary fuel supply) and non-bulk chemicals by truck, and electricity for backup power supply from Xcel Energy. The Facility will receive potable water from the Mankato municipal water supply system, and process water from the Mankato wastewater treatment plant ("WWTP").

Major equipment to be installed at the Facility will include:

- Two natural gas-fired combined cycle combustion turbine generators, capable of using low sulfur distillate oil as a secondary fuel.
- Two heat recovery steam generators, each equipped with natural gas-fired duct burners.
- One steam turbine generator.
- A multi-cell mechanical draft evaporative cooling tower.
- Certain other appurtenant pieces of machinery and equipment required for a safe and efficient operating power plant in the configuration described.

The proposed layout of the Facility is presented in **Figure 5**. Flow diagrams for the fuel handling process and plant water usage are provided in **Figures 3** and **6**. The Facility fuel

supply, major equipment, and transmission considerations are discussed in more detail in the **Site Permit Application**[3].

The Facility potentially will generate base load, intermediate load and peak load electricity. The Facility's total summer electricity generating capacity of 655 MW will be composed of approximately 505 MW base load capacity at summer ambient conditions and 150 MW peak load service at summer ambient conditions.

At winter ambient conditions, the Facility will have approximately 580 MW base load capacity and 150 MW peaking capacity, for a total winter electricity generating capacity of 730 MW.

The 505 MW summer base load capacity of the Facility will be generated from the two combustion turbine-driven generators and the single steam turbine-driven generator. The steam turbine receives steam from the heat recovery steam generators ("HRSG"), which use the waste heat from the combustion turbine exhaust streams to produce steam. The 150 MW peak load capacity will be generated by supplemental firing of the duct burners associated with the HRSGs. This combined cycle plant will offer a large efficiency advantage over a conventional simple-cycle plant, which relies only on combustion turbine-driven generators. The peak load generating capacity can be further augmented by injecting steam into the combustion turbines.

2.2.1 PRIMARY FUEL SUPPLY: Natural Gas

The primary fuel for the Facility will be natural gas. Natural gas will be delivered through a new lateral pipeline approximately 3.2 miles in length connecting the Facility to a branch of the NNG mainline. The Facility will have a peak daily gas requirement of approximately 135 million standard cubic feet per day ("MMscf/day") at the peak winter firing condition. On average, the Facility is expected to use about 32,500 MMscf per year, or an average of 89 MMscf/day. By comparison, an average residential customer consumes approximately 0.1 MMscf/day.

2.2.2 SECONDARY FUEL SUPPLY: Low Sulfur Distillate Fuel Oil

Above ground storage tank(s) will be installed at the Facility to store low sulfur distillate fuel oil as a back-up fuel supply during periods when natural gas is not available and the Facility must generate and supply electricity to the grid. MEC has agreed to limit the Facility's use of the fuel oil to 875 operating hours or less (10 percent of a year) per combustion turbine (based on a 12-month rolling average).

The storage capacity of the tank(s) will be as much as 900,000 gallons, which represents approximately 36 hours of uninterrupted electricity generation at the Facility when operating both combustion turbines at baseload. The fuel oil storage tank(s) will be situated on the southern portion of the Facility and will be constructed with a tank within a tank design, which is designed to contain 110 percent of the tank's working volume and will meet the compliance

[3] Site Permit Application, Mankato Energy Center, Docket No. 04-76-PPS CALPINE, Wenck Associates, March 3, 2004

requirements of all applicable state aboveground storage and federal SPCC regulations. The low sulfur distillate fuel oil will be delivered to the Facility via tanker truck. The tanker truck unloading area will also be equipped with secondary containment in accordance with federal SPCC requirements.
The incorporation of low sulfur distillate fuel oil capability increases the operating flexibility of the Facility in that having the ability to switch fuel sources can mitigate the restrictions or interruptions of natural gas supplies.

2.2.3 NATURAL GAS-FIRED COMBUSTION TURBINES

The Facility will be equipped with two natural gas-fired combustion turbines located outdoors in the central portion of the Facility. The combustion turbines will be Siemens-Westinghouse 501-FD model turbines and will have an output of approximately 290 MW each (at winter ambient conditions). Each combustion turbine generator will be 3,600 rpm, 18 kV or 15 kV, three phase, 60 Hz design. The maximum firing capacity of each combustion turbine will be 2,040 million British thermal units per hour ("MMBtu/hr") based on higher heating value ("HHV") of the fuel while firing natural gas and 2,052 MMBtu /hr (HHV) when firing on fuel oil (both ratings at winter ambient conditions). The combustion turbines also are capable of injecting steam into the combustion chamber to provide additional output during periods of large electrical power demand. Steam augmentation is limited to 1,500 hours per year per turbine.

The resulting hot gases from the combustion chamber will be directed to the turbine section where the steam will expand across a series of turbine blades, causing those blades to rotate. The rotating blades will turn a shaft connected to an electric generator. Each combustion turbine generator will then convert the mechanical energy from the rotating combustion turbines into electrical energy. Electricity from the combustion turbine generators will be transferred along above ground electrical bus duct to the transformer yard.

2.2.4 HEAT RECOVERY STEAM GENERATORS

In this "combined cycle" plant, hot gases exhausted from each combustion turbine are directed to a heat recovery steam generator ("HRSG"). The heat in the exhaust gas, which would otherwise be directed (wasted) up the exhaust stack, converts water that flows through tubes in the HRSG into steam. The steam that is produced in each of the two HRSGs is directed to the single steam turbine where it passes through a series of blades that rotate the steam turbine generator producing additional electric power. Steam exiting the steam turbine is condensed into water and returned to the HRSG for recirculation. The two HRSGs will be located outdoors and situated in line with (and adjacent to) the two natural gas-fired combustion turbines.

The HRSGs will be equipped with natural gas-fired duct burners used for supplemental duct firing of the combustion turbine exhaust gases, to provide additional peaking capacity at the steam turbine. Each duct burner incorporates a low-NO_x burner technology and has a maximum heat input rate of 800 MMBtu/hr. A selective catalytic reduction system ("SCR") will be used in each HRSG downstream of the duct burners to reduce NO_x emissions from the combustion turbines and duct burners.

An oxidation catalyst module will also be used in each HRSG to reduce emissions of CO and volatile organic compounds ("VOCs"). The exhaust gas from each HRSG will be directed to an exhaust stack. Exhaust stack emissions will comply with the federally enforceable air emissions permit to be issued by the MPCA.

Anhydrous ammonia will be used in each of the Facility HRSGs as an SCR reagent. Ammonia will be distributed to both HRSGs from two aboveground storage tanks, each with a 12,000-gallon storage capacity. The ammonia tanks will be situated in the northeastern portion of the Facility, west of the northern extent of the cooling towers. Ammonia will be delivered to the tank via tanker truck and will be transferred from the main storage tank to each of the ammonia injection skids situated immediately north of each HRSG.

2.2.5 STEAM TURBINE GENERATOR

The Facility will be equipped with one condensing steam turbine, one hydrogen-cooled steam turbine generator, and one associated steam turbine cooling system. The steam turbine generator will be equipped with one heat rejection system. The condensing steam turbine and the steam turbine generator will be placed in a weather enclosure.

The steam turbine generator will be 3,600 rpm, 18 kV, three phase, 60 Hz design, and will convert mechanical energy from the rotating steam turbine into electrical energy. The steam turbine will have the capacity to generate approximately 330 MW of additional electrical power. Electricity from the steam turbine generator will be transferred along aboveground electrical bus duct to the transformer yard.

The steam turbine condenser converts exhausted steam from the steam turbine back into liquid water so that it can be returned to the HRSGs to be converted into steam. The steam turbine condenser receives fresh demineralization water, cold water from the cooling tower and exhausted steam from the steam turbine. In the condenser, heat is transferred from the exhausted steam to the cooling tower cool water; the resulting warm water is then returned to the cooling tower. Because the steam turbine generator will use steam in a closed cycle, no additional air pollutants will be generated from this portion of the Facility.

2.2.6 RAW WATER TREATMENT SYSTEM

Raw water will be supplied to the Facility for use as process water and non-contact cooling water. The raw water supply source will be treated wastewater effluent or "gray water" from the City of Mankato's Waste Water Treatment Plant (WWTP), located approximately one mile due south of the Facility on the east bank of the Minnesota River. The Facility will draw about 2.7 million gallons of water per day ("MGD") on average and about 5.8 MGD at maximum conditions from the Mankato WWTP. Prior to conveyance and use at the Facility, effluent will be further treated in a new treatment system to be constructed adjacent to the Mankato WWTP (proposed to be installed by MEC). The new gray water treatment system will provide additional filtering and chlorination of the gray water in order to meet the Facility's process water quality needs.

Additionally, a storage pond will be constructed at the WWTP to provide a limited backup supply of cooling water for the Facility in the unlikely even that the WWTP remains off-line for a limited period.

Gray water from the Mankato WWTP will be piped directly to the Facility's approximate 1.5 million gallon capacity above ground raw water storage tank, situated in the southeastern portion of the Facility, west of the cooling towers. Water from the raw water storage tank will be transferred as needed to the cooling tower and the HRSG quench water system. If required for reliable service, a small service water tank (~10,000 gallons) may be installed to store potable water prior to conveyance to the demineralizer and service water system.

The Facility's service water system will supply water to all general plant water use activities at the Facility such as hose bibs, pump sealing water, and eyewash stations.. The Facility's service water system will use approximately 10,000 gallons per day of potable water. Approximately 60,000 gallons per day of gray water will be discharged as quench water to the blow down tank.

2.2.7 COOLING TOWER

The Facility will be equipped with a multi-cell evaporative cooling tower, situated along the eastern side of the Facility property. The cooling tower will cool hot water from the steam turbine condenser and other heat loads, such as generators and lube oil systems, and return the cooled water for reuse. The cooling tower will receive gray water at a rate of 2.50 MGD on average and 4.86 MGD at maximum conditions to replace water lost to evaporation and blow down from cooling operations. The cooling tower will also receive small quantities of recycled water from the oil/water separator and the HRSG blow down tank.

Fans located at the top of each cooling tower unit will maintain a draft within the cooling tower. The heated cooling water from the condenser will cool as it falls through the baffles from the top of the cooling tower to a basin at the bottom. Approximately 1.95 MGD (average) and 3.72 MGD (maximum) of gray water will be emitted to the atmosphere from the cooling towers through evaporation. The cooling tower will operate with a water circulation rate of approximately 180,000 gallons per minute. The cooling tower will have a liquid drift rate of approximately 0.0005 percent of the water circulation rate, which will be achieved using high efficiency (low-drift) mist eliminators.

The cooling tower will receive chemical feeds from the chemical storage enclosure situated approximately 75 feet west of the cooling tower. The chemicals will be stored in small quantities and will be used to assist in maintaining the appropriate water quality parameters for efficient operation of the cooling tower system. The cooling tower will discharge water as cooling tower blow down to maintain the appropriate quality of water in the cooling tower system. The cooling tower blow down, which will be directed to the Minnesota River under a NPDES wastewater discharge permit, will be treated with a phosphorus removal and dechlorination system prior to discharge to the river.

2.2.8 WASTEWATER COLLECTION/TREATMENT SYSTEMS

Process wastewater will be collected and treated at the Facility prior to discharge to the Minnesota River as authorized under an MPCA-issued National Pollutant Discharge Elimination System (NPDES) wastewater discharge permit. Approximately 0.69 MGD (average) and 1.47 MGD (maximum) of wastewater will be generated from the combination of the following in-plant sources:

- Cooling tower blow down (84-94%).
- RO/demineralization system (5-15%).
- Other sources (1-2%).

Gray water from the Mankato WWTP that is treated and routed to the Facility would otherwise be discharged directly to the Minnesota River under the Mankato WWTP's existing NPDES permit. Because this gray water will be further treated prior to being piped to the Facility, and because the wastewater generated from the Facility will be treated to remove phosphorus and chlorine prior to discharge from the Facility (as discussed above), it is anticipated that phosphorus and total suspended solids loads to the Minnesota River will decrease as a result of the Facility's planned water use and discharge.

The oil/water separator will be situated west of the cooling tower and approximately southeast of the cooling tower chemical feed enclosure. Water from the oil/water separator system will be recirculated into the cooling tower. Oil/sludge from the oil/water separator system will be collected and shipped off-site for appropriate disposal as a waste material.

Storm water generated at the Facility will be managed in one of two ways. Storm water runoff that comes into contact with the outdoor steam generator step-up transformer pad and combustion turbine pads, where there is potential for pollutant contamination by oils and other chemicals from pumps and motors, will be confined within curbed areas and drain to two area wastewater sump pump systems. The storm water that is collected in the wastewater sumps will then be pumped to the Facility's oil/water separator and recycled into the cooling tower make-up water system.

Storm water runoff from non-process areas of the Facility will be routed to the on-site storm water detention pond that will discharge to the existing drainage ditch along the east side of the site that flows into the Minnesota River. Storm water discharges from the site and detention pond will be regulated under an NPDES general storm water discharge permit and conditional use permit.

Domestic wastewater generated from the Facility (i.e., bathrooms and sink areas in the administrative building and water treatment building) will be discharged directly to the City of Mankato sanitary sewer system. This discharge will be authorized by the City of Mankato and subject to any appropriate discharge limits and monitoring requirements.

2.2.9. ANCILLARY STRUCTURES/BUILDINGS

Certain other pieces of machinery and equipment that are required for a safe and efficient operating power plant include:

- Auxiliary boiler.
- Emergency generator.
- Fire suppression systems, including a diesel-fueled fire pump.
- Natural gas conditioning system and a distillate fuel oil storage and handling system.
- Steam supply piping.
- Plant electrical systems.
- Plant buildings.

Emergency Generator --- The Facility will be equipped with a 1,850 horsepower diesel fuel-powered electric generator able to produce the relatively small amount of electrical power required to provide power to in-house critical components in the event of a loss of station power. The emergency generator has a maximum heat input capacity of 12.2 MMBtu/hr, and will operate no more than 300 hours per year.

The emergency generator will be equipped with two skid-mounted 2,000-gallon capacity diesel fuel tanks. Secondary containment will be provided for the diesel fuel tanks. The emergency generator will be situated in the western portion of the Facility, immediately south of Combustion Turbine Generator Step-up Transformer No. 2.

Fire Suppression Systems --- The Facility will be equipped with one centrifugal electric pump and one back-up diesel driven fire pump, if it is determined that the City of Mankato's water supply system will not be able to supply adequate flow, to draw water from the raw water tank to supply an underground fire water header. The header will supply water to yard hydrants and installed sprinkler deluge systems. A jockey pump will maintain water pressure in the firewater distribution header.

The combustion turbine enclosures will be equipped with a carbon dioxide fire suppression system. The low sulfur distillate fuel oil tank will be equipped with a foam suppression system. The low sulfur distillate fuel oil unloading station will be equipped with foam nozzle and hose stations for use in fire-fighting activities.

A 290-horsepower diesel engine-driven firewater pump will only be operated in the event of a fire and loss of power to the electric motor-driven firewater pump. The firewater pump will be equipped with a 300-gallon capacity diesel fuel tank.

Secondary containment will be provided for the diesel fuel tank. The diesel engine-driven firewater pump has a maximum heat input capacity of 2.0 MMBtu/hr and will operate no more than 300 hours per year.

Plant Buildings --- There will be an administrative/maintenance/warehouse/control building on the southern-most portion of the site. A parking lot for employees and visitors will adjoin the administrative building to the east and will be composed of one alley way and approximately 20 parking stalls.

The water treatment building will be situated just north of the administrative building and employee parking lot. The water treatment building will contain the sample panel and lab, cycle chemical feed, electrical switchgear and motor control centers, demineralizer system and redundant air compressors and dryers. A sump and pump that discharges to the cooling tower will be situated in the outdoor area south of the water treatment building.

The steam turbine generation building will be situated immediately north of the administrative building and will house the steam turbine, the hydrogen cooled steam turbine generator, steam turbine auxiliary skids, condenser, and condensate pumps.

Transformers --- All electricity generated from the two combustion turbine generators and the steam turbine generator is transferred to generator step-up transformers (one for each generator). The generator step-up transformers will increase voltage from 18 kV (steam turbine) or 15 kV (combustion turbine) to either 345 kV or 115 kV. An ISO phase bus duct will be used to transfer electricity from the generators to the generator step up transformers. Auxiliary transformers will be installed to step down the combustion turbine generators 15 kV output to 4.16 kV. The 4.16 kV power will be used to supply the Facility's auxiliary load.

Switchyard --- The switchyard will be 75-feet by 485-feet area situated along the west edge of the Facility property. The switchyard will consist of a high-side breaker and disconnect switch for each generator unit connected to a dead-end structure. Xcel will connect transmission lines to these dead-end structures to transport the high voltage electricity to the existing Wilmarth substation. The interconnection will consist of two separate voltages, 345 kV and 115 kV.

2.2.10 COST ESTIMATE AND DESIGN LIFE

The estimated cost of the Facility based in preliminary engineering estimates and evaluation of market conditions is approximately $240 million. This includes design and engineering, procurement of equipment, site preparation, building construction, equipment installation, plant start-up and testing, and other costs associated with development and construction of the Facility. The Facility is anticipated to have a useful life of at least 30 years.

2.2.11 PHASED CONSTRUCTION

MEC may elect to build the Facility in stages. In such event, the construction of the first combustion turbine, the first HRSG, and the steam turbine, along with all associated machinery and equipment, would commence immediately. The second combustion turbine and the second HRSG would be installed at a future date. It is uncertain at this writing when MEC will decide whether it will phase construction into two phases.

2.2.12. TRANSPORTATION

The existing roadway network and site access road are adequate to serve the Facility and no transportation improvements will be required for construction or operation. Access to the site is provided west of 3rd Avenue off Summit Avenue via an existing paved road that currently serves the demolition waste landfill. The closest main highway serving the facility is Highway 14 located approximately one-half mile to the south. A diamond intersection is located at the 3rd Avenue crossing providing a safe entrance and exit to and from the highway.

2.2.13. WATER AND SEWER

Potable water for steam cycle makeup, fire protection and domestic uses at the Facility such as drinking water, eyewash stations, showers, toilets, sinks, and other incidental water needs will be supplied by the City of Mankato through a lateral service line connection to the municipal water supply system. Raw water used at the Facility for non-contact cooling water, process water will be supplied by the City of Mankato in the form of treated wastewater effluent from their municipal wastewater treatment plant. The plant is located approximately one mile south of the project site on the east bank of the Minnesota River and treats municipal wastewater flows received from both the communities of Mankato and North Mankato. The plant recently completed a $24.5 million upgrade and expansion in 2000 and has adequate capacity to meet the Facility's water needs. The treated wastewater effluent will be piped to the facility via a buried underground pipeline to be constructed within the right-of-way of an existing city bike trail.

Domestic wastewater generated from the Facility (e.g., bathrooms and sink areas in the administrative building and water treatment/electrical control building) will be discharged directly to the City of Mankato sanitary sewer system through a lateral service line connection. This discharge will be authorized by the City of Mankato and subject to any appropriate discharge limits and monitoring requirements.

The water and sewer connections described above would be constructed and paid for in accordance with an interconnection agreement or service contract between MEC and the City of Mankato. Negotiations are currently taking place including what type of additional treatment of the wastewater effluent will be required (and associated pretreatment facilities to be constructed on the wastewater plant site) prior to conveyance to the Facility.

2.2.14. OTHER UTILITIES

Details regarding other utility connections to the Facility including electricity, telephone, and cable are not known at this time but will be worked out with local utility companies as necessary. Wherever possible, utilities will follow existing easements to help reduce costs and minimize local impacts.

2.3 NATURAL GAS PIPELINE

Additional natural gas facilities are needed to supply natural gas to the proposed power plant. MEC proposes to construct a 20-inch diameter steel gas line to serve the proposed power plant.

Northern Natural Gas will supply natural gas to the Facility through a new 20-inch outside diameter service distribution line with an operating pressure of approximately 550 pounds per square inch (a maximum operating pressure of 800 PSI). The distribution line will be buried underground and connected to the existing NNG 16-inch diameter interstate pipeline located approximately 3.5 miles east of the site near the Mankato Municipal Airport. A gas metering station will be constructed either near the connection point at the pipeline tap or at the Facility on the project site (downstream of the metering station, the operating pressure will be 475 PSI). The proposed route for the supply line from its connection at the NNG line to the MEC site is shown on **Figure 7** and generally follows an existing Xcel Energy 115 kV transmission line right-of-way, thus minimizing potential impacts to affected landowners. The pipeline would require a 50-foot construction easement and 30-foot permanent right-of-way and would be constructed using standard construction practices.

At this time, MEC intends to construct, own, and operate the service distribution line. Accordingly, a pipeline route permit application for the new pipeline was prepared and submitted to the EQB in accordance with the requirements of Minnesota Rules chapter 4415. The EQB is the agency responsible for regulatory review of the interconnection line.

The pipeline tap at the connection point with the NNG mainline would be subject to federal jurisdiction and requires approval by the Federal Energy Regulatory Commission ("FERC"). The Minnesota Office of Pipeline Safety will be involved in required inspections during and after construction.

It is expected that MEC will construct the natural gas line using standard pipeline construction practices and will comply with all applicable construction and safety codes. Gas pipeline construction would commence following the receipt of all required permits and the acquisition of sufficient ROW. Pipeline construction would begin with the preparation of the work area. If necessary, vegetation clearing and surface grading would be done to provide a sufficiently clear and level area to facilitate pipe-laying operations and allow passage of required construction equipment. Clearing and grading, if required, would be done on the minimum area necessary and in such a manner as to minimize interference with existing natural drainage

Following clearing and grading operations, a trench would be dug for the pipeline. The width of the trench would typically be approximately 14 inches greater than the diameter of the pipe and the depth of the trench would be sufficient to allow a cover of at least 36 inches above the top of the pipe. Material excavated during trenching operations that is suitable for backfill would be temporarily piled on one side of the ROW, separating topsoil and subsoil. Material that is unsuitable for backfill or in excess of backfill needs would be hauled away to a suitable location. Prior to beginning trenching operations, standard precautions would be taken to identify and avoid any existing underground utility lines that cross the ROW. Proper erosion control practices would be employed to minimize erosion during trenching and construction activities.

Railroads, large highways and ditches and streams are typically crossed, when feasible, by boring under them and installing the pipe through the bore hole. Crossings of driveways would normally be accomplished by open cut. Crossings accomplished through open cuts would be coordinated to ensure that any disruption to traffic would be minimized.

Pipe sections that have previously been delivered to one or more staging areas in the vicinity of the project site would be positioned along the prepared ROW. The pipe sections would then be lined up on supports and welded into a continuous pipeline along the side of the trench. A qualified inspector would inspect completed welds visually by using x-ray equipment. An external coating that is applied at the pipe mill would protect the pipe from corrosion. Following inspection of the welds, a coating would be applied to each welded joint and the coating on the remainder of the pipe would be inspected and repaired as necessary.

The bottom of the trench would be inspected to ensure that it is free of rocks and debris. If necessary, sand or soil padding would be placed in the bottom of the trench. The pipeline would then be lowered into the trench using side-boom tractors. A final inspection would be done to ensure that the pipeline is properly placed on the bottom of the trench, that all bends conform to the alignment of the trench, and that the pipe coating has not been damaged. The trench would then be backfilled, using material originally excavated from the trench, if possible. The fill would be compacted to avoid future settlement.

Finally, the ROW would be restored to the extent possible to pre-construction conditions. Surface grading would be done to reestablish natural contours. Revegetation would be accomplished in a manner compatible with pre-construction conditions and adjacent vegetation patterns. Roads and paved driveways crossed by open cutting would be repaved. Pipeline markers would be installed at power lines, river crossings, road crossings, and other locations according to safety code requirements. The markers would identify the pipeline operator and would display emergency telephone contact numbers.

Pipeline construction through agricultural lands can result in short-term losses and temporary yield reductions in crops near the construction activities. Crops growing within both the permanent and temporary easement areas would be removed for the construction of the pipeline, likely resulting in the total loss of those crops in the year of construction. Dust from construction work can coat leaves on nearby crops, encouraging crop diseases or reducing yields. The effects from dust coating are limited to the year of construction. The land over the pipeline could be farmed in subsequent years. There may be some decrease in crop productivity in the first years after construction.

The agricultural impacts noted above are generally short term and a primary concern relates to adequate monetary compensation to the landowners for lost crops during the year of construction and any reduced crop productivity in subsequent years.

The new MEC gas lines would be underground. The ROW for the gas lines and the clearing of vegetation necessary for construction could modify the visual landscape in some areas. The areas the gas lines would pass through, however, are used primarily for agriculture, with smaller areas of commercial development, principally gravel quarries. The potential aesthetic impacts from ROW vegetation clearing are expected to be limited, as the gas line routes passes do not pass through any forested land.

2.4 NEW HIGH VOLTAGE TRANSMISSION LINES

The plant as proposed by MEC will require three high voltage transmission circuits – a 345 kV line and two 115 kV lines – to connect the plant to the electrical system at the Wilmarth Substation. The Wilmarth Substation will be expanded in order to accommodate various pieces of equipment associated with the new 345 kV and 115 kV transmission lines. At the Wilmarth Substation, electricity from the Facility will enter Xcel Energy's transmission system for distribution within the Mid-Continent Area Power Pool (MAPP).

The two routes proposed for the transmission lines are shown in **Figure 8**. The proposed lines cross only Xcel Energy and Mankato Energy Center, LLC, property. The lines are less than 900 feet long. The majority of the construction for the two transmission lines will occur on Xcel Energy property. The estimated width of the right-of-way will be 75 feet for the double circuit 115 kV lines and 150 feet for the 345 kV lines. Some right-of-way will be required from MEC to locate transmission structures on MEC property to complete the interconnection.

Xcel Energy proposes to place the two 115 kV circuits on a single set of transmission structures, specifically on double circuit, single pole, galvanized steel, davit structures. The bases of the 115 kV steel poles will be approximately three to four feet in diameter and will require a concrete pier foundation approximately 15 to 20 feet deep. The 345 kV circuit will be constructed on single circuit, wood H-Frame structures. The 345 kV structures consist of two wood poles, approximately 2 feet in diameter at the base, spaced 27 feet apart.

Table 2-1 below summarizes the structure design for each of the two transmission lines.

Table 2-1 HVTL Structure Design Summary for Mankato Energy

Line Voltage	**115 Kilovolt**	**345 Kilovolt**
Structure Type	**Davit Arm**	**H-Frame**
Pole Type	**Steel**	**Wood**
Foundation	**Concrete**	**Direct Bury**
Double/Single Circuit	**Double**	**Single**
Height (feet)	**80 – 120**	**100 – 120**
Span Length (feet)	**200 – 600**	**200 – 600**
Conductor Type	**795 ACSR**	**Bundled 795 ACSR**
Conductor Capacity	**975 amps/ 190 MVA**	**1950 amps/ 388 MVA**

There will be some design changes to the Wilmarth Substation to accommodate these proposed HVTL lines. The fenced area of Wilmarth Substation will be expanded by approximately one acre to accommodate the transformers, switches, breakers and other equipment necessary to connect the plant to the transmission system.

Expansion of the substation to the north will include an area approximately 300 ft x 100 ft. in size for the equipment required to accommodate the 345 kV equipment. An expansion approximately 200 feet by 75 feet in size will occur to the south and west to accommodate moving existing 115-69 kV transformers to allow more space for the 115 kV transmission lines. The expansion will occur entirely on land owned by Xcel Energy.

While MEC has proposed the new transmission lines, the lines would be built, owned, and operated by Xcel Energy. Xcel is waiting for MEC to enter into an Interconnect Agreement with the Midwest Independent System Operator (MISO) before proceeding with the line design and applying for all necessary permits and approvals. In accordance with the requirements of Minnesota Rules chapter 4400, a transmission route permit application for the new transmission lines must be prepared and submitted to the EQB. That regulatory review will require a separate environmental assessment to evaluate potential human and environmental impacts associated with construction and operation of the proposed transmission lines.

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3.0 DESCRIPTION OF ALTERNATIVES TO THE PROPOSED POWER PLANT AND IMPACTS ANTICIPATED

Calpine reviewed numerous alternatives to the proposed Facility in its CON Application[4]. These alternatives included both alternative generating technologies and alternative sites. The list of alternative generating technologies reviewed was not as extensive as prior applications filed with the PUC by regulated utilities due to the exemptions granted by the PUC in the Exemption Order. The Exemption Order completely waived the need to discuss some of the data requirements and modified the topics or breadth of discussion with respect to other data requirements. Specifically, Calpine was exempted from the data requirements set forth in Minnesota Rules Part 7849.0250, Items B(1) to B(3) (purchased power, increased efficiency of existing facilities, including transmission lines, and new transmission lines).

Pursuant to Minnesota Rule 7849.0250(B)(4), the alternatives of a generating Facility of a different size or using a different energy source, in addition to aspects of the Facility that relate to its efficient operation, were considered. These alternative included the following: coal; oil-fired combustion turbine; simple cycle combustion turbine; customer-owned distributed generation; various renewable alternatives, including wind, solar, hydroelectric, and biomass; and various emerging technologies, including fuel cells, micro-turbines, batteries, pumped storage, compressed air, and superconducting magnets. In addition, the alternative of not building the proposed Facility was considered. Calpine did not consider the alternative of demand side management because the Exemption Order waived the requirement that this option be discussed.

Several alternatives to a combined cycle natural gas fired facility were identified in the Scoping Order. This section describes each of those alternatives. A general description of the following alternatives will be included . The number of alternatives to be considered is less than what the rules specify because the PUC granted an exemption from some of these requirements to Calpine in its order of February 6, 2004. Recognition of these exemptions granted is incorporated into EQB's Environmental Assessment Scoping Document discussed below.

In the EA Scoping Document dated May 20, 2004, found in Appendix A of this report, EQB Chair Robert A. Schroeder determined which issues were outside the scope of the EA. He determined the EQB will not, as part of this environmental review , consider the following matters:

1. Whether a different size or different type of transmission line should be built.

2. Whether no transmission line should be built.

3. Whether the proposed natural gas-fired turbines should be located on a site other than the one proposed by the applicant.

[4] Comments from Calpine Corporation regarding the scope of the Environmental Assessment, Kent Morton , June 16 & 17, 2004

4. What the relationship of the proposed facility is to overall state energy needs.

5. Whether the proposed facility satisfies state renewable energy goals.

6. Whether the proposed project is compatible with the state's current energy mix.

7. What markets power from the proposed facility will serve.

3.1 No- Build Alternative

The No-Action Alternative would result in no change in the number of power plants in the state. Electricity providers would have the same sources of electricity available as they have currently. It would be reasonable[5], in this report, to address the environmental implications of building capacity for market demand for export in Minnesota - comparing the effects of building single source gas & coal facilities, with the development of projects and facilities that maximize use, hybridization/combination of Minnesota renewable resources -- technologies and fuels.

3.2 Natural Gas Wind Combination

During the scoping process, there was much interest expressed in the possibility that construction of the Mankato Energy Center facility could lead to the expansion of wind power in the State of Minnesota. Since the use of renewable energy sources such as wind is given a preference over the use of nonrenewable fossil fuels such as natural gas under state policy, Minn. Stat. §216B.2422, subd. 4, several commenters requested that the Environmental Assessment include an analysis of the effect a new natural gas plant might have on wind development in the state and whether it might be possible to require the MEC gas plant (at least the merchant capacity) to not operate if the power could be supplied by wind turbines.

Commissioner Katy Wortel from Blue Earth County asked, " Is it in the best interests of the people of MN that this project be coupled with wind energy (that it indeed follow the load as part of permitting) ?" Later she asked , "If Calpine was to run this project through the past CON process, would they have to have a renewable portfolio component?"

The North American Water Office[6] ("NAWO")is not opposed to the proposed power plant if it is constructed and operated in a manner that promotes and enhances development of preferred renewable energy management and technology options established in Minnesota Statutes. Combined cycle natural gas power plants can be versatile, which enables them to complement wind generation capacity, which is variable but which is also a proven, cost-effective preferred energy resource.

[5]Comments from Communities United For Responsible Energy regarding the scope of the Environmental Assessment, Kristin Eide-Tollefson and Sig Anderson, May 10, 2004
[6] Comments of the North American Water Office regarding the scope of the Environmental Assessment, George Crocker, Executive Director, May 10, 2004

NAWO believes this section should examine how the proposed power plant could, in essence, be operated as a natural gas/wind hybrid Facility. The underlying goal should be to enable the wind component of the hybrid system to grow over the next several years. NAWO recommends that growth of the wind power component must be allowed to continue until it reaches the point where, when the wind is blowing adequately, the entire energy output called for by contract and power purchase agreements with this proposed Facility is provided by the wind component.

Minnesota rules give preference to renewable wind energy over nonrenewable natural gas. NAWO believes that Minnesota regulators, safe energy advocates, and wind developers will help Calpine find the necessary wind energy partners, and develop the necessary business arrangements to enable this hybrid wind-gas system.

Doing this right will require innovative business arrangements, which should not be impossible considering that we already recognize both the energy and the capacity value of kilowatt-hours of electricity. The arrangements between Calpine and its wind partners would simply have to find the equitable balance of energy value and capacity value for each kilowatt-hour the hybrid Facility puts into the grid. As both wind energy and energy from natural gas are purported to be economical and cost-effective, there is no reason why the energy from the hybrid system will not also be economical and cost-effective, particularly considering the likely volatility of natural gas prices over the life-time of the proposed Facility.

CURE's initial interest in the potential of state of the art combined cycle turbine technologies - to combine or hybridize renewable and traditional resources - dates to the 2000 and 2002 Xcel Integrated Resource Plans[7]. In those dockets, and through subsequent legislative sessions (2001 & 2003), CURE advocated for development of technical information on replacement power options for Prairie Island. During the course of those proceedings, Xcel

- analyzed a Wind-Gas replacement,
- developed a set of replacement power options that included a wind/gas combination for the Calpine Mankato gas bid and
- did an engineering study on the feasibility of full to partial conversion of Prairie Island to gas turbine technologies.

Gas turbine technology is impressive in the flexibility of the and its capacity to hybridize or combine traditional (gas) and renewable energy resources. This innovative technology gives Calpine the opportunity to work with Minnesota to further develop our information base and capacity. We are facing an unexpected developments in Minnesota's energy policy and in the State's plan, established by the 1994 State Legislature, for a transition to renewable energy. The urgent need for such a transition is established in numerous studies and initiatives around the globe to curb the effects of power plants upon air quality and global climate change.

[7]Comments from Communities United For Responsible Energy regarding the scope of the Environmental Assessment, Kristin Eide-Tollefson and Sig Anderson, May 10, 2004

It appears to CURE that the business plans of the industry to meet short term asset/growth goals and take advantage of pending coal and nuclear subsidies at the Federal level, are going in the opposite direction.

In Minnesota, We have been a national bastion of innovation and leadership on renewable energy, our utilities are proposing to 'invest in Minnesota's energy future' building new coal plants and expanding nuclear operations.

In 2003, CURE testified before the Regulated Industries Committee to our conviction that Minnesota's Energy Future is Everybody's Business and that the best business plan would be for our utilities to partner with Minnesota communities who want renewable energy infrastructure "*in our back yards*"; with regional economic development groups, agricultural interests and others -- to utilize the state's social, financial and natural capital to build a *renewable energy future for Minnesota.* To this end, now and in the future, I place my hope - as a Minnesotan - in the protection, utilization and stewardship of our land, air and water resources for present and future generations.

CURE is truly grateful for the opportunity to develop the information and analysis that could move this potential forward. And to the state's public need and environmental review procedures, PUC & EQB staff, ME3/MCEA's letter, the Commission's vote to move closer to development of wind/gas alternatives, the initiative of the Mankato area citizens on adding bio-fuels to alternatives, NAWO, MNProject, CURE and others and --- above all --- the willingness of Calpine to consider the potential mutual advantages of exploring the alternatives outlined in EQB's draft scope. I hope that our comments serve, at least, to provide a citizen-eye-view on the context of this proceeding.

What is significant about the present docket before the Minnesota Public Utilities Commission, is that it offers *a way out of the gas or coal debate*. What Calpine proposes to install is state of the art, combined cycle turbine technology that represents the best and most flexible technology to date. It is capable of utilizing a wide range of fuels and - as Calpine's letter boasts - of 'backing down' gas, to hybridize wind & gas for the supply, price, and environmental benefits cited in Xcel's 2002 integrated resource plan and February 3, 2003 legislative testimony. Parties are already working with Calpine to promote partnerships with southern Minnesota biofuels (to replace fuel oil as back up), and wind resources. The certificate of need environmental review should reflect the importance of this opportunity -- to fully 'scope' these alternatives and the information development that can make them a reality, now and in the near future.

Minnesota Statute 216B.243 subd. 3A states "The commission may not issue a certificate of need under this section for a large energy Facility that generates electric power by means of a nonrenewable energy source, or that transmits electric power generated by means of a nonrenewable energy source, unless the applicant for the certificate has demonstrated to the commission's satisfaction that it has explored the possibility of generating power by means of renewable energy source and has demonstrated that the alternative selected is less expensive (including environmental costs) than power generated by a renewable energy source." Based on this statutory language, it is appropriate for the EA to consider reasonable renewable alternatives to the proposed fuels for the project.

* Powering Up Minnesota's Energy Future: Act Now on a Long Term Vision. Report of the Citizens League Study Committee on Electricity Reliability for Minnesota, December 2002. *Executive Summary* (attached - also available on Citizen's League website), p. ii. "The study committee came to the following conclusions:

1) Despite some modest steps, neither the State of Minnesota nor the electric power industry has been sufficiently aggressive in moving toward an electricity supply system that provides an adequate and reliable supply of electric power without cumulative and unacceptable damage to the local and global environment and social impacts

2) The strong focus on keeping electrical energy prices as low as possible has de-emphasized consideration of environmental concerns. This needs to be rebalanced consistent with a reliable supply in the future...
5) The State has not been a leader in the development and implementation of new technologies or new practices that could improve the efficiency of electricity generation, conserve the use of electricity, or minimize the environmental damage associated with it.

6) The study committee believes there is an urgent need to act now to secure [Minnesota's] energy future. "
** Ibid., *Minnesota's Electric Power System*, page 7

This is the way out of the gas, coal dilemma towards a secure and reliable Minnesota energy future -- with the cost, socio-economic and environmental benefits of *combining fuels and technologies to maximize efficiencies and utilize the state's abundant renewable resource base.*

All-Wind Alternative[8]: The development of an all-wind alternative to the second turbine under discussion in these dockets, should proceed by developing the scenario laid out in Xcel's IRP, referred to above. This would mean that only the first turbine would be built , and that 1100 MW of wind would be contracted, along a timeline towards full integration. The necessary support and operational technologies should be identified, that would allow execution of a gas/wind scenario similar to that presented by Xcel to the MN Legislature in 2003 (2/3).

Calpine, All Wind Alternative[9]. The relatively small size of the Facility site effectively precludes the replacement of the Facility with wind technology due to the need for large spaces between the windmills. The lack of space would preclude installation of any significant wind generating capacity at the site. In addition, despite recent improvements to increase the reliability and decrease the costs associated with wind power, these measures both fall short of the reliability and cost associated with the Facility.

Natural Gas/Wind Combination[10] Details of design and operations of the turbine technology to support gas & wind combinations *should not assume token amounts of wind or develop token scenarios*. It should examine, at least, the *3 (MW wind) to 1 (MW gas) ratio* discussed in Xcel's 2002 IRP (see ME3/ MCEA comment letter in Appendix E1). The analysis could also identify a future goal of full integration of both (@320 MW) gas units with the full complement of supporting wind power, totaling up to @2,200 MW of wind

Analysis should ultimately, through the proceeding:

- identify hurdles to gas/wind integration, and
- identify potential advantages, if they exist, of supporting the gas plant with dispersed wind generation -- to alleviate reliability hazards associated with pressures on the surrounding 69 kV network, and constraint issues for the Wilmarth line, points North, East & South.

[8] Comments from Communities United For Responsible Energy regarding the scope of the Environmental Assessment, Kristin Eide-Tollefson and Sig Anderson, May 10, 2004
[9] Comments from Calpine Corporation regarding the scope of the Environmental Assessment, Kent Morton , June 16 & 17, 2004
[10] Ibid, CURE Comments, May 10, 2004

Another way of addressing the Natural Gas/Wind combination, given the limitations that Calpine has stated to its willingness or ability to 'do wind'[11] --- might be to:

1) require that Calpine provide the supporting technologies and identify the operational requirements to make flexible integration of wind possible and

2) implement an 'alternative of purchase power' by requiring that companies - presumably Minnesota utilities - who contract with Calpine for power (or buy the Facility) execute a (pre-established set?) of purchase power contracts for wind -- in the amount established by the record to optimize the potentials of wind/gas combination.

The Facility did not consider a wind-gas alternative in its Application; however, subsequent events led to consideration of this alternative in later filings.[12] Specifically, on March 23, 2004, the PUC held a hearing to discuss various matters associated with the proposed Facility. One item of discussion was the PUC staff recommendation that Calpine submit a supplement containing certain supplemental information identified by the Department of Commerce ("DOC"), and accept the application as substantially complete contingent upon submission of that supplemental filing. Detailed comments by the DOC on this supplement and the CON application are found in **Section 8** of this report.

During the course of the hearing, the Minnesota Center for Environmental Advocacy ("MCEA") suggested that a wind-gas combination alternative be addressed by the Facility in the course of the supplemental filing. The PUC agreed with this suggestion. Calpine provided a discussion of a wind-gas alternative in its Supplemental Information and Reply Comments filed with the PUC on March 29, 2004 ("Supplemental Filing").

Calpine described the wind-gas alternative and the reasons for rejecting it in the Supplemental Filing. The description of this alternative began with the statement that neither Mankato Energy Center nor Calpine has appropriate expertise in the business of developing, owning, or operating wind plants. Accordingly, the alternative of a wind-gas project would by necessity be made contingent upon entering into a contract, i.e., a purchase power agreement, with another entity for the acquisition of the wind-generated capacity. As noted above, the PUC, in the Exemption Order, specifically exempted Calpine from discussing the purchased power alternative. Thus, at the threshold level, this "alternative" is not applicable in the context of this proceeding due to the fact that Calpine is not a regulated utility that purchases power from other entities. Indeed, the business of Mankato Energy Center is just the opposite – it sells power to other entities. The combination alternative is more properly considered in the context of a proceeding where the applicant is a regulated utility that controls a system of plants and resources and has in its corporate mandate the desire and the means to purchase power.

[11] Comments from Communities United For Responsible Energy regarding the scope of the Environmental Assessment, Kristin Eide-Tollefson and Sig Anderson, May 10, 2004
[12] Comments from Calpine Corporation regarding the scope of the Environmental Assessment, Kent Morton , June 16 & 17, 2004

Subsequent to the Supplemental Filing on March 29, 2004, Calpine undertook an evaluation of substituting the power that could be generated by the portion of the Facility that is the subject of the CON process (355 MW maximum) with an equivalent amount of wind generation. Numerous assumptions had to be made in order to determine the "equivalent" amount of wind generation that would substitute for the portion of the Facility that is the subject of the CON process. The first major assumption concerned the capacity factor to be used. Because wind is an intermittent generating resource, a much greater amount of wind generation would be required to achieve the same capacity accreditation as a combined cycle plant that can be turned on or off according to the needs of the operator or purchaser. The second major assumption concerns the availability of land because the wind generation would have to be geographically diverse enough such that some portion of the "wind farm" would be generating power when others might not. Another major assumption was that the siting of the wind generation would be close enough to adequate transmission facilities that cost or timing issues, including evaluation, permitting, and construction, would not come into play to any great extent. Less major assumptions concerning land availability, land costs, capital costs, operating and maintenance costs, and the availability of the federal production tax credit also had to be made.

As noted previously, neither Mankato Energy Center nor Calpine has expertise in the area of wind development. Accordingly, the assumptions may not be entirely accurate. Given the magnitude of the results, however, and the effort put forward in the analysis to be conservative in some assumptions and liberal in others the outcome should be viewed as accurate with a leaning toward favoring the suggested wind-gas alternative.

Because, as seen in the internal analysis set forth in my last answer, wind and combined cycle generation are difficult to compare on a side-by-side basis, Calpine considered the effects of wind and combined cycle generation on a larger, system-wide basis. The benefits of combining wind and combined cycle generation on a larger scale were identified in the Supplemental Filing.

Mankato Energy stated[13] that on a larger scale:

"[C]ombined cycle power generation is extremely complementary with wind generation due to the ease with which the combined cycle generation can follow the energy production of a wind plant or system of wind plants. When operating, a combined cycle plant can "follow" the wind load by ramping up and down quickly. When the wind is blowing hard, the combined cycle plant can be ramped down; when the wind is not blowing or is blowing too softly to turn the wind turbines, the combined cycle plant can be ramped up. Coal and nuclear plants cannot match this ability. In situations where the combined cycle plant is not operating and additional power must be brought on line to make up for a decrease in wind energy delivered into the grid (whether due to the fact that the wind is not blowing or for any other reason), the combined cycle plant is able to meet the demand much more quickly than a coal or nuclear plant, and at a much higher efficiency level than a coal-fired plant. This ability helps to maintain system reliability in areas where wind energy constitutes a significant portion of the area energy mix."

The ability of a combined cycle plant to operate as a complement to wind generation is due to the fact that a combined cycle plant easily supplies what are referred to as "ancillary services." These services include: frequency regulation, load following via automatic generation control

[13] Certificate of Need Application, Supplemental Filing , Calpine Corporation, March 29, 2004

("AGC") for second-to-second, minute-to-minute, and hour-to-hour load fluctuations, spinning reserve, supplemental reserve, and voltage regulation and VAR dispatch.
A description of these ancillary services and their interplay with wind generation is provided in the Wind-Gas report included as **Appendix F**. That report discusses the need for such ancillary services (both for reliability and security) as more wind generation is brought into the system mix, and concludes that combined cycle generation is uniquely qualified to provide those services so as to allow for effective and efficient management of the generation system.

The specific types of ancillary services that the Facility can provide are described as follows:

- Frequency Regulation: Support of stable grid operation at 60 Hz by changing the operating speed of the Facility's generators.

- Load Following: Use of Automated Generation Control ("AGC") to respond to dispatch requests from the Energy Management System ("EMS") to follow the system load as it changes during the day. FACILITY will equip the Facility to respond to AGC for the exempt portion of the power output and expects the same will be required for the non-exempt portion.

- Unit commitment: The ability to dispatch the unit on demand with appropriate notice. The incorporation of a back-up fuel in the Facility's design will ensure that the plant can be dispatched on demand without regard to potential interruptions in fuel supplies.

- Spinning reserve: The ability to produce additional electricity when requested on an almost instantaneously basis. Spinning reserve is generally required to be on-line in order to satisfy the potential need for such service. The Facility may provide this service by means of duct firing or steam injection.

- Supplemental reserve: The ability of a generator to be quickly synchronized to the grid when needed. Given a hot start condition, the Facility may be synchronized to the grid in approximately 15 minutes.

- Reactive power: The Facility is designed with the ability to produce or absorb reactive power in order to maintain a constant system voltage.

The inherent design of a combined cycle plant allows for the provision of the ancillary services described above. Frequency regulation service is met by generator governor control. Load following is met with AGC. The unit will receive generation commands and quickly respond to the request by ramping generation levels at a rate of approximately 10 MW per minute up or down from its maximum rating to approximately 50 percent of its maximum rating with air permit conditions being the limiting factor. The estimated difference between the Facility's full load heat rate and its minimum load heat rate is 11 percent. Unit commitment operation is provided by means of the expected high availability of the plant. Spinning reserve is provided by having a large operating range. The Facility is designed to incorporate two independently dispatchable (60 percent to 100 percent load) combustion turbines each coupled with heat recovery steam generators capable of duct firing for additional peaking power (the portion that is the subject of the CON process and the portion that is not) and by means of power augmentation

that may be designed into the portion of the Facility that is the subject of the CON process. Finally, by changing the level of generator excitation to absorb or produce Vars (reactive power capacity) the Facility will be able to provide reactive power on demand.

Many of the ancillary services described above can be provided by simple cycle "peaking" units; however, combined cycle units such as the proposed Facility are able to provide the services more efficiently and with less environmental impact. The efficiency advantage is seen in the Facility's ability to recapture the heat energy of the exhaust gases that are wasted in a simple cycle unit. By capturing the heat of the exhaust gases before they are discharged up the stack, and using that heat to create steam that powers the steam turbine generator to create more electric energy, the Facility is able to beat the heat rate of the simple cycle unit by approximately 40 percent. This means less fuel is used to produce the same amount of power. The environmental advantage is seen in the decreased fuel use (less emissions for the same amount of power) and the ability of the combined cycle unit to incorporate additional emission control features such as Selective Catalytic Reduction to reduce the emissions of nitrogen oxides.

While it is difficult to make a direct comparison between wind and gas due to the fact that the generating characteristics of the technologies are so different, it is easy to point out the symbiotic relation that might, and in some cases, must, exist. Current legislation in Minnesota sets renewable energy objectives that require electrical utilities to make a good faith effort to generate or procure at least one percent of their total retail electric sales from renewable energy sources by 2005 and ten percent by 2015. Minn. Stat. § 216B.1691.[14] Wind generation is the better means to accomplish this renewable objective due to its availability (both in terms of land and generation potential). If Minnesota wants (or requires) more wind generation, it also needs resources like the proposed Facility that can provide the means to effectively incorporate those intermittent resources into the generation mix so that the electric system as a whole remains reliable and secure at a reasonable cost. For more detailed analyses, see **Appendix F**, Wind-Gas Analysis.

3.3 Alternative Back-up Fuels

The primary fuel for the Facility will be natural gas. Designing the Facility with natural gas as the primary fuel source will yield significantly lower impacts to the environment than using oil as a primary source. Emissions of sulfur dioxide, carbon monoxide, nitrogen oxides , and particulate matter will all be lower because of the use of natural gas as the primary fuel instead of fuel oil. It is anticipated that Calpine would plan to run the Facility on natural gas at least 90 % of the time. The Facility is required to have a back-up system in place that would operate no more than 10% of the year or less than 876 hours.

[14] To date, 13 states have implemented minimum renewable energy standards ("RES"). In September 2002, California enacted the largest RES in the nation, requiring the state's three largest investor-owned utilities to gradually increase their use of renewable energy for electricity to 20 percent by 2017. As part of restructuring their electricity industries, Arizona, Connecticut, Maine, Massachusetts, Nevada, New Jersey, New Mexico, and Texas enacted renewable energy standards. Pennsylvania included RES in restructuring settlements with distribution companies. Wisconsin enacted a renewable standard as part of electricity reliability legislation, without restructuring to allow retail competition. Iowa has enacted minimum renewable energy requirements for regulated utilities. Most recently, New Mexico joined Nevada in becoming the second state to revisit and significantly increase its RES. There is even talk of a federal RES as a cornerstone of the national energy policy.

There has been no determination made yet, as to how the Facility natural gas power generating capability would be restricted to take advantage of intermittent periods of wind power availability.

The planned secondary fuel source for the Facility is low sulfur distillate fuel oil. This back-up fuel supply during periods when natural gas is not available and the Facility must generate and supply electricity to the grid. In the EA Scoping meetings a number of citizens and groups expressed interest in the analysis of other potential secondary fuel sources.

The proposed Facility must be equipped for and required to use biodiesel or ethanol as the back-up for the natural gas that backs up the wind[15]. The Facility must be equipped to burn a liquid fuel as a back up no matter what, and Minnesota law gives preference to renewable fuels over fuel oil. Before it can be claimed that the cost of biodiesel or ethanol is prohibitive, a thorough and detailed analysis of the economics involved must be conducted.

This analysis must include scrutiny of the adverse impacts on local economic development in Minnesota if fuel oil is used instead of Minnesota-produced liquid biofuels, as well as the impact using Minnesota-produced liquid bio-fuels will have in terms of helping to develop a stable market for such fuels.

The environmental review should look at both short and long term (or cumulative) environmental implications of increased use of flexible, combined generation technology [16]- alongside effects of increased use of single source coal and natural gas. What environmental harms could be avoided and what benefits maximized by studying the full potential of the combined cycle turbine technology to support these uses, including alternative use of primary and back-up fuels, and wind/gas combinations? Understanding both the limitations and present and future potential uses of the equipment could maximize social, economic and environmental benefits.

Commissioner Wortel[17] asks, "Why are different fuels scoped for the Alternative Fuels in Primary Power Production and Alternative Back -Up fuels? What are the technical distinctions between the equipment needed to provide primary and back-up fuel use?"

- How should winter requirements to back down gas for heating priorities affect the development of this part of the record? The issue was raised in the public meeting. How does the potential use of the different bio-fuel back up options change the (MPCA) limitations (for fuel oil) on how much, or what percentage, of alternative fuel may be used?

- What environmental harms could be avoided and what benefits maximized by studying the potential to move towards a bio-fuel, wind combination (with natural gas back up)

[15] Comments of the North American Water Office regarding the scope of the Environmental Assessment, George Crocker, Executive Director, May 10, 2004
[16] Comments from Communities United For Responsible Energy regarding the scope of the Environmental Assessment, Kristin Eide-Tollefson and Sig Anderson, May 10, 2004
[17] Comments from, Blue Earth County Commissioner regarding the scope of the Environmental Assessment, Katy Wortel , May 12, 2004

using combined cycle turbine technology -- and identifying the investments/alterations that would be necessary to do so? I do not know if this has been discussed.

Combustion turbines[18] are able to burn a wide range of liquid and gaseous fuels. Natural gas(essentially methane) has proven to be the ideal fuel for combustion turbine operation due to its cleanliness (very low content of sulfur, salts, and metals) and ease of transport. Light distillate oil has also proven to be good for use in combustion turbines, but requires more maintenance of the turbines due to the higher amount of impurities in the fuel. With proper modifications or equipment enhancements, combustion turbines may be able to burn fuels as diverse as biodiesel, ethanol, other gases such as hydrogen and propane, and blends of all of the above. Gasified coal has also been used as a fuel in combustion turbines. Experiments with powdered coal as a combustion turbine fuel have been unsuccessful to date.

3.3.1 Biodiesel

There are two aspects to this alternative. One is to consider replacing fuel oil as a backup fuel with biodiesel. The other is to consider whether biodiesel could replace natural gas as the primary fuel. Comments on the biodiesel option were received from Mr. Mark Lindquist at the Minnesota Project.[19] The Minnesota Project supports these requests to consider biodiesel as an alternative to fuel oil. The Minnesota Project specifically recommends that EQB consider three biodiesel sub-alternatives to fuel oil:

1. 100% biodiesel (B100),
2. 20% biodiesel 80% fuel oil blend (B20), and
3. 2% biodiesel 98% fuel oil blend (B2)

These three sub-alternatives correspond to the most common blends used in diesel engines. In diesel engine applications, these blends provide real and measurable improvements in tail pipe emissions.
Air emissions associated with fuel oil use raised some of the greatest environmental concerns regarding this proposed project. The Minnesota Project recommends that the EA consider and compare in the section titled, “Environmental Effects of the Project - Air Quality:”

- Stack emissions for criteria pollutants and for net carbon dioxide releases,
- Ambient air quality,
- Acute risks assuming maximum hourly emissions when burning oil, and
- Chronic risks assuming oil-firing up to 10% of the time over a 12 month rolling average.

[18] Comments from Calpine Corporation regarding the scope of the Environmental Assessment, Kent Morton , June 16 & 17, 2004
[19] Comments from Minnesota Project regarding the scope of the Environmental Assessment, Mark Lindquist, May 12, 2004

Ms. Katy Wortel asked[20] , The use of biofuels, including biodiesel, should be evaluated for environmental improvement over using #2 fuel oil. I am concerned that if they would burn the maximum amount of fuel oil that they are allowed, it would worsen air quality substantially. It does not seem to me that this worst case has been evaluated, particularly how worst case would increase localized air pollution, adding in background levels from ADM and EXCEL Wilmarth, and possibly others. Could they burn other biofuels in the future to replace some of the natural gas (in addition to replacing fuel oil)? What is the economic benefit to MN of burning locally grown biofuels versus imported natural gas?

Biodiesel[21] has been used as both a fuel and a fuel additive in diesel engines. It is recommended for use only in compression-ignition engines that were designed to use petroleum diesel fuel. It has not been commercially proven in combustion turbines; however, there do not appear to be any technical reasons that biodiesel cannot be used in such application in blended form. Based on the ASTM specification, pure biodiesel fuel (also known as B100) when compared to low sulfur distillate fuel oil (No. 2 fuel oil) potentially contains (i) more ash, which can deposit on the combustion turbine blades and clog the fuel nozzles, (ii) more acid, which can promote corrosion of equipment parts, and (iii) higher phosphorus, which also can lead to corrosion. It also has a higher distillation temperature, which can result in poor ignition properties. For these reasons, biodiesel is typically blended with petroleum diesel in concentrations from 2 to 20 percent biodiesel. The primary drawbacks to increased usage of biodiesel are the higher fuel cost compared to petroleum diesel and the availability of the fuel in practical, sufficient quantities to use in the Facility. According to the National Biodiesel Board ("NBB"), there are presently more than 14 companies that are developing and marketing biodiesel manufacturing plants.

Current production capacity is reported to be about 200 million gallons per year through long-term production agreements with existing biodiesel marketing firms; however, only about 25 million gallons were sold in 2003. While many of the manufacturing facilities are located in the Midwest, others are located as far away as California, Texas, and North Carolina. Currently, there is no biodiesel production capacity in Minnesota; however, there are proposals to install approximately 60 million gallons of annual production capacity within the state. One of the proposed production plants is a 30 million gallon per year plant in Brewster, Minnesota, which is approximately 90 miles southwest of the Facility. Transportation of the fuel to the Facility site from areas outside of the Midwest would be uneconomical. In addition, according to industry sources cited by NBB, it is not recommended to store the biodiesel fuel for periods more than six months. Were biodiesel only to be used as a back-up fuel, this limitation may result in wasted fuel if it is not "turned over" with sufficient frequency. In addition, because specific gravity of biodiesel is greater than petroleum diesel, it would be difficult to store the fuels in the same tank for any longer period of time without stratification. Additional tankage would likely have to be added to the Facility site in order to ensure that the fuels could be blended together in proper ratios.

[20] Comments from, Blue Earth County Commissioner regarding the scope of the Environmental Assessment, Katy Wortel , May 12, 2004
[21] Comments from Calpine Corporation regarding the scope of the Environmental Assessment, Kent Morton , May 10, 2004

3.3.2 Biomass

The Minnesota Project[22] also recommends that the EQB consider biomass gasification. Gasification is a process where biomass (principally plant matter such as waste wood, agricultural residues, or food processing wastes/residues) is converted to a gaseous fuel. The United State Department of Energy notes "Large-scale demonstration facilities have been tested and commercial units are in operation worldwide.

The problems with the application of gasification have been economic, not technical." (see http://www.ott.doe.gov/biofuels/gasification.html) The changing price structure of natural gas is making this technology increasingly competitive on an economic basis. In addition there are numerous potential sources of biomass to supply such a plant in the Mankato area including:

- Demolition waste already being transported to the adjacent landfill,
- Refuse derived fuel already being transported to Wilmarth (Wilmarth is an older plant and its remaining life time is unknown – in addition, RDF has very limited "shelf-life" an alternative point to utilize the fuel would reduce the need for by-pass landfilling during scheduled or unscheduled shut downs at Wilmarth),
- Urban yard waste from the Mankato area,
- Organic waste streams from area food processing plants – such as the adjacent ADM soybean mill and the Honeymead Soybean Mill also located in Mankato,
- Agricultural residues,
- Dedicated energy crops (area institutions such as the Blue Earth River Basin Initiative and the Three Rivers Resource Conservation and Development District have already been working with some landowners on energy crop projects.

While it is not clear that a gasification plant relative to natural gas will necessarily reduce emissions of criteria pollutants, it is clear that net carbon dioxide emissions will be reduced. In addition, biomass will not be subject to interruption as will natural gas. Biogas emissions should be evaluated relative to total plant operation including a comparison to fuel oil within section 5.1 Environmental Effects of the Project - Air Quality:

Raw biomass cannot be used in a combustion turbine; however, certain biomass products may be converted into forms that can be used as an alternate back-up fuel in the Facility. The processes to convert the biomass to fuel, especially on a large scale as would be required at the Facility, have not been proven to be commercially feasible.

[22] Comments from Minnesota Project regarding the scope of the Environmental Assessment, Mark Lindquist, May 12, 2004

3.3.3 Ethanol

While Siemens-Westinghouse, the manufacturer of the Facility's combustion turbines[23], has no experience with operation of the equipment using ethanol or an ethanol blend, there are no technical reasons that ethanol cannot be used if it matches the fuel specifications required in the turbine units. In its unblended form, modifications to the combustion turbines would undoubtedly be required to account for the lower energy content of the fuel and the increased flow rates required to meet performance standards.

3.4 Alternative Types of Generation

3.4.1 Oil-fired Combined Cycle

OIL-FIRED COMBUSTION TURBINE ALTERNATIVE ANALYSIS[24]

The following discussion contrasts the proposed non-exempt natural gas fired combined cycle system with the oil-fired combined cycle alternative described in Section 5.2.8 of the Application[25]. Both the non-exempt natural gas fired combined cycle system and the oil-fired combined cycle alternatives are described more fully below.

Proposed (Non-Exempt) Facility Summary
The equipment associated with the natural gas-fueled power plant proposed by Mankato Energy is listed below. This equipment, which is compatible with the equipment associated with the portion of the Facility that is exempt from the CON process, will provide 355/325 MW (winter/summer) of electrical generating capacity. This information is provided for comparison in the alternative discussion to follow and in connection with the discussion of the wind-gas alternative suggested by the Minnesota Center for Environmental Advocacy on its comments submitted on March 12, 2004.

- One combined-cycle combustion turbine ("CT") with exhaust stack firing primarily natural gas; 10% annual capacity factor for distillate oil use.
- One heat recovery steam generator ("HRSG") with natural gas-fired duct burner.
- Additional five cells of cooling tower capacity (12 cells total) (compared to CON-exempt equipment of seven cells).
- Slightly larger water supply and discharge lines and slightly increased gas pipeline size (compared to CON-exempt equipment).
- Storage for 450,000 gallons of distillate oil.

[23] Comments from Calpine Corporation regarding the scope of the Environmental Assessment, Kent Morton , May 10, 2004
[24] Certificate of Need Application, Supplemental Filing , Calpine Corporation, March 29, 2004
[25] Certificate of Need Application, Calpine Corporation, March 2, 2004

The equipment proposed by Mankato Energy to be part of the Facility that is the subject of this proceeding, specifically the CT and HRSG, will be the same model/manufacturer as will be used in the portion of the Facility that is exempt from the CON process. It is necessary to use complementary equipment so as to maintain plant performance, reduce operation and maintenance costs, and better manage spare part inventories. There will be one steam turbine/generator associated with the entire Facility. The single steam turbine will be used by the CT/HRSG trains associated with both the exempt and non-exempt portions of the Facility.

Oil-Fired Alternative Description

The equipment associated with the oil-fired alternative is listed below. This equipment, which is compatible with the equipment associated with the portion of the Facility that is exempt from the CON process, will provide 355/325 MW (winter/summer) of electrical generating capacity.

1. • One combined cycle CT with exhaust stack firing 100% distillate fuel oil with 0.05% sulfur content.
2. • One HRSG with duct burner firing natural gas, which is the same as for the proposed (non-exempt) Facility.
3. • Additional five cooling tower cells (total of 12 cells) (compared to CON-exempt equipment of seven cells.) This results in the same total size as for the proposed non-exempt Facility
4. • Slightly larger water supply and discharge lines (compared to CON-exempt equipment).
5. The lines will be the same total size as for the proposed non-exempt Facility.
6. • Gas supply pipeline that is slightly smaller that associated with the non-exempt Facility because additional non-exempt capacity will not be supplied by gas.
7. • Additional oil tankage of approximately 3,000,000 gallons (approximately one week of firing).
8. • Additional RO/Demineralizer equipment to support the increased demineralized water requirement of 250 gallons per minute needed to control NOx creation by the combustion turbine.

As with the natural gas-fired (non-exempt) Facility proposed by Mankato Energy and described above, there will be one steam turbine/generator associated with the entire oil-fired facility. The single steam turbine will be used by the CT/HRSG trains associated with both the exempt and non-exempt portions of the Facility. Because there will be a HRSG in this case, we have assumed that there would be duct burners. However, we have assumed natural gas firing of those duct burners. Oil-firing of duct-burners is unlikely due to potential problems with fouling. Note also that there will continue to be a natural gas fired auxiliary boiler in the oil-fired case. It is assumed to be gas-fired because it will be required for the CON-exempt equipment.

Because the auxiliary boiler will be the same in both cases, its effects are not shown in the comparisons that follow.

Oil-Fired Alternative Analysis

• *The estimated range of land requirements for the facility with a discussion of assumptions on land requirements for water storage, cooling systems, and solid waste storage.*

The oil-fired plant would require additional space to accommodate additional oil storage and truck unloading capacity. Additional space would not be required for any other reasons. Mankato Energy estimates the additional oil storage requirement would be approximately one acre.

There would be no change in solid waste storage requirements between the simple cycle alternative and the proposed alternative.

• *The estimated amount of vehicular, rail, and barge traffic generated by construction and operation of the facility.*

There would be no change in the amount of vehicular, rail, and barge traffic associated with the construction of the oil-fired plant. Changes in traffic for this type of facility during operations would be primarily affected by fuel use patterns. The 100% distillate oil option will require significantly increased traffic for fuel delivery. The difference in total fuel oil usage (10% oil firing capacity compared to the 100% oil fired alternative for 355/325 MW winter/summer additional capacity) is estimated to be 140,600,000 gallons per year. This reflects 18,750 additional truck trips per year or approximately 50 additional trips per day. In order to efficiently receive the fuel oil shipments, four additional truck unloading stations would be required.

• *The expected regional source of fuel for the facility.*

For the proposed alternative, a capacity factor of up to 100% fuel oil is allowed. The regional source, i.e., refinery, of that oil and the source of oil for a 10% oil-fired alternative would likely be the same assuming that the regional source of distillate oil has adequate capacity. If the regional source does not have adequate capacity, a second or third source of distillate would be required.

• *The typical fuel requirement (in tons per hour, gallons per hour, or thousands of cubic feet per hour) during operation at rated capacity and the expected annual fuel requirement at the expected capacity factor.*

Fuel requirements are summarized in the following table. These values are for 355/325 MW (winter/summer) of additional power that is the subject of the CON Supplement.

Fuel and Averaging Time	**One - 100 % Oil Fired Combined Cycle Turbine - Duct Burner Firing Gas**	**One - Gas/Oil Fired Combined Cycle Turbine - Duct Burner Firing Gas**
Natural Gas - 100% hourly	0.7843 million ft3/hour	2.7843 million ft3/hour
Fuel Oil - 100% hourly	14,640 gal/hour	14,640 gal/hour
Natural Gas - 100% annual	6,871 million ft3/year	24,391 million ft3/year
Fuel Oil - annual	128 million gallons/year	12.8 million gallons/year

• *The expected rate of heat input of the facility in Btu per hour during operation at maximum rated capacity.*

The heat input rates of an oil-fired alternative compared to the proposed alternative are summarized below. These values are for 355/325 MW (winter/summer) additional power that is the subject of the CON Supplement.

Fuel	**One - 100 % Oil Fired Combined Cycle Turbine - Duct Burner Firing Gas**	**One - Gas/Oil Fired Combined Cycle Turbine - Duct Burner Firing Gas**
Natural Gas	800 million Btu/hr2	2,840 million Btu/hr
Fuel Oil	2,050 million Btu/hr	2,050 million Btu/hr

• *The typical range of the heat value of the fuel (in Btu per pound, Btu per gallon, or Btu per 1000 cubic feet) and the typical average heat value of the fuel.*

The fuel sources for the oil-fired alternative and for the proposed alternative are the same; therefore, there will be no difference in the typical ranges and in the average heat value between alternatives. The heat values used in analysis are:

1,020 Btu/scf – natural gas
140,000 Btu/gallon – distillate oil

• *The typical ranges of sulfur, ash, and moisture content of the fuel.*

Ash and moisture content of fuel oil will not vary significantly and any variations would be the same for the oil-fired alternative as for the oil-fired portion of the proposed alternative. Sulfur content of fuel oil for this alternative and for the proposed alternative is set by a proposed permit limitation of 0.05% sulfur. Moisture and ash contents for both fuels are For the oil-fired alternative it is not possible to operate solely on distillate oil.

It is necessary to combust natural gas in the duct burner for the Facility. identified as nil. (Reference: Babcock and Wilcox. Steam Its Generation and Use. 38th Edition, 1972)

• *The estimated range of trace element emissions and the maximum emissions of sulfur dioxide, nitrogen oxides, and particulates in pounds per hour during operation at rated capacity.*

The following summarizes maximum emissions of sulfur dioxide ("SO2"), nitrogen oxides ("NOx"), particulate matter ("PM"), and particulate matter less than or equal to 10 microns ("PM10") in pounds per hour at rated capacity under the listed conditions. The emissions calculations assume that controls on an oil-fired alternative will be the same as those proposed when burning distillate oil for the proposed case (gas/oil). Maximum emissions are estimated only for the 355/325 MW (winter/summer) additional capacity. This first table compares emissions from the primary fuel in each case:

One - 100 % Oil Fired Combined Cycle Turbine - with Duct Burners Firing Gas		**One - 100% Gas Fired Combined Cycle Turbine - with Duct Burners Firing Gas**
	(Lbs/hr at rated capacity)	**(Lbs/hour at rated capacity)**
SO2	86.25	3.41
NOx	53.29	36.71
PM	72.8	10.0
PM10	72.8	10.0

This second table compares the case of burning back-up distillate oil to the 100% distillate oil fired case:

One - 100 % Oil Fired Combined Cycle Turbine – with Duct Burner Firing Gas		**One - 100% Oil Fired Combined Cycle Turbine - with Duct Burner Firing Gas**
	(Lbs/hr at rated capacity)	**(Lbs/hour at rated capacity)**
SO2	86.25	86.25
NOx	53.29	53.29
PM	72.8	72.8
PM10	72.8	72.8

Emissions of SO2, NOx, PM, and PM10 for the two distillate oil-fired cases are the same on an hourly basis because it has been assumed that the same vendor guarantees available for the oil burning portion of the proposed alternative will be the same as for the 100% oil fired case.
The range of trace element concentration in the fuel is unaffected by this alternative as compared to the proposed Facility. The fuel sources are the same; therefore, the range in trace element concentrations will be the same in those fuels.

Trace element emissions (metals) are primarily from distillate oil combustion. Therefore, trace element emissions will increase for the 100% oil fired case when compared to gas firing. Trace element emissions are summarized below.

One - 100 % Oil Fired Combined Cycle Turbine - with Duct Burners Firing Gas		**One - 100% Gas Fired Combined Cycle Turbine - with Duct Burners Firing Gas**
	(Lbs/hr at rated capacity)	**(Lbs/hour at rated capacity)**
Arsenic	0.0227	0.000157
Beryllium	0.000645	0.00000941
Cadmium	0.0107	0.000863
Chromium	0.0236	0.00110
Cobalt	0.0000659	0.0000659
Lead	0.0291	0.000392
Manganese	1.62	0.000298
Mercury	0.00266	0.000204
Nickel	0.0111	0.00165
Selenium	0.0513	0.0000188

Trace element emissions, on a maximum pounds per hour basis, will be the same for the proposed case when burning back-up oil as for the 100% oil fired case. Trace element emissions for the proposed project are detailed in the Air Emission Risk Assessment submitted to the Minnesota Pollution Control Agency in coordination with the Minnesota Environmental Quality Board to support the preparation of the Site Permit.

> • *The estimated range of maximum contributions to 24-hour average ground level concentrations at specified distances from the stack of sulfur dioxide, nitrogen oxides, and particulates in micrograms per cubic meter during operation at rated capacity and assuming generalized worst-case meteorological conditions;*

The following table lists maximum 24-hour average ground level concentrations for SO2, NO2, and PM10. These estimates are at maximum hourly capacity for 24-hours and are predicted to occur with 320 meters of the stack.

One - 100 % Oil Fired Combined Cycle Turbine - with Duct Burner Firing Gas	**One -Gas/Oil Fired Combined Cycle Turbine - with Duct Burner Firing Gas**	**Applicable National/ Minnesota Ambient Air Quality Standard**
(ug/m3 at rated capacity)	**(ug/m3 at rated capacity)**	**(ug/m3)**
SO2 (1)	19.9	19.9	365
NO2 (2)	15.6	15.6	NA
PM10 (3)	15.5	15.5	150

(1) reflects high-second-high value for comparison to standard.

(2) reflects high-first-high since there is no applicable standard at this averaging time.

(3) reflects high-six-high over 5 years for comparison to standard.

The maximum impacts in this case are the same because the worst-case emissions estimates for the worst-case analysis are the same, i.e., 100% oil firing. The data listed in the table above do not represent a regulatory analysis for comparison to National or Minnesota Ambient Air Quality Standards ("AAQS"). The analysis was done to provide a specific comparison between the equipment that is different in the two cases. The results reflect only the impact of the listed equipment operating alone. Other sources at the facility are not reflected in the table. Background concentrations are also not considered in the above table. Total facility impacts are addressed in the Site Permit Application.

• *Water use by the facility for alternate cooling systems, including:*

(1) the estimated maximum use, including the groundwater pumping rate in gallons per minute and surface water appropriation in cubic fee per second

(2) the estimated groundwater appropriation in million gallons per year;

(3) the annual consumption in acre-feet;

Alternative types of cooling systems (other than cooling towers) were not considered for this site due to the environmental benefits associated with "recycling" recycled wastewater received from the City of Mankato publicly owned treatment works ("POTW") as well as the limited plant site area. Additionally, once-through cooling was not considered because of the substantially greater quantities of water required and the associated environmental impacts. Air-cooled condensers also were not included because of several factors, including a lower system efficiency and greater impacts on land area, noise and aesthetics. For either alternative there will not be a need to appropriate groundwater or surface water. See also discussion under the following bullet item.

• *The potential sources and types of discharges to water attributable to operation of the facility.*

The sources and types of discharges for the oil-fired alternative and the proposed non-exempt facility will be the same. The water requirement for the oil-fired alternative will be slightly larger than for the non-exempt portion of the Facility. Water demand in the oil-fired alternative will increase by approximately 500,000 gallons per day, as distillate oil combustion requires demineralized water to be injected into the combustor to control NOx formation. This water will be emitted as water vapor from the HRSG stack. The water appropriation for either alternative will be from the Mankato POTW.

Both cases will result in a decrease in volume of water discharged to the Minnesota River due to evaporative losses in the cooling towers compared to the no build option. The evaporative loss will be small in relationship to the river flows, even during periods of very low flow. Both cases will include effluent treatment to reduce phosphorus concentrations. The final design criteria are

being developed, however current estimates indicate that the facility will remove about 75% of the phosphorus it receives from the City of Mankato's wastewater treatment plant. Therefore, the proposed facility, whether oil or gas fired will result in decreased phosphorus loading to the Minnesota River. Phosphorus is a key factor influencing the lower dissolved oxygen impairments of the lower Minnesota River. Therefore, reduction in phosphorus will benefit the Minnesota River.

• *Radioactive releases, including: for fossil-fueled facilities, the estimated range of radioactivity released by the facility in curies per year.*

No radioactive releases are expected from the proposed Facility or the oil-fired alternative.

• *The potential types and quantities of solid wastes produced by the facility in tons per year at the expected capacity factor.*

Solid waste production is minimal and would not be different between the oil-fired alternative and proposed alternative.

• *The potential sources and types of audible noise attributable to operation of the facility.*

There will be no significant difference in noise from equipment associated with the oil-fired alternative and with the proposed non-exempt Facility. There will be increased noise due to increased truck traffic related to distillate oil deliveries.

• *The estimated work force required for construction and operation of the facility.*

The oil-fired alternative would require essentially the same resources to construct as the non-exempt portion of the proposed Facility.

• *The minimum number and size of transmission facilities required to provide a reliable outlet for the generating facility.*

Because the power generated in each case is the same there would be no difference between alternatives in the number and size of transmission facilities required.

Summary/Conclusions

The Facility will be capable of using low sulfur distillate oil as a back-up fuel. The use of the distillate oil will be restricted to ten percent of the Facility's operating hours based on 12-month rolling average. The incorporation of distillate oil capability increases the operating flexibility of the Facility in that switching fuel sources may mitigate restrictions or interruptions of natural gas supplies. Limiting the fuel source(s) for the Facility to only distillate oil would reduce this operating flexibility. As shown in the prior discussions the environmental impacts associated with an oil-fired combustion turbine would be significantly greater than the impacts associated with the proposed Facility. For example, emissions of sulfur dioxide, carbon monoxide, nitrogen oxides, and particulate matter would all be greater compared to combustion of natural gas. Water use would also be greater, and land use requirements also would be greater due to the need for large quantities of on-site oil storage capacity needed to support continuous operation.

Finally, the cost of operating an oil-fired facility is greater than operating a natural gas-fired facility in terms of both fuel costs and operating and maintenance costs.

3.4.2 Simple Cycle Combustion Cycle

SIMPLE-CYCLE COMBUSTION TURBINE ALTERNATIVE ANALYSIS[26]

The following discussion contrasts the proposed non-exempt natural gas fired combined cycle system with the simple cycle alternative described in Section 5.2.9 of the Application[27]. A summary description of the non-exempt natural gas fired combined cycle system was provided above. The simple cycle alternative is described more fully below.

Simple Cycle Alternative Description
The simple-cycle alternative for 355/325 MW (winter/summer) non-exempt capacity would have the following equipment:

1. • Two simple-cycle combustion turbines with a single exhaust stack firing primarily natural gas; 10% annual capacity factor for distillate oil use.
2. • No additional HRSG; no additional duct burners.
3. • Cooling tower will be the same as in CON-exempt case; seven cells total; five cells less than proposed non-exempt Facility.
4. • Slightly smaller water supply and discharge lines compared to proposed non-exempt Facility.
5. • Assumption of increased oil storage to maintain storage equivalent to 20 hours of oil-based capacity. This will increase oil storage by approximately 600,000 gallons above that required for the proposed non-exempt facility. Total oil storage capacity would be approximately 900,000 gallons.

There will be one steam turbine/generator overall, which will receive steam from the CON-exempt combined cycle combustion turbine system. The steam turbine will be the same size regardless of whether the non-exempt portion of the Facility is built or not. The major differences between the simple cycle alternative and proposed non-exempt Facility are the lack of a second HRSG, less cooling tower requirement, and the addition of a second combustion turbine. The second combustion turbine is required to address loss of capacity at associated with the steam cycle and duct burner capability in the HRSG.

Note also that there will continue to be a natural gas fired auxiliary boiler in the oil-fired case. It will be required for the CON-exempt equipment. Since the auxiliary boiler will be the same in both cases, its effects are not shown in the comparisons that follow. A significant advantage that a combined cycle facility has over a simple cycle facility is greater efficiency.

[26] Certificate of Need Application, Supplemental Filing , Calpine Corporation, March 29, 2004
[27] Certificate of Need Application, Calpine Corporation, March 2, 2004

The heat rate, the industry measure of efficiency, is the heat (measured in Btus) required to generate 1 kWh of electricity. Typically, the heat rate of a simple-cycle facility is about 11,000 Btu/kWh (Higher Heating Value) while the heat rate associated with the combined cycle portion of the Facility is about 7,000 Btu/kWh (HHV). The loss of efficiency from combined to simple cycle means more fuel use for the same amount of electric power, more emissions per the amount of power produced, and a higher cost of power. Moreover, the need to install a second CT to make up for the capacity lost without the steam cycle and duct burner capability increases the capital cost of the plant. It would require the addition of a fourth transformer as well as require changes to the switchyard.

Simple Cycle Alternative Analysis

- *The estimated range of land requirements for the facility with a discussion of assumptions on land requirements for water storage, cooling systems, and solid waste storage.*

A simple cycle plant will require approximately the same land area. Less land area would be required due to the lack of a HRSG and the lower number of cooling tower cells required. However, additional land would be required for oil storage and the second CT. The net change is expected to minimal. It is unlikely that the actual site size would change in any case given the layout of the facility and specifics of the site.

There would be no change in solid waste storage requirements between the simple cycle alternative and the proposed alternative.

- *The estimated amount of vehicular, rail, and barge traffic generated by construction and operation of the facility.*

It is expected that traffic patterns would change slightly during the construction phase. A HRSG requires more equipment deliveries than the CT that would be used to replace the incremental loss of power were the combined cycle replaced by the simple cycle alternative. The additional five cells in the cooling tower associated with combined cycle proposal would also not be required; thus, reducing equipment deliveries associated with that structure.

Changes in traffic for this type of facility during operations are primarily affected by fuel use patterns. The fuel mix for the simple cycle alternative is primarily natural gas with a provision for up to 10% distillate fuel oil. Changes in the amount of gas usage do not affect traffic counts. Changes in fuel oil usage would affect traffic counts. Given that a simple cycle facility is less efficient overall, that difference in efficiency would translate to increased fuel oil requirements should back-up fuel oil be required. The difference in total fuel oil usage (at 10% capacity) is estimated to be 10,699,714 gallons per year. This reflects 1,529 additional truck trips per year.

- *The expected regional source of fuel for the facility.*

The simple cycle alternative would have the same fuel sources as the proposed non-exempt, combined cycle facility.

• *The typical fuel requirement (in tons per hour, gallons per hour, or thousands of cubic feet per hour) during operation at rated capacity and the expected annual fuel requirement at the expected capacity factor.*

Fuel requirements are summarized below. These values are for the 355/325 MW (winter/summer) additional power that is the subject of the CON.

Fuel and Averaging Time	**Two Simple Cycle Turbines**	**One Combined Cycle Turbine with Duct Burner**
Natural Gas - 100% hourly	3.828 million ft3/hour	2.7843 million ft3/hr
Fuel Oil - 100% hourly	29,280 gallons/hour	14,640 gallons/hour
Natural Gas - 100% annual	32,120 million ft3/year	24,391 million ft3/yr
Fuel Oil - 10% annual	25.6 million gallons/year	12.84 million gallons/year

• *The expected rate of heat input of the facility in Btu per hour during operation at rated capacity.*

The heat input rates of a simple cycle alternative compared to the proposed alternative are summarized below. These values are for the 355/325 MW (winter/summer) additional power that is the subject of the CON.

Fuel	**Two Simple Cycle Turbines**	**One Combined Cycle Turbine with Duct Burner**
Natural Gas	4,160 million Btu/hr	2,840 million Btu/hr
Fuel Oil,	3,928 million Btu/hr	2,852 million Btu/hr3

• *The typical range of the heat value of the fuel (in Btu per pound, Btu per gallon, or Btu per 1000 cubic feet) and the typical average heat value of the fuel.*

The fuel sources for the simple cycle alternative and for the proposed alternative are the same and therefore there will be no difference in the typical ranges and in the average heat value between alternatives. The heat values used in this analysis are:

1,020 Btu/scf – natural gas
140,000 Btu/gallon – distillate oil

• *The typical ranges of sulfur, ash, and moisture content of the fuel.*

Sulfur, ash, and moisture content of natural gas will not vary significantly and any variations would be the same for the simple cycle alternative as for the proposed alternative.

3 Includes natural gas firing in duct burner.

Sulfur content of fuel oil for this alternative and for the proposed alternative is set by a proposed permit limitation of 0.05% sulfur. Moisture and ash contents are negligible for both alternatives.

Moisture and ash contents for both fuels are identified as nil. (Reference: Babcock and Wilcox. Steam Its Generation and Use. 38th Edition, 1972)

• The estimated range of trace element emissions and the maximum emissions of sulfur dioxide, nitrogen oxides, and particulates in pounds per hour during operation at rated capacity.

The following summarizes maximum emissions of sulfur dioxide ("SO2"), nitrogen oxides ("NOx"), particulates, and particulate matter less than or equal to 10 microns ("PM10") in pounds per hour at rated capacity under the listed conditions. The emissions calculations optimistically assume that controls on a simple cycle combustion turbine will be same as those proposed for the combined cycle alternative. In fact, NOx emissions from a simple cycle combustion turbine will be higher than those from combined cycle machines because of the technical obstacles associated with adapting catalytic controls to simple cycle combustion turbines. Maximum emissions are estimated only for the 355/325 MW (winter/summer) additional capacity. The first table compares emissions when the primarily fuel is natural gas in each case. The second table compares emissions when the primary fuel in fuel oil

Primary Fuel - Natural Gas

	Two Simple Cycle Turbines- 100% Gas	**One Combined Cycle Turbine with Duct Burner - 100% Gas**
	(Lbs/hr at rated capacity)	**(Lbs/hour at rated capacity)**
SO2	4.69	3.41
NOx	439.9	36.71
PM	20.0	10.0
PM10	20.0	10.0

Primary Fuel - Fuel Oil

	Two Simple Cycle Turbines - 100% Back-up Oil Case	**One Combined Cycle Turbine with Duct Burner - 100% Back-Up Oil Case with Gas firing in Duct Burners**
	(Lbs/hr at rated capacity)	**(Lbs/hour at rated capacity)**
SO2	196.44	86.25
NOx	656.35	53.29
PM	109.5	72.8
PM10	109.5	72.8

The range of trace element concentration is unaffected by this alternative as compared to the proposed project. The fuel sources are the same and therefore the range in trace element concentrations will be the same in those fuels. Trace element emissions are summarized below. There are no trace element emissions factors for natural gas firing of a simple cycle turbine. A comparison of trace element emissions for back-up oil firing is provided below.

Primary Fuel - Fuel Oil

	Two Simple Cycle Turbines - 100% Back-up Oil Case	**One Combined Cycle Turbine with Duct Burner - 100% Back-Up Oil Case with Gas firing in Duct Burners**
	(Lbs/hr at rated capacity)	**(Lbs/hour at rated capacity)**
Arsenic	0.0432	0.0227
Beryllium	0.00122	0.000645
Cadmium	0.0189	0.0107
Chromium	0.0432	0.0236
Cobalt	(1)	0.0000659(1)
Lead	0.0550	0.0291
Manganese	3.10	1.62
Mercury	0.00471	0.00266
Nickel	0.0181	0.0111
Selenium	0.0982	0.0513

(1) Cobalt emission factors are available only for natural gas firing in duct burners.

The simple cycle case shows increased trace element emissions due to increased fuel oil consumption when burning back-up fuel. The amount of increase varies depending on the influence on trace element emissions from the duct burners.
Trace element emissions for the proposed project are detailed in the Air Emission Risk Assessment submitted to the Minnesota Pollution Control Agency in coordination with the Minnesota Environmental Quality Board to support the Site Permit Application.

> • *The estimated range of maximum contributions to 24-hour average ground level concentrations at specified distances from the stack of sulfur dioxide, nitrogen oxides, and particulates in micrograms per cubic meter during operation at rated capacity and assuming generalized worst-case meteorological conditions.*

The following table lists maximum 24-hour average ground level concentrations for SO2, NO2, and PM10. These estimates are at maximum hourly capacity for 24-hours and are predicted to occur within 320 meters of the stack.

	Two Simple Cycle Turbines	**One Combined Cycle Turbine with Duct Burner firing Gas**	**Applicable National/ Minnesota Ambient Air Quality Standard**
	ug/m3 at rated capacity	**ug/m3 at rated capacity**	**ug/m3**
SO2 (1)	45.4	19.9	365
NO2 (2)	192	15.6	NA
PM10 (3)	23.3	15.5	150

(1) reflects high-second-high value for comparison to standard.
(2) reflects high-first-high since there is no applicable standard at this averaging time.
(3) reflects high-sixth-high over 5 years for comparison to standard.

The data listed in the table above do not represent a regulatory analysis for comparison to National or Minnesota Ambient Air Quality Standards ("AAQS"). The analysis was done to provide a specific comparison between the equipment that is different in the two cases. The results reflect only the impact of the listed equipment operating alone. Other sources at the Facility are not reflected in the table. Background concentrations are also not considered in the above table.

The results for the simple cycle alternative are higher due to the need to burn additional fuel oil to achieve the same power output. The results shown for the non-exempt Facility portion above represent the worst-case condition of 24-hours burning fuel oil.

Total Facility impacts are addressed in the Site Permit Application.

• *Water use by the facility for alternate cooling systems, including:*

(1) the estimated maximum use, including the groundwater-pumping rate in gallons per minute and surface water appropriation in cubic fee per second

(2) the estimated groundwater appropriation in million gallons per year;

(3) the annual consumption in acre-feet;

The simple cycle alternative does not require an evaporative cooling system. See further discussion under the following bullet item.

• *The potential sources and types of discharges to water attributable to operation of the facility.*

The simple cycle alternative does not require a cooling water system. The proposed CON-exempt Facility will require a cooling system because a HRSG will be used. The water appropriation for the CON-exempt portion of the Facility will be from the Mankato POTW. In the simple cycle case, because no evaporative cooling is being used, there would be no evaporative loss for that portion of the Facility. Evaporative losses from the cooling towers will be approximately 40% lower with a simple cycle system for the additional non-exempt capacity as compared to a facility with two combined-cycle systems. However, the change in evaporative loss is not sufficient to recommend a change in alternative to a simple-cycle system. Flows are sufficient in the Minnesota River even with two combined cycle systems and their associated evaporative losses.

Further, there is an asset to water use in this case by the Facility. Any water used by the Facility will be subject to effluent treatment to reduce phosphorus concentrations. The final design criteria are being developed, however current estimates indicate that the Facility will remove about 75% of the phosphorus it receives from the Mankato. Therefore, a combined cycle combustion turbine will result in decreased phosphorus loading to the Minnesota River compared to a simple cycle alternative. Phosphorus is a key factor influencing the lower dissolved oxygen impairments of the lower Minnesota River. Therefore, reduction in phosphorus will benefit the Minnesota River. Phosphorus reduction actually would be diminished due to less City water used and therefore, scrubbed of phosphorus. A simple cycle plant would result in a net detriment in regards to potential phosphorus loading to the environment when compared to the combined cycle plant.

> • *Radioactive releases, including: for fossil-fueled facilities, the estimated range of radioactivity released by the facility in curies per year.*

No radioactive releases are expected from the proposed facility or the oil-fired alternative.

> • *The potential types and quantities of solid wastes produced by the facility in tons per year at the expected capacity factor.*

Solid waste production is minimal and would not be different between the simple cycle and proposed alternative.

> • *The potential sources and types of audible noise attributable to operation of the facility.*

The change to a simple cycle alternative for the non-exempt portion of the facility could potentially affect the noise analysis due to the addition of a turbine generator, the lack of the HRSG and the lower number of cooling tower cells. An analysis was completed for that alternative facility. The analysis included both the CON-exempt portion and the non-exempt portion. This is important when considering noise because the impacts are additive in a linear fashion. The analysis did not address the addition of the fourth transformer required for the simple cycle alternative.

The results of the analysis for the entire Facility (one combined-cycle system and two simple-cycle turbines) is summarized below:

• At receptor 1, approximately 1,350 feet from the plant, the estimated daytime L50 is 53.1 dBA and the estimated nighttime L50 is 48.7 dBA. With the combined cycle option, the estimated daytime L50 was 53.2 dBA and the estimated nighttime L50 was 49.1 dBA. 4

• At receptor 2, approximately 2,050 feet from the plant, the estimated daytime L50 is 48.0 dBA and the estimated nighttime L50 is 46.2 dBA. With the combined cycle option, the estimated daytime L50 was 48.1 dBA and the estimated nighttime L50 was 46.4 dBA.4

The Minnesota daytime and nighttime noise standards will be met at both nearby residential receptors. The change to simple cycle for the non-exempt portion would be the the difference between daytime and nighttime noise levels is due primarily to decreased background noise at night. result in a slight decrease in noise – the decrease ranging from 0.1 to 0.4 dBA depending on the condition. If the fourth transformer were to be added this difference would decrease and likely be negligible.

• *The estimated work force required for construction and operation of the facility.*

The simple cycle alternative would require slightly less resources to construct than the proposed alternative since there would be no second HRSG and the cooling tower system would be smaller. These differences are not significant.

• *The minimum number and size of transmission facilities required to provide a reliable outlet for the generating facility.*

The requirement for two simple cycle combustion turbines compared to the proposed combined cycle plant would require an additional transformer and interconnection. Additionally the switchyard would have to be expanded & reworked to accommodate the addition tie-in.

Summary/Conclusions

The exempt portion of the Facility will use combined cycle technology. The decision to use combined-cycle technology rather than simple-cycle technology for that portion of the Facility stemmed from the initial solicitation for power resources issued by Xcel Energy. That solicitation requested both base/intermediate load and peaking capacity. The combined-cycle plant better satisfied the base/intermediate load portion of the solicitation. The ability to fire duct burners located in the HRSG is the method that will be used to meet a part of the peaking needs of Xcel Energy per the terms of the solicitation. By firing duct burners located in the HRSG, the Facility is able to produce more electric power than if the duct burners were not installed. In effect, this configuration allows for a power plant that is capable of producing clean and efficient electric power to meet varying electrical demand types, i.e., both intermediate and peaking.

The reasons for using combined cycle technology for the portion of the Facility that is the subject of this proceeding rather than simple cycle technology fall into two general categories: environmental and economic. The items addressed in this discussion show that the majority of environmental impacts from a simple cycle system are directly related to this difference in efficiency. All air quality impacts are increased with a simple cycle system. Other environmental impacts also increase. Finally, the simple cycle alternative would require an additional transformer as well as modification and expansions of the switchyard.

An economic comparison was set out in the CON Application, and clearly showed that combined cycle technology was more economical than simple cycle technology. A part of that comparison – fuel usage – was described in more detail above. While this is an important issue in terms of project-specific economics, it is also an important issue on a larger scale. By introducing natural gas-fueled intermediate generating resources into an area, it is actually possible to reduce natural gas consumption while generating the same amount of electric power. The intermediate resources would replace the dispatch of less efficient natural gas fired peaking resources. This issue is made more significant in Minnesota where the majority of generating sources are either baseload or peaking (with very little of anything in between) and where a growing percentage of the generating capacity is expected to come from wind. Further discussion of the compatibility of gas and wind generating resources is described below in response to comments from the Minnesota Center for Environmental Advocacy.

3.5 Transmission rather than Generation

Katy Wortel, Blue Earth County Commissioner asked [28] "is there enough room on the Wilmarth line for the energy from future renewable energy projects or will the energy from Calpine fill up the line? How much capacity is on the power line from Wilmarth to its destination (Twin Cities?). Is there room for the wind coming from the west and particularly new sources that are just now being proposed - not even in project stage yet, especially Big Blue in Faribault County?

Transmission System Impact of the Facility --- Calpine[29] performed an internal analysis to determine the amount of electric power generation that could be added to the Xcel Wilmarth Substation without degrading or adversely impacting the transmission system. The results of the analysis showed a generating plant capable of producing approximately 550 MW could be constructed with little to no transmission upgrades. In fact, the addition of Facility to the existing utility electric grid system will have positive impacts for Minnesota in both generation and transmission benefits. The Minneapolis/St. Paul metro area is a large load pocket located north of the Facility. For this reason, excess power that does not flow through the Wilmarth transformers to serve local load will most likely flow from Mankato in a northerly direction toward the large load area. Adding the Facility, which will be a large, efficient, and low cost generator, in an area of Minnesota that does not have such a generator at this time will benefit the stability and reliability of the system in that it will provide local voltage support. The

[28] Comments from, Blue Earth County Commissioner regarding the scope of the Environmental Assessment, Katy Wortel , May 12, 2004
[29] Certificate of Need Application for Mankato Energy Center, Docket No. IP6345/CN-03-1884, Wenck Associates, March 2, 2004

location of the Facility will also increase the geographic diversity of Minnesota's electric generation.

The new Facility appears to be on the transmission route between Minnesota's major wind resource along the Buffalo Ridge in Southwestern Minnesota, and Minnesota's major load centers in the Twin Cities region[30]. New transmission was recently authorized for Southwestern Minnesota for the expressed purpose of increasing the transmission outlet capacity in Southwest Minnesota from 260 MW up to 825 MW. The EA must examine as to whether this new Facility will consume any portion of that new transmission outlet capacity, and if it does, the proposal for this new Facility must include options for again raising transmission outlet capacity for wind from Southwest Minnesota back up to 825 MW.

Calpine[31] has been working on a formal Interconnection Analysis with Midwest Independent System Operator ("MISO". This report is currently not finalized, but for the purposes of the EA, Calpine agreed to release a summary of the draft report. Calpine states, "We are not comfortable with releasing the draft as yet due to inconsistencies in the report and certain omissions that we feel are needed to give an accurate assessment of the impacts. Initial conversations with MISO indicate that they are OK with the suggested changes we have put forward in these areas. Regardless of the drafting that will go into the final report, the results will remain the same."

The study has been completed, but the final report on the results of the study has not yet been issued. The final report is expected to be issued sometime in July 2004. The primary objective of the study was to assess the impact of interconnecting the Facility into the Wilmarth Substation. To do this, the study performed a stability analysis, a short circuit analysis, and a steady state or thermal analysis.

Electric energy generated at the Facility will be delivered into the grid via three independent interconnections that will be made into the Wilmarth Substation, which is adjacent to the Facility. The interconnection scheme will consist of one interconnection directly into the 345 kV bus and two interconnections directly into two separate 115 kV bus positions. The approximate distance of the generator leads from the Facility into the Wilmarth Substation is 1,000 feet.

On October 10, 2002, Calpine submitted a transmission interconnection request to the MISO for 667 MW. MISO is responsible for evaluating all interconnection requests for the NSP transmission system. On October 11, 2002 MISO processed the request and assigned the Facility an interconnection queue number 37540-02. On February 26, 2004, Calpine and MISO executed an Interconnection Evaluation Study Agreement and on April 23, 2004 Calpine and MISO executed an Interconnection Facilities Study Agreement.

[30] Comments of the North American Water Office regarding the scope of the Environmental Assessment, George Crocker, Executive Director, May 10, 2004
[31] Comments from Calpine Corporation regarding the scope of the Environmental Assessment,

Kent Morton , May 10, 2004

The impact of the Facility on local and regional area transient stability was evaluated as part of the study. The Minnesota area is known to be stability constrained due to heavy import of power from coal mines in North Dakota (the North Dakota Export constraint or NDEX) and hydroelectric generation in Manitoba, Canada (the Manitoba Hydro Export constraint or MHEX). Results of the interconnection study indicate that the Facility will not adversely affect the stability of other generators nor further degrade the regional stability of the bulk power system. In sum, there was no required stability upgrades associated with the interconnection of the Facility.

A short-circuit analysis was performed to evaluate the impact of the Facility on the fault current levels of the Wilmarth Substation and adjacent substations. The purpose of this analysis was to determine whether the existing breakers at these substations have adequate fault current interruption capability with the Facility in service. Fault currents with and without the Facility were tabulated by MISO. An independent set of short-circuit calculations were performed by NSP to calculate the breaker duties at the Wilmarth Substation both with and without the Facility. The 345 kV and 115 kV breakers at both the Wilmarth Substation and adjacent substations were found to be adequate and not overstressed both with and without the Facility. The 69 kV breakers at Wilmarth were found to be overstressed even without the Facility.

The resolution of any thermal overloads will be addressed as part of the delivery study. Because NSP will be the entity responsible for obtaining transmission service for power to be generated at the Facility for that portion of the power intended to meet Calpine's obligations under the PPA, and because the delivery point for the power to be generated by that portion of the Facility that is the subject of the CON proceeding (i.e., power in excess of that to be sold to NSP) has not yet been identified, it is not possible to say at this time what thermal impacts, if any, the Facility will have on the electric transmission system. With regard to the former limiting issue, NSP has submitted to MISO a Transmission Service Request (No. 75581651) for 379 MW from the Facility. MISO has indicated that the request would be answered by late July of this year. Pursuant to the terms of the PPA, NSP will be responsible for the transmission upgrades identified by the request for the 379 MW load. With regard to the latter limiting issue, any thermal impacts that may be discovered will need to be addressed by the Facility or the entity receiving the power from the Facility prior to transmitting power.

The short-circuit and stability interconnection analyses found no negative impacts on the electric grid that may result from the interconnection of the Facility. Additional studies must be completed to determine the impacts, if any, associated with transferring electric power from the Facility to pre-determined delivery point(s). While these latter studies are not yet complete, it is MISO policy that no transfers will be allowed unless all impacts under various contingencies have been identified and addressed so that there will be no adverse impacts to the electric grid.

The benefits associated with interconnecting the Facility to the electric grid generally revolve around the location of a new generating source inside rather than outside of Minnesota. Benefits are also realized by addressing all possible contingent faults through reinforcement of the local electric grid as extreme conditions warrant. Adequate reinforcement for all contingent faults means a higher degree of reliability under normal conditions.

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4.0 ASSESSMENT OF IMPACTS OF THE PROJECT AND EACH ALTERNATIVE

4.1 ENVIRONMENTAL SETTING OF PROPOSED SITE

The proposed Facility site is located just north of the Mankato city limits in Lime Township in Blue Earth County. The site is approximately 25 acres in size and is located within an area zoned for industrial use. It is situated on the southern portion of an old limestone quarry that has been mined to completion and currently serves as a demolition waste landfill and composting Facility owned and operated by SMC. A set of railroad tracks no longer in use runs along the south side of the site. Access to the site is provided from the south off Summit Avenue. Based on available records, the limestone quarry began operations back in the mid-1950s. In 1992, the site began accepting construction and demolition wastes under a permit issued by the MPCA. Site topography and a visual record of existing conditions and environmental setting are shown in **Figure 9**.

The dominant feature of the site is the demolition waste landfill located to the north. A recently improved gravel haul road leading to active landfill areas is located along the west side of the site. The site currently contains a few buildings used primarily for sorting demolition waste materials and storing equipment. An outside storage area containing sanitary and storm sewer pipe and miscellaneous construction material is located on the east side of the site. A mobile trailer located on the southern portion of the site is currently being used by SMC for office space. The truck scale, recycling bins, and compost piles also are located in this area. The Facility accepts yard and garden waste, brush, and other vegetation debris, which is processed, placed into compost piles and then sold to the general public. SMC also sells landscaping materials including wood chips, decorative rock, and retaining wall blocks, which are stored outside on the site property.

Adjacent lands consist of numerous industrial and manufacturing facilities including Xcel Energy's Wilmarth Generating Plant and electrical substation, a waste processing company, auto salvage yards, scrap metal operations, a construction company, a U.S. Postal Service mail processing Facility, and a household hazardous waste collection site. There are numerous railroad tracks and spur lines in the area as well as overhead electrical transmission lines. The closest residential dwelling is located approximately 1,500 feet from the center of the site. The nearest residential areas of Mankato lie more than one-half mile to the south on the other side of U.S. Highway 14.

The Minnesota River is located approximately 1,800 feet west of the Facility site. The river and adjacent wooded river bottoms provide wildlife habitat as well as recreational opportunities in the form of boating, fishing, and hunting. There are also trails, parks, and other recreational facilities in the general area. A large drainage ditch is located along the east side of the site, which flows in a north/northwesterly direction to the Minnesota River.

The Minnesota River valley extends approximately one mile to the east of the site at which point steep bluffs rising 150 feet dominate the landscape. Outlying rural areas to the north and east of the site in Lime Township consist predominately of agricultural and conservation lands.

4.2 EFFECTS ON LAND BASED ECONOMIES

The Cities of Mankato and North Mankato with a combined population of 44,245 have experienced tremendous growth over the past decade, evolving into a regional retail, manufacturing, health care, and trade center providing goods and services to the surrounding Counties of Blue Earth, Nicollet, and Le Sueur as well as other outlying areas of Southern Minnesota. As will be discussed in Section 4.6, construction and operation of the Facility will provide positive economic benefits to Mankato and the surrounding area.

The proposed project site is located within an area zoned for industrial use and is situated on the southern portion of an old limestone quarry that has been mined to completion and is currently being used as a demolition waste landfill and composting Facility owned and operated by SMC. The landfill began accepting construction and demolition wastes in 1992. SMC is currently in the process of permitting a new demolition waste landfill site on property they own approximately one mile to the north. SMC will eventually move their operations to this new site once the storage capacity of the existing Facility is reached and/or the landfill is closed. SMC will be fairly compensated for the amount of land purchased by the Facilty upon which to build their power plant.

As described below, the Facility will not affect the agricultural, forestry, or mining industries in the area nor will the Facility adversely impact existing tourism.

4.2.1 AGRICULTURE

No agricultural land will be taken out of production as a result of the construction and operation of the Facility. The closest agricultural lands are located approximately one-half mile to the north and will not be affected by the Facility.

4.2.2 FORESTRY

There will be no adverse effects to the forestry economy as a result of the Facility. The Facility site is not located on or near any commercial forestry land.

4.2.3 TOURISM

There will be no adverse effects to the tourism economy from the Facility. The Facility site is not located on or near any tourist attractions.

4.2.4 MINING

There will be no adverse effects to the mining economy from the Facility. The Facility site is a former limestone quarry that has been mined to completion. There are other old limestone quarries in the area but no active mining is taking place at this time. Land is currently being cleared along the west side of County Road 5 approximately one-mile north of the site for a future gravel mining operation, but this area will not be affected by the Facility.

4.3. DISPLACEMENT OF EXISTING RESIDENCES OR BUSINESSES

The project site is zoned for industrial use. The closest residential dwelling is located approximately 700 feet northeast of the demolition waste landfill's site boundary. No one will be physically displaced by the Facility nor should the Facility alter the usage of adjacent property.

4.4 AESTHETIC IMPACTS

The Facility proposed by MEC is very similar in appearance to the picture on the front cover of this report. The Facility will blend into the established industrial area on the north edge of Mankato. The Facility site is adjacent to the Xcel Wilmarth Generating Station and related Wilmarth electrical substation. The Wilmarth Generating Station is a two-unit generating plant that was built in the late 1940s to burn coal. The Facility's two generating units were converted to burn processed municipal solid waste in 1987. Other adjacent industrial and manufacturing facilities located adjacent to the Facility site include a waste processing company, auto salvage yards, scrap metal operations, a construction company, a U.S. Postal Service mail processing Facility, and a household hazardous waste collection site.

The various buildings, pieces of equipment, exhaust stacks, storage tanks, cooling tower, and ancillary equipment that make up the Mankato Energy Center will be arranged on the site as shown on the proposed site layout plan **Figure 5**. All roads at the Facility will be paved and will be designed to efficiently and safely move traffic onto, around and off of the Site. Sufficient paved parking areas for employees and visitors will also be provided on site.

The tallest building at the Facility will be the steam turbine generation building on the south side of the site at an approximate design height of 110 feet above ground level. The other two main buildings (administrative building and water treatment building) are based on approximate design heights of 25 feet. The two HRSGs will be located outdoors with their design heights varying between 60 and 114 feet. The height of the adjacent combustion turbine generators will vary between 25 and 70 feet. The design height of the cooling tower to be located on the east side of the site is 45 feet.

The tallest structures at the Facility will be the two HRSG stacks, which are proposed to be 200 feet tall. If the stacks were to exceed 200 feet in height, the Federal Aviation Administration ("FAA") could impose requirements such as obstruction warning lights and other measures intended to improve visibility of the structures. Notification will be provided to the FAA of the planned construction of these structures, and the Facility expects that a determination of "no hazard" will be issued and that no additional lighting requirements will be imposed.

The HRSG stacks would be most visible from the west end of Summit Avenue and would possibly be visible from along the Minnesota River depending on the vantage point. The stacks will look similar to the two stacks located at the nearby Wilmarth Generating Plant, which are shown in the lower right-hand photo on **Figure 9** and stand 158 feet tall. Due to the existing topography, finished grades at the demolition waste landfill, a dense grove of mature trees located around the perimeter of the site, and the distance away from adjacent roadways, most of the other structures at the Facility should not be visible to the general public.

As flue gas is emitted from the HRSG stacks, the water vapor present in the flue gas may condense to form a visible steam plume. In addition, water vapor emitted from cooling tower may result in a similar, visible plume. The length and persistence of these visible plumes are influenced by prevailing weather conditions such as temperature, relative humidity, and wind speed. The plumes would be most persistent and visible during cold and damp weather, principally during the winter. On most days of the year, however, visible steam or vapor plumes, if present, would disperse and evaporate after traveling only a moderate distance aloft.

In addition to effects on visibility associated with water vapor, certain stack emissions have the potential to impact local visibility. Emissions of particulate matter can reduce visibility by scattering light, and emissions of nitrogen oxides can reduce visibility by absorbing light. The Facility must apply Best Available Control Technology ("BACT") for both of these visibility-related pollutants, as explained in **Section 5.1**. Furthermore, the emissions of nitrogen oxides will be continuously monitored to ensure compliance with BACT-related emission limits. Accordingly, emissions from the Facility are not expected to have a significant impact on local visibility. This conclusion is substantiated by the fact that the maximum projected air quality impacts as presented in **Section 5.2** have been shown to be well below the federal and state ambient air quality standards.

Lighting at the Facility will be provided for security and plant operational purposes. The Facility will light the grounds in a manner similar to other industrial sites using directional lighting and minimizing light impacts onto adjacent property. Off-site lighting impacts should be minimal and are not expected to affect any residential areas.

The Facility is located within an industrial area on the north edge of Mankato, and most of the buildings and structures will be far enough away from adjacent roadways or screened from view by exiting trees or other physical barriers; therefore, no significant visual impacts to the surrounding area are anticipated. Overall, the Facility will blend in well with existing adjacent industrial and manufacturing facilities including the Wilmarth Generating Station, which has been a part of the local area for more than 50 years.

4.5. NOISE IMPACTS

The site is located within an established industrial and manufacturing area on the north edge of Mankato more than one-half mile from the nearest residential areas of town. Two sensitive noise receptors consisting of residential dwellings are located near the site and are shown on **Figure 10**. The nearest residential dwelling (receptor 1) is located on the west side of 3rd Avenue just south of Brad's Auto Parts approximately 1,500 feet away from the center of the site. The next closest residential dwelling (receptor 2) is approximately 2,500 feet away to the northeast. There are no other known sensitive noise receptors in the area. Existing noise sources located in the general vicinity of the proposed site include industrial facilities, highways, county roads, and railroad tracks.

Noise will be generated during construction of the Facility as well as during normal operation of the Facility. The largest potential noise impacts will likely be generated during the construction of the Facility. Construction noise will be temporary and will be mitigated as described in **Section 4.5.2:** Noise During Facility Construction on page 70.

Noise associated with tanker truck traffic to replenish the back-up fuel oil supply tank will be temporary and intermittent. Curtailment of the primary natural gas fuel supply, which would require an increase in truck deliveries to replenish the back-up fuel oil supply, is expected to be rare.

The major components of the plant that will generate noise during the operation of the Facility include the cooling tower, the combustion turbine generators, transformers and HRSG's. Facility will use noise mitigation and control methods and equipment in the final design of the Facility as necessary to mitigate noise emissions in excess of MPCA standards during normal operation.

The Facility will be designed to operate within the State of Minnesota Noise Standards (Minnesota Rules 7030.0040) listed in **Table 4-1** below. The City of Mankato does not have a noise ordinance but relies on the State's noise level restrictions for local control of noise problems. The noise area classification ("NAC") is determined by the land use activity of the receiver. Land use activities are generally divided into four NACs; 1) residential, 2) commercial, 3) industrial and agricultural, and 4) unclassified (undeveloped and unused land and water areas). The Facility and adjacent industrial and manufacturing facilities would be characterized as NAC 3. The most sensitive receptor area would be classified as NAC 1 during the nighttime.

TABLE 4-1

MINNESOTA NOISE STANDARDS (MINNESOTA RULES 7030.0040)

Receiver Noise Area Classification (NAC)	Daytime (7 am to 10 pm)		Nighttime (10 pm to 7 am)	
	L_{50}	L_{10}	L_{50}	L_{10}
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Noise limits are in decibels on the A scale, abbreviated dBA.

L_{50} is the sound level exceeded for 50% of the time and is considered the "average" sound level.

L_{10} is the sound level exceeded for 10% of the time.

4.5.1 Baseline Noise Survey

A baseline environmental noise survey was conducted on November 25 and 26, 2003 at the site to document existing noise levels. Noise monitoring was conducted at three locations along the west, south, and east site boundaries and two locations at nearby residential receptors to Facility **Figure 3**. Noise measurements were taken during the daytime and nighttime hours in accordance with the procedures outlined in the Minnesota Noise Standards. The results of these measurements will be used to evaluate the noise impact under existing conditions and utilize this information in finalizing the design of the Facility.

The daytime noise survey results showed that the baseline noise levels are below the applicable limits at the residential and boundary locations. The major daytime noise sources during the survey period included traffic on nearby roadways (3rd Avenue, U S Highways 169 & 14), traffic associated with landfill operations and flyover of geese.

The nighttime noise survey results also were below the applicable limits at the residential and boundary locations. The major nighttime noise sources during the survey period included traffic on nearby roadways (3rd Avenue, U S Highways 169 & 14) and local industrial operations.

4.5.2 Noise During Facility Construction

Construction noise would occur on a temporary basis throughout the construction of the new plant. The noises would come from a series of intermittent sources, most of which would be diesel engine drive systems that power most construction equipment. It is likely that during peak construction, construction work may occur for 10 to 16 hours per day. Typical construction noises, modeled for a similar power plant project in southeastern Wisconsin, are illustrated in **Table 4-2**. As Table 4-2 shows, there could also be very loud noise (ranging from 120-134 dBA at 50 feet from the event) created during short-term steam or air blows in the final stages of plant installation. Steam blows generally range from thirty seconds in duration to about five minutes, with an average duration of about one minute.

Facility construction is expected to consist of site excavation and grading, foundation work, steel erection, finishing, and the installation of Facility equipment. Sources of noise during the construction period will include delivery trucks and haul trucks, earth moving and grading equipment (bulldozers, graders), cranes, and fabrication activities (pneumatic wrenches, saws, welding equipment). Many of these noise sources are intermittent and of short-term duration during the construction period. The most intrusive sources of noise during construction would be from dynamic pile driving activities, to the extent such activities would be required. Portions of the construction of the Facility will involve indoor work such as pipefitting, electrical wiring, and equipment installation. Those indoor activities normally do not result in appreciable outdoor noise.

Construction noise is unavoidable, but the impacts are temporary as construction is a limited-duration activity and a number of noise-abatement measures will be implemented to help mitigate these impacts, including the following:

- Outdoor and noisy construction activity to will be limited to daylight hours to the extent practicable.
- Controlling the extent and duration of pile driving and other noisy activities that may be required during construction.

- Limiting the duration of the overall construction period, by contracting for sufficient construction resources and through efficient scheduling and coordination of construction activities.

Based on the mitigation measures that will be taken, existing background noise levels, and distance to sensitive noise receptors, it is anticipated that any noise impacts due to the construction of the Facility will be minimal.

Noise mitigation measures that would be incorporated in the operation of the Facility include: exhaust stack silencers, outlet silencers and increased thickness casing panels on the HRSGs; inlet silencers, exhaust diffusers acoustic enclosures and low-noise enclosure vent fans on the Combustion Turbines; low-noise fans and acoustic enclosures around the fan drive motors on the cooling tower; and acoustic enclosures around the boiler feed pumps. Additional measures that could be taken if noise were a continuing problem in the local community include landscape plantings, berms and the possible addition of more sound enclosures for Facility components.

Table 4-2 Estimated maximum noise levels for typical construction equipment.

Construction Equipment	Maximum Noise Level (dBA) Typical Range = 50 Feet
Steam blow off (4-8-inch line)	124-134
Air blow off (4-8-inch line)	120-130
Blasting	93-94
Dozer (250-700 horsepower)	85-90
Front end loader (6-15 cubic yards)	86-90
Trucks (200-400 horsepower)	84-87
Grader (13-16-foot blade)	83-86
Shovels (2-5 cubic yards)	82-86
Portable generators (50-200 kW)	81-87
Derrick crane (11-20 tons)	82-83
Mobile cranes (11-20 tons)	82-83
Concrete pumps (3-150 cubic yards)	78-84
Tractor (3/4 to 2 cubic yards)	77-82
Unquieted paving breaker	75-85
Quieted paving breaker	69-77

Noise could be reduced by keeping the diesel engine mufflers in good working order, and timing most noise for daytime or first-shift periods to the extent possible. The steam and air blows could be limited to daytime hours with some sort of notification.

4.5.3 Noise During Facility Operation

Sources of noise during routine Facility operation will include operation of process equipment, fuel oil delivery trucks, and maintenance activities. Delivery of fuel oil and associated noise from delivery trucks will be temporary and limited to those periods when fuel oil is burned as a backup fuel, which is expected to be infrequent and of limited duration.

In a worst-case situation where the natural gas supply is interrupted for an extended period of time and the on-site fuel oil storage is depleted, the average number of tanker trucks delivering backup fuel oil would be approximately 56 trucks per day. This calculation is based on unloading of two 7,000-gallon capacity tanker trucks simultaneously, with approximately 45 minutes per tanker truck required for unloading and approximately 6 minutes required to switch from one tanker truck to another.

Noise from the Facility is expected to be relatively constant during operation. There may be brief episodes of intrusive noise (e.g., relief valve discharges) during periods of abnormal operations and Facility start-up and shut down. The major equipment noise sources during normal operation include:

- Multi-cell cooling tower
- Two combustion turbine generators
- Three step-up electrical transformers
- Steam turbine generator
- Two heat recovery steam generators

The potential impacts of noise on nearby residential receptors 1 and 2, which were identified during the baseline noise survey, were evaluated quantitatively. Noise emission data for each source was compiled from three references. The cooling tower noise emission data was provided by Marley Cooling Technology (1/19/04). The HRSG noise estimate was supplied by another equipment supplier, Nooter Eriksen (1/15/04). Data on noise from the combustion turbines was provided by Siemens-Westinghouse (1/23/04). The remaining equipment noise levels were taken from a noise assessment report prepared for a similar Calpine Facility in Beloit, Wisconsin.[32]

[32] Fox Energy Center Noise Impact Assessment, Calpine Corporation, July 2003.

This data was used along with the baseline noise survey results to estimate noise levels at nearby receptors and determine compliance with noise standards. The adjacent properties to the site are classified as NAC 3 (Industrial) receptors, where the Minnesota Noise Standards allow for greater noise levels than at NAC 1 (Residential) receptors. The calculated noise levels during Facility operations are shown on the noise contours of **Figure 3** of this report. The projected noise levels at the industrial receptors are well within the NAC 3 limits. Further numerical results and related discussion are also provided in the complete noise report prepared by Wenck Associates for this project[33]

The Facility will include stack silencers, low-noise fans and related equipment at the cooling tower, equipment enclosures and other noise control methods as necessary to mitigate noise emissions during normal operation. Noise generated at the Facility will comply with applicable Minnesota Noise Standards. It is anticipated that noise impacts due to Facility operations will not have an adverse effect on the surrounding area.

4.6 SOCIOECONOMIC IMPACTS

The Facility will benefit the local and regional communities as well as the State of Minnesota. The Facility will support efforts by Xcel Energy to enhance and diversify their power supply portfolio in meeting the utility's growing demand for electricity. The Facility utilizes natural gas, a clean-burning fossil fuel, and highly efficient combustion technology to generate reliable electricity while minimizing environmental impacts. The Facility has been carefully sited close to a major natural gas pipeline and high-voltage electric transmission system minimizing impacts associated with infrastructure connections.

The Facility will provide many benefits to the local community including economic benefits resulting from the construction and operation of the Facility and through the purchase of local goods and services. Some of the economic benefits include the following:

- Construction of the Facility is estimated to cost $240 million and will employ as many as 450 construction workers at peak construction periods. It is anticipated that workers commuting to the site from the three-county area (Blue Earth, Nicollet, and Le Sueur) will fill most of the construction job needs. These jobs (include welders, pipe fitters, iron workers, millwrights, carpenters, electricians, and other trades) will benefit the local economy during the construction phase. Once in operation, the Facility will employ approximately 24 full-time workers, with many of these positions being filled from within the local community.

[33] ***Wenck Associates, Noise Report***

- The state of Minnesota and Blue Earth County will receive sales and income tax revenue from the construction of the project as well as income taxes from permanent full-time employees once the Facility is up and operating.

- The Facility will also bring indirect jobs to the area in the form of local support services.

- The Facility will generate additional tax revenue for local taxing authorities including the City of Mankato, Blue Earth County, and the local school district. It is estimated that the Facility will contribute annually in real estate property taxes, which can benefit a wide range of community services.

- Facility intends to be an active member of the local community, participating in charitable events, community service organizations, and outreach programs.

- The Facility is anticipated to have a useful life of at least 30 years, meaning that the Facility will provide the City of Mankato / Blue Earth County area with a reliable, consistent source of economic and other benefits for many years.

Addition of the Facility to the existing utility electric grid system also will have positive impacts for Minnesota in terms of both generation and transmission benefits. The Minneapolis/St. Paul metro area is a large load pocket located north of the Facility site. For this reason, excess power that does not flow through the nearby Wilmarth Substation transformers to serve local load will most likely flow from Mankato in a northerly direction toward the large load area. Adding the Facility, a large, efficient, and low-cost generator, in this area of Minnesota will benefit the stability and reliability of the system through local system voltage support. The location of the Facility also will enhance the geographic and fuel diversity of Minnesota's electric generation fleet.

4.7 HISTORY AND CULTURAL VALUES

Prior to the mid-1800s, the Mankato area along the banks of the Minnesota River was inhabited mainly by Dakota (Sioux) Indian tribes. The first white settlers began to arrive in the area in the early 1850s after the Dakota had ceded the land to the United States government under the Treaty of Traverse des Sioux in 1851. The Minnesota River and its tributary streams provided easy access to the area from the territorial capital of St. Paul (located 80 miles downstream) and Mankato was one of several cities platted along the upper Minnesota River in 1852. Mankato was named the Blue Earth County Seat in 1853, and the city grew rapidly in the 1850's and 60's after a crude military road was built between Mankato and St. Paul and with the westerly expansion of the railroads.

Mankato became a railroad hub for southern Minnesota, which helped establish the town as an important regional center for providing goods and services to the surrounding area.

Today, the Cities of Mankato and North Mankato with a combined population of 44,245 continue to be a significant regional center for education, health care, commerce, industry, and agriculture. In addition to serving as the county seat for Blue Earth County, Mankato provides goods and services to the nearby Counties of Nicollet and Le Sueur as well as other outlying areas of southern Minnesota.

The Facility site is located within an area zoned for industrial use and is situated on the southern portion of an old limestone quarry that has been mined to completion and currently serves as a demolition waste landfill and composting Facility. A set of railroad tracks run along the south side of the site. Based on available records, operation of the limestone quarry began in the mid-1950s. In 1992, the site began accepting construction and demolition wastes under a permit issued by the MPCA.

4.8 ARCHEOLOGICAL AND HISTORIC RESOURCES

Information was requested from the State Historic Preservation Office ("SHPO") about possible archeological, historical, or architectural resources located on or near the proposed project site. A response letter dated September 9, 2003 was received from SHPO indicating that no known or suspected archeological, historical, or architectural resources are present in the area that would be affected by the project (see attached letter from SHPO in **Appendix C**). Based on these findings and due to the disturbed nature of the site from past limestone and gravel mining activities, construction and operation of the proposed Facility will have no impact on any such resources.

The Minnesota Historical Society was contacted about possible archeological, historical or architectural resources located on or near the Site. Upon review of their records, the SHPO concluded that there are no known or suspected resources present on or near the site that would be affected by the Facility. Based on SHPO's findings and the disturbed nature of the site from past limestone and gravel mining activities, construction and operation of the Facility should have no impact on cultural values in the area.

4.9 RECREATION

There are no designated recreational facilities located on or immediately adjacent to the Facility site. The Facility site is located in the southern end of the East Minnesota River State Game Refuge. This refuge extends north to the town of Kasota along the east side of the Minnesota River. There is no state-owned land within the game refuge; all land is under private ownership. Based on discussions with Minnesota Department of Natural Resources ("DNR") staff, state game refuge status is given to local property owners who wish to protect waterfowl and deer by restricting firearm hunting on their property. This refuge is not managed by the DNR and does not carry any special environmental regulations or land use restrictions other than use for hunting. Proposed developments must follow typical zoning requirements enforced by the local government agencies.

The Minnesota River is located approximately 1,800 feet west of the Facility site. The river and adjacent river bottoms provide recreational opportunities in the form of boating, fishing, and hunting. However, there are no public access points, boat landings, designated trails, or developed public facilities along the stretch of river flowing near the Facility site.

The Sakatah Singing Hills State Trail is a 39-mile paved multi-use trail running between Mankato and Faribault. The trail begins at Lime Valley Road approximately one mile east of the Facility site and follows an abandoned railroad grade through the countryside near pastures, farmland, and lakes, and passing through several small towns. The Sakatah Trail connects with other trails in the area that are part of the Mankato trail system.

There are also several city parks and recreational facilities located in the general vicinity of the Facility site including Columbia Park, Tourtelotte Park and swimming pool, Hiniker Pond Park, and the Mankato Golf Club (a private club with an 18-hole golf course, driving range, and swimming pool). These recreational facilities are located at least three-quarters of a mile from the Facility site. There are numerous state parks, county parks, and wildlife management areas along the Minnesota River and its tributary streams, but none within three miles of the Facility site.

Although there are recreational facilities in the area of the Facility site, as described above, construction and operation of the Facility will not directly impact any existing public land, trails, parks, or other areas used for recreation.

4.10 TRAFFIC

The existing roadway network and site access road are adequate to serve the Facility and no transportation improvements will be required for construction or operation. Access to the site will be provided off Summit Avenue via 3rd Avenue (County Road 5). The closest main highway serving the Facility is Highway 14 located approximately one-half mile to the south. A diamond intersection is located at the 3rd Avenue crossing providing a safe entrance and exit to and from the highway. There are no private residences along Summit Avenue or along the section of 3rd Avenue between Summit and Highway 14 that would be affected by traffic generated by the Facility. Vehicles going to and from the Facility would not have to pass through the central business district or any nearby residential neighborhoods.

During normal operations, the Facility will employ approximately 24 full-time employees and the impact on existing traffic is expected to be insignificant. Natural gas is the primary fuel for the combustion turbines and will be transported to the site via an underground gas pipeline to be constructed and connected to the main natural gas pipeline located approximately three miles away.

To ensure uninterrupted operation of the Facility and maintain MAPP accreditation, fuel oil will be stored on-site and burned as a back-up fuel. The fuel oil will be stored in an aboveground storage tank with a capacity of up to 900,000 gallons, which represents approximately 36 hours of uninterrupted electricity generation (with two combustion turbines operating) when the primary fuel is unavailable. Fuel oil will be delivered to the site via tanker truck.

Facility has applied for an air emissions permit to operate the Facility for up to 875 hours per year (roughly five weeks) on fuel oil but anticipates actual usage to be much less than this as interruptions or curtailment of the natural gas supply are expected to be rare, isolated, and of minimal duration. Fuel oil tanker trucks hold an average of 7,000 gallons of fuel. Therefore, in the extremely unlikely event of an extended use of fuel oil, it would take approximately 130 tanker truck deliveries to refill the storage tank. This would present a temporary, but significant, increase in traffic on the local roadways. Fuel tanker truck deliveries could be spaced over several days to refill the storage tank after the primary fuel supply has been restored; however, if the primary fuel supply were interrupted for a period of time beyond the onsite storage capacity, the average number of tanker truck delivering back-up fuel to the Facility would be approximately three trucks per hour.

Existing traffic levels will increase temporarily during construction of the Facility and will vary during different phases of the construction period. Construction of the Facility will take place over a period of approximately 20 months and will employ up to 450 construction workers at peak construction periods. It is anticipated that workers commuting to the site from the three-county area (Blue Earth, Nicollet, and Le Sueur) will fill most of the construction job needs. Construction traffic at the site will include the movement of work crews, delivery of construction equipment and materials, and support personnel.

Impacts on local roads can be expected at the beginning and end of each workday and at shift changes. Occasional large and/or slow-moving vehicles on local roadways (similar to the movement of existing farm equipment and machinery) and utilities installed to serve the Facility (gas, sewer, water, telephone, etc.) may also temporarily impact traffic during construction and could result in temporary lane closures and/or traffic rerouting. These temporary closures and rerouting would be coordinated with the City, Township, and County as appropriate. A set of existing railroad tracks no longer in use run along the south side of the site. It has not yet been determined whether these tracks and the existing railway system will be utilized to deliver any materials or equipment during construction of the Facility. If the rail line is utilized, it would be limited to transporting a few pieces of very large equipment and possibly some bulk equipment like boiler pipes and traffic impacts would be minimal.

Given the location of the Facility in an industrial area on the edge of town and the capacity of existing highways and local roads serving the site and surrounding area, vehicular traffic during construction and operation of the Facility should not significantly affect existing traffic flows except on rare occasions when the natural gas supply is interrupted and tanker trucks are needed to deliver fuel oil on a continuous basis.

4.11 AIRCRAFT

The FAA requires notification of all structures with a height of greater than 200 feet above existing ground elevation or those with the potential to obstruct air navigation. FAA Form 7460-1, Notice of Proposed Construction or Alteration, requires identification of the exact coordinates and height of structures. Through review of this application, the FAA determines whether any interference with flight patterns will result in impacts and may require obstruction marking and lighting for aviation safety. The tallest building structures at the Facility will be the two HRSG stacks, which are proposed to be 110 feet tall; therefore, no structures exceed the 200-foot threshold triggering FAA notification.

The Mankato Municipal Airport, located approximately 3.7 miles to the northeast in Lime Township, is the closest active airport to the site. It is one of the busiest municipal airports in the state with two paved runways that accommodates personal, business/commercial, and instructional uses. Orientations of the two runways at the airport are such that the site is not located within the general flight paths for aircraft landing or takeoff. Furthermore, the airport is located on top of the river bluff and the base elevation of the airport (1,020 feet) is higher than the elevation of the top of the stacks (995 feet). Because of the distance from the airport and the orientation and elevation of the runways, the Facility should not represent a potential impact to aircraft operations.

4.12 PUBLIC SERVICES

4.12.1 Transportation System

As discussed in Section 3.1, the existing public roadway network and site access road are adequate to serve the Facility, and no public transportation improvements will be required for construction or operation. Access to the site is provided west of 3rd Avenue off Summit Avenue via an existing paved road that currently serves the demolition waste landfill. It has not yet been determined if the set of existing railroad tracks running along the south side of the site will be utilized to deliver any materials or equipment during construction of the Facility.

If these tracks and the existing railway system are utilized, minor upgrades and improvements to the tracks may be required.

The Mankato Municipal Airport, located approximately 3.7 miles to the northeast in Lime Township, is the closest active airport to the site. The Facility should not affect airport operations in any way.

4.12.2 Water and Sewer Services

As discussed previously in Section 2 , Facility water and sewer services will be provided by the City of Mankato in accordance with an interconnection agreement or service contract between the Facility and the City. The City will supply both process water and potable water to the Facility and will receive domestic wastewater discharges. The Facility will construct its own water storage facilities on site. Details regarding the location of utility lines to be extended onto the site and connections to the existing municipal systems will be finalized at a later date. Wherever possible, utilities will follow existing easements to help reduce costs and minimize local impacts.

4.12.3 Waste Collection and Disposal

The Facility will privately contract with local waste haulers to properly collect and dispose of all liquid and solid wastes generated at the Facility. No municipal services would be required.

4.12.4 Fire and Police Protection

During construction of the Facility, the City of Mankato will provide fire and police protection and rescue services. The Facility will be equipped with a security system and fire suppression system. The City of Mankato will continue to provide emergency services as necessary once the plant is up and running, and coverage of the Facility should not affect the existing capabilities of the City's fire and police departments.

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5.0 ENVIRONMENTAL IMPACTS OF THE FACILITY

5.1 AIR QUALITY IMPACTS

The projected emissions from the Facility will comply with the primary and secondary NAAQS and PSD increment standards. EPA has set the primary standards to protect human health, and the secondary standards to protect public welfare, including that of visibility, plants, soils, and animals. The PSD increment standards prevent the degradation of air quality in areas with clean healthful air. Land in the immediate vicinity of the proposed Facility, is classified in the 1999 Blue Earth County Land Use and Cover Survey as consisting of gravel pits and open mines (mostly gravel and non-paved surfaces.)

The National Ambient Air Quality Standards (NAAQS) for sulfur dioxide (SO_2), nitrogen oxides (NOx), carbon monoxide (CO), particulates less than 10 microns in diameter (PM_{10}), lead (Pb), and mercury (Hg) set the limits on air pollutant emissions to prevent adverse human health and welfare impacts. Emission control equipment proposed for installation at the MEC facility includes NO_x control technology, CO control technology, VOC control technology and high-efficiency mist eliminators that control PM emissions. A continuous emission monitoring system (CEMS) would also be required, under state and federal authority, to monitor NOx emissions from the turbine exhaust stacks. Compliance with the secondary NAAQS will ensure that there are not adverse impacts to the types of soils and vegetation in the vicinity of the proposed Facility.

5.1.1 AIR EMISSION SOURCES

Natural gas does not contain significant quantities of sulfur or sulfur containing compounds; therefore, SO_2 emissions during natural gas firing would be minimal. Limited use of distillate fuel oil would minimize any significant increase in SO_2 emissions during the combustion of this fuel. Devices for controlling PM emissions from combined-cycle/HRSGs are currently not available. The combustion of natural gas and low sulfur distillate fuel oil would help minimize the potential formation of PM emissions. The mechanical draft cooling tower would be equipped with the state-of-the-art high efficiency mist eliminators that would control PM emissions. The Facility will include two identical combustion turbines (rated at approximately 205 MW each at winter ambient conditions) equipped with dry low-NOx (DLN) combustors. The combustion turbines will be fired primarily by natural gas with low sulfur distillate oil as a backup fuel. Backup oil firing is limited to 10 percent of the available annual operating hours. The combustion turbines will also have the capability of injecting steam for the generation of additional power as dictated by demand. This is referred to as power augmentation.

Each of the combustion turbines will exhaust to a separate HRSG having a supplementary duct firing capacity of 800 MMBtu/hr. The duct burners are fired only with natural gas. FACILITY will install a selective catalytic reduction system to reduce NO_x emissions and a catalyst oxidation system to control CO emissions from the combustion turbine duct burner exhaust.

Secondary combustion sources include an auxiliary boiler with a rated heat input of 70 MMBtu/hr and an emergency generator. Facility will also install a fire pump engine if it is determined that the City of Mankato's water system will not be able to supply the Facility with adequate flow. The auxiliary boiler will be fired with natural gas only and the emergency generator and fire pump engine will be fired with diesel fuel. Other non-combustion related sources include fuel oil storage tanks and the cooling tower.

5.1.2 AIR POLLUTANTS EMITTED

The Facility must obtain a Prevention of Significant Deterioration ("PSD") permit from the MPCA prior to construction of the Facility. An air permit application was submitted to the MPCA on December 3, 2003. Combustion-related emissions of particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, volatile organic compounds and sulfuric acid are of primary interest because these pollutants are emitted in quantities that exceed the threshold triggering PSD review. The estimated annual emissions of these pollutants from the PSD application are shown in Table 5-1. In addition to the above pollutants, there will be a small release of ammonia from the combined cycle system stacks. Facility is proposing to utilize SCR systems to control NO_x emissions from the combustion turbines. Ammonia emissions result from the use of ammonia as a reagent in the SCR system. Ammonia emissions, also referred to as "ammonia slip," will be at a concentration of less than 10 ppm.

5.1.3 EMISSION CONTROL MEASURES

As noted earlier, the Facility must obtain a PSD permit from the MPCA to authorize construction of the proposed Facility. This requires the application of the Best Available Control Technology ("BACT") to control emissions from the Facility's emission units. Facility will satisfy BACT requirements by applying the most effective of available options to control NO_x, CO, VOC, and organic emissions from the combustion turbines. The Facility will utilize the following emissions control strategies:

- Firing primarily natural gas in the turbines (distillate oil firing limited to 875 hours per year) to minimize sulfur dioxide and particulate emissions from the turbine;
- DLN combustors and water injection are used while firing natural gas and oil, respectively, to minimize the formation of oxides of nitrogen in the combustion turbines;
- SCR to reduce oxides of nitrogen emissions in the combustion turbine exhaust gas;
- Catalytic oxidation to reduce CO, VOC, and organic air pollutant emissions from the combined cycle system exhaust gas;
- Firing solely natural gas in the auxiliary boiler to minimize pollutant emissions;

- Limiting operation of the emergency generator and fire pump to less than 300 hours per year; and

Installation of high efficiency mist eliminators to reduce cooling tower drift rate to minimize particulate matter emissions from the cooling tower.

5.1.4 Compliance Testing

Compliance with emissions permit limits will be demonstrated by means of Continuous Emission Monitors ("CEMS") operating according to demonstrated performance criteria, by periodic stack emissions tests, or by monitoring fuel. The Facility is proposing to install CEMS to continuously measure CO and NO_x emissions in the combined cycle system exhaust. Stack testing or fuel monitoring will be required for the other pollutants as specified by the MPCA in the air permit for the Facility.

5.1.5 Criteria Pollutant Impacts Significant Impact Level Analysis

As part of the PSD permit application, air dispersion modeling was performed to demonstrate that the emissions from the Facility will not cause or contribute to a violation of an ambient air quality standard or PSD increment. Preliminary modeling was performed using a modeling protocol that conformed to U.S. Environmental Protection Agency (EPA) standards to predict the maximum ambient concentrations of NO_2, CO, PM_{10}, and SO_2 resulting from the Facility's emissions alone. These concentrations were compared to the PSD ambient air significant impact levels ("SILs"). The ambient impact significance levels serve as screening criteria to determine if further analyses are required to verify that the emissions will not cause or contribute to an exceedence of an ambient air quality standard or PSD increment. If all modeled concentrations are below their respective SILs, then further modeling for the National and Minnesota Ambient Air Quality Standards ("NAAQS" and "MAAQS", respectively) and PSD increment compliance is not required.

Preliminary modeling of the Facility's emissions alone yielded predicted CO concentrations below the PSD significant ambient impact levels; therefore, no further modeling was required for CO. Further modeling to more thoroughly assess NAAQS/MAAQS and PSD increment compliance was performed for NO_2, SO_2, and PM_{10}. Table 5-2 summarizes the preliminary modeling results and compares the results to their respective SIL.

TABLE 5-1 COMBINED CYCLE SYSTEM PERMIT LIMITS AND ANNUAL EMISSION RATES

Pollutant	Maximum Emissions		Proposed Emission Controls	Compliance Basis
	Proposed Permit Limit [1]	Potential to Emit (tpy)		
Particulate Matter (PM)/PM_{10}	30.1 lb/hr natural gas combustion, 72.8-lb/hr distillate oil combustion.	301	Good combustion control practices and use of clean fuels.	Performance Test
Nitrogen Oxides ("NO_x")	3.0 ppmvd without power augmentation, 3.5 ppmvd with power augmentation, 5.5-ppmvd fuel oil combustion.	341	DLN combustor technology and the installation of selective catalytic reduction. (SCR) on the combined cycle combustion turbines.	Continuous Emission Monitor (CEM)
Carbon Monoxide ("CO")	4.0 ppmvd without power augmentation, 4.5 ppmvd with power augmentation, 4.8 ppmvd fuel oil combustion.	254	Good combustion control practices and the installation of an oxidation catalyst system on the combined cycle combustion turbines	Continuous Emission Monitor (CEM)
Volatile Organic Compounds ("VOCs")	3.0 ppmvd without power augmentation, 3.8 ppmvd with power augmentation, 2.0 ppmvd fuel oil combustion.	121	Good combustion control practices and the installation of an oxidation catalyst system on the combined cycle combustion turbines.	Performance Test
Sulfur Dioxide ("SO_2")	< 0.8 grains of Sulfur/100 scf in natural gas, <0.05% sulfur content of distillate oil.	114	Good combustion practices and use of clean-burning fuel.	Monitor sulfur content of fuel.
Sulfuric Acid	< 0.8 grains of Sulfur/100 scf in natural gas, <0.05% sulfur content of distillate oil.	13.6	Good combustion control practices and use of clean-burning fuel.	Monitor sulfur content of fuel.

[1]All concentrations based on a ppmdv are corrected to 15% oxygen.

TABLE 5-2 PRELIMINARY MODELING RESULTS

Pollutant	Averaging Period	Predicted Ambient Concentration ($\mu g/m^3$)	PSD Significant Ambient Impact Level ($\mu g/m^3$)
SO_2	3-hour	86.72	25
	24-hour	39.43	5
	Annual	4.43	1
NO_x	Annual	3.79	1
PM_{10}	24-hour	27.85	5
	Annual	1.79	1
CO	1-hour	147.68	2,000
	8-hour	81.77	500

5.1.6 Increment Modeling

PSD increments have been established for NO_2, SO_2, and PM_{10} to prevent degradation to air quality by limiting the cumulative change in ambient concentrations that can occur due to construction or modification of stationary sources in the region after the specific baseline date for each pollutant. The baseline date for SO_2 for this region was triggered in 1985 and the NO_2 baseline date for this region was triggered in 2000. Therefore it is necessary to include changes at other facilities occurring after the baseline date in assessing the PSD increments. The minor source baseline date for PM_{10} is triggered by this project so only Facility sources are included in the PM_{10} increment analysis.

The modeling results presented in **Table 5-3** demonstrate compliance with the PSD increments for all applicable averaging periods.

TABLE 5-3 INCREMENT MODELING RESULTS

Pollutant	Averaging Period	Predicted Ambient Concentration ($\mu g/m^3$)	PSD Increment Ambient Impact Level ($\mu g/m^3$)
PM_{10}	24-hour	22.27	30
	Annual	1.79	17
NO_2	Annual	3.79	25
SO_2	3-hour	88.2	512
	24-hour	33.1	91
	Annual	5.60	20

5.1.7 NAAQS Modeling

Facility sources were modeled to determine compliance with the ambient air quality standards. MPCA guidance was relied upon in determining appropriate background concentrations for NO_2, SO_2, and PM_{10}. The modeling results for the $PM_{10,}$ NO_x, and SO_2 ambient air quality standards presented in Table 5-4 demonstrate compliance with the applicable standards for all averaging periods.

TABLE 5-4 MODELING RESULTS - $PM_{10,}$ NO_2, and SO_2 NAAQS/MAAQS

Pollutant	Averaging Period	Facility's Contribution to Predicted Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Total Concentration ($\mu g/m^3$)	Ambient Air Quality Standard ($\mu g/m^3$)
PM_{10}	24-Hour	22.27	42	64.27	150
	Annual	1.79	21	22.79	50
NO_2	Annual	3.79	23	26.79	100
SO_2	1-Hour	104.47	181	285.47	1300
	3-Hour	76.42	128	204.42	1300
	24-Hour	33.36	60	93.36	365
	Annual	4.43	5	9.43	80/60

A complete modeling report will be prepared as part of the PSD permit application. The PSD permit application will be reviewed by the MPCA and will be placed on public notice in accordance with the requirements of the application process.

5.1.8 Air Toxics Review

MEC submitted to the Minnesota Pollution Control Agency an Air Emissions Risk Analysis ("AERA") in accordance with MPCA technical guidance (Facility Air Emissions Risk Analysis Guidance; Version 1.0; September 2003) in February 2004[34]. MEC supplemented its analysis in response to a request from the Pollution Control Agency on June 2, 2004.

[34] Air Risk Analysis, Mankato Energy Center. Wenck Associates, Inc., February 18, 2004 and June 2, 2004

The purpose of an AERA is to assess the potential health risk attributed to air emissions from a given source. The MPCA exempts natural gas-fired combustion units from AERA review. Further, the diesel fired emergency generator and fire pump are limited to 300 hours per year. These limits exempt those units from AERA review under the MPCA guidance. Therefore, the AERA is needed only to address the emissions resulting from combustion of the low-sulfur distillate oil back-up fuel in the combustion turbines.

An AERA includes both quantitative and qualitative analyses. In the quantitative portion of the analysis, the potential incremental cancer risks and non-cancer hazard indices are estimated using procedures outlined in MPCA guidance. The qualitative portion of the analysis identifies and discusses items of potential interest that cannot be easily quantified.

For the quantitative portion of the analysis, MEC analyzed emissions for about 40 different chemicals for both 1-hour and annual emission scenarios. The 1-hour scenario assumed 100% firing of fuel oil, while the annual emission rates assumed 875 hours of operation at 100% load on fuel oil. Dispersion modeling was then used to calculate the potential concentration of chemicals in the ambient air. The chemicals analyzed included trace metals, acid gases, ammonia, and aromatic hydrocarbons resulting from incomplete combustion.

For those chemicals that are not considered to be carcinogenic (not cancer causing), the estimated ambient concentrations are then compared with exposure levels that have been determined by the U.S. Environmental Protection Agency to be a level at which no adverse health effects are expected to occur for a particular chemical. That level is called a reference concentration. A hazard quotient, which is the ratio of the estimated level to the reference concentration, can then be calculated for each noncarcinogenic chemical. A hazard quotient of less than or equal to one is an indication that emissions of the particular chemicals evaluated will not be hazardous to health.

MEC submitted an AERA for the proposed facility in which the hazard quotient for the sum of each noncarcinogenic chemical analyzed was below one. The sum hazard quotient, or hazardous index, estimated is shown in the Table below.

For carcinogens (those chemicals that might cause cancer), an excess lifetime cancer risk (ELCR) is calculated. The ELCR estimate is an upper-bound probability that an individual exposure during a lifetime to carcinogenic chemicals could result in cancer. If the ELCR for each contaminant evaluated is less than or equal to one in one hundred thousand (1×10^{-5}), the Minnesota Department of Health considers the risk negligible. The highest ELCR calculated by MEC is 3×10^{-6} (**Table 5-5**).

The qualitative portion of the analysis is intended to identify any issues of concern that are not addressed by a quantitative analysis (as well as to put risk numbers into context with a particular facility). Such issues might include the presence of sensitive populations, the presence of sensitive plant or animal species, bioaccumulation or multi-chemical synergistic effects.

Now that MEC has submitted its AERA, the Pollution Control Agency staff is reviewing the data to determine whether the PCA staff agrees with the calculations and assumptions. The PCA staff may conduct additional analysis. The PCA will submit a statement into the administrative record before the record is closed stating the staff's conclusions regarding potential health risks associated with the burning of fuel oil in the proposed facility.

TABLE 5-5 MEC PRELIMINARY AERA RESULTS

	Results	Acceptable Level
Acute Hazard Index	0.3	1.0
Sub-chronic Hazard Index	<0.01	1.0
Chronic Hazard Index	0.07	1.0
Cancer Risk	3×10^{-6}	1×10^{-5}

5.1.9 Air Permitting Requirements

The Federal and MPCA air-permitting requirements anticipated for the Facility are summarized in Section 7, Permits and Approval.

5.1.10 VAPOR PLUMES

As flue gas is emitted from the stacks, the water vapor present in the flue gas can condense to form a visible steam plume. In addition, water vapor emitted from cooling towers can result in a similar, visible plume. The length and persistence of these visible plumes are influenced by the prevailing weather conditions such as temperature, relative humidity, and wind speed. The plumes will be most persistent and visible during cold and damp weather, principally during the winter. On most days of the year, however, visible steam or vapor plumes, if present, will disperse and evaporate after traveling only a moderate distance aloft.

The visible plumes from the stacks and from the cooling tower at the Facility are not expected to impair visibility or safety on adjacent roadways. The plume rising from the 200-foot stacks should dissipate well before reaching ground level. The cooling tower will be designed to incorporate "high efficiency drift eliminators to minimize fogging and icing potential from the plant. Summit Avenue and 3rd Avenue, the nearest adjacent roadways, are at least 800 feet away from the cooling tower**.**

5.1.11 FOGGING AND ICING

The Facility would include a twelve cell cooling tower to provide thermally regulated water for use in power generation. The heat and humidity from the cooling tower may be sufficient to form localized fogging and rime icing under certain atmospheric conditions. Rime ice can generally be defined as a coating of ice that forms when extremely cold water droplets freeze almost instantaneously on a cold surface. Past air quality modeling on the Calpine plant in Beloit, Wisconsin has shown that this potential problem diminishes to virtually zero within 1000 feet of the cooling towers. Fogging and Icing of Highway 14 south of the Facility is not expected to be a problem from the installation of the Facility.

Calpine proposes to install driver/traffic warning lights along the roadways, where fogging and icing would be expected to occur. The lights and signage, which would be activated during potential events (based on weather conditions), would alert drivers to low visibility conditions and possible slippery road conditions. Calpine would also notify local police to request assistance in alerting motorists of potential driving conditions near the Mankato Energy Center

5.1.12 DUST

Potential dust resulting from construction activities and truck traffic would be controlled through standard construction practices, which may include watering of exposed surfaces, covering disturbed areas, paving, reduced speed limits on the site or other such practices as needed. Following construction, fugitive dust related to vehicular traffic at the proposed Facility would most likely be minimized because of paving the access road and parking areas.

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5.2 WATER QUALITY IMPACTS

5.2.1 PUBLIC WATER SUPPLY

No groundwater wells will be installed on site to serve the Facility. Cooling and process water will be supplied from effluent taken from the Mankato municipal wastewater treatment plant and piped through a dedicated line to the Facility. Potable water for domestic uses such as drinking water, showers, toilets, sinks, and other incidental water needs will be supplied by the municipal water supply system through a lateral service line. Additionally it is anticipated that the Facility will use potable water to supply its boiler makeup, consuming up to 200 gallons/minute ("gpm").

The Cities of Mankato and North Mankato maintain separate municipal water supply systems. Mankato has five groundwater wells located throughout the city and none are within two miles of the project site. North Mankato has four groundwater wells and likewise, they are more than two miles from the project site. Therefore, it is assumed the site is well beyond the boundaries of the wellhead protection area and no potential impacts to existing groundwater resources or water supplies that could affect public health and safety are anticipated as a result of construction and operation of the Facility.

5.2.2 WATER RESOURCES

5.2.2.1 Floodplains

A review of the Federal Emergency Management Agency ("FEMA") mapping done for Blue Earth County and the City of Mankato indicate that the Facility site is not located with a regulated 100-year floodplain area. Designated 100-year floodplain areas along the Minnesota River within Blue Earth County and the City of Mankato were delineated as part of FEMA's National Flood Insurance Program. **Figure 12** shows 100-year floodplain areas within the general vicinity of the site. The 100-year floodplain elevations range from 774 to 775 feet. Existing ground elevations vary from 780 feet in the low area of the old limestone quarry on the north side of the site to 808 feet on the south side of the site where SMC's office building and compost piles are located. The final base elevation for the developed portion of the Facility site is anticipated to be between 795 and 800 feet. Therefore, any site grading, excavation, and fill activities associated with site development would occur well above the 100-year floodplain and would not result in any floodplain impacts or undue risk of flooding.

5.2.2.2 Shore land Protection Areas

Based on discussions with City of Mankato staff, the drainage ditch running along the east side of the site is classified as a tributary stream in the Blue Earth County Shore land Ordinance. Any proposed structures must maintain a 50-foot setback from the top of the bank of the channel or a 10-foot setback from the top of the embankment if the embankment slope is greater than 10 degrees and further than 50 feet from the stream. These setback requirements are in place to minimize impacts to the stream and protect water quality and have been taken into account in preparing the site layout plan for the Facility.

5.2.2.3 Wetlands

Based on visual observations made during site visits and review of existing wetland mapping, there is no indication that existing wetlands would be impacted by the project. The U.S. Fish and Wildlife National Wetlands Inventory ("NWI") maps were reviewed to make a preliminary evaluation of possible wetlands located on the project site. NWI maps covering the area were prepared in 1990 based on interpretation of high altitude 1980 aerial photography and limited field checks to classify and delineate approximate wetland locations.

Figure 13 shows the wetland areas identified on the NWI map within the general vicinity of the project site. These wetlands are confined to low outlying areas and are generally classified as seasonally flooded basins and inland shallow marshes. Since the portion of the site to be developed for the Facility is in upland areas or within disturbed areas of the former limestone quarry and current demolition waste landfill and composting site, it appears that no existing wetlands would be impacted by the project.

The DNR Public Waters Inventory map for Blue Earth County (revised 1996) also was reviewed for the presence of regulated waters and wetlands. The Minnesota River and an unnamed tributary to the north that flows along the north side of the landfill and into the Minnesota River are both classified as DNR protected watercourses. No other state protected waters or wetlands are located in the general vicinity of the Project area.

The actual route and required easements across adjacent properties needed for the wastewater discharge pipe from the Facility site to the Minnesota River have not been finalized at this time. It is anticipated that the pipe will extend to the north and then turn west to the river, passing through land owned by SMC. The buried pipe will have to cross the wetland area shown on **Figure 13** at some point. Wetland areas will be temporarily impacted during installation of the pipe, but the utility work will not alter the original cross-sections of the basin. Impacts to the wetland will be minimal, and all disturbed areas will be properly restored. Installation of the pipe would be exempt from the Minnesota Wetland Conservation Act and will be covered under a U.S. Army Corps of Engineers ("ACOE") General Permit.

The Facility will obtain other necessary permits from the DNR and ACOE for construction of the discharge outfall pipe and structure along the bank of the Minnesota River.

5.2.2.4 Groundwater

No groundwater wells will be installed on site to serve the Facility and, therefore, no adverse impacts to groundwater resources are anticipated. As discussed previously, raw water for cooling and process water will be supplied in the form of treated wastewater effluent ("gray water") taken from the Mankato WWTP and piped through a dedicated line to the Facility. The Mankato WWTP recently completed a major upgrade and expansion in 2000 and has adequate capacity to meet the Facility's water needs. The use of the gray water as a water source will not require a DNR water appropriation permit. The DNR has made a determination that gray water is not considered to be a "water of the state", and therefore is not regulated by the DNR relative to water appropriation and consumptive use. Despite this regulatory determination, the Minnesota Legislature approved the consumptive use of water for the proposed Facility during its 2003 Legislative session.[35]

Potable water will be supplied by the City of Mankato's municipal water supply system through a lateral service line and used for steam cycle makeup and fire water, as well as for domestic uses such as drinking water, eye wash stations, showers, toilets, sinks, and other incidental water needs. Chemicals used at the Facility will be stored indoors or within appropriate containment areas. Fuel oil storage tanks and unloading areas will be equipped with secondary containment in accordance with federal SPCC requirements.

5.2.2.5 Storm water Runoff

Storm water runoff from the east half of the site currently flows overland to an existing drainage ditch that flows along the east side of the site. Adjacent industrial properties to the south and east of the site also drain to the ditch, which flows in a north/northwesterly direction discharging to the Minnesota River. The Minnesota River, flows in a northeasterly direction eventually discharging into the Mississippi River near Fort Snelling in St. Paul.

The west half of the site drains to the north into the bottom of the old limestone quarry where storm water runoff is then routed to a sediment basin located along the east side of the demolition waste landfill. The sediment basin, constructed by SMC as part of the landfill's operation plan, also receives drainage from landfill areas to the north including both active fill areas and areas that have been filled to capacity, capped, and vegetated.

[35] Minnesota Session Laws 2003, 1st Special Session, Chapter 11, Article 3, Section 15.

The sediment basin discharges to the drainage ditch through a plastic perforated standpipe located on the east side of the basin. The majority of the storm water flowing into the basin infiltrates into the underlying permeable soils. According to SMC staff, discharges from the storm water basin to the drainage ditch typically occur only in April or during heavy rainfall events.

As stated previously and as shown on the preliminary site plan aerial overlay (see Figure 11), roughly three-quarters of the 25-acre site will be disturbed during site grading and construction activities. Impervious surfaces will be added such as buildings and structures, power generation equipment, concrete equipment pads, storage tanks, paved areas, and access and service roads that will affect site drainage. There will also be hard-packed gravel surfaces scattered throughout the Facility. Other areas of the Facility site will be landscaped as appropriate with grass, trees and shrubs. Storm water runoff from the Facility site will be managed as described in the next section.

5.2.2.6 Storm water Management

An increase in storm water runoff can be expected as a result of the added impervious surfaces from the proposed Facility. Storm water runoff from general plant areas (non-process areas) will be directed to a storm water pond to be constructed on the east side of the site next to the cooling tower as shown on **Figure 11**. The storm water pond will provide settling capacity and discharge rate control prior to discharging to the nearby drainage ditch. The storm water pond and outlet will be designed to meet the City of Mankato's requirements for water retention areas for new development projects that create new impervious surfaces of one acre or greater. Due to the nature of the existing permeable soils and underlying bedrock material, the pond will function as an infiltration basin, retaining water for short periods of time and thus providing additional storm water treatment and further reducing runoff volumes and peak discharge rates.

Storm water runoff coming into contact with the outdoor steam generator step-up transformer pad, combustion turbine pads and other process areas where there is potential for pollutant contamination by oils and other chemicals from pumps and motors, will be confined within curbed areas and drain to two area sump pump systems. The storm water that is collected will then be routed to the Facility's oil/water separator and recycled into the cooling tower make-up water system. To ensure efficient operation of the oil/water separator, routine inspection and maintenance will be performed and accumulated materials cleaned out on an as-needed basis. All materials removed from the structure will be properly managed and disposed of offsite in accordance with applicable local, state, and federal requirements.

The Facility site will be properly maintained and good site housekeeping practices will be implemented to keep all road surfaces clean, reducing solids loading in storm water runoff.

Landscaped areas and natural vegetation buffer strips along the perimeter of the Facility site, which have low runoff potential, will provide further treatment of storm water runoff by filtering out nutrients and suspended solids and promoting infiltration into underlying permeable soils.

The proposed best management practices ("BMPs") described above that will be implemented at the Facility have been proven to be effective methods of treating storm water runoff and are management techniques typically recommended by the MPCA, watershed management organizations, and other water management and planning agencies. As a result, storm water runoff from the Facility is not expected to adversely affect the flow rates or water quality in downstream receiving waters. The existing sediment basin constructed as part of the demolition waste landfill will not be affected by construction of the Facility and will continue to serve runoff from landfill areas in accordance with the landfill closure plan.

5.2.2.7 Storm Water Pollution Prevention Plan

A Storm water Pollution Prevention Plan ("SWPPP") will be prepared for the Facility in compliance with coverage under Minnesota National Pollutant Discharge Elimination System ("NPDES") General Storm water Discharge Permit MN G611000 for industrial activities. The SWPPP will identify potential pollutant sources at the Facility, outline operating procedures for material handling activities, and describe controls and BMPs that will be implemented to minimize pollutants in storm water runoff. In addition to the storm water management provisions described above, management practices will also include storage of chemicals indoors or within appropriate containment areas, good site housekeeping practices, and proper disposal of any waste materials.

5.2.2.8 Erosion and Sediment Control

A large amount of cut and fill will be required to adequately level the site and allow for construction of the Facility to the planned base elevation. It is likely that borrow material obtained from higher elevations will be used for fill material in low areas. A significant portion of the on-site fill consists of fine to medium sand, which is suitable material for use in building areas. Concrete rubble that is excavated will likely be crushed and reused as structural fill below equipment and buildings and to balance soils on the site. If any of the existing soil material on the site is found to be unsuitable for use, it will be excavated and hauled offsite and placed in a designated upland area.

Since construction of the Facility will disturb more than one acre of land, a permit application for coverage under Minnesota NPDES General Storm water Discharge Permit MN R100001 for construction activities is required and will be submitted to the MPCA prior to construction. The permit application certifies that temporary and permanent erosion and sediment control plans have been prepared and implemented to prevent soil particles from being transported offsite.

This general permit requires that runoff from a project's new impervious surfaces must be directed to an on-site storm water treatment Facility when development creates one or more acres of cumulative impervious surface. The proposed storm water pond will satisfy this requirement and will be designed to in accordance with the criteria set forth in the General Permit for sedimentation/infiltration basins. The pond will also serve as a temporary sediment basin during construction.

The Facility will work with the City of Mankato to ensure that adequate measures are taken to minimize soil erosion and sedimentation on the site. Temporary erosion and sediment control measures will be maintained during construction and will remain in place until the Facility site has been stabilized and vegetation has been reestablished. In addition to the storm water pond, control measures such as silt fence, staked hay bales, sediment filters and traps, erosion control matting, mulching, and crushed rock pads will also be used where applicable. All disturbed areas of the Facility site will be seeded and mulched as soon as practical after the grading, excavation work, and final development have been completed.

5.2.2.9 Temporary Dewatering

Temporary site dewatering of local groundwater may be required to facilitate excavation for building and equipment foundations and underground utility installation work. If dewatering is required, appropriate permits and approvals will be obtained from the DNR. Temporary dewatering, if required, is expected to have a minimal impact on groundwater levels outside the Facility development area.

5.2.2.10 Wastewater Discharges

The Facility will have two separate discharge points – one each for process and domestic wastewater. The Facility has been designed to maximize water reuse and recycling and to minimize wastewater discharges. As shown on the water usage flow diagram **Figure 6**, process wastewater consisting of cooling tower blow down, reverse osmosis reject, and other minor low volume waste streams will be discharged to the Minnesota River under an NPDES discharge permit to be obtained from the MPCA. Boiler blow down and oil/water separator decant will be recycled to supplement the makeup water for the cooling tower and are components of the cooling tower blow down.

It is estimated that the discharge rate to the Minnesota River will be approximately 0.69 MGD under average conditions and 1.47 MGD under maximum summertime conditions. The actual rate of discharge will be influenced by the ambient temperature and operating load of the Facility. Due to evaporative losses of water through the cooling tower, the dissolved solids in the gray water will become more concentrated as the water is recirculated.

However, the total mass of dissolved solids will be essentially the same as that taken from the City of Mankato's WWTP. Any residual volatile compound left in the gray water after pretreatment will be expected to have been removed at the cooling tower and therefore will not be expected in the discharge effluent.

The process wastewater will be treated onsite with a phosphorus removal and dechlorination system prior to discharge to the river. The phosphorus removal system will consist of adding ferric chloride to the wastewater stream to chemically react with the phosphate and induce precipitation of iron phosphate. The precipitate that settles out in the clarifier is transferred to a sludge thickener where the solids content is increased through the addition of a polymer as a flocculent aid. The sludge is then transferred to a filter press where solids containing the precipitated phosphate are removed. The dewatered solids are collected and transported off site for proper disposal. The treated wastewater from the clarifier is then routed through a dechlorination system to remove residual chlorine prior to being piped to the Minnesota River.

A minor amount of wastewater also will be generated from intermittent off-line washing of the combustion turbines to remove any particulates accumulated on the compressor blades. The used wash water will be collected and stored in an onsite holding tank and will be trucked to a permitted offsite disposal Facility by a licensed hauler on an as-needed basis.

The NPDES permit application is currently being prepared by FACILITY and is expected to be submitted to the MPCA in March 2004. The NPDES permit will regulate the wastewater discharge from the plant to ensure the protection of humans, aquatic life, wildlife, and beneficial uses of the Minnesota River. The NPDES permit will include discharge limitations and monitoring requirements to ensure compliance with permit conditions and water quality standards for the Minnesota River.

Gray water from the Mankato WWTP that is treated and routed to the Facility would otherwise be discharged directly to the Minnesota River under the Mankato WWTP's existing NPDES permit. Because this gray water will be further treated prior to being piped to the Facility, and because the wastewater generated from the Facility will be treated for phosphorus and chlorine removal prior to discharge from the Facility as described above, it is anticipated that phosphorus and total suspended solids loads to the Minnesota River will be reduced as a direct result of the Facility's planned water use and discharge.

Domestic wastewater generated from the Facility will be discharged directly to the City of Mankato's sanitary sewer system through a lateral service connection line. This discharge will be authorized by the City of Mankato and subject to any appropriate discharge limits and monitoring requirements.

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5.3 LAND USE AND QUALITY IMPACTS

5.3.1 Introduction

Site topography and a visual record of existing conditions are provided in **Figure 9**. The Facility site is approximately 25 acres in size and is located within an area zoned for industrial use. This site is situated on the southern portion of an old limestone quarry that has been mined to completion and currently serves as a demolition waste landfill and composting Facility owned and operated by SMC. A set of railroad tracks no longer in use runs along the south side of the site. A paved access road to the site is provided from the south off Summit Avenue. Based on available records, the limestone quarry began operations back in the mid-1950s. In 1992, the site began accepting construction and demolition wastes under a permit issued by the MPCA.

The site currently contains a few buildings used primarily for sorting demolition waste materials and storing equipment. An outside storage area containing sanitary and storm sewer pipe and miscellaneous construction material is located on the east side of the site. A mobile trailer located on the southern portion of the site is currently being used by SMC for office space. The truck scale, recycling bins, and compost piles also are located in this area. The Facility accepts yard and garden waste, brush, and other vegetation debris, which is processed, placed into compost piles and sold to the general public. SMC also sells landscaping materials including wood chips, decorative rock, and retaining wall blocks, which are stored outside on the site property. A recently improved gravel haul road leading to active fill areas of the demolition waste landfill is located on the west side of the site.

The majority of the site has been previously disturbed by activities associated with past gravel and limestone gravel mining activities and more recently with demolition waste landfill and compost operations described above. Wooded areas exist on the east edge of the site along a drainage ditch, which receives storm water runoff from the site and surrounding areas and flows northerly to the Minnesota River. A railroad trestle is located east of the site access road where the railroad tracks cross the drainage ditch. Wooded areas also exist along the south side of the site along the railroad tracks.

The Facility conducted a Phase I Environmental Site Assessment in September 2003 to determine the potential for environmental liabilities associated with the Facility site and adjacent properties. Findings from this environmental assessment are documented in a report prepared by Wenck Associates, Inc. dated October 2003. Subsequently, a Limited Phase II Environmental Site Assessment ("Phase II") was conducted by the Facility in November 2003 focusing on those recognized environmental conditions identified in the Phase I study relevant to the site itself.

The Phase II study included a subsurface investigation that involved soil and groundwater sampling at five locations. Based on the results presented in the Phase II report prepared by Wenck Associates, Inc. dated December 2003, it was determined that no environmental hazards were evident at the Facility site due to past land use that would require further action.

As shown on the preliminary site plan aerial photo overlay provided in **Figure 11**, roughly three-quarters of the 25-acre site would be developed as part of the Facility. The proposed development is generally confined to areas of the site previously disturbed by activities associated with gravel and limestone gravel mining activities and demolition waste landfill and compost operations. Existing wooded areas located along the east and south sides of the site will not be disturbed and will continue to serve as a buffer and visual barrier between the site and adjacent properties while also serving as a wildlife habitat.

Based on the contours from the latest site survey completed by the Facility in November 2003, existing ground elevations on the site vary from approximately 780 feet to 808 feet. A large amount of cut and fill will be required to adequately level the site and allow for construction of the Facility at a planned base elevation of 795 to 800 feet. The demolition waste landfill operates under a MPCA permit that specifies a closure plan. The existing closure plan will be amended to include a 50-foot setback between the north property line of the Facility site and demolition waste landfill material that will eventually be placed in this part of the landfill as part of the ongoing landfill operations. The final grade of the landfill cover will slope upwards from this point at an approximate 5:1 slope to its planned final landfill elevation of approximately 840 feet.

5.3.2 Subsurface Investigations

Eight soil borings were taken at various depths across the site in September 2003 as part of a preliminary subsurface investigation and geotechnical evaluation. The investigation was performed to determine existing soil conditions and aid in the design of building and major equipment foundations, floor slabs, pavements, utility support, and earthworks for the Facility. Subsurface site information was collected to help describe the site geology, characterize existing soil conditions, and determine groundwater levels in the area. Results of the soils investigation are provided in a written report to Calpine prepared by STS Consultants, Ltd., dated October 15, 2003.

The site is situated on a topographic high point in the area that has been impacted by historic gravel and limestone quarrying operations. Based on bedrock geology mapping, the site is located within a small residual knob of Platteville limestone underlain by Jordan sandstone.

The area surrounding the site was eroded during and after glacial times, and it consists of reworked sandstone and outwash sand and gravel deposits resulting from flow through the glacial valley of the Minnesota River. The limestone bedrock quarrying operations has resulted in removal of most of the limestone from the site to the sandstone interface. Groundwater is estimated to flow in a westerly direction toward the Minnesota River.

The soil profile generally consists of fill material of varying thickness consisting primarily of sand, silty sand, gravel, clay, topsoil, and concrete rubble overlying weathered limestone bedrock or Jordan sandstone. During the investigation, groundwater was encountered in three of the eight borings varying in depths from 6.9 to 21.5 feet below the ground surface, corresponding to elevations from 775 to 795 feet. The higher water level observed in one of the borings is likely perched water above clayey fill material that was encountered. The long-term hydrostatic groundwater table is probably closer to the lower elevation of 775, which is consistent with the average groundwater levels observed in the monitoring wells installed on the site as part of the Limited Phase II study described above. Variations in the location of the groundwater table should be expected seasonally and with variations in precipitation, evaporation, and surface runoff. Based on the above information, groundwater levels are roughly 20 feet below the Facility's proposed minimum base elevation of 795 feet and therefore, should not be impacted during construction and operation of the Facility.

5.4 BIOLOGICAL RESOURCE IMPACTS

The U. S. Fish and Wildlife Service ("USFWS") and the Minnesota DNR were contacted about possible threatened and endangered plant and animal species that may exist at or near the Facility and may be affected by its construction and/or operation. According to correspondence with the USFWS and DNR (**Appendix D**), review of their records indicates that no significant species have been documented at the Facility site. Based on these findings and the disturbed nature of the existing site and surrounding area, the Facility should not adversely affect any significant biological resources including plants, animals, and critical wildlife habitat areas. Although there may be some loss of vegetation, trees, and shrubs as a result of the Facility's construction, abundant wildlife habitat exists in areas surrounding the Site.

Existing wooded and wetland areas located on the east, west, and south sides on the Facility site will not be disturbed by the development of the proposed Facility and will continue to provide wildlife habitat for birds, deer, and other animals found in the area. The Facility site is located approximately 1,800 east of the Minnesota River. As discussed previously, storm water runoff will be routed through an onsite storm water pond prior to discharging into the existing drainage ditch that flows into the Minnesota River. As a result of the substantial distance from the Minnesota River and the storm water management system that will be utilized at the Facility, the Facility will not adversely affect fish and aquatic species or their habitat.

A review of the Minnesota Natural Heritage Information System database was requested from the DNR to determine if any rare plant communities or animal species, unique resources, or other significant natural features are known to occur on or near the proposed project site. As stated in a letter from the DNR dated September 11, 2003, results of the database search indicated that nine rare features consisting of animals (snakes, fish, and birds) and natural plant communities (mesic prairie and floodplain forest) were known to occur within the vicinity of the project area. These rare features are beyond the site boundaries and, therefore, will not be directly affected by the project.

This finding is confirmed in the DNR letter, which concludes that based on the nature and location of the proposed project, the known occurrences of rare features identified by the search would not be affected. A copy of the DNR letter is provided in **Appendix D**.

Information was also requested from the USFWS in a letter dated August 21, 2003 about possible federally threatened and endangered species that may exist at or near the proposed project site. FACILITY was verbally informed in a follow-up telephone conversation on September 5, 2003 with Lori Fairchild, USFWS Wildlife Biologist covering Blue Earth County that a review of their records indicates that no federally listed species have been documented near the project area. Based on this finding, she stated that the project would not adversely affect any threatened and endangered species or their critical habitat. Due to budget constraints, the USFWS only responds in writing if any issues or effects have been identified. The agency no longer sends out confirmation letters if a "no effect" determination has been made.

5.5 UNAVOIDABLE IMPACTS

As discussed and documented within this application, the FACILITY Center will not cause significant adverse effects to humans or the environment. As with any type of development, there will be some unavoidable impacts; however, the Facility has been designed to minimize potential impacts to the greatest practical extent. Furthermore, as listed in **Tables 10-1, 10-2 & 10-3** in the next section, MEC will obtain all federal, state, and local permits required for construction and operation of the Facility.

Unavoidable impacts to the local community and natural environment are summarized below.

5.5.1 General Construction

The steps in construction include: survey, installation of temporary facilities (water, power and phone service), site clearing and grading, construction of a storm water collection system, construction of permanent perimeter fencing, construction of a temporary gravel road, stabilization of the construction entrance, installation of all underground utilities, excavation, construction of foundations, installation of major equipment and tanks, building/erecting buildings, installation of all supporting utilities, installation of power transformer and substation, removal of temporary roads and other facilities, paving main road, parking and access area and final grading and landscaping.

Erosion and sediment control measures would be employed and maintained throughout construction All site runoff would go to an on-site storm water detention basin or be routed to natural drainage features on site. All temporary construction impacts that include excavation, trenching and grading would be temporary in nature and all areas that are not part of the proposed Facility would be re-vegetated and proper drainage patterns re-established.

5.5.2 Noise Impacts

Noise will be generated during construction and operation of the Facility. The Site is located within an established industrial area on the edge of Mankato more than one-half mile from the nearest residential areas and approximately 1,500 feet from the nearest residential dwelling. Due to the planned noise mitigation measures that will be taken at the Facility, other noise sources in proximity to the Facility, and the distance to sensitive noise receptors, it is anticipated that any noise generated due to Facility construction and operation will not adversely affect the surrounding area. The Facility will comply with the Minnesota Noise Standards (Minnesota Rules 7030.0040) for all off-site receptors.

5.5.3 Visible Plumes

Exhaust stacks associated with plant equipment, as well as the Facility's cooling tower may occasionally produce visible steam and vapor plumes. The length and persistence of these plumes are influenced by the prevailing weather conditions such as temperature, relative humidity, and wind speed. The plumes will be most persistent and visible during cold and damp weather, principally during the winter. On most days of the year, however, visible steam or vapor plumes, if present, will disperse and evaporate after traveling only a moderate distance aloft and should not impact local roadways or residences. The impacts of these plumes, if any, will be aesthetic, rather than environmental.

5.5.4 Air Emissions

Air pollutant emissions will be generated from the Facility as a result of combustion of fuels from several sources within the proposed Facility. The primary sources of combustion-related air pollutant emissions are the combined-cycle gas turbines and associated duct firing systems. Secondary sources of combustion-related emissions include the auxiliary boiler, emergency generator, and fire pump engine. These emissions will result in ambient impacts that represent only minor fractions of the applicable air quality standards and, therefore, will not adversely impact public health and safety, plants, animals, or soils. Advanced emission control equipment will be designed and implemented at the Facility to mitigate emissions to the air through the exhaust stacks and from other equipment. MEC must obtain the required state and federal air permits prior to construction and operation of the Facility and will comply with requirements to monitor and test air pollutant emissions to demonstrate compliance with established permit limits.

5.5.5 Traffic

Overall, vehicle traffic levels in the area will temporarily increase during construction of the Facility and will vary during different stages of the construction period, which is expected to last about 20 months. Minor impacts on local roads can be expected at the beginning and end of each workday and at shift changes. To ensure the capability of the Facility to operate in the event of a natural gas curtailment and maintain MAPP accreditation, fuel oil will be stored on-site and burned as a back up fuel. Because of the limited amount of onsite fuel storage capacity, tanker trunks delivering fuel oil to the Facility during gas curtailments would represent a temporary, but significant increase in traffic on the local roadways. MEC will be limited under the MPCA air emissions operating permit as to the amount of time that each combustion turbine is allowed to operate while firing fuel oil. Instances where fuel oil will be used is expected to be rare, isolated, and of minimal duration. Furthermore, fuel tanker truck deliveries required to refill the fuel storage tank(s) will be spaced over several days where possible to minimize traffic impacts to the extent possible.

5.5.6 Wastewater Discharges

Cooling tower blow down and low volume wastewater from the Facility will be discharged to the Minnesota River. The wastewater will be treated with ferric chloride and will be processed through a dechlorination system to remove phosphorus and residual chlorine prior to discharge to the river. This discharge will be authorized by an NPDES permit to be issued by the MPCA.

This permit will include discharge limitations and monitoring requirements to ensure compliance and protection of humans, aquatic life, wildlife, and beneficial uses of the Minnesota River.

Because water quality would be maintained at acceptable regulatory levels, no impacts to the biota of the river would be expected because of the wastewater discharge. However, due to the limited soft sediment and the riverbed, dredging that would be required to install the outfall stabilization pad, some benthic macro invertebrates and aquatic macrophytes may be removed. Calpine has data on the sediment composition and the appropriate biological surveys and would avoid, to the extent practicable, areas of heavy concentration of invertebrates or aquatic plants and contaminated sediments. Additionally, construction in the river may cause a nuisance to other aquatic species. These impacts would be expected to be temporary in nature and strict adherence to BMPs and other marine construction techniques would be required.

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6.0 ENVIRONMENTAL EFFECTS OF THE PROPOSED HVTL

This section contains site specific information on the human and environmental impacts of the proposed high voltage transmission line. The impacts evaluated include those resulting from construction and operation of the line and include potential impacts of the proposed plant on water resources, air quality, noise, vegetation, fish, wildlife, traffic, land use, socioeconomic factors, and cultural resources. Specific information supplied by Xcel Energy on this HVTL is found in **Section 2.4** of this report.

6.1 Air Quality

During construction of the project, there will be emissions from vehicles and other construction equipment and fugitive dust from ROW excavation and clearing activities. Temporary air quality impacts caused by the proposed construction-related emissions are expected to occur during this phase of activity.

There will be no significant adverse impacts to the surrounding environment because of the short and intermittent nature of the emission and dust-producing construction phases.

6.2 Biological Resources

6.2.1 Flora

The pre-settlement nature in the vicinity of the proposed LEPGP was riverine temperate forest. The U. S. Fish and Wildlife Service ("USFWS") and the Minnesota DNR were contacted about possible threatened and endangered plant and animal species that may exist at or near the Facility and may be affected by its construction and/or operation. According to correspondence with the USFWS and DNR (see **Appendix D**), review of their records indicates that no significant species have been documented at the Facility site. Based on these findings and the disturbed nature of the existing site and surrounding area, the Facility should not adversely affect any significant biological resources including plants, animals, and critical wildlife habitat areas. Although there may be some loss of vegetation, trees, and shrubs as a result of the Facility's construction, abundant wildlife habitat exists in areas surrounding the Site.

The area comprising the HVTL route corridor will be subject to vegetation management; tall growing plants will be managed so that they do not reach a height above approximately 15 feet. As a consequence of this vegetation management and the clearing of the trees along the transmission route corridor the land will be converted to lower growing vegetation. As stated earlier, preparation and maintenance activities along the transmission line ROW will consist of clearing of any trees that have the potential to encroach on the transmission line. Areas disturbed by construction will be graded and re-seeded with native plants typical of the region.

6.2.2 Fauna

Existing wooded and wetland areas located on the east, west, and south sides on the Facility site will not be disturbed by the development of the proposed Facility and will continue to provide wildlife habitat for birds, deer, and other animals found in the area. The Facility site is located approximately 1,800 east of the Minnesota River. Storm water runoff will be routed through an onsite storm water pond prior to discharging into the existing drainage ditch that flows into the Minnesota River.

As a result of the substantial distance from the Minnesota River and the storm water management system that will be utilized at the Facility, the Facility will not adversely affect fish and aquatic species or their habitat.

6.2.3 Rare and Unique Natural Resources

A review of the Minnesota Natural Heritage Information System database was requested from the DNR to determine if any rare plant communities or animal species, unique resources, or other significant natural features are known to occur on or near the proposed project site. As stated in a letter from the DNR dated September 11, 2003, results of the database search indicated that nine rare features consisting of animals (snakes, fish, and birds) and natural plant communities (mesic prairie and floodplain forest) were known to occur within the vicinity of the project area. These rare features are beyond the site boundaries and, therefore, will not be directly affected by the project. This finding is confirmed in the DNR letter, which concludes that based on the nature and location of the proposed project, the known occurrences of rare features identified by the search would not be affected. A copy of the DNR letter is provided in **Appendix D**.

Information was also requested from the USFWS in a letter dated August 21, 2003 about possible federally threatened and endangered species that may exist at or near the proposed project site. FACILITY was verbally informed in a follow-up telephone conversation on September 5, 2003 with Lori Fairchild, USFWS Wildlife Biologist covering Blue Earth County that a review of their records indicates that no federally listed species have been documented near the project area. Based on this finding, she stated that the project would not adversely affect any threatened and endangered species or their critical habitat. Due to budget constraints, the USFWS only responds in writing if any issues or effects have been identified. The agency no longer sends out confirmation letters if a “no effect” determination has been made.

6.3 Cultural Resources

6.3.1 Human Settlement

No displacements of any residences or businesses will occur as a result of the construction of the HVTL along the preferred or alternative routes.

6.3.2 Archaeological and Historic Resources

The State Historic Preservation Office reviewed the proposed project area for potential archaeological and/or historical resources. The SHPO indicated that there were "no properties eligible for or listed on the National Register of Historic places will be affected by this project" (**Appendix C**).

6.4 Geology and Soils

The steel HVTL support structures will be carried by a drilled concrete pier foundation that will require an excavation 15 to 20 feet deep and four to six feet in diameter. Any excess soil will be removed from the site unless otherwise requested by the landowner. Erosion control measures will be implemented to minimize erosion during construction.

During construction, crews will attempt to limit ground disturbance wherever possible. Upon completion of construction activities, landowners will be contacted to determine if any additional restoration due to construction is necessary. Disturbed areas will be restored to their original condition to the extent practicable and as negotiated with the landowner. Post-construction reclamation activities include the removing and disposing of debris, dismantling all temporary facilities (including staging and lay down areas), leveling or filling tire ruts, employing appropriate erosion control measures and reseeding areas disturbed by construction activities with vegetation similar to that, which was removed.

6.5 Health and Safety

6.5.1 Electric and Magnetic Fields

The term EMF refers to electric and magnetic fields that are present around any electrical device. Electric and magnetic fields arise from the flow of electricity and the voltage of a line. The intensity of the electric field is related to the voltage of the line and the intensity of the magnetic field is related to the current flow through the conductors.

The question of whether exposure to power-frequency (60 Hz) electric and magnetic fields can cause biological responses or even health effects has been the subject of considerable research for the past three decades. The EQB has addressed this issue in the environmental review documents it has prepared for other proposed transmission lines. See *Environmental Assessment for Great River Energy 115 kV Proposal – Plymouth Maple Grove,* EQB Docket No. 03-65-TR-GRE PMG and *Environmental Assessment for Xcel Energy Lakefield Junction – Fox Lake 161 kV Transmission Line,* EQB Docket No. 03-64-TR-Xcel. Both of these environmental assessments are available on the EQB webpage:

http://www.eqb.state.mn.us/

Xcel Energy, too, has addressed the EMF issue in previous CON applications and in applications for EQB HVTL permits. Xcel will conduct EMF measurements for landowners, customers and employees who request them. In addition, Xcel has followed "prudent avoidance" guidance suggested by most public agencies. This includes using structure designs that minimize magnetic field levels and siting facilities in locations with fewer people living nearby.

Electric Fields --- Voltage on any wire (conductor) produces an electric field in the area surrounding the wire. The electric field associated with a high voltage transmission line extends from the energized conductors to other nearby objects such as the ground, towers, vegetation, buildings and vehicles.

The strength of an electric field from a power line decreases with increasing distance from the line. Nearby trees and building material also greatly reduce the strength of power line electric fields. The intensity of electric fields is measured in kilovolts per meter (kV/M).

The maximum limit that has been a permit condition previously imposed by the MEQB in other HVTL route permits is 8 kV per meter. The MEQB permit condition was designed to prevent serious hazard from shocks when touching large objects, such as semi tractor trailers or large farm equipment, parked under extra high voltage transmission lines of 500 kV or greater. See "Public Health and Safety Effects of High Voltage Overhead Transmission Lines" prepared by Robert S. Banks, Minnesota Department of Health, 1977.

Magnetic Fields --- Current passing through any conductor, including a wire, produces a magnetic field in the area around the wire. The magnetic field associated with a high voltage transmission line surrounds the conductor and decreases rapidly with increasing distance from the conductor. The magnetic field is expressed in units of magnetic flux density, gauss (G).

The estimated magnetic field for the existing 345/115 transmission line and the proposed transmission line has been calculated at various distances from the center of the proposed transmission line. According to Xcel Energy, the maximum calculated ground level magnetic field expected when the new line and the existing line are both conducting electricity is approximately 50 milligauss directly below the new line.

Neither the Environmental Quality Board nor any other Minnesota agency has established a limit on the maximum magnetic field permitted under a high voltage transmission line. The only two states that have established standards are Florida (a 150 mill gauss limit) and New York state (a 200 milligauss limit). The maximum magnetic field expected from the new line proposed here is well under those limits.

Electric and Magnetic Fields and Public Health --- The following discussion about the health concerns related to electric and magnetic fields is taken from the *Environmental Assessment for Great River Energy 115 kV Proposal – Plymouth Maple Grove.*

The Minnesota Department of Health maintains a web page with information about electric and magnetic fields. The following statement is found at

http://www.health.state.mn.us/divs/eh/radiation/emf/index.html[21]

> Even though electric and magnetic fields are present around appliances and power lines, more recent interest has focused on the potential health effects of magnetic fields. This is because some epidemiological studies have suggested that there may be an association between increased cancer risks and magnetic fields.

6.5.2 Interagency White Paper on EMF

In 2002, Minnesota formed an Interagency Working Group to evaluate the body of research and develop policy recommendations to protect the public health from any potential problems resulting from HVTL EMF effects. The Working Group consisted of staff from the Department of Health, the Department of Commerce, the Public Utilities Commission, the Pollution Control Agency, and the Environmental Quality Board. The Department of Health coordinated the activities of the Working Group. In September 2002, the Working Group published its findings in a White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options (hereinafter "White Paper").[36] The following quote from the White Paper summarizes the findings of the Working Group:

> "Research on the health effects of EMF has been carried out since the 1970's. Epidemiological studies have mixed results – some have shown no statistically significant association between exposure to EMF and health effects, some have shown a weak association. More recently, laboratory studies have failed to show such an association, or to establish a biological mechanism for how magnetic fields may cause cancer. A number of scientific panels convened by national and international health agencies and the United States Congress have reviewed the research carried out to date. Most concluded that there is insufficient evidence to prove an association between EMF and health effects; however many of them also concluded that there is insufficient evidence to prove that EMF exposure is safe."[37]

Given the questions and controversy surrounding this issue, several Minnesota agencies that regularly deal with electric generation and transmission formed an Interagency workgroup to provide information and options to policy- makers. Based on its review the Work Group believes the most appropriate public health policy is to take a prudent avoidance approach to regulating EMF. Policy recommendations of the Work-Group include:

- apply low-cost EMF mitigation options in electric infrastructure construction projects,
- encourage energy conservation,
- encourage distributed generation,
- continue to monitor EMF research,
- encourage utilities to work with customers on household EMF issues and
- provide public education on EMF issues.[38]

Other EMF Studies --- Recent studies of potential human health effects from transmission line EMF done in California[39] and for the Arrowhead line EIS in Wisconsin[40] have shown the same conclusions of no discernible health impacts from power lines.

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[36] A White Paper on Electric and Magnetic Field (EMF) Policy and Mitigation Options, Minnesota State Interagency Working Group on EMF Issues, September 2002, http://www.health.state.mn.us/divs/eh/radiation/emf/emfrept.pdf
[37] "White Paper" pg. 1
[38] Ibid, pg. 2
[39] California Department of Health, California EMF Program (2002), An Evaluation of Possible Risks from Electric and Magnetic Fields (EMFs) from Power Lines, Internal Wiring , Electrical Occupations and Appliances AND Policy Options in the Face of Possible Risks from Power Frequency Electric and Magnetic Fields (EMF) pg. 383
[40] Arrowhead-Weston Transmission Project, Final Environmental Impact Statement (EIS) Wisconsin Public Service Comm., Oct 10, 2000 pg 5-21

Both of these studies recommend the general precaution of minimizing unnecessary contact and advise prudent avoidance to EMF exposure.

The 1999 National Academy of Science report from its National Research Council found,

> "No clear, convincing evidence exists to show that residential exposures to electric and magnetic fields (EMFs) are a threat to human health. After examining more than 500 studies spanning 17 years of research, the committee said there is no conclusive evidence that electromagnetic fields play a role in the development of cancer, reproductive and developmental abnormalities, or learning and behavioral problems. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects. [41]"

Committee chair Charles F. Stevens, investigator, Howard Hughes Medical Institute, and professor, Salk Institute, La Jolla, Calif. Said, "Research has not shown in any convincing way that electromagnetic fields common in homes can cause health problems, and extensive laboratory tests have not shown that EMFs can damage the cell in a way that is harmful to human health."[42]

EMF Standards --- The White Paper states: "Electric utilities have a variety of methods for reducing EMF exposures when they upgrade or install transmission and distribution lines. The main methods for mitigating EMF include increasing distance from the line, using phase cancellation, shielding, and limiting voltage and current flow levels."[43]

The White Paper continues: "Currently there are no federal or state *health-based* exposure standards for magnetic fields. This is due to the fact that there is inadequate scientific evidence to develop a health-based standard. References to safe/unsafe magnetic field levels in studies are not health-based standards; they are arbitrary exposure cut off points used by researchers, and they provide no scientific basis to evaluate or estimate potential health risks."[44]

On the basis of the most current information available and the expert advice of the Interagency workgroup on EMF lead by the Minnesota Department of Health, the EQB has not established any standard or regulatory limit on magnetic fields from HVTLs.

6.5.3 *Stray Voltage*

Stray voltage is defined as a small electric current that can be found between two contact points in an animal confinement area where electricity is used. Electrical systems, including farm systems and utility distribution systems, must be grounded to the earth by code to ensure continuous safety and reliability. Inevitably, some current flows through the earth at each point where the electrical system is grounded and a small voltage develops. This voltage is called

[41] National Academy of Science, National Research Council, Stevens, et al, 1999, Possible Exposure to Residential Electric and Magnetic Fields pg. 132
[42] Ibid, pg. 134
[43] "White Paper" pg. 2
[44] White Paper" pg. 2

neutral-to-earth voltage (NEV). When a NEV is measured between two objects that may be simultaneously touched by an animal, it is frequently called stray voltage. Stray voltage is not electrocution, ground currents, EMF or earth currents.

Stray voltage can be a concern on some dairy farms because it can impact milk production. Problems are usually related to the distribution and service lines directly serving the farm or the wiring on a farm. In those instances when transmission lines have been shown to contribute to stray voltage, the electric distribution system directly serving the farm or the wiring on a farm was directly under and parallel to the transmission line. These circumstances are considered in installing transmission lines and the potential for a stray voltage problem can be readily eliminated. The proposed transmission line will not run parallel to any existing distribution line for long distances. Therefore, no stray voltage issues are anticipated with this transmission line.

6.5.4 Radio and TV Interference

Corona on transmission line conductors can generate electromagnetic noise at the frequencies at which radio and television signals are transmitted. This noise can cause interference (primarily with AM radio stations and the video portion of TV signals) with the reception of these signals depending on the frequency and strength of the radio and television signal. However, this interference is often due to weak broadcast signals or poor receiving equipment. If interference occurs because of the power line, the electric utility is required to remedy problems so that reception is restored to its original quality.

6.6 Land Use

The proposed HVTL takes advantage of the new LEPGP being adjacent to the existing Wilmarth substation. The only landowners involved will be the Calpine MEC facility and Xcel Energy. The existing land use is industrial and the land is zoned in that classification. This HVTL route is consistent with the State's nonproliferation policy for selecting transmission line routes[45].

The route proposed by Xcel Energy and the MEC does not contain any prohibitive sites, including:

- National Parks;
- National historic sites and landmarks;
- National historic districts;
- National wildlife refuges;
- National monuments;
- National wild, scenic, and recreational river ways;
- State wild, scenic, and recreational rivers and their land use districts;
- State parks;
- Nature conservancy preserves;
- State Scientific and Natural Areas; and,
- State and national wilderness areas.

[45] People for Environmental Enlightenment and Responsibility (PEER) v. Minnesota Environmental Quality Council, 266NW2d858 (Minn. 1978)

6.61 Zoning and Displacement

The area along the HVTL route is zoned industrial by the City of Mankato. The Project will not require the displacement of any occupied residences or businesses. The nearest residential area lies approximately 200 feet west of the proposed HVTL route.

6.6.2 Aesthetics and Visual Impacts

Xcel Energy proposes to place the two 115 kV circuits on a single set of transmission structures, specifically on double circuit, single pole, galvanized steel, davit structures. We propose to place the 345 kV circuit on single circuit, wood H-Frame structures. Each of the transmission lines will be approximately 900 feet long. The aesthetic and visual impact will be insignificant.

6.7 Noise

Construction Noise --- Noise will be generated by the construction of the HVTL; the construction noise will be predominantly intermittent sources originating from diesel engine driven construction equipment. Potential noise impacts will be mitigated by proper muffling equipment fitted to construction equipment and restricting activities conducted during nighttime hours.

Corona Noise --- Transmission conductors produce noise under certain conditions. The level of noise or its loudness depends on conductor conditions, voltage level, and weather conditions. Generally, noise levels during operation and maintenance of transmission lines is minimal.

Noise impacts from the proposed construction are incremental and not significant. Noise emission from a transmission line occurs during heavy rain and wet conductor conditions. In foggy, damp, or rainy weather conditions, power lines can create a subtle crackling sound due to the small amount of the electricity ionizing the moist air near the wires. During heavy rain the general background noise level, rain falling and wind blowing, is usually greater than the noise from the transmission line. In these conditions, very few people are out near the transmission line. For these reasons audible noise is not noticeable during heavy rain. During light rain, dense fog, snow, and other times when there is moisture in the air, the proposed transmission lines will produce audible noise higher than rural background levels but similar to household background levels. During dry weather, audible noise from transmission lines is a barely perceptible, sporadic crackling sound.

6.8 Transportation

Traffic near the proposed HVTL will increase during construction. Local motorists would be temporarily inconvenienced by the increase in large construction vehicles on the roadways and possible delays in traffic. This impact is expected to last during the construction period of 12 months. Traffic due to the construction workers could be expected to produce local impacts over a thirty-minute period at the beginning and end of the day and each time a change in shift occurs.

6.9 Water Resources

Transmission structures are generally designed for installation at existing grades, therefore, structure sites will not be graded or leveled, unless it is necessary to provide a reasonably level area for construction access and activities. Once construction is completed, any graded area will be restored to its original contour to the extent practicable.

The steel structures will be supported by a drilled concrete pier foundation that will require an excavation 15 to 20 feet deep and four to six feet in diameter. Any excess soil will be removed from the site unless otherwise requested by the landowner.

6.9.1 Surface Water

Natural drainage in the area has been altered by previous development

There are no DNR Public Waters, as defined by Minnesota Statutes, Section 103G.005, subd 15., within the HVTL route proposed by Xcel Energy.

Floodplain data was obtained from the Federal Emergency Management Agency (FEMA) and Flood Insurance Rate Maps (FIRM).[46] The HVTL route will cross a small section of the 100 year floodplain of the Minnesota River just north of Mankato. The HVTL route is situated at an elevation of approximately 780 feet above sea level.

6.9.2 Groundwater

The near-surface or water table aquifer is approximately twelve feet below grade[47]. The transmission line support structure foundations will be set in the ground approximately 15 to 20 feet below grade. Groundwater, in the near surface water bearing zone or water-table aquifer, may be encountered during construction excavation. Dewatering for construction may require a MDNR General Permit (i.e., 97-0005). This general permit authorizes temporary water appropriations for construction dewatering, landscaping, dust control, and hydrostatic testing of pipelines, tanks, and wastewater ponds.[48]

6.9.3 Wetlands

Once the transmission line structure locations are finalized, potential wetland sites will be precisely delineated and applications for the wetland permits will be submitted, if necessary. Federal regulations provide a definition for wetlands. Although not anticipated for this project, a permit from the US Army Corps of Engineers must be obtained for any dredging or filling activities in regulated wetlands.

Some small wetland areas may be impacted due to pole placement and substation expansion. The proposed transmission lines will cross wetlands that have been identified by the USFWS on National Wetland Inventory maps. The presence of these wetlands was confirmed during a field visit.

[46] http://www.msc.fema.gov/
[47] Minnesota Department of Health, County Well Index (CWI)
[48] Department of Natural Resources, General Permit for Temporary Water Appropriations. June, 1997.

The wetland areas are vegetated in sedges, cattails, bulrush, iris, marsh marigold, reed canary grass. Actual wetland impacts will be determined once the substation and transmission line designs are finalized. Xcel Energy will make every attempt to minimize impacts to the wetlands through placement of the poles and design of the substation. Our first choice will be to span wetland areas if possible. Should some impacts be unavoidable, Xcel Energy will acquire the appropriate permits from the Corps of Engineers as stated previously. The Company expects the impacts to wetlands from the construction to be small, if any.

7.0 MITIGATIVE MEASURES

Our[49] primary concern is for the potential of this flexible technology to be fully explored with relation to the requirements of Certificate of Need statute and rule, the ME3/MCEA letter of March 12 found in **Appendix E1**, and issues raised in subsequent discussions between parties -- on the potential *environmental benefits of combining gas, bio-fuels and wind.* Our second concern is that the siting of the Mankato plant and its use of the Wilmarth line be reviewed for the environ-mental implications of its effects upon transmission paths and outlet capacity supporting wind from southern Minnesota.

Export Capacity Since it has not been clear in comparing the application with representation of 'need' for the project in public informational meetings, it must be established for both review and need records,

1) what portion of the capacity from the proposed plant will be available for serving load In Minnesota and in what portion - and

2) by what path - it will be utilized by Xcel or others to serve competitive markets beyond load service territories.

The environmental benefits of serving both need and market demand with hybridized combinations of turbine technologies and renewable energy - rather than an expansion of single source coal and gas - should be established in this record, particularly as it effects the decision criteria under the Certificate of Need,

Indirect demand: Claims have been made that export of bulk power from Minnesota produces demand on generation to balance load. If this is the case, then this certificate of need and environmental review should establish

1) the percentage of export from this plant (*both turbines*) and

2) compare the effects of drawing upon wind or wind/gas generation -- with the effects of increased demand upon coal plants (at IA border ?) or gas generation].

We need further information and a thorough introduction to, and discussion of the combined cycle turbine technology - types of burners, etc. The development of this information is a critical element of 1) CON decision record and 2) the ability to implement alternative fuel uses and wind/gas combinations, *now and in the future*. This is not well understood and is one of the prime goals of the ME3/MCEA intervention and negotiations with Calpine.

[49]Comments from Communities United For Responsible Energy regarding the scope of the Environmental Assessment, Kristin Eide-Tollefson and Sig Anderson, May 10, 2004

- Review and need proceedings should ensure that evaluation of *present and future environmental effects and socio-economic benefits and costs* associated with this proposal -- focus on Calpine project's potential to *incorporate renewable energy resources* to meet demand *now and in the future.* Investments and design decisions made now should anticipate and not preclude these alternative uses.

Technical details of the capacity of this technology are important to include in the scope, as *potential environmental benefits are more likely to be realized* if the technical capacity is examined in sufficient detail to allow the parties to understand how the implementation of the alternatives considered would proceed.

High Voltage Transmission and Alternatives section should include inter-connection and operational parameters for implementing alternatives. The review should outline the development of specific design elements for both interconnection and operations that - in conjunction with plant and operations design elements - would allow/optimize the potential of alternatives outlined in the sections under ALTERNATIVES TO THE PROPOSED POWER PLANT - particularly the Natural Gas/Wind Combination .

- As mentioned previously, effects of this interconnecting line upon the reliability, penetration, and outlet capacity of MN wind generation should be examined, as having implicit environmental effects - by either limiting or creating the ability to maximize utilization of MN's wind resources.

Waste Heat

Waste heat was briefly discussed at the scoping meeting on April 21 as it related to thermal loadings on the Minnesota River. The Minnesota Project[50] would suggest that the scope of the EA would clearly be more fully developed if it fully looked at the opportunities to utilize all the energy available from the Calpine Facility.

It is possible to utilize the waste heat from the plant at the adjacent soybean mill? Long-term energy stability and sustainability requires increased investments into combined heat and power projects. We would suggest it appropriate to examine the relationship of the available waste heat (with and without the combined cycle operation) to the thermal loads of the adjacent industrial Facility. Some discussion of the potential for a CHP Facility should be included in Section 3 Alternatives to the Proposed LEPGP. It is my understanding that the adjacent soybean mill uses coal as its principal fuel source. Substantial environmental improvement would be achieved through conversion to a natural gas or biogas fired CHP plant.

[50] Comments from Minnesota Project regarding the scope of the Environmental Assessment, Mark Lindquist, May 12, 2004

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8.0 CERTIFICATE OF NEED ANALYSIS

On November 25, 2003, Calpine submitted a written request to the PUC to: (1) seek exemptions, pursuant to Minnesota Rules 7849.0200, Subp. 6, from certain CON data requirements that are not necessary to determine the need for an independent power production Facility; and (2) establish that the scope of data required for Calpine's application for a CON should relate only to power generated for the wholesale market, excluding data related to power production already certified through a PUC-approved resource plan solicitation.

Calpine asked that the first request for exemption be granted because the data at issue is either not applicable to a generation project proposed by an independent power producer, not reasonably available to Calpine, or not necessary to determine the need for the proposed Facility. With regard to the second request, Calpine presented its position that it is both prudent and efficient to confirm the scope of required data before filing its CON application with the PUC.

Comments on Calpine's request were submitted by the Department of Commerce ("DOC") on December 29, 2003 with a recommendation that approval with modifications be granted. On January 8, 2004, Calpine issued a response to the DOC's comments. The PUC considered the matter at their January 22, 2004 meeting and approved Calpine's request in its entirety with qualifications as suggested by PUC staff in its briefing papers prepared for the meeting. The PUC's findings are summarized in an Order dated February 6, 2004.

Calpine submitted a CON application supplement in response to questions and requests for further information from the DOC and PUC on March 2, 2004 to address the additional equipment and associated generating capacity associated with the wholesale power production of the plant. An extract of DOC's analysis of the CON and comments on the CON Petition is found in this section of the report.

8.1 INTRODUCTION

DOC staff provided technical comments summarizing Calpine's *Certificate of Need Application for Mankato Energy Center* (Petition) for the Facility[51] proposed in this proceeding. DOC presents the four criteria established by Minnesota Rules that the PUC will use to decide whether to approve the Facility's Petition; presents the DOC's position on the three criteria that we examined in this case, regarding:

[51] Text derived in Section 3 is largely extracted from comments on the CON supplied to EQB staff by Department of Commerce staff, Matt Lacey on June 8, 2004

1) the proposed Facility's effect on the future adequacy, reliability, or efficiency of Minnesota's (and the region's) energy supply,

2) the available alternatives, and

3) compliance with government rules and regulations;

and summarizes the Department's overall findings and recommendations for the Commission to consider in this case.

The terms :Calpine and the Facility are used throughout the document. The two terms are not strictly interchangeable, although these are often used synonymously. Calpine is the parent company of the Facility and was the party that submitted a bid in response to Xcel's 2001 All Source competitive bidding process. Mankato Energy Center (Facility), LLC is a wholly owned subsidiary of Calpine Corporation. Calpine is the party who filed the Certificate of Need (CON) application. The Facility is responsible for developing, constructing and operating the proposed LEPGP. Calpine was the party cited in the PUC's *Order Granting Exemptions from Filing Requirements and Limiting Scope* (the February 6 Order) and *Order Finding Application Substantially Complete Contingent upon Additional Filing and Referring Matter to the Office of Administrative Hearings* (the April 6 Order). Thus, we will refer to Calpine in discussing certain filing requirements as a result of the February 6 Order, the exemptions apply to the large electric power generating plant ("LEPGP") or ("Facility") proposed by Mankato Energy Center.

8.2 SUMMARY OF CERTIFICATE OF NEED

Calpine requests a CON for a new LEPGP in Mankato, Minnesota. This proposed Facility is described in detail in Section 2 of this report. It will be a combined cycle, natural gas-fired, combustion turbine ("CT") generator and one heat recovery steam generator (HRSG). Low sulfur distillate oil will be used as a back-up fuel to ensure uninterrupted operation of the LEPGP. The CT/HRSG will have a capacity of about 355 MW in winter and 325 MW in summer. The Facility would interconnect to Xcel's existing Wilmarth substation. The LEPGP that is the subject of the CON application would be located at the same site as the Facility proposed in the Power Purchase Agreement (PPA) between Xcel Energy and the Facility (See Docket No. E002/M-04-451). The Facility would be located at a 25-acre site in Lime Township, Blue Earth County, north of the City of Mankato, Minnesota.

The major associated facilities of the proposed LEPGP are a new 20 inch diameter high pressure natural gas pipeline, fed by the existing NNG pipeline located 3.5 miles east of the proposed site and A new 345 kV and two new 115 kV transmission interconnections, approximately 900 feet long, from the site of the proposed Facility to the existing Wilmarth substation. There would also be the addition of two cells to the draft-cooling tower; and Water supply and discharge pipelines. The water supply, water discharge and natural gas pipelines would be slightly greater in size, relative to what would be needed for the Facility to meet its obligations of the PPA between Xcel Energy and the Facility.

Calpine states that the proposed LEPGP is needed to maintain an adequate supply of capacity in the U.S. region of the Mid Continent Area Power Pool (MAPP-US)[52]. The North American Electric Reliability Council's (NERC) Reliability Assessment for 2003-2012 is forecasting a MAPP-US summer capacity reserve margin of 12.7 percent in 2006 and 8.5 percent in 2012, less than MAPP's requirement that member systems maintain reserve margins at or above 15 percent. Reserve margins of 15 percent are equivalent to a 13.04% capacity margin requirement.

The reserve margin requirement is intended to ensure the reliability of the bulk power system such that a utility would be able to meet customer demand above its peak load or in the case of a loss of a transmission line or generator. Furthermore, MAPP's *Load and Capability Report*, issued July 1, 2003, summarizes the forecasted load and generating capability of the region for the ten-year period between the summer 2003 and summer 2012. The information included demonstrates that the generating resources for MAPP-US are sufficient to cover forecasted demand but inadequate for covering reserve capacity obligations in the summer seasons of 2006 and 2008-2012.

8.3 DOC's INVESTIGATION OF RELEVANT PUC CRITERIA

Minnesota Rules part 7849.0120 provide four criteria for the Commission to consider:

1) the probable result of denial would adversely affect the future adequacy, reliability or efficiency of energy supply to the applicant, to the applicant's customers, or to the people of Minnesota and neighboring states;

2) a more reasonable and prudent alternative to the proposed Facility has not been demonstrated by a preponderance of the evidence on the record by parties or persons other than the applicant;

3) the consequences to society of granting the CON are more favorable than the consequences of denying the Certificate of Need; and

4) it has not been demonstrated on the record that the design, construction, or operation of the proposed Facility will fail to comply with those relevant policies, rules, and regulations of other local, state, and federal agencies.

In addition, Minnesota Statute § 216B.243, subd. 3a states that the PUC may not issue a CON for a Facility that transmits electric power generated by means of a nonrenewable energy source unless the applicant demonstrates that: the Company has explored the possibility of generating power by means of renewable energy resources; and the alternative selected is less expensive (including environmental costs) than power generated by a renewable energy resource.

[52] Ibid, Certificate of Need Application etc

Finally, Minnesota Statute § 216B.1694, subd. 2(a), part 5. states that the PUC shall, before approving the construction of a fossil-fuel-fired generation Facility, consider an "innovative energy project" as a supply option.

Subdivision 1 of Minnesota Statute § 216B.1694 defines an "innovative energy project" as one:

> (1) that makes use of an innovative generation technology utilizing coal as a primary fuel in a highly efficient combined-cycle configuration with significantly reduced sulfur dioxide, nitrogen oxide, particulate, and mercury emissions from those of traditional technologies;
>
> (2) that the project developer or owner certifies is a project capable of offering a long-term supply contract at a hedged, predictable cost; and
>
> (3) that is designated by the commissioner of the Iron Range Resources and Rehabilitation Board as a project that is located in the taconite tax relief area on a site that has substantial real property with adequate infrastructure to support new or expanded development and that has received prior financial and other support from the board

The DOC is not sponsoring testimony on the third criterion regarding the socioeconomic impacts of the proposed Facility. Instead, the DOC will evaluate the information provided by other sources, including the EQB's EA. During the evidentiary hearings, public hearings and in post-hearing submissions the DOC will evaluate the socioeconomic information.

8.4 FUTURE ADEQUACY, RELIABILITY AND EFFICIENCY OF MINNESOTA'S ENERGY SUPPLY

Minnesota Rules 7849.0120, part (A) states that the following must be considered when determining if the probable result of denial would be an adverse effect upon the future adequacy, reliability, or efficiency of energy supply to the applicant, to the applicant's customers, or to the people of Minnesota and neighboring states:

> (1) the accuracy of the applicant's forecast of demand for the type of energy that would be supplied by the proposed Facility;
>
> (2) the effects of the applicant's existing or expected conservation programs and state and federal conservation programs;
>
> (3) the effects of promotional practices of the applicant that may have given rise to the increase in the energy demand, particularly promotional activities, which have occurred since 1974;
>
> (4) the ability of current facilities and planned facilities not requiring certificates of need to meet the future demand; and

(5) the effect of the proposed Facility, or a suitable modification thereof, in making efficient use of resources.

PUC has granted Calpine exemptions to some of the five considerations listed above. In its February 6 Order the PUC granted Calpine eight exemptions to data requirements in the certificate of need rules (parts 77849.0010 et seq.). Three of exemptions granted relate to considerations (1)-(3) of Minnesota Rules 7849.0120, part (A).

These are discussed below:

1 Forecast of Demand for Energy

The PUC's February 6 Order exempted Calpine from discussing data concerning peak demand and projected annual electric consumption on the applicant's system since Calpine does not have a system as defined in Minnesota Rules 7849.0010. Instead, Calpine has stated that it would describe the regional need for the capacity and energy from the proposed LEPGP. The CON Petition includes five separate analyses of demand and energy forecasts for the MAPP region:

1. The NERC *2003-2012 Reliability Assessment*;
2. The NERC *2003/2004 Winter Assessment*;
3. The MAPP July 1, 2003, *Load and Capability Report*;
4. The Minnesota DOC's *2001 Minnesota Energy Planning Report*; and
5. The Minnesota DOC's *2000 Energy Policy and Conservation Report*.

DOC's most recent Energy Policy and Conservation Report ("EPCR") was completed in 2000. Page 18 of the 2000 EPCR states that Minnesota does not have excess generation to meet increasing demand in the years immediately following 2000, concluding that "significant new generation will be necessary to serve the electric needs of the state and the region."

The MAPP *Load and Capability Report* (L&C Report) provides an assessment of the forecasted demand, and generation capacity to meet the demand, for the region over the next two years (on a monthly basis) and the next ten years (on a seasonal basis). L&C Report concludes that sufficient capacity exists in the Canada portion of the MAPP region. However, transmission for the deliverability of that capacity to within the MAPP-US region is constrained.

Each of these reports support the Facility's conclusion that additional generation is needed in the MAPP region to maintain adequate capacity reserve margins. The failure to maintain MAPP's recommended capacity reserves has the potential to decrease the reliability of Minnesota and surrounding region's electricity supply. As a result, contingency events such as unplanned transmission or generation outages are more likely to result in load shedding.

2 Effects of the applicant's conservation programs

Since Calpine is an Independent Power Producer ("IPP") that does not serve retail electricity customers, the PUC's February 6 Order exempted Calpine from describing the effect of present and future energy conservation and efficiency plans in reducing the need for new generation facilities (Minnesota Rules 7849.0290).

4. The Effects of the Applicant's Promotional Activities

PUC's February 6 Order exempted Calpine from discussing the need for the proposed Facility in relation to Minnesota Rules 7849.0240, subp. 2 (B). Since Calpine had not engaged in any promotional activities and so had no data to report, the PUC has not required Calpine to discuss the relationship of the proposed Facility to promotional activities that gave rise to the demand for the Facility.

5. Ability of Current Facilities or Facilities Not Requiring CON to Meet Future Demand

The primary alternatives to the Facility that would not require CON are power purchases from existing facilities, purchases from planned facilities outside of Minnesota, or construction of facilities within Minnesota that would have a generating capability less than 50 MW. The NERC Reliability Assessment and the MAPP L&C forecasts indicate that MAPP-US will experience capacity deficits beginning in the summer of 2006 (and continuing again in 2008). Therefore, power purchases from within the MAPP-US region would not be a viable alternative. Acquiring the power from outside of Minnesota or the MAPP-US region would also prove difficult.

One of the contributing factors to Xcel's *Application to the Minnesota Public Utilities Commission for a Certificate of Need - Blue Lake Generating Plant Expansion Project*[53] (the Blue Lake CON) was the decreasing capability to reserve firm transmission service for purchased power from generation outside of Minnesota during the peak summer months. As a result, firm power transmission constraints reduces the reliability of obtaining purchased power from outside of the MAPP region and therefore could not serve to reduce the MAPP-US forecasted summer deficit.

Finally, it would require a large number of facilities that are small enough to be exempt from the CON process to eliminate the forecasted deficit. For example, Xcel Energy is still attempting to fulfill the mandate to acquire biomass generation under Minnesota Statutes § 216B.2424 nearly a decade after that statute was first enacted. As for wind power, the Midwest Independent Transmission System Operator (MISO) accredits wind capacity anywhere from 10%-20%.

Thus, to achieve the same level of dependable capacity that could be achieved by the proposed LEPGP installed wind capacity may need to be as great as ten times the capacity of the proposed Facility. One can conclude that facilities exempt from a certificate of need would not be able to meet the expected demand

[53] Docket No. E002/CN-04-76, filed January 16, 2004.

6. The Effect of the Proposed Facility, or a Modification of it, in Making Efficient Use of Resources

The thermal efficiency of the proposed LEPGP was compared relative to alternative LEPGP plants. The thermal efficiency is measured by the estimated heat rate, high heating value (HHV), of the facilities. The higher the estimated heat rate, the greater the amount of energy required to create electric energy from the fuel source. Comparison of the proposed Facility's estimated heat rate to the estimated heat rate of other types of fossil-fueled generation facilities was conducted , including: the Facility's alternative fuel oil-fired combined cycle plant; A generic combined-cycle Facility; MEC's alternative natural gas-fired simply cycle combustion turbine generation Facility; and A pulverized coal Facility.

Minnesota Statutes 216C.051, subd. 7, part (d) states, in part: "…the more efficient a technology is that utilizes an energy source, the more preferred it is for use in generating electricity for distribution and consumption in the state." Based on the results above the proposed LEPGP and its fuel oil alternative would be the most preferred fossil-fueled resources.

2001 REIS data also reveals that two percent (2%) of Minnesota's electricity was generated by natural gas. However, that information did not include generation data from natural gas-fired generation facilities that are currently in-service, including Xcel's Black Dog Repowering Project and Great River Energy's ("GRE") Lakefield Junction Facility . The addition of the generation of those projects to the 2001 data would increase the natural gas share of generation to 5.3%. If all of the proposed natural gas generation facilities (Faribault Energy Park, MEC-PPA, and MEC-CON) are in-service by 2006 DOC estimates that nearly ten percent of Minnesota's electricity will be generated by natural gas. This estimate does not, however, include the addition of natural gas generation that would be added as part of Xcel Energy's metro emissions reduction project ("MERP").

8.5 RENEWABLE ALTERNATIVES TO PROPOSED FACILITY

Minnesota Statutes § 216B.243, subdivision 3a, establishes two criteria for the PUC to consider. The Facility must demonstrate to the PUC's satisfaction that the Facility has explored the possibility of generating power by means of renewable energy sources, and demonstrated that the alternative selected is less expensive (including environmental costs) than power generated by a renewable energy source. The statute sets up a two-step process whereby renewable generation sources are first analyzed to determine their ability to meet the project goals of the proposed LEPGP.

Next, for those renewable sources that pass the applicability test, it must be determined whether the renewable generation is less expensive than the proposed LEPGP. Thus, if the renewable generation cannot meet the goals of the proposed Facility (the type criterion) there is no merit in determining whether the renewable resource is capable of producing electricity at a lower cost.

The Facility briefly summarized the potential use of generation from renewable resources in Section 5.2 of the Petition. Furthermore, as part of its March 29, 2004 supplement to the CON application, the Facility included an analysis of a gas-wind combination alternative as required by the Commission in its April 6 Order. Calpine's position is that renewable resource alternatives could not meet the project's primary objectives of applicability and availability. MEC concludes that no renewable alternative clearly supports all project objectives. The DOC agrees that requiring the Facility to provide a cost analysis of renewable alternatives to its proposed project would be unduly burdensome and unreasonable in this particular case.. The proposed alternative can make capacity and energy available to the wholesale market within Minnesota and the greater MAPP region. The Facility can provide a commercially proven Facility at the several-hundred MW scale at any point between the 2006 summer season and the end of 2009. The proposed alternative enhances the reliability of the bulk electric system and minimizes environmental and community impacts. MEC's alternative implements the least cost alternative and provides economic benefits to the community.

Wind ---

Assuming a capacity factor of 20% for wind, it would take approximately 1,775 MW of installed wind capacity to equal the output from the proposed Facility. According to the website of the American Wind Energy Association (www.awea.org/projects/index.html) Minnesota currently has 562.7 MW of installed wind capacity. There is virtually no chance for the development of more than three times current wind capacity within the next two years. Thus, wind fails the applicability criterion.

Biomass ----

Xcel Energy is still attempting to fulfill the mandate to acquire biomass generation under Minnesota Statutes § 216B.2424 nearly a decade after that statute was first enacted. It is unlikely that enough biomass facilities capable of producing 355 MW could be constructed before summer 2006. Therefore, the biomass alternative fails the availability criterion.

Wind-Gas Alternative ---

First, the site chosen for the proposed LEPGP, at 25 acres, is not large enough for a substantial wind farm. Also, the Facility's parent company, Calpine, has never constructed or operated any wind generation. Thus, from a practical standpoint, the wind-gas alternative would have to be pursued through a power purchase agreement between the Facility and a wind developer, presumably from southwest Minnesota where the majority of Minnesota's wind generation development has occurred. .

Wind producers sell their energy to retail electricity suppliers who supply the electricity to their end-use customers. As an IPP, the Facility does not, and will not, have any retail electric customers to serve.

Thus, under the wind-gas alternative considered here the Facility would have to purchase that wind power at wholesale and then sell that electricity at wholesale to a retail electric provider. In order to cover its transaction costs, the Facility would need to raise the price of the wind energy it purchased. Therefore, it would be cheaper and more efficient for a retail electric provider to purchase wind energy directly from a wind generator than from the Facility. In the end, raising the price of wind energy will not help its acceptance in the market.

Xcel Energy, in its 2002 Integrated Resource Plan ("IRP") (Docket No. E002/RP-02-2065), examined the possibility of replacing Prairie Island generating station with a wind-gas alternative. Xcel stated that "Under the right circumstances it may be economical to supplement some additional gas fired generation with electric energy purchases from wind turbines. The key considerations involve the amount of wind relative to the dispatch of gas on the system, the cost of transmission to bring wind generation to load and the continuation of the renewable energy tax credit." Xcel's modeling determined that a wind-gas alternative to Prairie Island would be less expensive than a gas-only alternative. However, Xcel concluded that "Large additions of wind production will, in all likelihood, be in remote locations, away from the core of the transmission system. They will require significant transmission investments. Transmission has not been included in our simple test case here, but could again completely overwhelm and negate the [lower cost] result."

Thus, based on the additional evidence of Xcel's analysis, it is easy to conclude that a wind-gas alternative would not be feasible given the need for additional transmission capacity that would take years to construct. That is, it would be impossible for new transmission capacity to be built by the summer of 2006.

Biodiesel Fuel Backup ---

The use of biodiesel fuel as an alternative backup fuel to fuel oil would make economic sense. However, no forward market exists for biodiesel prices, making it impossible to perform a detailed cost analysis of using biodiesel as a backup fuel. www.Biodiesel.org, the website of the National Biodiesel Board, a group that promotes the use and development of biodiesel, advises prospective biodiesel users to contact suppliers directly. Using the information available one can make some general conclusions. First, the most likely fuel mixture to use is B20, a mixture of 20% biodiesel and 80% petroleum diesel. B100, 100% biodiesel, may not be a viable alternative in Minnesota since the viscosity of the fuel increases as the temperature decreases.
This is important since the proposed Facility would be operational year round. The cost difference of using biodiesel fuel as a backup fuel would likely have a negligible impact on the Facility's overall cost for two reasons. First, the backup fuel will only be used for a short part of the year, if at all. Second, because B20 is primarily composed of petroleum diesel, the cost of biodiesel backup fuel would be driven primarily by the cost of petroleum diesel.

Although the use of a biofuel for backup fuel may be feasible, the incomplete information currently available does not recommend that biodiesel fuel be used as the Facility's backup fuel.

The following alternatives will not be discussed since the Facility received an exemption per the Commission's February 6 Order: demand-side management; purchased power; and the construction or reconditioning of transmission lines. The combined cycle design of the proposed LEPGP allows it to produce both baseload and peaking power. Any alternative to the Facility's proposed LEPGP must be capable of producing both baseload and peaking capacity.

Future Natural Gas Prices ---

Citizen groups have raised the issue of future natural gas price volatility and availability in relation to this proposed project.. Facility's forecast of the cost of natural gas is based on the Energy Information Administration's ("EIA") *Annual Energy Outlook 2004 with Projections to 2025* (AEO 2004). DOC's analysis of Facility's fuel costs was based on obtaining the prices for natural gas and fuel oil for electric generation, in the West North Central Region, from the AEO 2004. (Table 14 of AEO 2004 provides fuel prices to electric generators for 2001 to 2025 (in 2002 dollars per million Btu)). DOC concludes that use of natural gas would result in a lower cost alternative to the fuel oil option. Analysis of the estimated fuel costs concluded that the natural gas-fired combined cycle alternative is a lower cost alternative than a fuel oil-fired alternative. Based on the fuel analysis above, DOC concluded that the proposed natural gas-fired alternative is a more economical generation choice than the fuel oil alternative.

Reliability ---

The North American Electric Reliability Council's (NERC) *2003 Long-Term Reliability Assessment*, from December 2003, defines the reliability of the interconnected bulk electric systems in terms of two basic, functional aspects: adequacy and operating reliability. Adequacy refers to the ability of the electric system to supply the aggregate electrical demand and energy requirements of customers at all times, taking into account scheduled and reasonably expected unscheduled outages of system elements. Operating reliability is the ability of the electric system to withstand sudden disturbances such as electric short circuits or unanticipated failure of system elements. These definitions are specific to the bulk electric system rather than individual generating stations. However, with reasonable adaptations the adequacy criterion can be made to fit an individual generating station. Calpine's response to DOC states that the proposed Facility would have an availability factor of approximately 90%, meaning that the Facility would be able to supply power 90% of the time when called upon to do so. The availability of a fuel oil-fired alternative would be the same or slightly lower than the natural gas-fired alternative. Any difference would be accounted for by the increased maintenance related to the fuel oil alternative. Calpine estimates that a simple cycle combustion turbine would have availability near 98%. However, simple cycle (peaking) generators are used less than combined cycle (intermediate) generators that implies that a simple cycle generator has a lower probability of being unavailable.

The site permit application was submitted on March 29, 2004, as part of the Facility's supplemental filing, to address the application's completeness. The failure of the Facility to obtain any of these permits would mean that the proposed project would not be constructed, regardless of the PUC's decision regarding the Petition.

Energy efficiency in an area can often be gained without new electric energy production. Energy conservation is one method of "demand-side management" (DSM) as opposed to "supply-side management." DSM techniques include energy conservation, fuel switching, and load management. PUC has ordered that Facility is not required to conduct DSM analysis for this Facility.

Other Sites ---No other locations for this project have been proposed.

9.0 REGULATORY PERMITS AND APPROVALS REQUIRED

In addition to applying for a Site Permit in accordance with the Minnesota Power Plant Siting Act as documented herein, the proposed project will require numerous federal, state, and local permits and approvals for construction and operation of the Facility. Anticipated permits and approvals are listed below in Table 11-1 and were discussed in previous sections of this permit application.

TABLE 9-1 FEDERAL REQUIRED PERMITS AND APPROVALS

Unit of Government*	Type of Approval	Regulated Activity	Status
Federal			
FAA	**Notice of Proposed Stack Construction**	**Stack height greater than 200 feet above ground level**	**To be provided**
U.S. EPA	**Acid Rain Permit**	**Title IV Acid Rain Certificate of Representation for the discharge of sulfur oxides**	**To be obtained**
	Risk Management Plan/Process Safety Management (RMP/PSM)	**Risk management plan is required for facilities possessing more than threshold quantities of regulated chemicals (e.g., anhydrous ammonia)**	**To be developed**
	Notice of Hazardous Waste Generation	**Hazardous waste generation**	**To be provided if needed; anticipated to qualify as CESQG**
USACOE	**Section 404 Permit; GP/LOP-98-MN**	**Discharges of dredged or fill material within wetland areas associated with installation of cooling water discharge pipe and outfall structure; covered by General Permit (non-reporting)**	**No application required; confirm compliance with general permit terms and conditions prior to construction**
	Section 10 Permit	**Construction of outfall structure at the Minnesota River (a navigable water)**	**To be obtained**
U.S. Fish & Wildlife Service	**Threatened and Endangered Species Review**	**Review of agency records for federally threatened and endangered species that may exist at or near the site and may be affected by the project**	**Completed - Verbal comments received Sep-5-03**

TABLE 9-2 MINNESOTA REQUIRED PERMITS AND APPROVALS

Unit of Government*	Type of Approval	Regulated Activity	Status
PUC	**Certificate of Need**	**Certification that electricity generated by the Facility is needed**	**To be obtained; Request for exemption from certain data filing requirements and order approved on Jan-22-04**
MAPP	**Approval as a Network Resource for Xcel**	**Generator interconnection and transmission access**	**To be obtained**
EQB	**Power Plant Siting Permit**	**Review of potential human and environmental impacts associated with the siting of a large electric power generating plant. Qualifies for alternative review process for facilities fueled by natural gas**	**Pending - Permit application submitted February 2004 (this document)**
SHPO	**Cultural Resources Review**	**Review of agency records for the presence of archeological, historical, or architectural resources at or near the site that may be affected by the project**	**Completed - Received comment letter dated Sep-9-03**
MDNR	**Minnesota Natural Heritage Database Review**	**Review of the Minnesota Natural Heritage Information System database for the presence of any rare plant communities or animal species, unique resources, or other significant natural features at or near the project site**	Completed - Received comment letter dated Sep-11-03
	Protected Waters Permit	**Construction of outfall structure at the Minnesota River**	To be obtained
MPCA	NPDES/SDS Discharge Permit	**Discharge of cooling water and other low volume wastewater to the Minnesota River**	**To be obtained**
	NPDES/SDS General Storm water Discharge Permit (MN R100001) for Construction	**Storm water discharges associated with construction activities disturbing one or more acres of land**	**To be obtained**
	NPDES/SDS General Storm water Discharge Permit (MN G611000) for Industrial Activities	**Storm water discharges associated with industrial activities at the Facility. Coverage under the permit requires preparation of a Storm water Pollution Prevention Plan**	**To be obtained**
	Air Emission Facility Permit (Combined Construction and Title V Operating)	**Air emissions - permitting requirements associated with federal PSD new source review and NSPS requirements, and other applicable state/federal requirements**	Pending - Permit application submitted Dec-3-03

TABLE 9-3 STATE AND LOCAL REQUIRED PERMITS AND APPROVALS

Unit of Government*	Type of Approval	Regulated Activity	Status
MPCA	**Air Toxics Review**	**Air emissions risk analysis to evaluate potential health risks associated with burning low sulfur distillate oil as back-up fuel**	**To be complete**
	Section 401 Water Quality Certification	**Review and certification of construction activities affecting wetlands requiring a USACOE permit**	**To be obtained**
	Hazardous Waste Generator License	**Hazardous waste generation**	**To be obtained if needed**
	Spill Prevention, Control and Countermeasure Plan	**Aboveground storage of greater than 1,320 gallons of fuel oil; plan to be prepared and maintained at the Facility**	**To be completed**
	Oil and chemical storage requirements	**Certain tank construction and installation requirements must be met; provisions and measures to prevent discharges will be incorporated in the design of the fuel oil storage tank**	**To be met**
Local			
City of Mankato	**Conditional Use Permit**	**Electric generating Facility within areas zoned M-2, Heavy Industrial District**	**To be obtained**
	Building Permit	**Site grading, development, construction, and occupancy approval**	**To be obtained**
	Minnesota Wetland Conservation Act Exemption	Exemption from wetland replacement associated with installation of cooling water discharge pipe through wetland areas	**To be obtained**
	Orderly Annexation	**City of Mankato and Lime Township entered into Joint Resolution for Orderly Annexation whereby the City agreed to annex areas to be developed for industrial purposes.**	**To be obtained**
	Other	***Applicable Permits/approvals for connections to municipal sewer and water as well and gray water from WWTP***	**To be obtained if required**
Other			
Utilities	**Utility Connection Permits and Approvals**	**Installation of necessary utilities and related equipment (e.g., water, wastewater, gas pipelines, transmission lines, telecommunications)**	**Responsibility of Supplier** **Gas pipeline permits listed in separate pipeline route permit application submitted to the EQB**

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10.0 ACRONYMS, ABBREVIATIONS AND DEFINITIONS USED IN EA

AEO	Annual Energy Outlook
ACOE	U.S. Army Corps of Engineers
AERA	Air Emissions Risk Analysis
AGC	Automated Generation Control
ASTM	American Society of Testing and Methods
AWEA	American Wind Energy Association
BACT	Best Available Control Technology
BMP	Best Management Practices
CEM	Continuous Emission Monitors
CESQG	Conditionally Exempt Small Quantity Generator
CO	Carbon Monoxide
CON	Certificate of Need
CT	Combustion Turbine
CURE	Communities United For Responsible Energy
DNR	Minnesota Department of Natural Resources
DOC	Department of Commerce
DSM	Demand-Side Management
EA	Environmental Assessment
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EMF	Electric and Magnetic Fields
EMS	Energy Management System
EPA	United States Environmental Protection Agency
EPCR	Energy Policy and Conservation Report
EQB	Minnesota Environmental Quality Board
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Maps
G	Gauss , units of magnetic flux density

GPM	Gallons Per Minute (gpm)
GRE	Great River Energy
HHV	Higher Heating Value
HRSG	Heat Recovery Steam Generators
HVTL	High Voltage Transmission Lines
HZ	Hertz (cycles/second)
IPP	Independent Power Producer
IRP	Integrated Resource Plan
KV	Kilovolt (one thousand volts)
KV/M	KiloVolts per Meter, a measure of the intensity of electric fields
LEPGP	Large Electric Power Generating Plant
MAPP	Mid-Continent Area Power Pool
MAAQS	Minnesota Ambient Air Quality Standards
MCEA	Minnesota Center for Environmental Advocacy
MDNR	Minnesota Department of Natural Resources
MEC	Mankato Energy Center a.k.a the “Facility”
MERP	Metropolitan Emissions Reduction Project
MGD	Million Gallons of water per Day
MHEX	Manitoba Hydro Export constraint
MISO	Midwest Independent System Operator
MMBtu/hr	Million British Thermal Units per hour (“MMBTU/hr
MMscf/d	Million Standard Cubic Feet per Day
MPCA	Minnesota Pollution Control Agency
MW	Megawatts (one million watts)
MWH	Megawatt Hour
NAC	Noise Area Classification
NAAQS	National Ambient Air Quality Standards
NAWO	North American Water Office
NBB	National Biodiesel Board
NDEX	North Dakota Export
NEV	Neutral to Earth Voltage
NNG	Northern Natural Gas
NO_x	Nitrogen Oxides

NPDES/SDS	National Pollution Discharge Elimination System/State Disposal System
NSP	Northern States Power (former name of the Minnesota utility, Xcel Energy)
NSPS	New Source Performance Standards
NWI	National Wetlands Inventory
O&M	Operating and Maintenance
PM	Particulate Matter
PM_{10}	Particulate Matter, (10 microns in diameter)
POTW	Publicly Owned Treatment Works
PPA	Purchase Power Agreement
PSD	Prevention of Significant Deterioration
PSI	Pound per Square Inch
PUC	Minnesota Public Utilities Commission or "MPUC" or "Commission"
Q&A	Questions and Answers
RES	Renewable Energy Standards
RFP	Request for Proposal
ROW	Right Of Way
RPM	Revolutions Per Minute (rpm)
SCADA	System Control and Data Acquisition
SCR	Selective Catalytic Reduction system
SHPO	Minnesota State Historical Preservation Office
SIL	Significant Impact Levels
SO_2	Sulfur Dioxide
SMC	Southern Minnesota Construction Company, Inc.
SPCC	Spill Prevention Control and Countermeasure
SWPPP	Storm water Pollution Prevention Plan
TPY	Tons Per Year
USACOE	United States Army Corps of Engineers
USFWS	U. S. Fish and Wildlife Service
VOCs	Volatile Organic Compounds
WWTP	Wastewater Treatment Plant
Xcel	Xcel Energy, (Minnesota utility formerly known as NSP)
$\mu g/m^3$	microgram (one-millionth gram) per cubic meter of air

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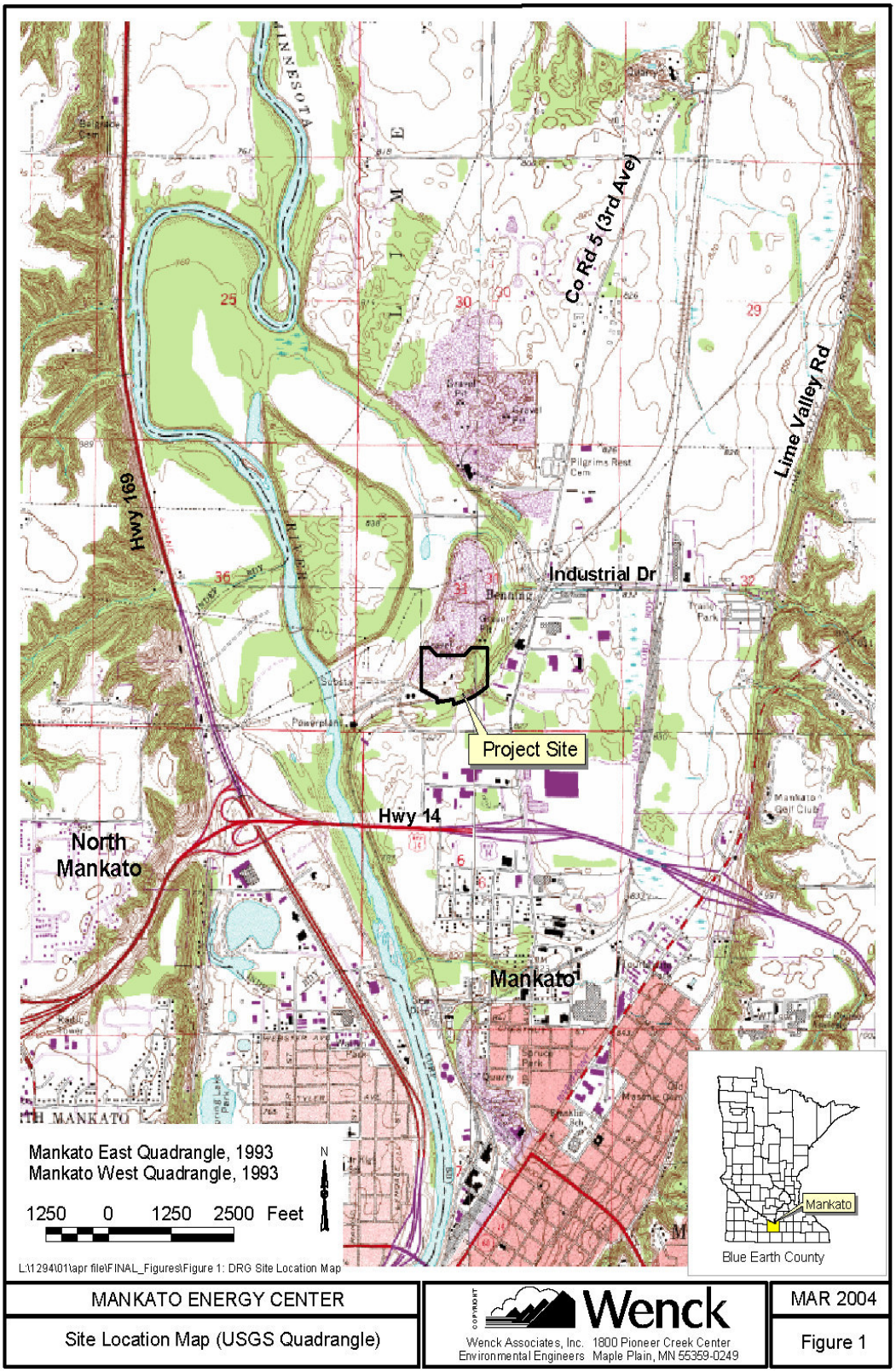
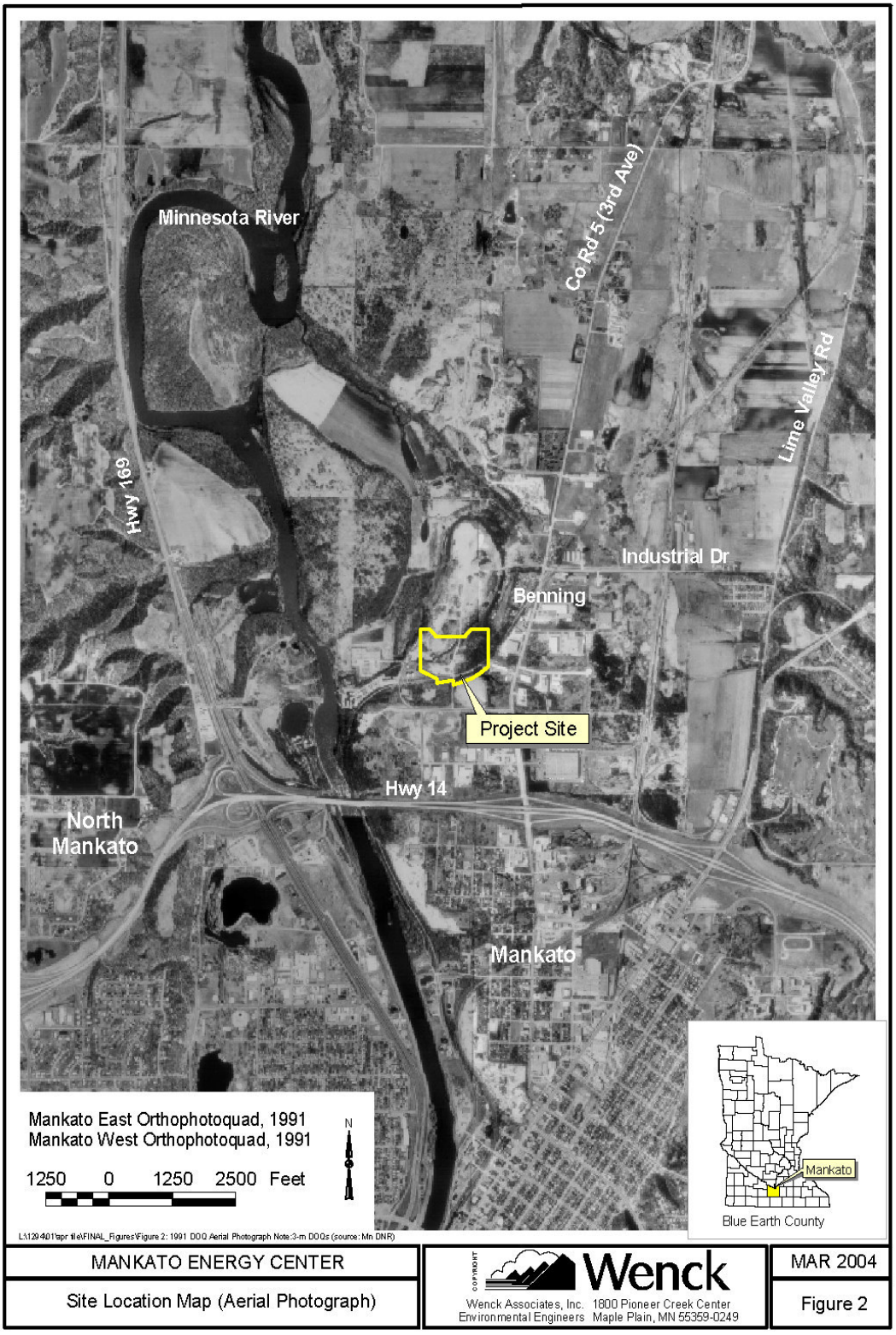
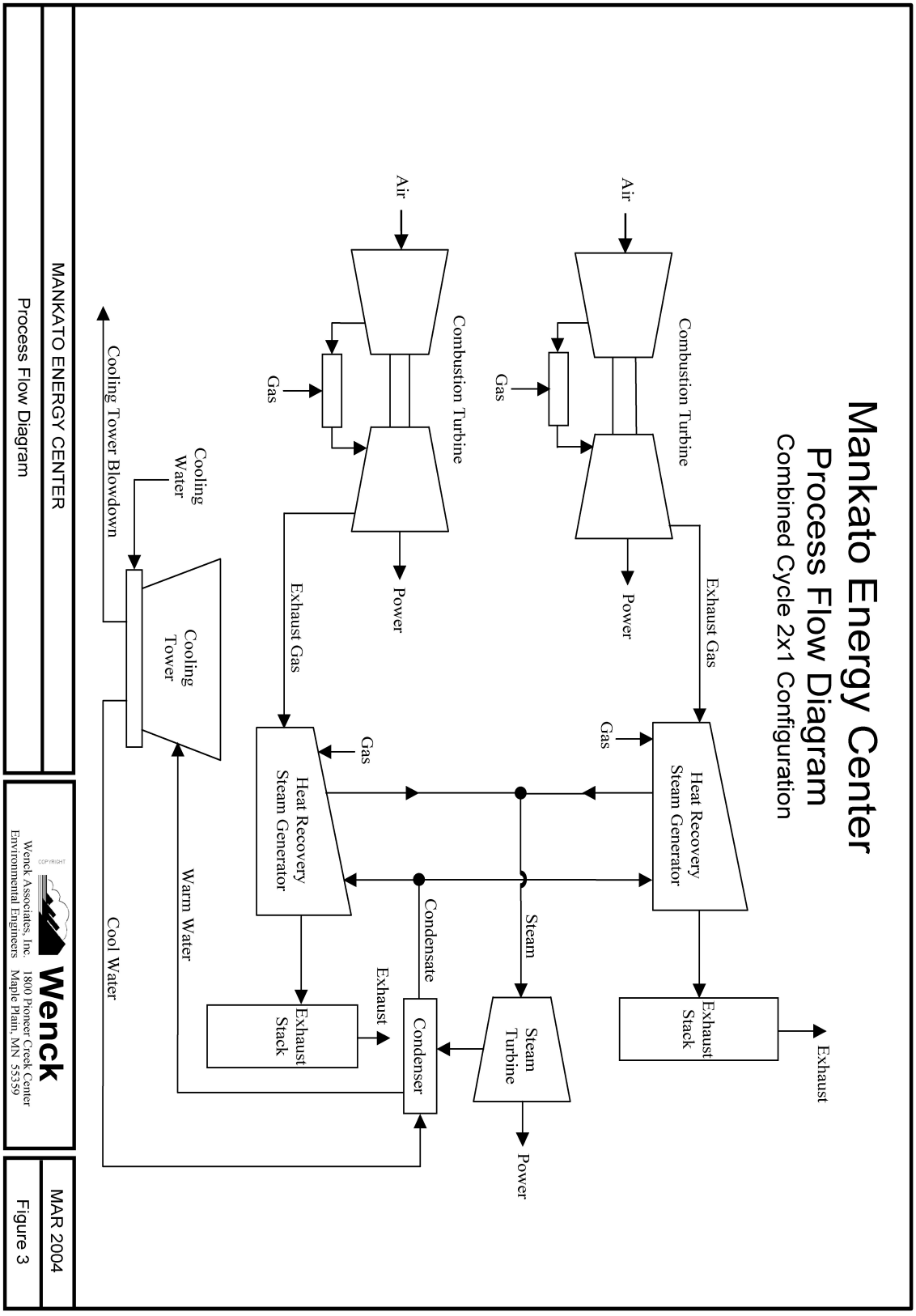
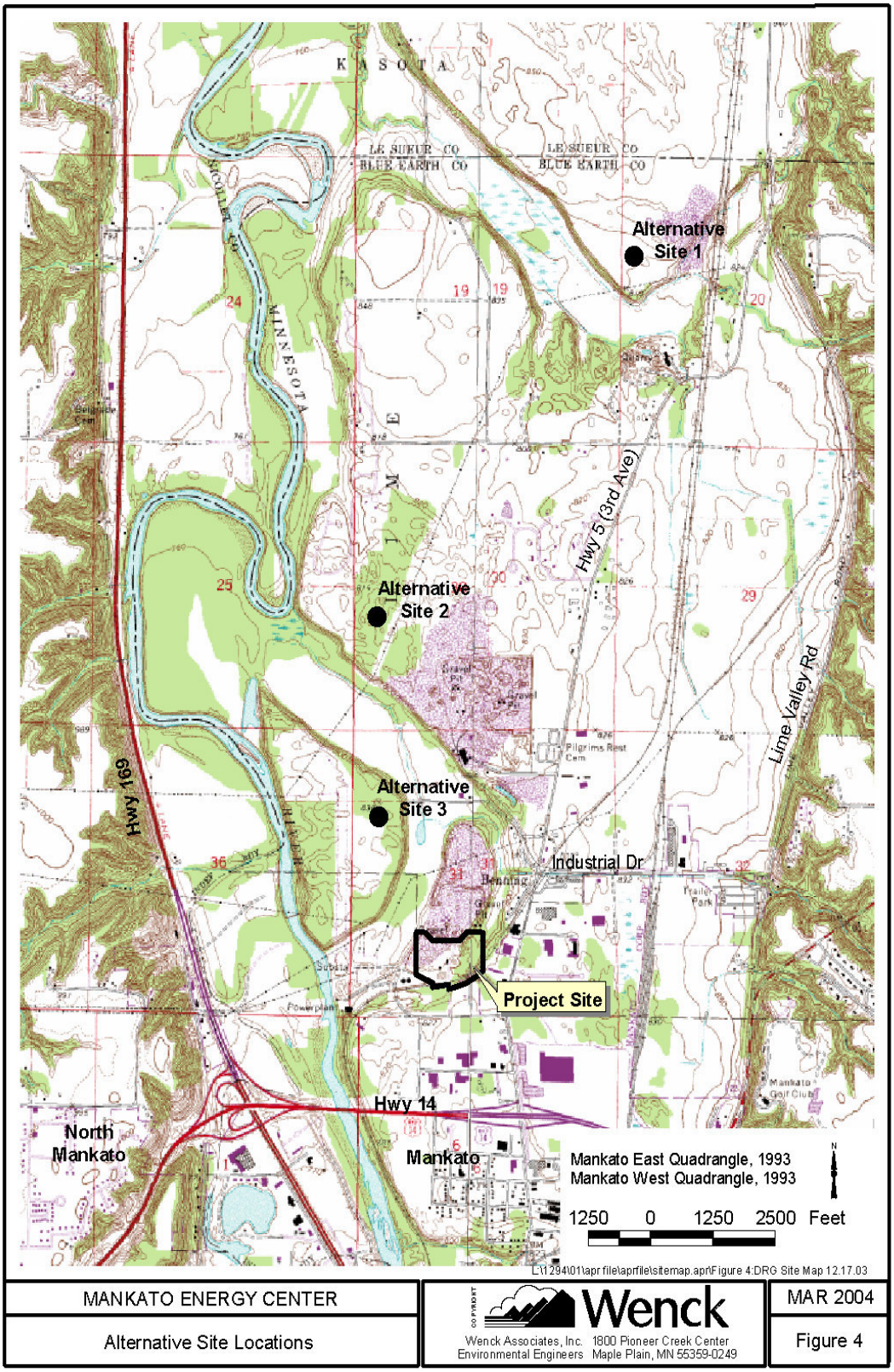
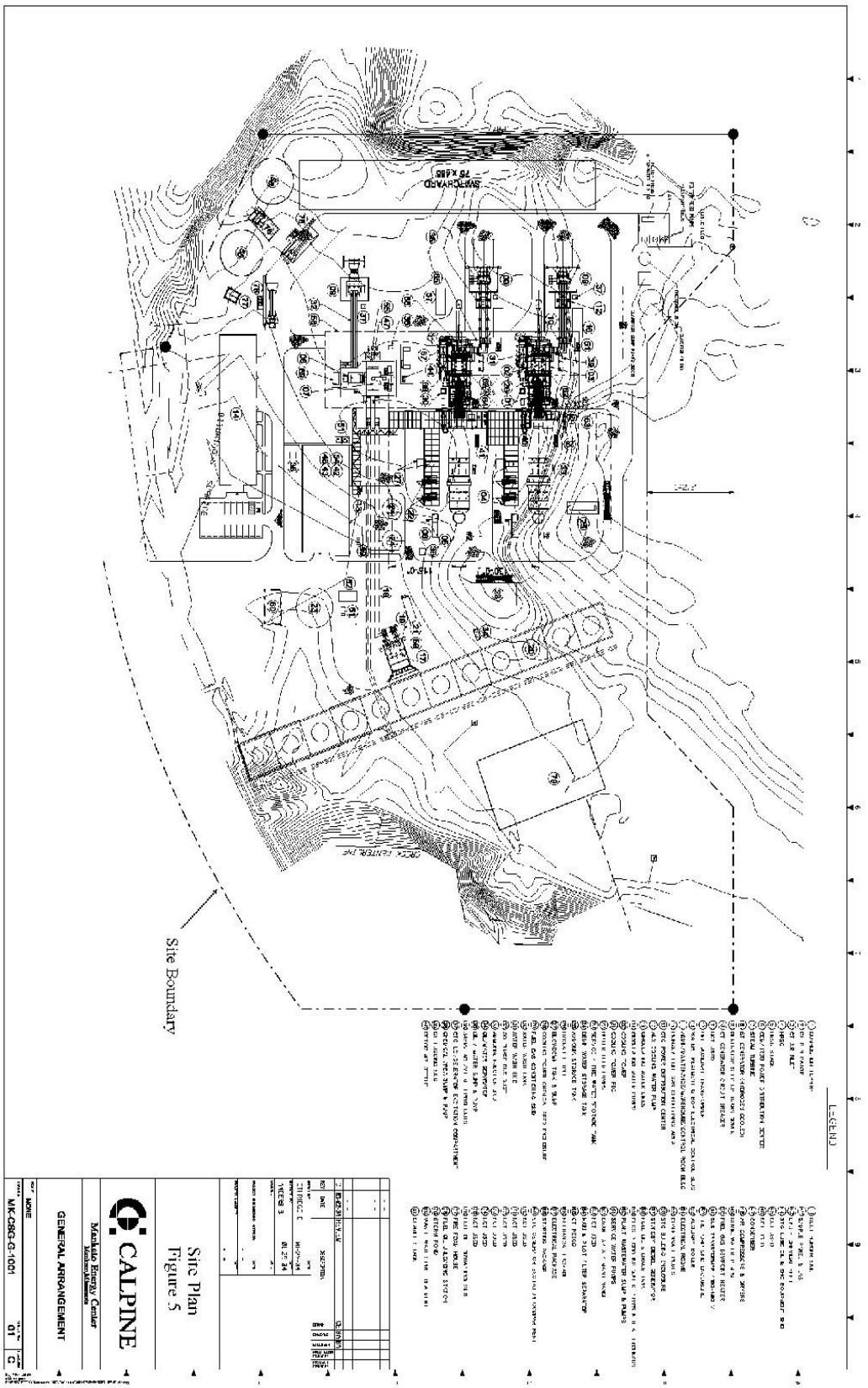
FIGURES

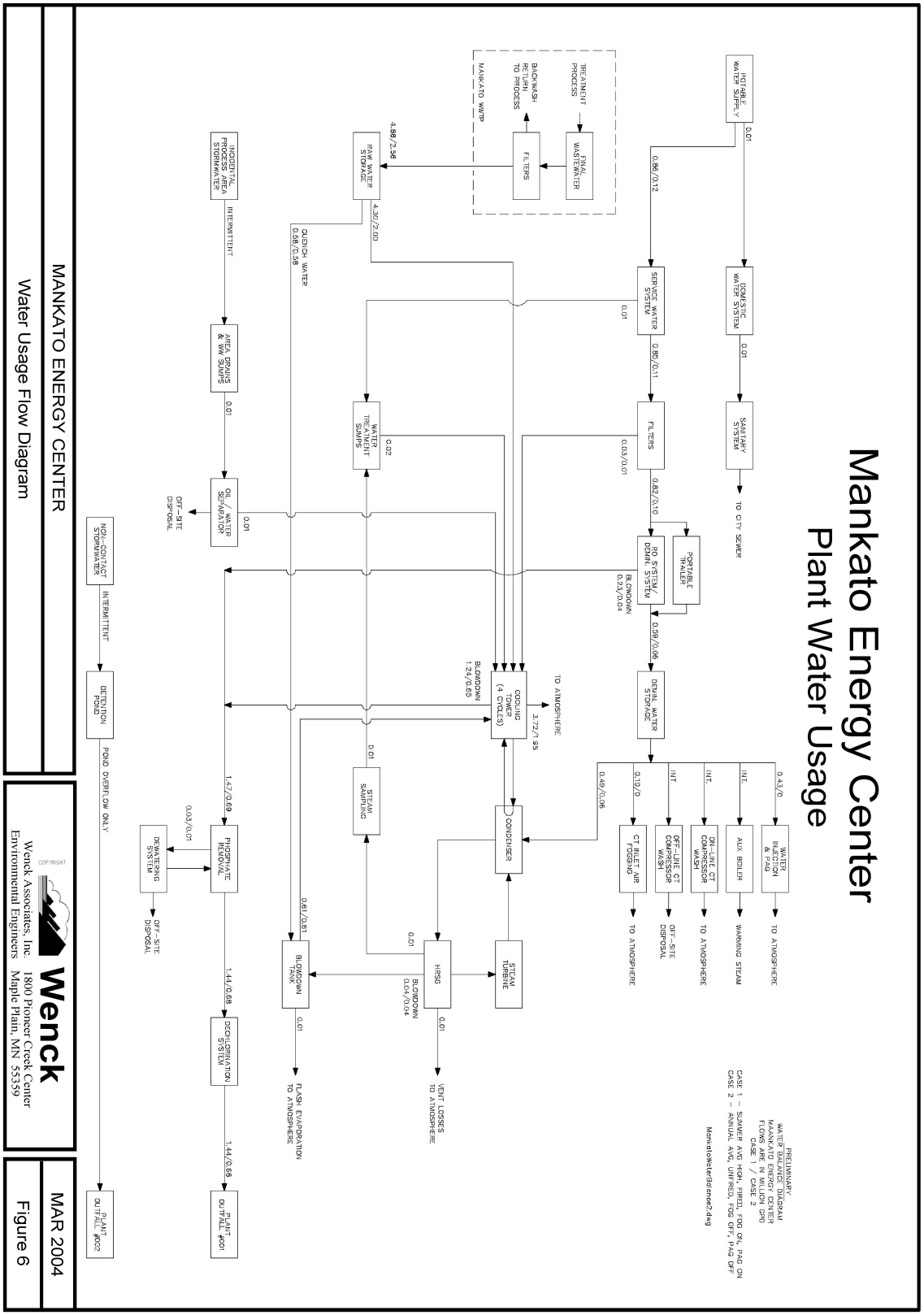

Co Rd 5 (3rd Ave)
Lime Valley Rd
Hwy 169
Industrial Dr
Project Site
Hwy 14
North Mankato
Mankato
Mankato East Quadrangle, 1993
Mankato West Quadrangle, 1993
1250 0 1250 2500 Feet
N
Mankato
Blue Earth County
L:\1294\01\apr file\FINAL_Figures\Figure 1: DRG Site Location Map
MANKATO ENERGY CENTER
Site Location Map (USGS Quadrangle)
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 1

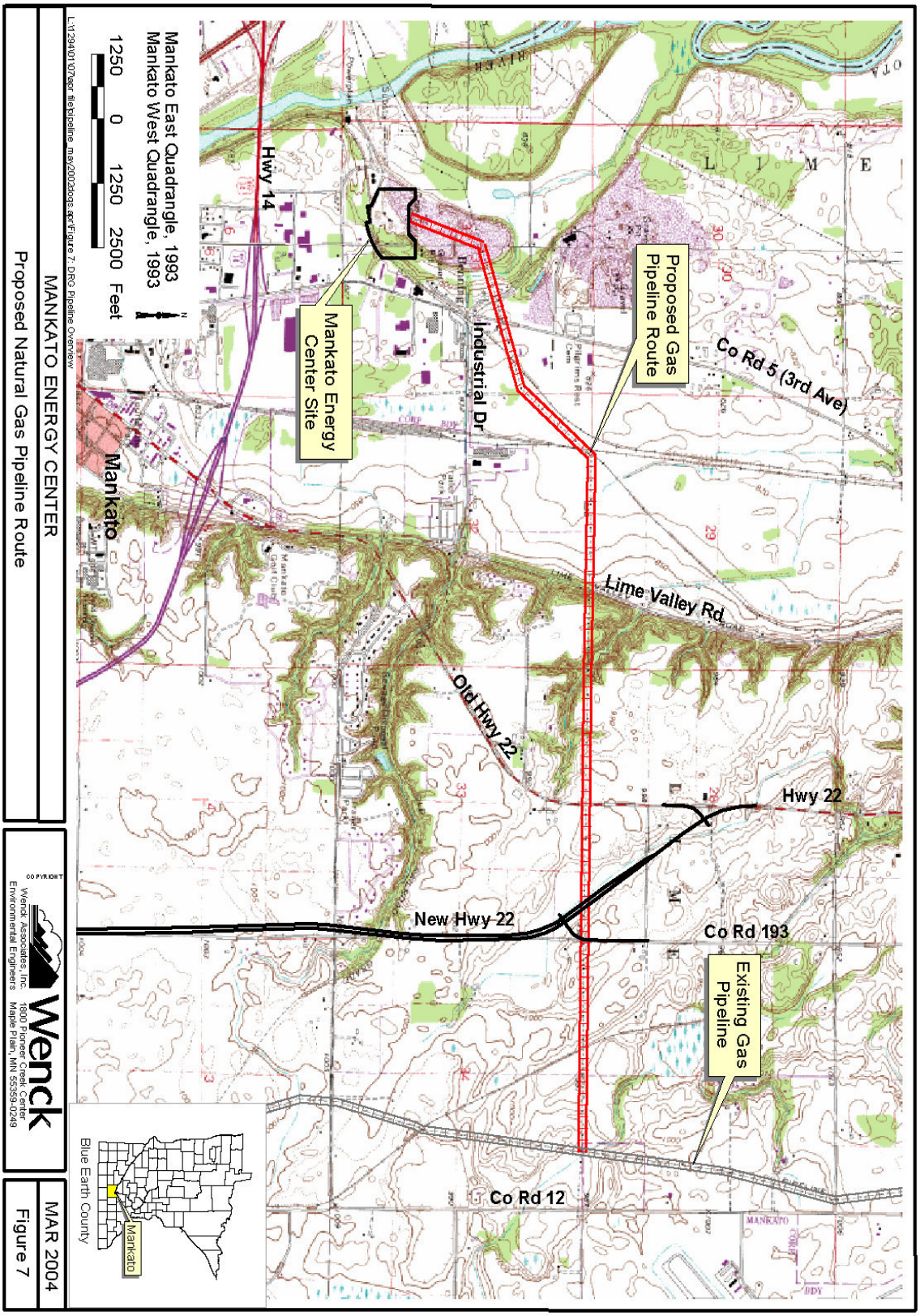

Minnesota River
Co Rd 5 (3rd Ave)
Lime Valley Rd
Hwy 169
Industrial Dr
Benning
Project Site
Hwy 14
North Mankato
Mankato
Mankato East Orthophotoquad, 1991
Mankato West Orthophotoquad, 1991
1250 0 1250 2500 Feet
N
Mankato
Blue Earth County
L:\1294-01\tpr file\FINAL_Figures\Figure 2: 1991 DOQ Aerial Photograph Note:3-m DOQs (source: Mn DNR)
MANKATO ENERGY CENTER
Site Location Map (Aerial Photograph)
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 2

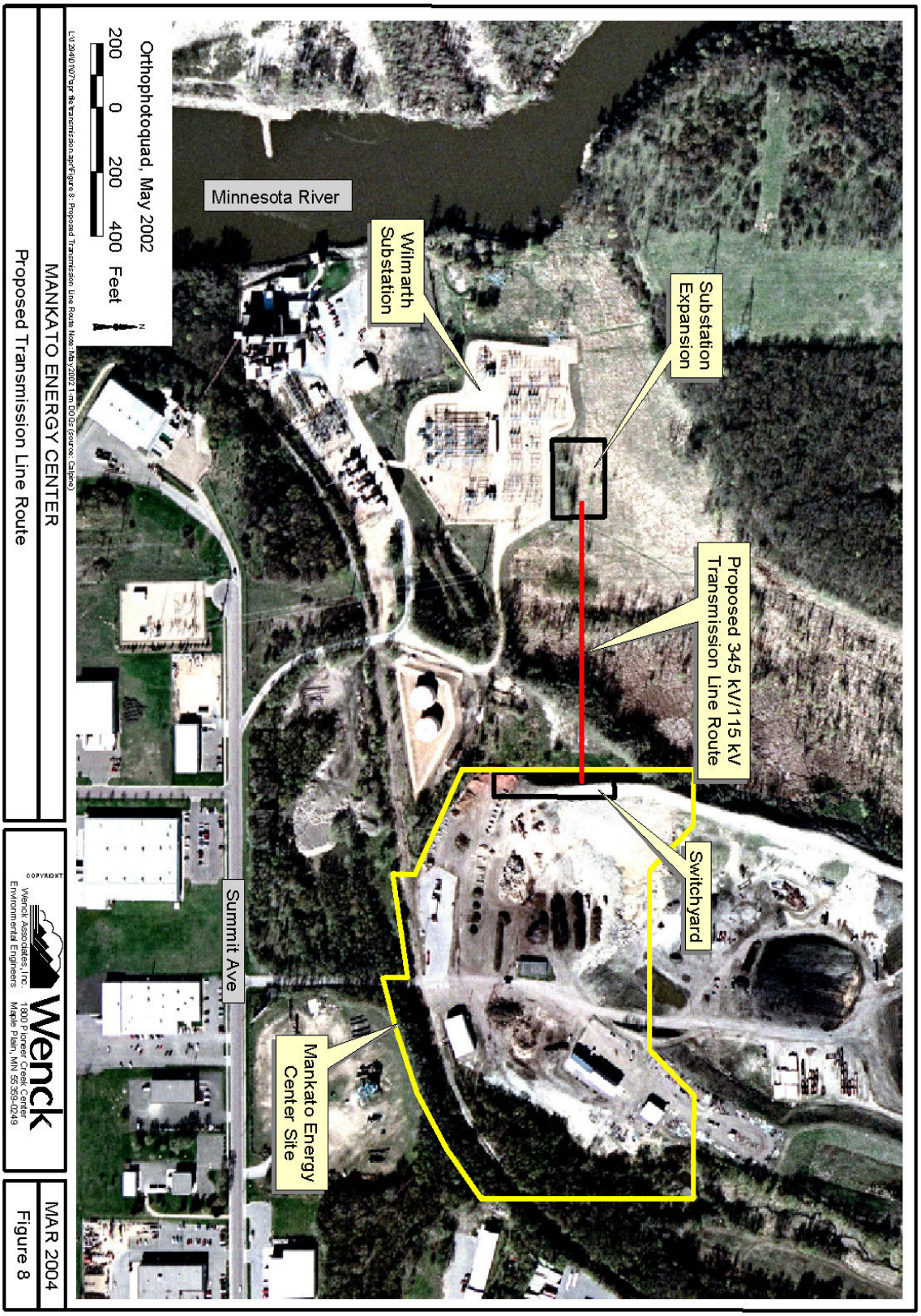

Mankato Energy Center
Process Flow Diagram
Combined Cycle 2x1 Configuration
Air
Combustion Turbine
Gas
Power
Exhaust Gas
Heat Recovery Steam Generator
Gas
Exhaust Stack
Exhaust
Steam
Steam Turbine
Power
Condensate
Condenser
Exhaust
Air
Combustion Turbine
Gas
Power
Exhaust Gas
Heat Recovery Steam Generator
Gas
Exhaust Stack
Cooling Water
Cooling Tower Blowdown
Cooling Tower
Warm Water
Cool Water
MANKATO ENERGY CENTER
Process Flow Diagram
Wenck
Wenck Associates, Inc.
Environmental Engineers
1800 Pioneer Creek Center
Maple Plain, MN 55359
MAR 2004
Figure 3


Alternative Site 1
Alternative Site 2
Alternative Site 3
Project Site
Hwy 169
Hwy 5 (3rd Ave)
Lime Valley Rd
Industrial Dr
Hwy 14
North Mankato
Mankato
Mankato East Quadrangle, 1993
Mankato West Quadrangle, 1993
1250 0 1250 2500 Feet
L:\1294\01\apr file\aprfile\sitemap.apr\Figure 4:DRG Site Map 12.17.03
MANKATO ENERGY CENTER
Alternative Site Locations
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 4

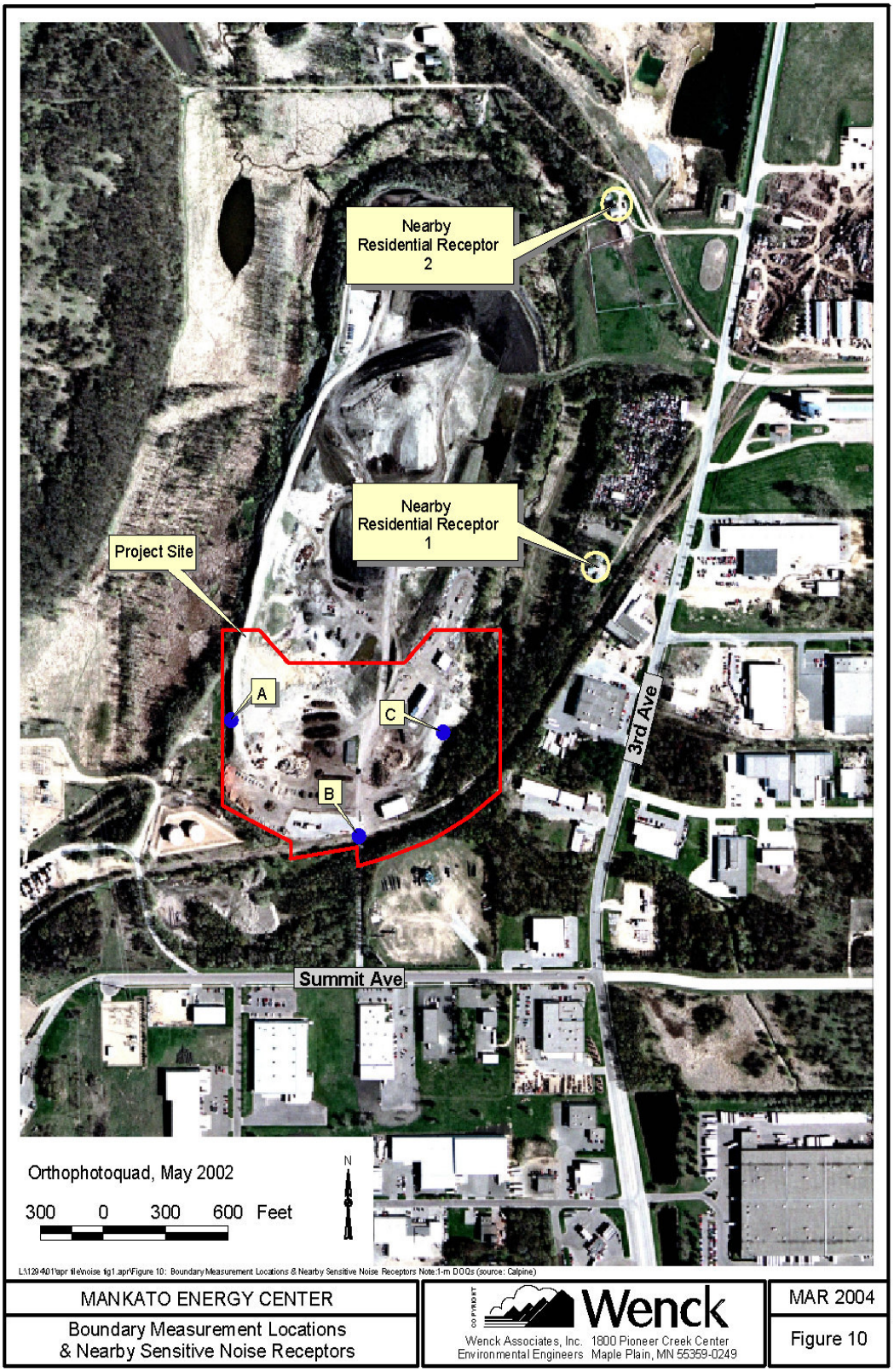

Site Boundary
Site Plan
Figure 5
CALPINE
Mankato Energy Center
GENERAL ARRANGEMENT
MK-083-G-1001

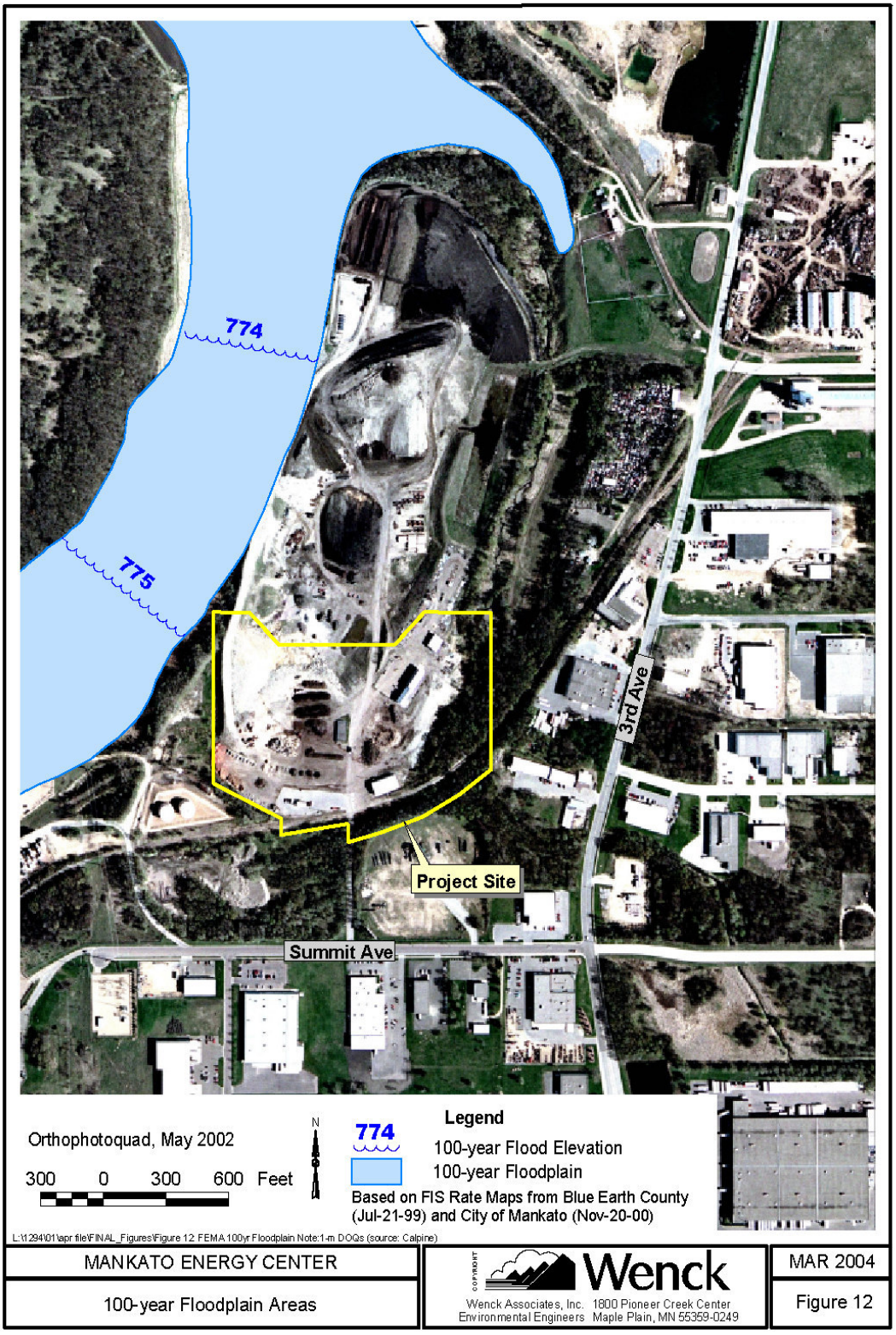

Mankato Energy Center
Plant Water Usage
MANKATO ENERGY CENTER
Water Usage Flow Diagram
MAR 2004
Figure 6
Wenck
Wenck Associates, Inc.
Environmental Engineers
1800 Pioneer Creek Center
Maple Plain, MN 55359
COPYRIGHT
PRELIMINARY
WATER BALANCE DIAGRAM
MANKATO ENERGY CENTER
FLOWS ARE IN MILLION GPD
CASE 1 / CASE 2
CASE 1 – SUMMER AVG HIGH, FIRED, FOG ON, PAG ON
CASE 2 – ANNUAL AVG, UNFIRED, FOG OFF, PAG OFF
MankatoWaterBalance2.dwg
MUNICIPAL WATER SUPPLY
DOMESTIC WATER SYSTEM
SANITARY SYSTEM
TO CITY SEWER
SEPTAGE WATER SYSTEM
FILTERS
RO SYSTEM/ DEMIN. SYSTEM
PORTABLE TRAILER
DEMIN. WATER STORAGE
WATER INJECTION & PAG
TO ATMOSPHERE
AUX. BOILER
WARMING STEAM
ON-LINE CT COMPRESSOR WASH
OFF-LINE CT COMPRESSOR WASH
OFF-SITE DISPOSAL
CT INLET AIR FOGGING
TREATMENT PROCESS
FINAL WASTEWATER
BACKWASH RETURN TO PROCESS
MANKATO WWTP
RAW WATER STORAGE
QUENCH WATER
WATER TREATMENT SUMPS
INDUSTRIAL PROCESS AREA STORMWATER
AREA DRAINS & WW SUMPS
OIL / WATER SEPARATOR
OFF-SITE DISPOSAL
NON-CONTACT STORMWATER
DETENTION POND
POND OVERFLOW ONLY
PLANT OUTFALL #002
COOLING TOWER (4 CYCLES)
BLOWDOWN
TO ATMOSPHERE
CONDENSER
STEAM SAMPLING
HRSG
STEAM TURBINE
VENT LOSSES TO ATMOSPHERE
BLOWDOWN TANK
FLASH EVAPORATION TO ATMOSPHERE
PHOSPHATE REMOVAL
DEWATERING SYSTEM
OFF-SITE DISPOSAL
DECHLORINATION SYSTEM
PLANT OUTFALL #001
INTERMITTENT
0.01
0.96/0.12
0.85/0.11
0.82/0.10
0.99/0.06
0.49/0.06
0.43/0
0.10/0
0.03/0.01
0.02
4.89/2.58
4.30/2.00
0.68/0.58
1.24/0.65
3.72/1.95
0.67/0.61
0.01
1.47/0.69
0.43/0.07
1.44/0.68
1.44/0.68

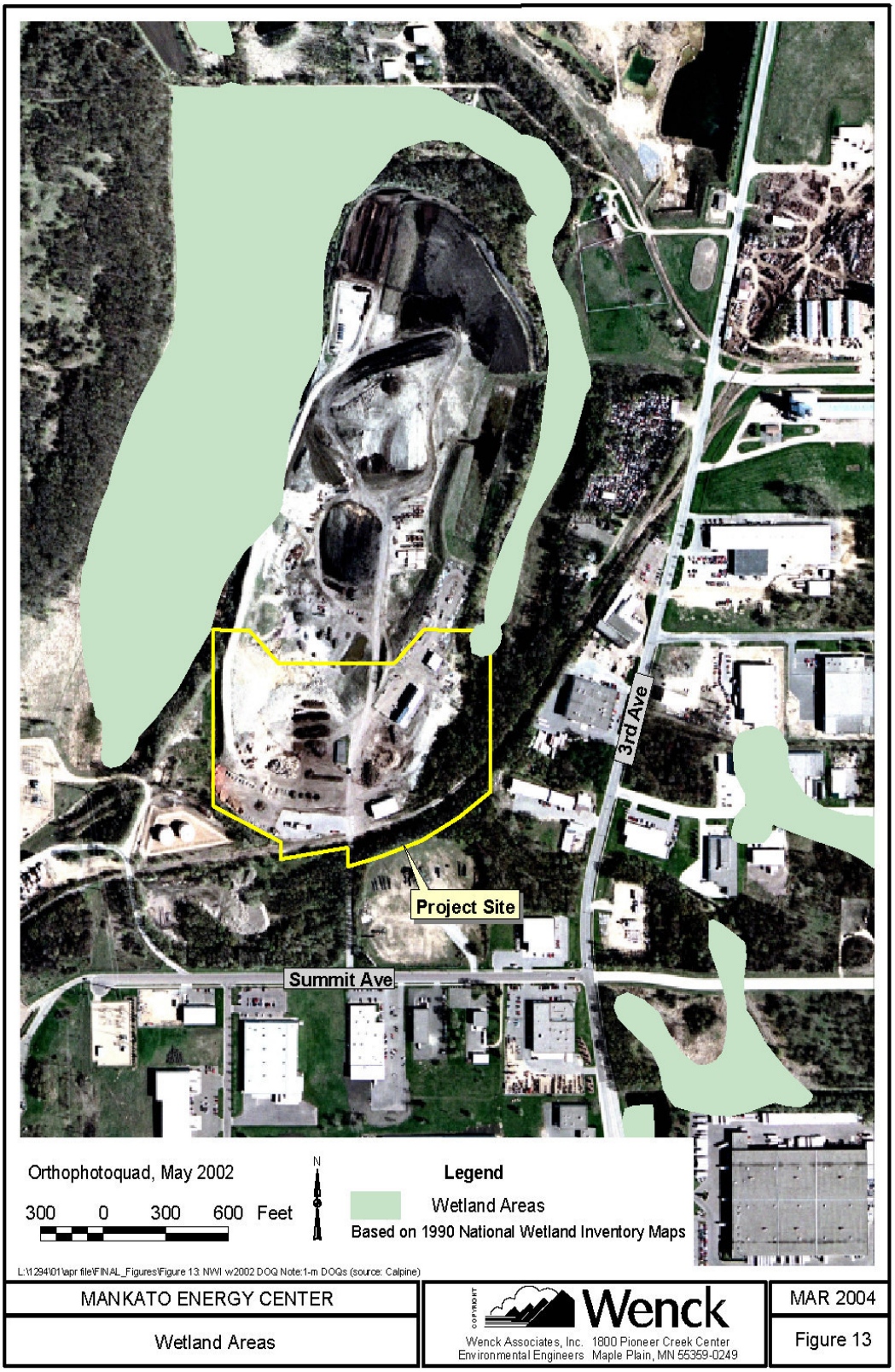

Mankato East Quadrangle, 1993
Mankato West Quadrangle, 1993
1250 0 1250 2500 Feet
L:\1294\0107\gis\ fileb\pipeline_may2002\maps.apr\Figure 7 DRG Pipeline Overview
Hwy 14
Mankato Energy Center Site
Proposed Gas Pipeline Route
Industrial Dr
Co Rd 5 (3rd Ave)
Mankato
Lime Valley Rd
Old Hwy 22
Hwy 22
New Hwy 22
Co Rd 193
Existing Gas Pipeline
Co Rd 12
Blue Earth County
Mankato
MANKATO ENERGY CENTER
Proposed Natural Gas Pipeline Route
COPYRIGHT
Wenck Associates, Inc.
Environmental Engineers
1800 Pioneer Creek Center
Maple Plain, MN 55359-0249
MAR 2004
Figure 7

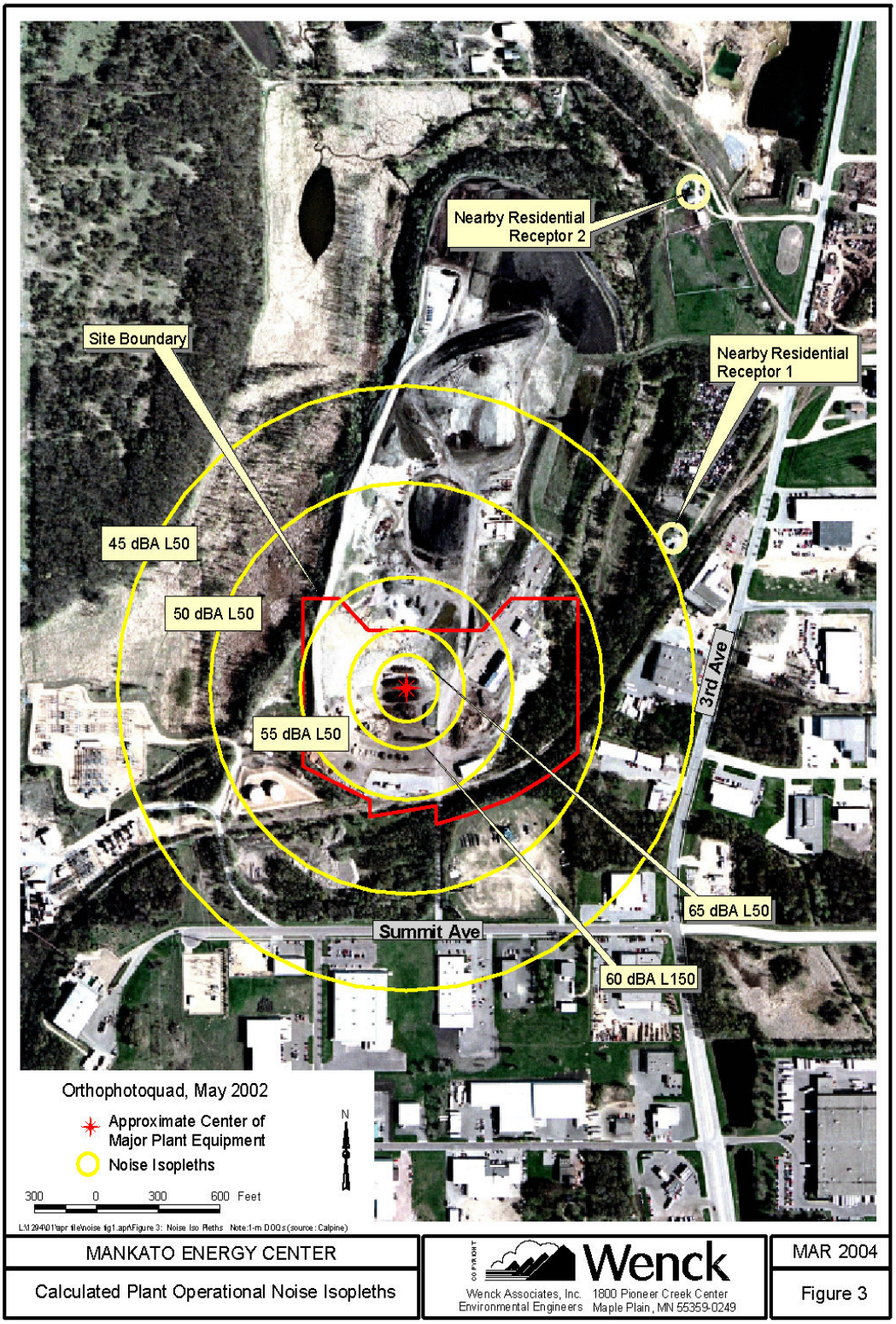

Minnesota River
Wilmarth Substation
Substation Expansion
Proposed 345 kV/115 kV Transmission Line Route
Switchyard
Mankato Energy Center Site
Summit Ave
Orthophotoquad, May 2002
200 0 200 400 Feet
N
L:\1394\0107\gis\Transmission.apr\Figure 8: Proposed Transmission line Route Note: Nov 2002 Ortho DOQs (source: Calpine)
MANKATO ENERGY CENTER
Proposed Transmission Line Route
COPYRIGHT
Wenck Associates, Inc.
Environmental Engineers
Wenck
1800 Pioneer Creek Center
Maple Plain, MN 55359-0249
MAR 2004
Figure 8


Project Site
3rd Ave
Summit Ave
Xcel Energy Wilmarth
Generating Plant
Orthophotoquad, May 2002
300 0 300 600 Feet
N
L:\1294\01\apr file\Photo_figureView.apr\Figure 9: May 2002 DOQ Views of Existing Site Conditions Note:1-m DOQs (source: Calpine)
MANKATO ENERGY CENTER
Views of Existing Site Conditions
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 9


Nearby
Residential Receptor
2
Nearby
Residential Receptor
1
Project Site
A
B
C
3rd Ave
Summit Ave
Orthophotoquad, May 2002
300 0 300 600 Feet
N
L:\1294\01\apr file\noise fig1.apr\Figure 10: Boundary Measurement Locations & Nearby Sensitive Noise Receptors Note:1-m DOQs (source: Calpine)
MANKATO ENERGY CENTER
Boundary Measurement Locations
& Nearby Sensitive Noise Receptors
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 10


774
775
3rd Ave
Project Site
Summit Ave
Orthophotoquad, May 2002
300 0 300 600 Feet
N
774
Legend
100-year Flood Elevation
100-year Floodplain
Based on FIS Rate Maps from Blue Earth County
(Jul-21-99) and City of Mankato (Nov-20-00)
L:\1294\01\apr file\FINAL_Figures\Figure 12 FEMA 100yr Floodplain Note:1-m DOQs (source: Calpine)
MANKATO ENERGY CENTER
100-year Floodplain Areas
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 12


3rd Ave
Project Site
Summit Ave
Orthophotoquad, May 2002
300 0 300 600 Feet
N
Legend
Wetland Areas
Based on 1990 National Wetland Inventory Maps
L:\1294\01\apr file\FINAL_Figures\Figure 13 NWI w2002 DOQ Note:1-m DOQs (source: Calpine)
MANKATO ENERGY CENTER
Wetland Areas
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 13


Nearby Residential Receptor 2
Site Boundary
Nearby Residential Receptor 1
45 dBA L50
50 dBA L50
55 dBA L50
3rd Ave
65 dBA L50
Summit Ave
60 dBA L150
Orthophotoquad, May 2002
Approximate Center of Major Plant Equipment
Noise Isopleths
N
300 0 300 600 Feet
L:\1294\01\apr file\noise fig1.apr\Figure 3: Noise Iso Pleths Note:1-m DOQs (source: Calpine)
MANKATO ENERGY CENTER
Calculated Plant Operational Noise Isopleths
Wenck
Wenck Associates, Inc. 1800 Pioneer Creek Center
Environmental Engineers Maple Plain, MN 55359-0249
MAR 2004
Figure 3

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APPENDICES

APPENDIX A

ENVIRONMENTAL SCOPING DECISION

(Original signed by EQB Chair Schroeder)

STATE OF MINNESOTA

ENVIRONMENTAL QUALITY BOARD

In the Matter of the Application by Mankato Energy Center, LLC, for a Certificate of Need for a Large Electric Power Generating Plant in Blue Earth County, Minnesota, and an Application for a Site Permit for the Plant and a Route Permit for a High Voltage Transmission line.

ENVIRONMENTAL ASSESSMENT SCOPING DECISION

EQB Docket No. 04-76-PPS-Calpine
PUC Docket No. IP6345/CN-03-188

The above-entitled matter came before the Chair of the Minnesota Environmental Quality Board (MEQB) for a decision on the scope of the Environmental Assessment (EA) to be prepared on the proposal by Mankato Energy Center, a wholly owned subsidiary of Calpine Corporation, to construct a natural gas fired power plant in Mankato, Minnesota.

The EQB held a public meeting on April 21, 2004, to discuss the project with the public and to solicit input into the scope of the EA to be prepared. The public was given until May 10, 2004, to submit written comments regarding the scope of the EA. Not all suggestions in the comments are included in this scoping document because although certain issues may be important for the Public Utilities Commission to address in determining the question of need for the proposed facility, not all of these issues are necessarily ones that are properly addressed in the Environmental Assessment prepared by the EQB.

Having reviewed the comments submitted and consulted with EQB staff, I hereby make the following Scoping Order.

MATTERS TO BE ADDRESSED

The Environmental Assessment on the proposed Mankato Energy Center project will address the following matters:

1.0 **INTRODUCTION**

(A brief overview of the process and identification of what is discussed in the document.)

2.0 **PROJECT DESCRIPTION**

2.1 **The Plant** (The following specific features of the proposed power plant as proposed by the applicant will be described. The description will address the entire 655 MW that are proposed because the Site Permit requests that amount.)

2.1.1 General
2.1.2 Power Generating Equipment and Processes
2.1.3 Air Emission Control Equipment
2.1.4 Water Use
2.1.5 Wastewater
2.1.6 Solid and Hazardous Waste Generation
2.1.6 Fuel Supply

2.2 **The High Voltage Transmission Line** (The following specific features of the short interconnection to the nearby Wilmarth Substation will be described. Xcel Energy will actually be the applicant for the route permit for the HVTL.)

2.2.1 General
2.2.2 Design
2.2.3 Right-of-Way Requirements and Acquisition
2.2.4 Construction
2.2.5 Operation and Maintenance

2.3 **The Pipeline** (A natural gas pipeline is also required as part of this project, and the features of the pipeline will be described.)

3.0 DESCRIPTION OF ALTERNATIVES TO THE PROPOSED POWER PLANT

(A general description of the following alternatives will be included. The number of alternatives to be considered is less than what the rules specify because the PUC granted an exemption from some of these requirements in its order of Feb. 6, 2004.)

3.1 No-build Alternative

3.2 Natural Gas/Wind Combination (This alternative will address the possibility of substituting wind generated power for the power proposed to be generated by the nonexempt portion of the facility.)

3.3 Alternative Back-Up Fuels (The possibility of using something other than fuel oil to back-up the natural gas.)
3.3.1 Biodiesel
3.3.2 Biomass
3.3.3 Ethanol

3.4 Alternative Types of Generation

3.4.1 Oil-fired Combined Cycle Turbine
3.4.2 Simple Cycle Combustion Turbine

3.5 Transmission Rather than Generation

4.0 ANALYSIS OF IMPACTS OF THE PROJECT AND EACH ALTERNATIVE

(This section will describe the potential environmental and human effects related to the generation of electricity through the various alternative means described in section 3.0.)

4.1 Air Quality Impacts
4.2 Water Quality Impacts
4.3 Solid and Hazardous Wastes
4.4 Noise Impacts
4.5 Land Use Impacts
4.6 Impacts on Cultural Resources
4.7 Fuel Availability
4.8 Impact on Transmission Grid

5.0 POTENTIAL SITE SPECIFIC EFFECTS

(This section will describe the potential environmental effects of locating the project on the site proposed by the applicant. Because this information will be considered by the EQB in considering the request for a site permit, the analysis will consider the full 655 MW of capacity. No alternative sites to the one proposed by the applicant are evaluated.)

5.1 Air Quality
- 5.1.1 Criteria Pollutants
- 5.1.2 Hazardous Air Pollutants

5.2 Biological Resources
- 5.2.1 Flora
- 5.2.2 Fauna
- 5.2.3 Rare & Unique Natural resources

5.3 Cultural Resources
- 5.3.1 Public Services & Infrastructure
- 5.3.2 Archaeological & Historic Resources

5.4 Geology and Soils

5.5 Health and Safety

5.6 Land Use
- 5.6.1 Zoning & Displacement
- 5.6.2 Aesthetics & Visual Impacts

5.7 Noise
- 5.7.1 Project Noise
- 5.7.2 Noise Standards
- 5.7.3 Current Noise Environment

5.8 Transportation

5.9 Water Resources
- 5.9.1 Surface Water
- 5.9.2 Groundwater
- 5.9.3 Minnesota River Impacts from Water use and wastewater reuse
  - 5.9.3.1 Low flow conditions
  - 5.9.3.2 Evaporative Withdrawal
- 5.9.4 Wetlands

5.10 Waste Management and Disposal

6.0 POTENTIAL ENVIRONMENTAL EFFECTS OF THE PROPOSED TRANSMISSION LINE

(This section will describe the potential environmental effects of the 115 kV transmission line that will connect the new plant to the Wilmarth Substation.)

6.1 Air Quality

6.2 Biological Resources
- 6.2.1 Flora
- 6.2.2 Fauna
- 6.6.3 Rare & Unique Natural Resources

6.3 Cultural Resources
- 6.3.1 Human Settlements
- 6.3.2 Archaeological & Historic Resources
- 6.3.3 Radio and TV Interference

6.4 Geology and Soils

6.5 Electric and Magnetic Fields

6.6 Land Use
- 6.6.1 Zoning & Displacement
- 6.6.2 Aesthetics & Visual Impacts

6.7 Noise

6.8 Transportation

6.9 Water Resources

6.9.1 Surface Water
6.9.2 Groundwater
6.9.3 Wetlands

7.0 ANALYSIS OF MITIGATIVE MEASURES

(Any specific measures for mitigating any potential environmental or human impacts of the proposed project or alternatives will be described.)

8.0 ANALYSIS OF THE FEASIBILITY AND AVAILABILITY OF EACH ALTERNATIVE.

9.0 OTHER PERMITS

(A list of all permits that will be required by the applicant to construct the project will be included.)

ISSUES OUTSIDE THE SCOPE OF THE EA

The EQB will not, as part of this environmental review, consider the following matters:

1. Whether a different size or different type of transmission line should be built.
2. Whether no transmission line should be built.
3. Whether the proposed natural gas-fired turbines should be located on a site other than the one proposed by the applicant.
4. What the relationship of the proposed facility is to overall state energy needs.
5. Whether the proposed facility satisfies state renewable energy goals
6. Whether the proposed project is compatible with the state's current energy mix
7. What markets power from the proposed facility will serve.

SCHEDULE

The EA will be completed by July 1, 2004.

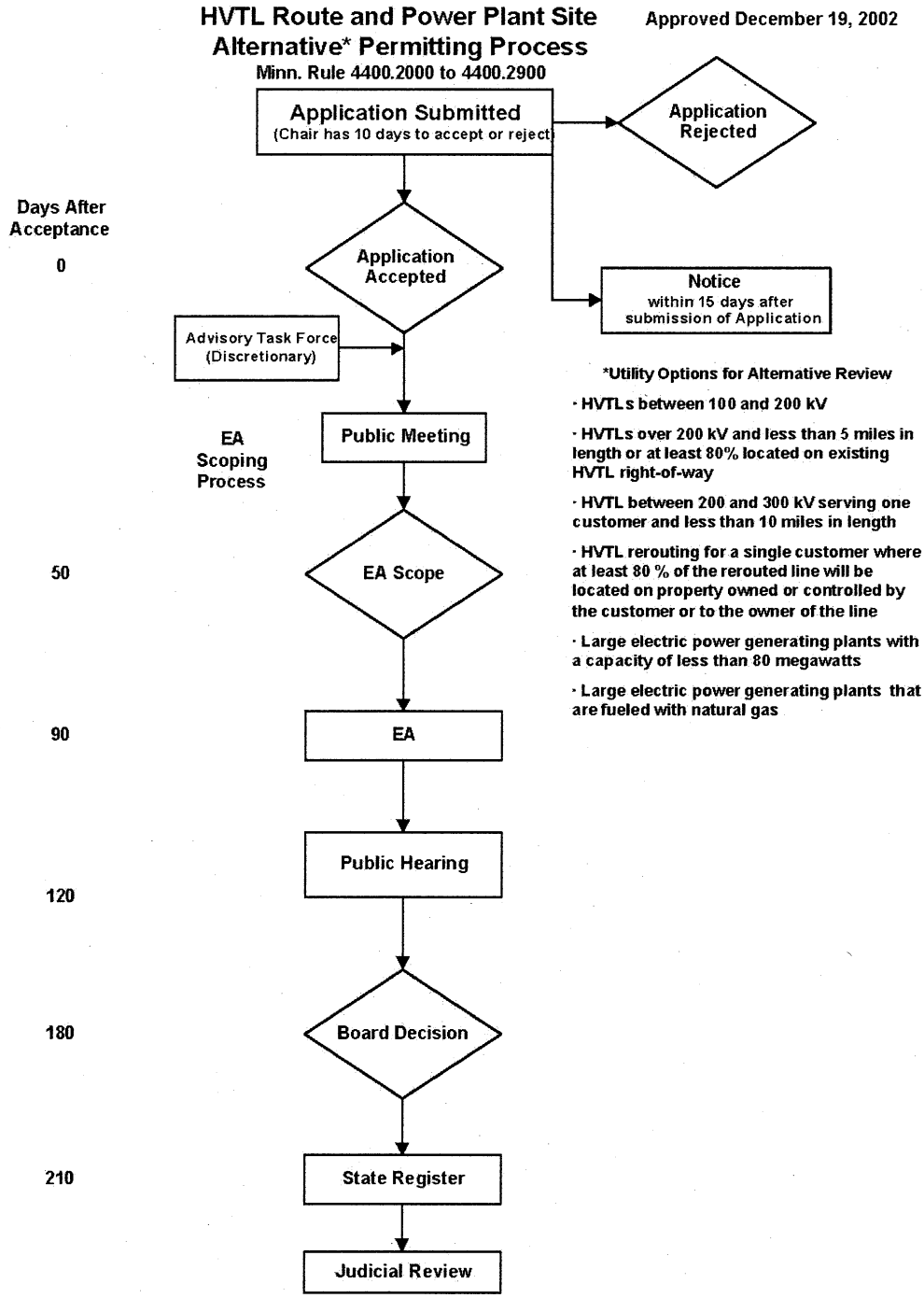
Signed this 20 day of May, 2004

STATE OF MINNESOTA
ENVIRONMENTAL QUALITY BOARD

Robert A. Schroeder,
Chair

APPENDIX B

Appendix B Flow Chart of Alternative Review Process


HVTL Route and Power Plant Site Alternative* Permitting Process
Minn. Rule 4400.2000 to 4400.2900
Approved December 19, 2002
Application Submitted
(Chair has 10 days to accept or reject)
Application Rejected
Days After Acceptance
0
Application Accepted
Notice
within 15 days after submission of Application
Advisory Task Force
(Discretionary)
EA Scoping Process
Public Meeting
50
EA Scope
90
EA
Public Hearing
120
180
Board Decision
210
State Register
Judicial Review
*Utility Options for Alternative Review
· HVTLs between 100 and 200 kV
· HVTLs over 200 kV and less than 5 miles in length or at least 80% located on existing HVTL right-of-way
· HVTL between 200 and 300 kV serving one customer and less than 10 miles in length
· HVTL rerouting for a single customer where at least 80 % of the rerouted line will be located on property owned or controlled by the customer or to the owner of the line
· Large electric power generating plants with a capacity of less than 80 megawatts
· Large electric power generating plants that are fueled with natural gas

APPENDIX C

Appendix C DNR Response Letter

Minnesota Department of Natural Resources
Natural Heritage and Nongame Research Program, Box 25
500 Lafayette Road
St. Paul, Minnesota 55155-40__
Phone: (651) 296-7863 Fax: (651) 296-1811 E-mail: sarah.hoffmann@dnr.state.mn.us

September 11, 2003

RECEIVED BY
SEP 16 2003
WENCK ASSOCIATES, INC.

Dale Claridge
Wenck Associates, Inc.
P.O. Box 249
Maple Plain, MN 55359

Re: Request for Natural Heritage information for vicinity of proposed Calpine Mankato Natural Gas Plant, T109N R26W Section 31, Blue Earth County
NHNRP Contact #: ERDB 20040172

Dear Mr. Claridge

The Minnesota Natural Heritage database has been reviewed to determine if any rare plant or animal species or other significant natural features are known to occur within an approximate one-mile radius of the area indicated on the map enclosed with your information request. Based on this review, there are 9 known occurrences of rare species or natural communities in the area searched (for details, see enclosed database printout and explanation of selected fields). However, based on the nature and location of the proposed project I do not believe it will affect any known occurrences of rare features.

The Natural Heritage database is maintained by the Natural Heritage and Nongame Research Program, a unit within the Division of Ecological Services, Department of Natural Resources. It is continually updated as new information becomes available, and is the most complete source of data on Minnesota's rare or otherwise significant species, natural communities, and other natural features. Its purpose is to foster better understanding and protection of these features.

Because our information is not based on a comprehensive inventory, there may be rare or otherwise significant natural features in the state that are not represented in the database. A county-by-county survey of rare natural features is now underway, and has been completed for Blue Earth County. Our information about natural communities is, therefore, quite thorough for that county. However, because survey work for rare plants and animals is less exhaustive, and because there has not been an on-site survey of all areas of the county, ecologically significant features for which we have no records may exist on the project area.

The enclosed results of the database search are provided in two formats: index and full record. To control the release of locational information which might result in the damage or destruction of a rare element, both printout formats are copyrighted.

The index provides rare feature locations only to the nearest section, and may be reprinted, unaltered, in an Environmental Assessment Worksheet, municipal natural resource plan, or report compiled by your company for the project listed above. If you wish to reproduce the index for any other purpose, please contact me to request written permission. Copyright notice for the index should include the following disclaimer:

> "Copyright (year) State of Minnesota, Department of Natural Resources. This index may be reprinted, unaltered, in Environmental Assessment Worksheets, municipal natural resource plans, and internal reports. For any other use, written permission is required."

The full-record printout includes more detailed locational information, and is for your personal use only. **If you wish to reprint the full-record printouts for any purpose, please contact me to request written permission.**

Please be aware that review by the Natural Heritage and Nongame Research Program focuses only on *rare natural features*. It does not constitute review or approval by the Department of Natural Resources as a whole. If you require further information on the environmental review process for other wildlife-related issues, you may contact your Regional Environmental Assessment Ecologist, Shannon Fisher, at (507) 359-6073.

An invoice for the work completed is enclosed. You are being billed for map and database search and staff scientist review. Please forward this invoice to your Accounts Payable Department. Thank you for consulting us on this matter, and for your interest in preserving Minnesota's rare natural resources.

Sincerely,

Chandra Carter for

Sarah D. Hoffmann
Endangered Species Environmental Review Coordinator

encl: Database search results
Rare Feature Database Print-Outs: An Explanation of Fields
Invoice

APPENDIX D

Appendix D Minnesota Historical Society And SHPO Comments

MINNESOTA HISTORICAL SOCIETY
STATE HISTORIC PRESERVATION OFFICE

September 9, 2003

RECEIVED BY
SEP 10 2003
WENCK ASSOCIATES, INC.

Mr. Dale Claridge
Wenck Associates
PO Box 249
Maple Plain, MN 55359-0249

RE: Caipine Mankato Energy Center
T109 R26 S31 SW, Lime Twp., Blue Earth County
SHPO Number: 2003-3616

Dear Mr. Claridge:

Thank you for consulting with our office during the preparation of an Environmental Assessment Worksheet for the above referenced project.

Based on our review of the project information, we conclude that there are no properties listed on the National or State Registers of Historic Places, and no known or suspected archaeological properties in the area that will be affected by this project.

Please note that this comment letter does not address the requirements of Section 106 of the National Historic Preservation Act of 1966 and 36CFR800, Procedures of the Advisory Council on Historic Preservation for the protection of historic properties. If this project is considered for federal assistance, or requires a federal permit or license, it should be submitted to our office with reference to the assisting federal agency.

Please contact us at (651) 296-5462 if you have any questions regarding our comments on this project.

Sincerely,

Dennis A. Gimmestad
Government Programs and Compliance Officer

345 Kellogg Boulevard West / Saint Paul, Minnesota 55102-1906 / Telephone (651) 296-6126

APPENDIX E

PUBLIC COMMENTS ON EA SCOPING DOCUMENT

E1 **Minnesota Center for Environmental Advocacy Comments on the EA Scope – Janette Brimmer**

E2 **Calpine Comments on EA Scope - Jason Goodwin**

E3 **Minnesota Soybean Growers Association Comments on the EA Scope – Ron Jacobsen**

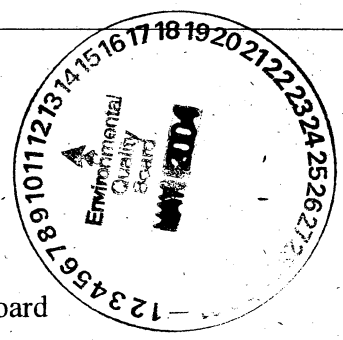
E1

Minnesota Center for Environmental Advocacy Comments

--Janette Brimmer

Minnesota Center for
Environmental Advocacy

26 East Exchange Street - Suite 206
Saint Paul, MN 55101-1667
651.223.5969
651.223.5967 fax
mcea@mncenter.org
www.mncenter.org



May 10, 2004

Mr. Robert Schroeder, Chair
Minnesota Environmental Quality Board
658 Cedar Street, Room 300
St. Paul, Minnesota 55155

Attn: Alan Mitchell and George Johnson

Re: ME3 Comments Regarding the Environmental Review Scoping of Certificate of Need/Sitting Applications by Mankato Energy Center, LLC EQB Docket No. 04-76-PPS Calpine

Dear Mr. Schroeder:

In response to a request by the Minnesota Center for Environmental Advocacy ("MCEA") on behalf of Minnesotans for an Energy Efficient Economy ("ME3") on March 12, 2004, the Minnesota Public Utilities Commission issued its order of April 6, 2004, finding Calpine's application substantially complete, contingent upon Mankato Energy's submission of "the analysis of a wind-gas combination as recommended by ME3...." (see Exh. A).

In response, Calpine's memorandum of March 29,2004, (see Exh. B), discussed in a preliminary fashion the benefits inherent in combining wind and gas on a macro scale, due to the ability of a gas plant to follow the wind generation, thus helping to maintain system reliability where wind energy constitutes a significant portion of the area mix. Additionally, the "proposed location of the facility ...is ideal for complementing the wind energy generated" at Buffalo ridge because energy from the plant will follow similar transmission paths as that wind generated energy into the Twin Cities.

Several recently completed U.S. studies of wind integration support some important insights. The key issue is not whether a system with a significant amount of wind capacity can be operated reliably, but rather the extent to which wind variability increases operating cost impacts. These impacts potentially include regulation, load following and unit commitment. It is clear from the studies to date that, even at moderate wind penetrations, the need for additional generation to compensate for wind variations is substantially less than one-for-

one.[1] The addition of a large natural gas fired generator in the region should help mitigate the operating impacts for new wind generation. Also, the new wind energy provides quantifiable benefits to the natural gas generation through price stability and the mitigation of fuel price risk within the resource portfolio[2].

We expect that Mankato Energy will be submitting a more refined and detailed outline of the scope of the discussion to be included in the Environmental Report/Assessment of the synergies between the proposed new plant and current and future wind resources in Minnesota. Due to the critical importance of examining the relationship between gas fired and wind generated sources in Minnesota, especially between this facility and existing and potential wind resources in southwestern Minnesota, we suggest that at a minimum discussion include;

1. An additional section should be included to address the impacts of the facility on state energy supplies, particularly wind power, pursuant to MS 216B. 243 requiring an examination of the relationship of the facility to overall state energy needs.

   The State's Renewable Energy Objective, set forth in MS 216B.1691 will result in a gradually increasing percentage in the amount of wind energy and other renewable energy generation, an amount which should reach ten percent of retail sales of electricity in Minnesota by 2015 (in addition to the requirements imposed upon Xcel as a result of the Prairie Island compromise). Thus, the discussion should address the needs of the present and future expected wind generation in Minnesota during the expected life of the proposed facility for support from gas generation at this facility.

2. Minn Rule 7849.0120 requires as a part of the CON decision, a consideration of the whether the absence of the facility would be adverse to the future adequacy, reliability or efficiency of energy supply to the people of Minnesota and neighboring states. An examination of the synergistic effects of the proposed facility on those factors through support of new and existing wind resources is appropriate.

3. The applicant should provide the specifics of the facility's potential to interface with wind. We suggest that the discussion include:

   a. Identify and discuss qualitatively the synergies between natural gas generation and wind power including mitigation of the operating impacts of variable wind power, economic benefits of price stability as a hedge and of portfolio diversity, increased utilization of transmission facilities through the transportation of non-firm wind energy on when the proposed plant is operating at less than full capacity;

---

[1] Smith, C., DeMeo, E.; *Wind Power Impacts on Electric-Power-Operating Costs, Summary and Perspective on Work Done to Date*. Utility Wind Interest Group, November 2003. http://www.uwig.org/UWIGOpImpFinal11-03.pdf

[2] *Quantifying the Value that Wind Power Provides as a Hedge Against Volatile Natural Gas Prices* Bolinger, M., R. Wiser and W. Golove, June 2002. http://eetd.lbl.gov/ea/EMS/reports/50484.pdf

b. Analyze the Xcel North (Northern States Power) control area, generation and load, with and without the proposed new plant and identify the approximate amount of new wind generation supportable by the new plant through mitigation of operating impacts;

c. Identify what additional technology, if any, is required for the plant to provide support to the wind generation identified above;

d. Quantify approximate economic benefits that would result from the price stability of wind energy as a hedge against volatile natural gas prices and portfolio diversity.

4. Discuss the alternative of substituting wind power for the facility itself, or at least the portion for which a CON is sought in this matter.

Thank you for providing us with the opportunity to comment on this matter,

Sincerely,

Janette K Brimmer
Legal Director, MCEA
On behalf of ME3

Enclosures

JB:mb

Reply to Comments of Minnesota Center for Environmental Advocacy
Completeness Review of the Application of Certificate of Need for the Mankato Energy Center

DATE: March 29, 2004

DOCKET NO: IP-6345/CN-03-1884

RESPONDANT: Jason Goodwin

REFERENCE: Minnesota Rule 7849.0250, Item B

---

1. Minnesota Rule 7849.0250, Item B – Availability of Alternatives to the Facility

Wind-Gas Combination Alternative

Mankato Energy addressed the alternative of replacing the portion of the Facility that is the subject of the Application with a wind plant. See Section 5.2.12.1 of the Application. As noted in the Application with respect to renewable alternatives in general, Calpine Corporation, the parent company of Mankato Energy, has never developed, constructed, owned, or operated renewable generating facilities other than geothermal plants, nor is it in Calpine's corporate mandate to develop, own, or operate such facilities. With respect to the specific alternative of wind generation, Mankato Energy stated:

> The relatively small size of the Facility site effectively precludes the use of wind technology due to the need for large spaces between the windmills. The lack of space would preclude installation of any significant wind generating capacity at the site. In addition, despite recent improvements to increase the reliability and decrease the costs associated with wind power, these measures both fall short of the reliability and cost associated with the generation that is the subject of this Application.

The Minnesota Center for Environmental Advocacy ("MCEA"), in comments submitted to the Commission on March 12, 2004, suggested that a combination of wind energy and natural gas should be included in the docket. MCEA noted that such an alternative "may involve purchased wind power, and would not need to be limited to the site of the natural gas generation facility." MCEA went on to note that "[t]here is the potential that such an alternative could provide the same capacity value as the Calpine proposal, but with lower energy costs."

The threshold issue of whether Calpine is willing to develop, own, or operate a wind plant exists with either the stand-alone alternative addressed in the Application or the combination wind-gas alternative suggested by MCEA. Because Calpine is not willing to enter into a business outside of its corporate mandate, the alternative of a wind-gas project would be made contingent upon entering into a contract, i.e., a purchase power

agreement, with another entity for the acquisition of the wind-generated capacity. The Commission, in its February 6, 2004 Order Granting Exemptions from Filing Requirements and Limiting Scope, *In the Matter of the Application of Calpine Corporation for a Certificate of Need for a Large Electric Generating Facility*, specifically exempted Mankato Energy from discussing the purchased power alternative. This same reasoning applies to any other suggested combination of gas-renewable alternatives available in Minnesota.[5]

Further (and without conceding the need to discuss this issue past the threshold described above), from a practical standpoint the wind-gas alternative *in this proceeding* just does not make sense. Assuming Mankato Energy were to purchase wind energy then resell it as part of its energy resources in Minnesota, the cost of that sale would always be greater than were the provider of the wind energy to sell the energy directly to the ultimate purchaser because, if for no other reasons, there would be no "middle man" or transaction costs involved.

From an environmental standpoint, the impacts associated with the wind-gas alternative would, by definition, always be greater than those impacts associated with the project proposed by Mankato Energy. Mankato Energy has proposed to incrementally expand the portion of the Facility that is exempt from the CON process by adding certain pieces of machinery and equipment that are compatible with the machinery and equipment that comprise the portion of the Facility that is exempt from the CON process. Those pieces of machinery and equipment and the impacts associated therewith would be a part of the overall wind-gas alternative. Adding the impacts associated with the wind portion of the alternative – land use impacts, noise impacts, visual impacts, impacts on birds, etc. – would always be incrementally more than were the natural gas project proposed by Mankato Energy to be constructed without the wind portion of the suggested alternative.

Having pointed out the inappropriateness of the wind-gas combination alternative *in this proceeding*, Mankato Energy is well aware of the benefits inherent in combining these generating sources on a macro scale. On such a scale, combined cycle power generation is extremely complementary with wind generation due to the ease with which the combined cycle generation can follow the energy production of a wind plant or system of wind plants. When operating, a combined cycle plant can "follow" the wind load by ramping up and down quickly. When the wind is blowing hard, the combined cycle plant can be ramped down; when the wind is not blowing or is blowing too softly to turn the wind turbines, the combined cycle plant can be ramped up. Coal and nuclear plants cannot match this ability. In situations where the combined cycle plant is not operating and additional power must be brought on line to make up for a decrease in wind energy delivered into the grid (whether due to the fact that the wind is not blowing or for any other reason), the combined cycle plant is able to meet the demand much more quickly than a coal or nuclear plant, and at a much higher efficiency level than a coal-fired plant. This ability helps to maintain system reliability in areas where wind energy constitutes a significant portion of the area energy mix.

---

[5] Calpine Corporation is the world's largest generator of renewable geothermal power. As noted in the Application, geothermal energy production is not considered feasible in Minnesota.

On a more project-specific basis, the proposed location of the Facility within the Minnesota electrical grid is ideal for complementing the wind energy generated in the Buffalo Ridge area. This is because the energy from the Buffalo Ridge area follows the same path into the Minneapolis/St. Paul area as would the energy generated by the Facility. Strategically located combined cycle generating plants – like the Mankato Energy Center – will help maintain the reliability of the electric grid as more wind generation is brought on line.

BEFORE THE MINNESOTA PUBLIC UTILITIES COMMISSION

LeRoy Koppendrayer	Chair
Marshall Johnson	Commissioner
Ken Nickolai	Commissioner
Phyllis A. Reha	Commissioner
Gregory Scott	Commissioner

In the Matter of the Application of Calpine Corporation for a Certificate of Need for a Large Electric Generating Facility

ISSUE DATE: April 6, 2004

DOCKET NO. IP-6345/CN-03-1884

ORDER FINDING APPLICATION SUBSTANTIALLY COMPLETE CONTINGENT UPON ADDITIONAL FILING AND REFERRING MATTER TO THE OFFICE OF ADMINISTRATIVE HEARINGS

PROCEDURAL HISTORY

On November 14, 2003, Calpine Corporation (Calpine) filed a petition stating that it intended to submit an application for a certificate of need to construct a natural-gas-fired combined cycle electric-generating facility at a site near Mankato. The petition requested exemptions from certain data requirements in the certificate of need rules,[1] claiming that the data in issue is not applicable to a generation project proposed by an independent power producer, not reasonably available to Calpine or not necessary to determine the need for the proposed facility.

Calpine's petition also requested that the Commission confirm that the scope of the required data should relate only to power generated for the wholesale market, excluding data related to power production already certified through a Commission-approved resource plan solicitation.[2]

On February 6, 2004, the Commission issued its ORDER GRANTING EXEMPTIONS FROM FILING REQUIREMENTS AND LIMITING SCOPE. The Order granted Calpine's request for exemptions from specific data requirements and also granted Calpine's request to limit the scope of its certificate of need application with certain qualifications.

On March 2, 2004, Mankato Energy Center, LLC (Mankato Energy), a wholly owned subsidiary of Calpine, filed its certificate of need application for the portion of the plant that is not included in

[1] Minn. Rules, parts 7849.0010 et seq.

[2] See Minn. Stat. § 216B.2422, subd. 5.

a pending contract with Northern States Power Company d/b/a Xcel Energy (Xcel), pursuant to a Commission approved bidding process.[3]

On March 12, 2004, the Department of Commerce and Minnesotans for an Energy-Efficient Economy (ME3) each filed comments on the completeness of Mankato Energy's application.

On March 23, 2003, the Purchased Power Agreement (PPA) between Xcel and Mankato Energy was submitted for approval in Docket No. E002/M-04-451.

The matter came before the Commission on March 23, 2004.

FINDINGS AND CONCLUSIONS

I. Mankato Energy's Proposal

Mankato Energy proposed building a power plant using natural gas-fired combustion turbines in a combined cycle configuration, which will be capable of generating approximately 655 megawatts (MW) of electric power at summer ambient conditions and 730 MW at winter ambient conditions. This generating capacity includes both baseload capacity (approximately 505 MW) and peaking capacity (approximately 150 MW) to be obtained from power augmentation equipment.

The facility will use natural gas with low-sulfur distillate oil as a back-up fuel. The facility as a whole will include two combined cycle combustion turbine generators, two heat recovery steam generators equipped with duct burners, one steam turbine generator/condenser, and one multi-cell mechanical draft-cooling tower, and various other machinery and equipment.

Mankato Energy has committed to supply approximately 375 megawatts of power to Xcel after being selected in a bidding process approved by the Commission. Mankato Energy will offer the power not committed to Xcel in the PPA to wholesale customers, including Minnesota utilities and cooperatives.

In the application herein, Mankato Energy seeks a certificate of need for the wholesale power production of the facility. This portion of the facility could produce 355 MW at ambient winter conditions and 325 MW at summer ambient conditions.

The portion of the facility that will generate the wholesale power includes one combustion turbine, one heat recovery steam generator and two additional cells on the cooling tower. In addition, both the lateral natural gas pipeline connection and the water supply and discharge pipelines will be slightly larger than they would be if the facility was built only to satisfy the requirements of the PPA.

---

[3] *In the Matter of Northern States Power Company's Application for Approval of its 2000-2014 Resource Plan,* Docket E-002/RP-00-787, ORDER APPROVING XCEL ENERGY'S 2000-2014 RESOURCE PLAN, AS MODIFIED (August 29, 2001).

The facility site is approximately 25 acres in size and is located north of the Mankato City limits within Lime Township. It will connect to the Northern Natural Gas pipeline approximately four miles east of the site and will have direct access to the transmission grid at the Wilmarth Substation approximately 1,500 feet west of the site. Mankato Energy is planning to have the facility in-service by mid-2006.

II. General Requirements

The generation facility described in Mankato Energy's application falls under the definition of "large energy facility" in Minn. Stat. § 216B.2421, subd. 2 (1). Therefore, in accordance with Minn. Stat. § 216B.243, subd. 2, the generation portion of the project, as described in the application, cannot be sited or constructed in Minnesota unless the Commission issues a certificate of need to the Applicant. The certificate of need rules that specify application requirements are Minn. Rules, parts 7849.0010 to 7849.0400.

III. APPLICATION SUBSTANTIALLY COMPLETE

A. Applicable Rule

Minn. Rules, part 7849.0200, subp. 5 states as follows:

> **Complete applications.** The commission must notify the applicant within 30 days of the receipt of an application if the application is not substantially complete. On notification, the applicant may correct any deficiency and may resubmit the application. If the revised application is substantially complete, the date of its submission is considered the application date.

B. DOC's Recommendation

The DOC recommended that the Commission find the application complete pending the submission of the following data:

- Minn. Rules, part 7849.0250, A(3) – a projection of the availability of fuel over the projected life of the facility, and any alternate fuels.
- Minn. Rules, part 7849.0250, C(9) – major assumptions in providing the information for the proposed project and its available alternatives, including the projected escalation rates for fuel costs and operating and maintenance costs.
- Minn. Rules, part 7849.0310 and 7849.0320 – environmental information on the proposed facility and for each alternative considered.

The DOC also recommended that Mankato Energy provide a status report on the PPA to be entered into between Mankato Energy and Xcel.[4]

---

[4] The PPA was filed on March 23, 2004.

Finally, the DOC indicated that it would not oppose condensing the need and the permitting process if the Commission and the Environmental Quality Board (EQB) conclude that a joint hearing is reasonable, more efficient and may further the public interest.

C. Mankato Energy's Response

At hearing, Mankato Energy agreed to provide the supplementary information requested by the DOC. Mankato Energy also indicated that it supported a joint hearing with the EQB and referral of the matter to the OAH for a contested case proceeding.

D. ME3

ME3 argued that the Mankato Energy should be required to provide an analysis of a wind-gas combination alternative to the proposed facility, as provided for in Minn. Rules, part 7849.0250 B(5). ME3 argued that such an alternative might provide the same value as the Mankato Energy proposal, but with lower energy costs.

E. Commission's Analysis and Action Regarding Completeness of the Application

The Commission finds that contingent upon Mankato Energy's submission of the supplementary material that addresses each item found lacking by the Department, and the analysis of a wind-gas combination as recommended by ME3, Mankato Energy's application is substantially complete within the meaning of Minn. Rules, Part 7849.0200, subp. 5.

Likewise , as provided by the rule, the date that the supplemental material is filed will be considered the application date for purposes of beginning the Commission's six-month review period.

The Commission further clarifies that the Applicant's obligation to provide information about its proposed project does not end with a finding that its application is substantially complete. Any remaining concerns about the accuracy or breadth of the filed information can, of course, be addressed with discovery requests and tested during the course of the proceeding.

IV. CONTESTED CASE PROCEEDING APPROPRIATE

If the proceeding were started as an informal proceeding but factual disputes arose later, the proceeding could take more time than if it were started as a contested case. In addition, Minn. Stat. § 216B.243, subd. 4 indicates that the Commission "shall hold at least one public hearing pursuant to chapter 14." Someone will have to run that hearing and administrative law judges are accustomed to performing that role.

In these circumstances, therefore, the Commission finds that treating this matter as a contested case at the outset is administratively efficient and prudent, particularly in light of the tight timeline established for reaching a decision on the merits of this application.

Accordingly, the Commission will refer Mankato Energy's application to the Office of Administrative Hearings for a contested case proceeding. The Commission is issuing a NOTICE AND ORDER FOR HEARING before the Administrative Law Judge (ALJ) assigned to this matter contemporaneously with this Order.

V. PROSPECT OF JOINT HEARINGS

The Commission has responsibility to determine whether to grant a certificate of need for the project in question and the EQB has the responsibility to grant or deny a site permit for the project.

Minn. Stat. § 216B.243, subd. 4 provides that a joint hearing may be held on siting and need issues if the Commission and the EQB determines that a joint hearing on the siting and need is feasible, more efficient, and may further the public interest.[5]

At the hearing on this matter, the Department and Mankato Energy stated their belief that joint hearings on the Company's application to the EQB for site and route permits and on its application to the Commission for a certificate of need would be more efficient than separate hearings, since the time frames of these applications are essentially the same and the people and parties interested in these matters are also largely the same.

The Commission favors administrative efficiencies in general, consistent with due consideration to the issues to be addressed. Accordingly, it will approve joint hearings in this case and authorize its staff to request that the ALJ adopt a hearing schedule that provides for at least some joint hearings in this matter, if the EQB similarly agrees that joint hearings are appropriate.

ORDER

1. The Commission shall require Mankato Energy to submit a supplement to its application containing the following information:

   a. Minn. Rules, part 7849.0250, A(3) – a projection of the availability of fuel over the projected life of the facility, and any alternate fuels.

   b. Minn. Rules, part 7849.0250, C(9) – major assumptions in providing the information for the proposed project and its available alternatives, including the projected escalation rates for fuel costs and operating and maintenance costs.

   c. Minn. Rules, part 7849.0310 and 7849.0320 – environmental information on the proposed facility and for each alternative considered.

   d. Minn. Rules, part 7849.0250 B(5) – an analysis of a wind-gas combination alternative.

2. Mankato Energy's application shall be accepted as substantially complete contingent upon the filing of the supplementary information required in ordering paragraph 1. Additional information may have to be provided by Mankato Energy to the EQB and the DOC to facilitate preparation of an environmental review document and a thorough review of the proposed project.

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[5] Similarly, see Minn. Rules, Part 4410.7060, subp. 4

3. The date the supplementary materials are filed shall be the official application date for Mankato Energy's proposal.

4. The Commission refers this matter to the Office of Administrative Hearings for a contested case proceeding, including the public hearing required as part of the review of a Certificate of Need Application for a large energy facility.

5. Pursuant to Minn. Stat. § 216B.243, subd. 4, the Commission hereby approves holding joint hearings on the issues raised in 1) the Company's siting petition to the EQB and 2) the Company's application for certificate of need in this docket. If joint hearings are acceptable to the EQB, Commission Staff is authorized to request at the prehearing conference, held pursuant to the Commission's referral of this matter to the Office of Administrative Hearings, that the Administrative Law Judge (or Judges) assigned to the case adopt a schedule that includes joint hearings on the siting and need issues.

6. This Order shall become effective immediately.

BY ORDER OF THE COMMISSION

Burl W. Haar
Executive Secretary

(S E A L)

This document can be made available in alternative formats (i.e., large print or audio tape) by calling (651) 297-4596 (voice), or 1-800-627-3529 (MN relay service).

E2

Calpine Comments - Jason Goodwin

CALPINE

4160 UNDERWOOD ROAD
PASADENA, TEXAS 77507
832.476.4400 (DIRECT)
281.291.7089 (FAX

May 8, 2004

Mr. George Johnson
Minnesota Environmental Quality Board
Department of Administration
Suite 300
658 Cedar Street
St. Paul, MN 55155

Re: Comments on Mankato Energy Center's Environmental Assessment Scoping Document; EQB Docket No. 04-76-PPS-Calpine

Dear Mr. Johnson:

Mankato Energy Center, LLC ("MEC") would like to propose the following amendments to the draft Environmental Assessment Scoping Decision, which you sent to interested parties on April 29, 2004:

1. MEC requests the addition of a new section to discuss the impacts of the proposed project on state energy supplies, including wind power. This section would consider some of the significant legal requirements and policy matters relevant to PUC's approval, including "the relationship of the proposed facility to overall state energy needs" (Minn. Stat. § 216B.243, subd. 3(3) (showing required for certificate of need ("CON")); the satisfaction of the renewable power mandates (Minn. Stat. § 216B.1691); the compatibility of the proposed project with the state's current energy mix both in terms of fuel diversity and type of generation resource (e.g., baseload, intermediate, and peaking) (Minn. Stat. § 216C (promoting balanced energy planning and conservation)); and whether "the probable effect of denial would be an adverse effect upon the future adequacy, reliability or efficiency of energy supply to the people of Minnesota and neighboring states" (Minn. R. § 7849.0120 (criteria for granting CON)).

2. MEC requests Section 3.2 ("Natural Gas/Wind Combination") include the following clarification: "This alternative will address the possibility of substituting wind generated power for the power proposed to be generated by the non-exempt portion of the facility."

3. MEC requests Section 3.0 ("Alternatives to the Proposed Power Plant") be amended to include two additional alternatives raised by MEC in its CON application (see CON Application at pages 5-10 to 5-12, 5-16 to 5-17):

(a) Oil Combustion Alternative: Oil-fired Combined Cycle Turbine
(b) Simple Cycle Combustion Turbine Alternative

George Johnson
May 8, 2004
Page 2

If you have any questions regarding these comments, please contact me by phone at 832.476.4463 or by email at jgoodwin@calpine.com.

Sincerely,

Jason M. Goodwin, P.E.
Manager – Safety, Health, Environmental
Midwest Power Region
On Behalf of Mankato Energy Center, LLC

cc: Burl W. Haar, Executive Secretary, PUC
Kathy Aslakson, MN Dept. of Commerce
Karen Finstad Hammel, Assistant Attorney General
Alan R. Mitchell, Environmental Quality Board
B. Andrew Brown, Dorsey & Whitney LLP
Kent Morton, Calpine Corporation
Janet Shaddix Elling, Shaddix & Assoc.
Charles Dayton, MCEA
Michael Noble, ME3
George Crocker, NAWO
Kristen Eide-Tollefson, CURE

E3

Minnesota Soybean Growers Association Comments - Ron Jacobsen

Minnesota Soybean Growers Association

360 Pierce Avenue, Suite #110, North Mankato, MN 56003
Phone (507) 388-1635 • Fax (507) 388-6751
Toll-free (888) 896-9678 • www.mnsoybean.org

June 30, 2004

George E. Johnson
Energy Facility Permitting
Minnesota Environmental Quality Board
658 Cedar St., Room 300
St. Paul, MN 55155

Re: Calpine / Mankato Energy Park Environmental Assessment

Dear Mr. Johnson,

On behalf of the Minnesota Soybean Growers Association and the Blue Earth County Soybean Growers Association, I am writing to request that the Environmental Quality Board consider the possibilities of utilizing biodiesel, biodiesel blends or other soybean oil based fuels as "backup" fuels for the new natural gas fired power plant being considered in Mankato, MN.

As you may be aware, biodiesel is a clean burning, renewable fuel made from soybean oil and other ag-based products farmers produce right here in Minnesota. Biodiesel is one of the fasted growing renewable fuels in the US with over 25 million gallons of pure biodiesel being sold last year.

While most of the research and development on biodiesel has been completed for use in reciprocating internal combustion diesel engines, such as those used in transportation trucks, biodiesel is now being considered for other applications where diesel fuel is used. In particular, biodiesel usage for diesel-powered electrical generators has been experiencing tremendous interest around Minnesota, as well as other parts of the US. In this area of biodiesel research and development Minnesota is a leader. Through our cooperative efforts with the University of Minnesota, the Center for Diesel Research has become the leading authority in this area as well as they first in the nation to do cutting edge work on the use of minimally processed soybean oil that could be directly burned as fuel for gas turbine generators, like what's being considered for the Calpine plant in Mankato.

We feel that there is an opportunity to enhance this project by not only lessening our dependence on natural gas and the diesel fuel back-up fuel but it would help build a growing market for Minnesota's soybean farmers.

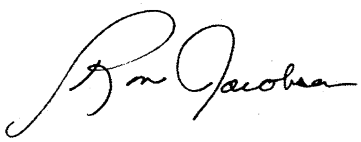
Minnesota is the third largest soybean producing state in the US producing over 300+ million bushels of soybeans annually. That 300 million bushels equates to over 450 million gallons of soybean oil produced every year. Currently we export about 50% of our production out of Minnesota and a portion of the oil that is processed here goes to the food industry, we still have plenty to supply a substantial biodiesel market. It seems strangely coincidental that the Calpine

plant will be located in Mankato, a town that is also recognized as the #1 soybean-processing town in all of North America. With the Archer Daniels Midland (ADM) and Cenex Harvest States (CHS) plants able to crush over 200,000 bushels of soybeans per day, 350+ days per year, a potential ready source of energy for this project. ADM and CHS are not planning on producing biodiesel at this time, but there are plans being finalized right now for three new biodiesel plants within 100 miles of Mankato. These new biodiesel plants would have the combined capacity of over 60+ million gallons of biodiesel production per year making Minnesota the largest biodiesel producing state in the nation. The first plant is scheduled to come on-line this October with the other two slated for April of 2005.

Thus, as I stated earlier, we would like to request that the EQB address the use of biodiesel, biodiesel blends or other soyoil products in the Environmental Assessment for this project. We asked our friends at the Center for Diesel Research to provide you with the attached information about biodiesel and it's possible use in this application.

We thank you for your consideration and if you have questions please feel free to contact Mike Youngerberg, our staff person in our Mankato office at 888-896-9678.

Sincerely,



Ron Jacobsen
President

CC: Blue Earth County Directors
Ken Bickel
Mark Lindquist

Attachments (2)

APPENDIX F

WIND – GAS ANALYSIS FROM CALPINE

WIND GAS ANALYSIS by R.M. Zavadil June 17, 2004

1.1 INTRODUCTION

Wind generation is the fastest growing form of electric generation in the world. Minnesota has been a leader in new wind generation development since the mid-1990's, and is currently ranked third behind California and Texas in installed capacity. Minnesota ranks ninth in the country in wind generation potential, and with the current broad-based support for wind generation will likely see a substantial increase in installed capacity over the coming decade.

The Xcel Energy control area in Minnesota currently has about 400 MW of wind generation. Xcel Energy is committed to increasing the amount to at least 825 MW over the next few years. They are also co-sponsoring a study with the Minnesota Department of Commerce to assess how up to 1500 MW might be integrated into their control area operations by the year 2010. Other utilities operating in the state of Minnesota, such as Great River Energy, are also in the process of assessing how substantial amounts of wind generation would perform in their overall resource portfolio.

Wind generation is a clean, renewable, and increasingly cost-effective source of electric energy. Electric energy production from a wind plant over a period of time – months, years, or the life of the project – can be estimated accurately enough to secure financing for the large amount of capital to construct the Facility. Over shorter time frames, however, production is less predictable. One of the most significant barriers to further development of wind generation in the U.S. stems from the fact that the processes and procedures for the design, planning, and operating of large interconnected utility systems, are necessarily biased toward resource capacity – the rate of energy transfer to the grid, not the amount delivered over a longer period of time - to insure the adequacy, reliability, and security of the electric supply for all end-users. Integrating large amounts of wind energy into the larger portfolio of electric generation resources requires some special considerations on the part of those charged with operating the electric system. Substantial amounts of wind generation in a utility system can increase the demand for the various non-revenue-generating actions that are the subject of the next section. The ability of and cost to the control area to provide the required level of these services for successful integration depends on the makeup of its generating fleet, agreements with neighboring control areas, or the existence of competitive markets for such services. While the various conventional electric generating technologies are able to provide some level of integration services, certain technologies such as combustion turbines operating in combined cycles may be more appropriate from the cost and capability perspective.

1.2 ANCILLARY SERVICES FOR INSURING POWER SYSTEM RELIABILITY AND SECURITY

Interconnected power systems are large and extremely complex machines. The mechanisms responsible for their control must continually adjust the supply of electric energy to meet the combined and ever-changing electric demand of the systems users. There are a host of constraints and objectives that govern how this is done. In total, however, those actions must result in:

- Keeping voltage at each node (a point where two or more system elements – lines, transformers, loads, generators, etc. – connect) of the system within prescribed limits;
- Regulating the frequency (the steady electrical speed at which all generators in the system are rotating) of the system to keep all generating units in synchronism; and
- Maintaining the system in a state where it is able to withstand and recover from unplanned failures or losses of major elements.

"Ancillary services" is the term generally used to describe the actions and functions related to the operation of a control area within an interconnected electric power system necessary for maintaining performance and reliability. While there is no universal agreement on the number or specific definition of these services, the following list generally encompasses the range of technical aspects that must be considered for reliable operation of the system:

- Regulation – the process of maintaining system frequency by adjusting certain generating units in response to fast fluctuations in the total system load;
- Load following – ramping generation up (in the morning) or down (late in the day) in response to the daily load patterns;
- Frequency-responding spinning reserve – maintaining an adequate supply of generating capacity (usually on-line, synchronized to the grid) that is able to quickly respond to the loss of a major transmission network element or another generating unit;
- Supplemental Reserve – managing an additional back-up supply of generating capacity that can be brought on line relatively quickly to serve load in case of the unplanned loss of operating generation; and
- Voltage regulation and VAR dispatch – deploying devices capable of controlling reactive power[54] to manage voltages at all points in the network.

These ancillary services are critical for maintaining the reliability and security of the electric grid. For any foreseeable combination of equipment failures or mis-operation, operating generating units must remain synchronized to prevent cascading equipment outages and subsequent blackouts.

Historically, a single entity had complete autonomy over operation of the generation and transmission assets in a service territory and the responsibility for operating them in a manner to achieve high reliability at the lowest cost. Ancillary services are tools for achieving these goals. With the deregulation of the wholesale electric power industry, the institutional responsibility for certain of these functions in some regions of the country is being been reallocated. Their

[54] Electric machinery requires two components of current to operate: power producing current and magnetizing current. Power producing or working current is current that is converted by the equipment into work. The unit of measurement of active power is the Watt. Magnetizing current, also known as reactive current, is the current required to produce the flux necessary to the operation of electromagnetic devices. Without magnetizing current, energy could not flow through the core of a transformer or across the air gap of an induction motor. The unit of measurement of reactive power is the VAR. Management of reactive power is the primary mechanism for controlling voltage at points within the network. System operators dispatch various devices capable of producing reactive power, including generators, shunt capacitor banks, static VAR compensators, etc., to control voltages in response to continually varying customer demand.

technical reality, however, has not been changed in that they must still be provided somehow, some way, by someone.

The implementation of competitive markets for ancillary services is in its relative infancy and is not uniform across the country. The emergence of market competition, in any form, has changed many of the procedures and processes for power system control and operation. Bidding supply into markets for the next hour or next day has replaced the historical top-down decision making process used to commit and schedule generating units. Some bi-lateral agreements between neighboring utilities for exchanging economic energy on short notices have been supplanted by spot markets. Planning for the appropriate level of reserve supply is now in some locales the function of capacity markets.

1.3 ANCILLARY SERVICE REQUIREMENTS FOR WIND GENERATION

Much of the concern over how significant amounts of variable wind generation can be integrated into the operation of a control area stems from the inability to predict accurately what the generation level will be in the minutes, hours, or days ahead. The nature of control area operations in real-time or in planning for the hours and days ahead is such that increased knowledge of what will happen correlates strongly to better strategies for managing the system. Much of this process is already based on predictions of uncertain quantities. Hour-by-hour forecasts of load for the next day or several days, for example, are critical inputs to the process of deploying electric generating units and scheduling their operation. While it is recognized that load forecasts for future periods can never be 100 percent accurate, they nonetheless are the foundation for all of the procedures and processes for operating the power system. Increasingly sophisticated load forecasting techniques and decades of experience in applying this information have done much to lessen the effects of the inherent uncertainty.

The nature of its fuel supply is what distinguishes wind generation from more traditional means for producing electric energy. The electric power output of a wind turbine generation is primarily a function of the speed of the wind passing over its blades. The speed of this moving air stream exhibits variability on a wide range of time scales – from seconds to hours, days, and seasons. The degree to which these variations can be predicted with some level of accuracy also varies. It should be noted that this is not an entirely unique situation for electric generators. Hydroelectric plants, for example, depend on water storage that can vary from year to year or even seasonally. Generators that rely on natural gas as their sole fuel source can be subject to supply disruptions or storage limitations. That said, the overall effects of the variable fuel supply are significantly larger for wind generation.

Impacts on the operation of the transmission grid and the control area relative to wind generation are dependent on the performance of the wind plants within that area as a whole, as well as on the characteristics of the aggregate system load and the generation fleet that serves it. Large wind generation facilities that are connected directly to the transmission grid employ large numbers of individual wind turbine generators. Individual wind turbine generators that comprise a wind plant are usually spread out over a significant geographical expanse. This has the effect of exposing each turbine to a slightly different fuel supply. This spatial diversity has the beneficial effect of "smoothing out" some of the variations in electrical output.
The benefits of spatial diversity are also apparent on larger geographical scales, as the combined output of multiple wind plants will be less variable than with each plant individually.

The system load itself exhibits some unpredictable variations, both within an hour and over the course of the day. Because system operators are concerned with the balance of net load to net generation in their control area, load and wind variations cannot be considered separately. The impact of uncorrelated variations in load and wind over time will be considerably less than the arithmetic sum of the individual variations. This aggregation effect is already a critical part of control area operations, as responding to or balancing the variations in individual system loads, rather than the aggregate, would be exorbitantly complicated and expensive, as well as non-productive.

Wind generation forecasting is acknowledged to very important for continued growth of the industry. Despite the increasingly sophisticated methods used to forecast wind generation, and the improving accuracy thereof, it is certain that large amounts of wind generation within a grid control area will increase the overall demand for ancillary services. Very large amounts of wind generation may result in redeployment of certain existing generating units, as the projected costs of wind energy going forward are expected to continue declining. Higher cost conventional units would then be displaced, possibly being relegated to assisting with the management of the control area, which is the subject of the following paragraphs.

1.4 ASSESSMENTS OF ANCILLARY SERVICE REQUIREMENTS AND IMPACTS ON POWER SYSTEM OPERATIONS

Within the wind industry and for those transmission system operators who now have significant experience with large wind plants, the attention has turned to not whether wind plants require such support but rather to the type and quantity of such services necessary for successful integration. With respect to the ancillary services listed earlier, there is a growing emphasis on better understanding how significant wind generation in a control area affects operations in the very short term – i.e., real-time and a few hours ahead – and planning activities for the next day or several days.

Recent studies considering the impact of wind generation facilities on real-time operation and short-term planning for various control areas are summarized in Reference [1]. The methods employed and the characteristics of the power systems analyzed vary substantially. There are some common findings and themes throughout these studies, however, including:

- Despite differing methodologies and levels of detail, ancillary service costs resulting from integrating wind generation facilities are relatively modest for the growth in U.S. wind generation expected over the next three to five years.
- The cost to the operator of the control area to integrate a wind generation Facility is obviously non-zero, and increases as the ratio of wind generation to conventional supply sources or the peak load in the control area increases.
- For the penetration levels considered in the studies summarized in the paper (generally less than 20 percent) the integration costs per MWH of wind energy were relatively modest. As penetration levels begin to approach 20 percent, however, the costs begin to rise in a non-linear fashion.

- Wind generation is variable and uncertain, but how this variation and uncertainty combines with other uncertainties inherent in power system operation (e.g. variations in load and load forecast uncertainty) is a critical factor in determining integration costs.
- The effect of spatial diversity with large numbers of individual wind turbines is a key factor in smoothing the output of wind plants and reducing their ancillary service requirements from a system-wide perspective

1.5 WHERE DO ANCILLARY SERVICES "COME FROM"?

Meeting the operational objectives for the power system is accomplished through coordinated control of individual generators as well as the transmission network itself and associated auxiliary equipment such as shunt capacitor banks.

How individual plants are deployed and scheduled is primarily a function of economics. Historically, vertically-integrated electric utilities would schedule their generating assets to minimize their total production costs for the forecast load while observing any constraints on the operation of the generating units in their fleet. In bulk power markets, competitive bidding either partially or wholly supplants the top-down optimization performed by vertically-integrated utilities. In either case, the economics of unit power production have the primary influence on how a plant is scheduled.

In addition, the entity responsible for the operation of the control area – an individual utility or a regional transmission organization, for example – must manage some generating units to regulate frequency and control power exchanges in real time, to make up discrepancies between actual and forecast loads, and provide adequate reserves to cover an unexpected loss of supply.

The efficiency of thermal generating units typically varies with loading, so for each unit there is a point at which the cost of energy produced will be at a minimum. For large fossil-fired and nuclear generating units, the cost of generation generally declines with increasing loading up to rated output. As a result, economics dictate that these units be "base loaded" for as many hours as possible when in operation.[55] Other factors, such as thermodynamic system time constants or mechanical and thermal stresses may also result in certain units being loaded at fairly constant levels while online.

Against these operating constraints for certain units, other generating resources are deployed and scheduled to not only produce electric energy but also to provide the flexibility required by the operators to regulate system frequency, follow the aggregate system load as it trends up in the morning and down late in the day, and provide reserve capacity in the case of a generating unit or tie line failure. Some of these functions are under the auspices of a central, hierarchical control system generally referred to as automatic generation control or AGC. Others are the result of human intervention by the control area operators. In either case, the generating units participating in the system control activities must:

[55]The term "base loaded" is generally used to describe the operation of large generating units with high capital and operating costs but low fuel costs that are loaded to near maximum capability for most of the hours they are in service. In traditional electric utility system planning, the "base load" is sometimes defined as the minimum hourly system demand over the course of a year.

- Be responsive to commands issued by the control area EMS (energy management system), otherwise known as "being on AGC". Participating in AGC generally requires a specific infrastructure for communications with control center SCADA (System Control and Data Acquisition) system.
- Operate such that there is the appropriate "head room" to increase generation or reduce generation without violating minimum loading limits if commanded by the system operator or energy management system.
- Be able to change their output (move up or down, or "ramp") quickly enough to provide the required system regulation

As the electric power industry evolves, it is increasingly likely that third-party generators will play a large role in control area operations through various mechanisms and markets for ancillary services. Once such mechanism is the short-term "imbalance market," sometimes conducted on an interval as short as five minutes, where generators bid to help the control area operators make up for real-time mismatches between control area supply and demand. Capacity markets are being developed in some parts of the country as a means for insuring adequate reserve generation and system reliability.

1.6 CHARACTERISTICS OF A COMBINED CYCLE PLANT

Combined cycle generating facilities that consist of at least one combustion turbine and a steam turbine receiving steam produced from the combustion turbine's hot exhaust are uniquely qualified to provide ancillary services. First, AGC is commonly installed on combined cycle plants allowing them to automatically respond to commands from the control area operator's energy management system. Second, the combustion turbines are able to respond quickly to EMS commands as the system load and generation levels change minute-to-minute and hour-to-hour. Third, they are capable of operating on a unit commitment basis by running for hours or days at a time. While this is the type of service more typically provided by coal or nuclear units, it is helpful to have other means of such generation in the event of an emergency or a technology or regulatory change that precludes operation of the coal or nuclear units.

In addition, unlike simple cycle combustion turbines that discharge their hot exhaust gases to the atmosphere, combined cycle plants recover this energy and produce unit contingent power more efficiently than simple cycle combustion turbine or coal units. Fourth, given their large operating range, they can easily provide spinning and supplemental reserve to address or alleviate major disruptions in transmission or generation units.
Finally, combustion turbine and steam turbine generators can easily change their excitation to absorb or produce VARS (reactive power) in response to power grid voltage fluctuations resulting in a more stable grid.

In summary, the ability of combined cycle plants to provide ancillary services – an ability that wind turbines lack, especially load following – make them an extremely attractive alternative to support wind generation (which is subject to the variability of the wind) and the electric bulk power system in general They are uniquely qualified to easily and efficiently follow the ups and

downs in wind energy production, and can be used to effectively and efficiently manage the system's need for ancillary services.

1.7 APPENDIX H REFERENCES

[1] Parsons, B.P, et. al. "Grid Impacts of Wind Power; A Summary of Recent Studies in the United States" presented at the 2003 European Wind Energy Conference, Madrid, Spain, June 2003.

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[3] Milligan, M. "Windpower and System Operation in the Hourly Time Domain" presented at the 2003 AWEA Windpower Conference, May 18-21, 2003, Austin, TX. NREL/CP-500-33955

[4] Hirst, Eric, "Interaction of Wind Farms with Bulk Power Operations and Markets" prepared for the Project for Sustainable FERC Energy Policy, September 2001

[5] Milligan, M.R. "A Chronological Reliability Model to Assess Operating Reserve Allocation to Wind Power Plants" presented at the 2001 European Wind Energy Conference, July 2-6, 2001, Copenhagen, Denmark. NREL/CP-500-30490

[6] Milligan, M.R. "A Chronological Reliability Model Incorporating Wind Forecasts to Assess Wind Plant Reserve Allocation" presented at 2002 AWEA Windpower Conference, June 3-5, 2002, Portland, OR. NREL/CP-500-32210

[7] Karady, George G., et. al., "Economic Impact Analysis of Load Forecasting", IEEE Transactions on Power Systems, Volume 12, No. 3, August, 1997. pp. 1388 – 1392.

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[9] Hirst, Erich, and Kirby, Brendan, "Separating and Measuring the Regulation and Load Following Ancillary Services" November, 1998 White Paper

[10] Milligan, M.R., et. al. "An Enumerative Technique for Modeling Wind Power Variations in Production Costing" presented at the International Conference on Probabilistic Methods Applied to Power Systems, Vancouver, BC, Canada, September 21-25, 1997. NREL/CP-440-22868

[11] Milligan, M.R., et. al. "An Enumerated Probabilistic Simulation Technique and Case Study: Integrating Wind Power into Utility Production Cost Models" presented at the IEEE Power Engineering Society Summer Meeting, Denver, CO, July 29 – August 1, 1996. NREL/TP-440-21530

[12] Milligan, M.R., "Measuring Wind Plant Capacity Value" NREL White Paper

[13] Milligan, M.R. "A Sliding Window Technique for Calculating System LOLP Contributions of Wind Power Plants" presented at the 2001 AWEA Windpower Conference, Washington, DC, June 4-7, 2001. NREL/CP-500-30363

APPENDIX G

BIODIESEL INFORMATION FROM MINNESOTA SOYBEAN GROWERS ASSOCIATION

Biodiesel and emissions from diesel engines and turbine engines

Background: Biodiesel is a clean burning fuel produced from renewable resources like soybean oil or recycled restaurant grease. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend. It can be used in compression-ignition (diesel) engines with no major modifications. Biodiesel is simple to use, biodegradable, nontoxic, and essentially sulfur-free. Pure biodiesel, designated B100, should meet the requirements of ASTM D 6751 "Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels."

Biodiesel and biodiesel blends: Biodiesel is the pure, or 100 percent, biodiesel fuel. It is referred to as B100 or "neat" biodiesel. A biodiesel blend is pure biodiesel blended with petrodiesel. Biodiesel blends are referred to as Bxx. The xx indicates the amount of biodiesel in the blend (i.e., a B20 blend is 20 percent by volume biodiesel and 80 percent by volume petrodiesel).

There is considerable experience in the U.S with the use of B20. B20 provides significant reduction in emissions, and is less expensive that B100. B20 has been designated as an alternative fuel by the Environmental Protection Agency.

"Low blends", blends of 1%-5% biodiesel, have become common and are available at pumps throughout the Midwest. Minnesota has passed legislation that will require that most of the diesel fuel sold in the state contain 2% biodiesel, beginning in July 2005. The properties of B2 are essentially the same as the base diesel fuel, with the possible exception of fuel lubricity, since small additions of biodiesel can provide a significant increase in lubricity.

Energy balance and greenhouse gas reductions: A 1998 study by the U.S. Department of Energy (DOE) and the U.S. Department of Agriculture (USDA) concluded that biodiesel yields 3.2 units of fuel product energy for every unit of fossil energy consumed in its life cycle.[1] The same study also found that B20 provides a 15.7 percent reduction in CO_2 (the principal greenhouse gas) emissions, and that the overall life cycle emissions of CO_2 from B100 are 78.5 percent lower than those of petroleum diesel.

Biodiesel and emissions from diesel engines: Biodiesel is the first and only alternative fuel to have a complete evaluation of emission results and potential health effects submitted to the U.S. Environmental Protection Agency (EPA) under the Clean Air Act Section 211(b).[2] These programs include the most stringent emissions testing protocols ever required by EPA for certification of fuels or fuel additives.

EPA has also surveyed the large body of biodiesel emissions studies and obtained the average change in engine emissions for B100 and biodiesel blends.[3] These data were obtained from studies of over-the-road engines evaluated under transient engine conditions. The results are given in the table below:

1.8 AVERAGE CHANGE IN EMISSIONS FROM DIESEL ENGINES WHEN USING B100 AND B20

Pollutant	B100	2.0 B20
2.1.1 Regulated Pollutants		
Total Unburned Hydrocarbons	-67%	-20%
Carbon Monoxide	-48%	-12%
Particulate Matter	-47%	-12%
NOx (Nitrogen Oxides)	+10%	+2%
2.1.2 Non-Regulated Pollutants		
Sulfates	-100%	-20%*
PAH (Polycyclic Aromatic Hydrocarbons)**	-80%	-13%
nPAH (nitrated PAH's)**	-90%	50%***
Ozone potential of speciated HC	-50%	-10%

* Estimated from B100 result
** Average reduction across all compounds measured
*** 2-nitroflourine results were within test method variability

Specifications of turbine fuels and biodiesel: The properties of B100 are similar to fuels used in turbines. Appendix A gives a comparison of the requirements for turbine fuels (as specified in ASTM 2880 "Standard Specification of Gas Turbine Fuels), and biodiesel (as specified in ASTM D 6751 "Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels"). The properties of biodiesel blends will be dependant on the base fuel, the B100 used for blending, and the amount of biodiesel in the blend.

Biodiesel and emissions from turbine engines: Biodiesel is similar to ethanol in gasoline, it reduces emissions by providing oxygen for combustion. In general, oxygenates in fuel will reduce emissions of particulate, carbon monoxide, and hydrocarbons. While little direct testing of biodiesel in turbine engines has been done, the change in emissions using biodiesel blends are expected to be similar. In a study examining the use of biodiesel on the performance of a gas turbine powered locomotive, the author assumed emissions reductions using biodiesel based on the emissions from diesel engines.[4]

The gas turbine engine operates under steady-state conditions and the combustion process, once started, is maintained continuously. This characteristic of turbines is similar to other "open-flame" applications such as boilers. In combustion tests of biodiesel and home heating oil blends, Brookhaven National Laboratory found that the use of biodiesel blends reduced emissions of nitrogen oxides from commercial and residential boilers.[5]

The University of Minnesota, Purdue University, and Baylor University have all initiated projects examining the use of biodiesel in turbine engines. As a part of each of these projects, the changes in emissions when biodiesel is used in turbines will be measured.

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Appendix A

Comparison of Gas Turbine Fuel Oils and Biodiesel Specifications

ASTM D2880 Standard Specification of Gas Turbine Fuel Oils

ASTM D6751 Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels

		Turbine Fuel Oils						
		Grade					Biodiesel	
Property	ASTM Test Method	No. 0-GT	No. 1-GT	No. 2-GT	No. 3-GT	No. 4-GT		
Flash point	D93		38 (100)	38 (100)	55 (130)	66 (150)	130 (266)	
oC (oF) min								
Water and sediment	D2790	0.05	0.05	0.05	na	na	0.05	
% vol max	D1796	na	na	na	1.0	1.0		
Distillation Temperature	D86							
oC (oF)								
90% vol recovered								
min		na	na	282	na	na	na	
max		na	288	338	na	na	360	(note: D11
Kinematic viscosity	D445							
mm/s								
At 40 oC (104 oF) min			1.3	1.9	5.5	5.5	1.9-6.0	
At 100 oC (212 oF) max			2.4	4.1	na	na	na	
Ramsbottom	D524	0.15	0.15	0.35	na	na		
carbon residue							0.05	(note: D45
on 10 % distillation								
Ash	D482	0.01	0.01	0.01	0.03	na	na	
% mass, max								
Density at 15 oC	D1298	na	850	876			na	
kg/m3 max								
Pour point	D97		-18	-6			na	
oC (oF) max								

Note:
No. 0-GT includes naptha, jet fuel and other volatile hydrocarbon liquids
No. 1-GT corresponds to D 396 Grade 1 fuel and D975 Grade 1-D fuel in physical properties
No. 2-GT corresponds to D 396 No. 2 fuel and D975 Grade 2-D fuel in physical properties
No. 3-GT and No. 4-GT viscosity range brackets spec D396 Grades No. 4, No. 5 (light) No. 5 (heavy) and No. 6, and D975 Grade 4-D diesel fuel in physical properties

Trace Metal Limits

	Trace metal Limits (mg/kg)			
Grade	Vanadium	Sodium + Potassium	Calcium	Lead
No. 0-GT	0.5	0.5	0.5	0.5
No. 1-GT	0.5	0.5	0.5	0.5
No. 2-GT	0.5	0.5	0.5	0.5
No. 3-GT	0.5	0.5	0.5	0.5
No. 4-GT	(consult turbine manufactuers)			

Test Method D3605 may be use for vanadium sodium, calcium and lead

Biodiesel		< 0.5		
		(DIN 51616)		

APPENDIX H

BIODIESEL INFORMATION FROM WENCK ASSOCIATES

Impacts of Biodiesel on Pollutant Emissions of a JP-8 Fueled Turbine Engine

Paper # 751

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ABSTRACT

The impacts of biodiesel on gaseous and particulate matter (PM) emissions of a JP-8 fueled T63 engine were investigated. Jet fuel was blended with the vegetable oil-derived soy methyl ester (SME) bio-fuel at various concentrations and combusted in the turbine engine. The engine was operated at three power settings, namely ground idle, cruise and take-off power, to study the impact of the biodiesel at significantly different pressure and temperature conditions. Particulate emissions were characterized by measuring the particle number density (PND) (particulate concentration), the particle size distribution and the total particulate mass. PM samples were collected for off-line analysis to obtain information about the effect of the biodiesel on the polycyclic aromatic hydrocarbon (PAH) content and carbon composition of the particles. In addition, temperature programmed oxidation (TPO) was performed on the collected soot samples to obtain information about the carbonaceous content (elemental or organic). Major and minor gaseous emissions were quantified using a total hydrocarbon analyzer, an oxygen analyzer and a Fourier Transform Infrared (FTIR) analyzer. Test results showed the potential of biodiesel to reduce soot emissions in the jet-fueled turbine engine without negatively impacting the engine performance. These reductions, however, were observed only at the higher power settings with relatively high concentrations of biodiesel. Specifically, reductions of approximately 15% in the PND were observed at cruise and take-off conditions with 20% biodiesel in the jet fuel. At the idle condition, slight increases in PND were observed; however, evidence shows this increase to be the result of condensed uncombusted biodiesel. Most of the gaseous emissions were unaffected under all conditions. The biodiesel was observed to have minimal effect on the formation of PAHs during this study. In addition to the combustion results, discussion of the physical and chemical characteristics of the blended fuels obtained using standard ASTM fuel specifications methods are presented.

INTRODUCTION

Air quality has become a major concern in many U.S. cities. The U.S. Environmental Protection (EPA) standards for ozone and fine particulate matter (PM) promulgated in 1997 serve to highlight the continuing threat to public health posed by air pollution from human activities. At high ground concentrations, PM has been linked to adverse health affects, such as dysrhythmia, cardiovascular diseases and even death.[1] Commercial and military aircraft have been identified as major sources of both gaseous and PM emissions. Despite on-going efforts to reduce the emission levels from these sources, viable reduction strategies are unavailable.[2] In fact, the EPA predicts that emission rates of some pollutants will triple by 2010.[3] The commercial and military aviation communities are aware of the need to reduce aircraft emissions and are pursuing a variety of engine- and fuel-based strategies to provide significant reductions. Various technological and procedural approaches have been tested and used to reduce harmful aircraft emissions. The Federal Aviation Administration (FAA) reviewed reducing emissions on an operational level by minimizing the number of engines used during taxi-in/out and reducing power settings during take-off and landings procedures.[4] In diesel engines, cetane improvers have been shown to reduce the overall emissions; however, these additives did not display a noticeable reduction when evaluated in a turbine engine.[5]

Two viable methods of reducing soot emissions from hydrocarbon fueled engines are by adding oxygen or by reducing the overall aromatic concentration of the fuel. Accordingly, one fuel-based strategy recently receiving increased consideration is the blending of biodiesel with the base jet fuel. Biodiesel is a mixture of fatty acid methyl esters, which have chemical and physical properties similar to those of conventional diesel. Biodiesel has been shown to reduce particulate emissions on diesel engines when blended with conventional diesel.[6] It contains fuel bound oxygen while being aromatic free; therefore, it has the capability of reducing soot emissions from turbine engines when blended with standard jet fuels. In addition to the potential environmental benefits, biodiesel has been researched as a fuel extender or supplement in various modes of transportation fuels since it is a potential source of alternate fuel and may reduce future fuel costs. It is estimated that the use of blends containing even relatively small amounts (5%) of biodiesel, could equate to a petroleum fuel savings of approximately 37.5 million gallons of base crude per day.[7]

Previous studies have shown the benefits of blending biodiesel the JP-8 military jet fuel. Tests completed by Kimble and coworkers showed that the lubricity of jet fuel was improved with even a small amount of biodiesel added.[7] Blending with the biodiesel was also found to increase the flashpoint of the mixture relative to the neat JP-8, which could provide for safer handling. Furthermore, turbine engine tests showed that blends of biodiesel (up to 20% biodiesel) with JP-8 could produce power performances similar to the neat JP-8. Other studies have shown improved emissions using biodiesel on aircraft engines.[8] However, these tests concluded that more detailed and specific emissions research was necessary to determine the impacts of biodiesel on the environment, and more specifically, on criteria pollutants. While biodiesel presents potentially significant benefits for use in turbine engines, it also has several unfavorable characteristics relative to jet fuel that should be addressed. A few of these are: higher production cost, slightly lower energy content, material compatibility issues, and relatively poor low temperature properties.

EXPERIMENTAL

T63 Engine and Fuel System

A T63-A-700 turboshaft engine, used primarily in helicopter applications, was used in this investigation. The engine is located in the Engine Environment Research Facility (EERF) in the Propulsion Directorate at Wright-Patterson Air Force Base, and is used to evaluate turbine engine lubricants, fuels, fuel additives, and sensors in an actual engine environment. A detailed description of the engine is provided in an earlier publication.[5] For these tests, the engine was operated at idle, cruise and take-off (maximum) power conditions.

The baseline JP-8 fuel was supplied to the engine from an underground facility tank. The blend ratio of JP-8 and biodiesel was controlled by injecting the biodiesel via two ISCO Model 1000D syringe pumps immediately downstream of the engine fuel flow meter. The syringe pumps were controlled via a computer feedback loop to provide the required biodiesel flow rate for the desired JP-8/biodiesel ratio. The JP-8/biodiesel blend passed through a static mixer to ensure a homogeneous mixture at the engine fuel nozzle. For one test, the biodiesel was premixed at 20% by volume in a separate fuel tank to compare with results obtained using the injection method. For a given engine operating condition, the fuel flow rate was controlled to obtain a constant T_5 (turbine exit temperature). This approach assured the best run-to-run repeatability with respect to engine power output and exhaust temperature for the studies conducted.

Emissions Instrumentation

Particulate Matter Instrumentation

Particulate emissions from the T63 engine were captured and transported to the analytical instruments via an oil-cooled probe. The probe is installed facing the flow in the center and near the exit of the engine to help capture a "representative" sample of the engine exhaust and avoid diluting or contaminating with surrounding air. The sample is immediately diluted at the probe tip to help prevent water condensation and particulate loss to the wall due to high wall-sample temperature gradients. Sample dilution also prevents saturation of the analytical equipment. The diluted sample was drawn into the instruments via a vacuum pump, and the air dilution and sample flows were controlled with high precision flow controllers.

On-line analysis of the particulate emissions was performed primarily using a TSI Model 3022A Condensation Nuclei Counter (CNC) to provide a count of particles per unit volume (particle number density), and a TSI Model 3936 Scanning Mobility Particle Sizer (SMPS) to obtain a particle size distribution. A Differential Mobility Analyzer (DMA) TSI Model 3081 was used in the SMPS to classify the particles by size. A Rupprecht & Pataschnick Tapered Element Oscillating Microbalance (TEOM) was used to provide direct real-time measurement of the particulate mass emissions. Furthermore, a Roseco Smoke Machine was used to collect particulate samples for subsequent analysis. This included determination of engine smoke number, temperature programmed oxidation (TPO) to determine the carbon type of the samples,

and perform analysis of the absorbed polycyclic aromatic hydrocarbons (PAH) via Gas Chromatography/Mass Spectrometry (GC/MS).

Gaseous Emissions Instrumentation

Gaseous emissions were quantified using a Horiba FIA-510 total hydrocarbon analyzer (THC), an M&C PMA-10 oxygen analyzer, and an MKS MultiGas 2030 Fourier-Transform Infrared (FTIR) based gas analyzer. The FTIR analyzer is capable of quantifying all non-symmetric gaseous species at parts-per-billion (ppb) to % sensitivity. The MultiGas 2030 can perform analysis in gas streams containing up to 30% water, and can simultaneously analyze and quantify more than thirty gases. Sample is introduced into a heated (150°C) gas cell with a 5.11 meter pathlength and the infrared beam is preferentially absorbed by the gaseous species present. The MultiGas 2030 analyzer measures the absorption spectrum, and its analysis algorithm measures the concentration of each gas using pre-loaded calibrations. The software allows for the continuous real-time measurement, display and recording of a sample stream.

Composition of JP-8 (POSF-3773) and Biodiesel (SME)

The JP-8 (POSF-3773) and biodiesel fuels were analyzed using GC/MS to provide quantitative information about the chemical composition. The gas chromatograms are shown in Figure 1. The JP-8 fuel is composed of numerous hydrocarbons with normal alkanes being the primary species within the fuel. The *n*-alkanes range from n-octane (*n*-C_8) to n-hexadecane (*n*-C_{16}), with maximum concentration from *n*-decane (*n*-C_{10}) to *n*-dodecane (n-C_{12}). Biodiesel is a complex mixture of long-chain methyl esters with carbon numbers of 18 and 19. Specifically, in-house analyses show that the biodiesel is comprised of methyl palminate (5%), methyl linoleate (43%), methyl oleate (43%), methyl stearate (4%) and methyl linolenate (5%). The differences in the molecular weights, volatility and chemical functionalities of the two fuels could affect the overall engine performance and thus, alter the particulate and gaseous emissions.

COMPARISON OF BIODIESEL AND JP-8 FUEL SPECIFICATION

Standard specification tests for aviation turbine fuel were conducted on the JP-8 and the biodiesel/JP-8 blends used in the emission testing. It should be noted that the neat JP-8 sample did not meet the fuel system icing inhibitor (FSII) specification limit. However, this property has no known influence on combustion characteristics or emissions and therefore, should not affect the test results or trends. Comparisons of the experimental JP-8 and JP-8/biodiesel blends and the JP-8 specification standards are shown in Table 1.

Figure 1: GC/MS Chromatogram of JP-8 and Biodiesel Fuel used in this Study. The JP-8 is Primarily Comprised of Linear Alkanes while the Biodiesel is Comprised of Five High Molecular Weight Methyl Esters

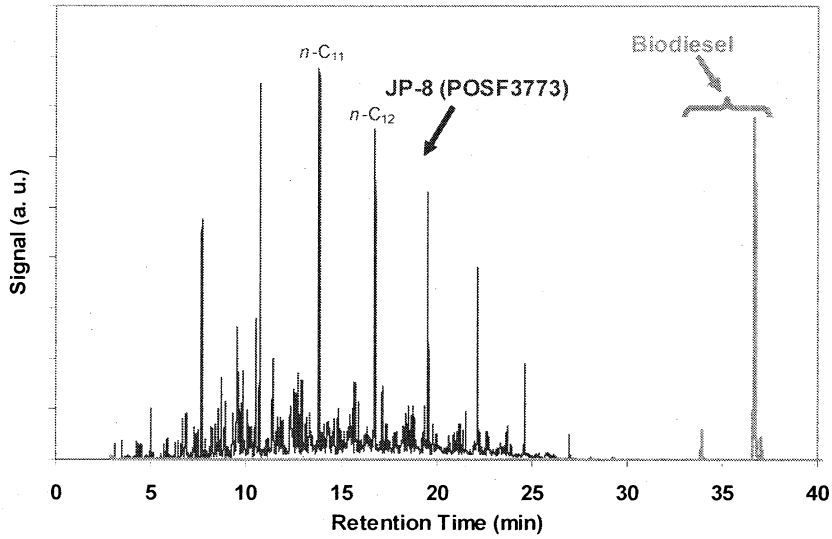


Table 1: Specification parameters in JP-8/Biodiesel Blends

ASTM Tests	Standard	JP-8	2% Biodiesel	10% Biodiesel	20% Biodiesel
Total Acid Number, mg KOH/g (D3242)	Max 0.015	0.000	0.008	0.022*	0.040*
Aromatics, %vol (D1319)	Max 25.0	15.9	17.2	22.6*	30.4*
Distillation-Residue, % vol (D86)	Max 1.5	0.7	1.8*	1.6*	1.0
Distillation-EP, deg C (D86)	Max 300	256	288	339*	344*
Freezing Point, deg C (D5972)	Max -47	-51	-50	-27*	-19*
Existent Gum, mg/100mL (D381)	Max 7.0	1.0	10.2*	14.8*	228.0*
Viscosity @ -20deg C, cSt (D445)	Max 8.0	4.4	4.3	5.1	Failed*
Particulate Matter, mg/L (D5452)	Max 1.0	0.2	0.3	3.9*	Failed*
Water Reaction (D1094)	Max 1B	1B	4*	4*	4*
FSII (DiEGME), % vol (D5006)	0.10-0.15	0.07*	0.05*	0.05*	0.05*
Conductivity, pS/m (D2624)	150-600	176	129*	93*	135*

*Did not meet specifications; all blends were premixed.

Total Acid Number

The total acid number (TAN) of the blends was shown to increase as the biodiesel concentration increased. The standard acidity tests or TAN of biodiesel blends has established the incompatibility of biodiesel with elastomers (primarily rubber). Biodiesel has been shown to burn through rubber tubing, which could damage o-rings and other rubber components in the engine and fuel system.[7] Filtering or refining the SME may alleviate this problem; however, supplemental studies are required to determine the degree the biodiesel might damage these materials and investigate possible solutions.

Aromatic Content

As stated previously, the aromatic content in the blends will be lower than in the neat JP-8 since the biodiesel is essentially aromatic-free. The specification tests, however, showed an increase in the aromatic concentration as the biodiesel concentration increased. Since the aromatic test (ASTM D1319) is a standard for only petroleum-derived fuels, the test results were apparently an artifact of the biodiesel addition. A different test method is needed, such as ASTM 5769, to determine the actual aromatic content in the biodiesel blends.

Distillation Tests

The volatility and ease of vaporization of a fuel are determined in the distillation test (D86). Test results showed that the biodiesel blends did not meet either the evaporation point (EP) temperature or residue by volume limits. The higher EP of the biodiesel blend was expected since biodiesel has a higher flashpoint (FP), (i.e., is less volatile) than JP-8. There are concerns that increasing the FP and EP may negatively affect engine performance. However, testing conducted by Kimble and associates showed only a small decrease in engine performance.[7] Additional testing and analysis is required to determine if the decrease in performance is still suitable for aircraft applications. Though a higher EP may not be detrimental, a higher residue % by volume is not favorable. The residue may coat the combustion chamber and turbine blades causing a subsequent reduction in performance. However, it may be possible to remove promoters of the residue formation, such as glycerol in the biodiesel, during processing, transportation, or storage.[9]

Viscosity and Freezing Point

Increases in the JP-8/biodiesel freezing point were observed as the biodiesel concentration increased. In addition, the viscosity of the 20% biodiesel blend was shown to exceed the JP-8 specification limit. However, it is believed that improved processing of the biodiesel may alleviate this problem. Tests conducted by Dunn and coworkers have demonstrated a lower freezing point can be obtained when the biodiesel is cold-filtered and mixed with winterizing additives.[10] Further studies are required to identify more efficient solutions to these potential low temperature problems.

Existent Gum

The main test for fuel storage stability is the gum existent test. Gum is a nonvolatile residue left after the evaporation of the fuel, which is similar to the distillation EP and residue% by volume.[11] The existence and formation of gum in SME is largely attributed to the glycerol, a co-product from the transesterification of the parent oil.[9] As previously stated, glycerol could be removed through improved filtration and handling during processing.

Particulate Matter and Water Reaction

The high particulates in the biodiesel blends can be linked to the existence of gums and foreign residue. Similarly, changes in the filtration and processing may result in a more compliant biodiesel blend. Water reaction is an important property since absorbed water can affect engine combustion characteristics.[11] At all concentrations, the biodiesel blends did not meet the standard for this property. Nevertheless, previous studies have shown that more refined biodiesel is less prone to absorbing moisture.[8] This standard may be met through improved processing.

Standard Additives

The presence of additives can assist in fuel storage, delivery, and dispensing by improving the physical/chemical characteristics of the fuel.[11] There are two additive related-characteristic concerns identified in the JP-8/biodiesel blends specification testing: fuel system icing inhibitors (FSII) and thermal conductivity. Since biodiesel does not contain any FSII or anti-static additive, blending the fuels diluted the concentration of these components below the required levels. Accordingly, these specifications could be met by dosing the additives based on the ratio of JP-8 and biodiesel in the blend.

ENGINE TEST RESULTS

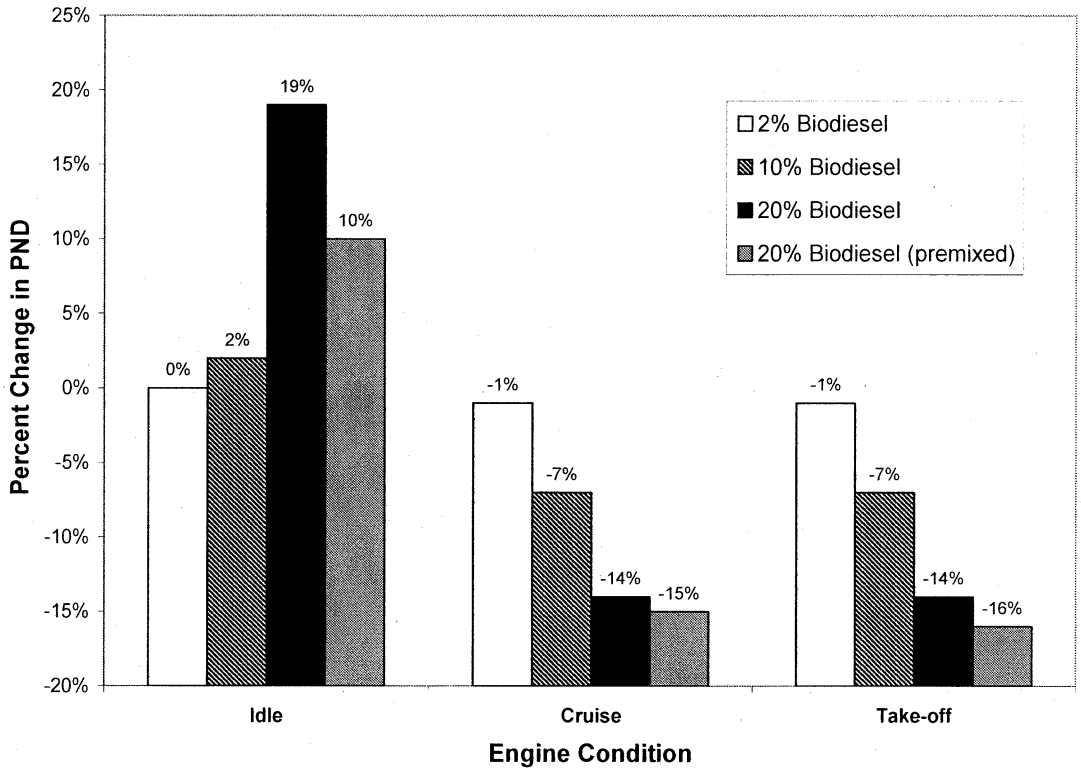
Engine Performance

Engine performance parameters were monitored throughout the test series to assess if the addition of biodiesel would have any adverse effects. The engine power output and overall performance were observed to be unaffected by the addition of biodiesel for all the test cases evaluated. It was observed that at 20% biodiesel, there was a penalty in fuel flow of less than 4% by mass (higher fuel flow of the blend required to maintain same engine output). This is most likely the result of slightly lower biodiesel heating value relative to the JP-8.

Particle Number Density (PND)

Figure 2 depicts the effects of the biodiesel blends on the particulate emissions of the T63 engine as a function of the power setting. As shown, the relatively low biodiesel concentration of 2% had negligible effect on the PND at all conditions under all engine conditions. As the concentration of biodiesel was increased, reductions in PND were observed at the two higher

Figure 2: Impacts of Biodiesel on Particle Number Density Emissions of T63 engine



power settings. As previously noted, reductions in particle emissions were anticipated due to the dilution of the aromatic content in the fuel. However, these reductions in emissions were considerably lower than for blends of JP-8 with similar concentrations of non-aromatic solvents.[12] Reductions of up to 22% with blends of 20% by volume of Norpar-13 (an Exxon solvent with an average carbon number of 13) were previously observed on the T63 platform at cruise condition. Furthermore, reductions in PND of over 35% with the 20% Norpar-13 at idle condition were observed. These reductions with Norpar-13 were primarily attributed to the dilution of aromatics, which are known soot precursors. However, it was hypothesized that other chemical or physical processes also have a significant effect on the production of soot. In the present study, the beneficial effect of diluting the aromatics with biodiesel may have been offset by an increase in soot formation due to fragmentation, polymerization and molecular growth reactions (at the high power conditions) of the long-chain biodiesel components. Improved performance may be attainable for shorter chain biodiesel fuels. At idle, the PND was unaffected until the biodiesel concentration was increased to 20%, where increases of 10-19% in PND were observed. This increase in PND at idle was likely due to inefficient combustion of the high molecular weight biodiesel components, which resulted in the condensation of uncombusted bio-fuel. Improved combustion of the biodiesel at the high power conditions precluded the presence of uncombusted biodiesel in the engine exhaust. Analyses of soot samples (discussed below) support this hypothesis.

Particle Size Distribution

The particle size distribution for the idle and cruise conditions are shown in Figures 3 and 4.

Figure 3: Particle Size Distribution from T63 Engine at Idle for JP-8 and JP-8/Biodiesel Blends

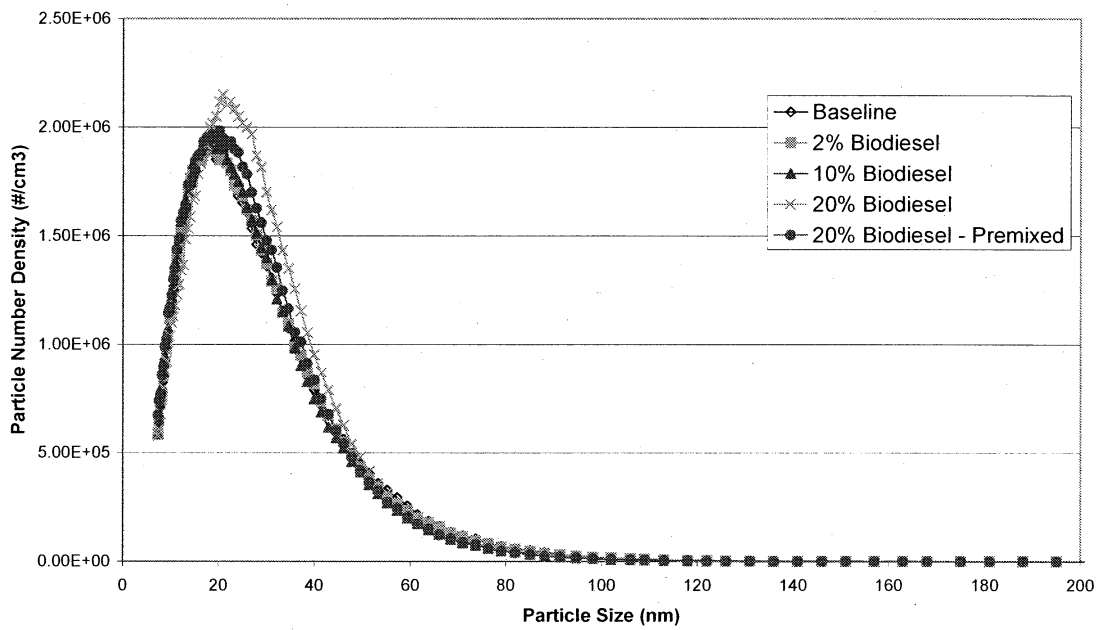
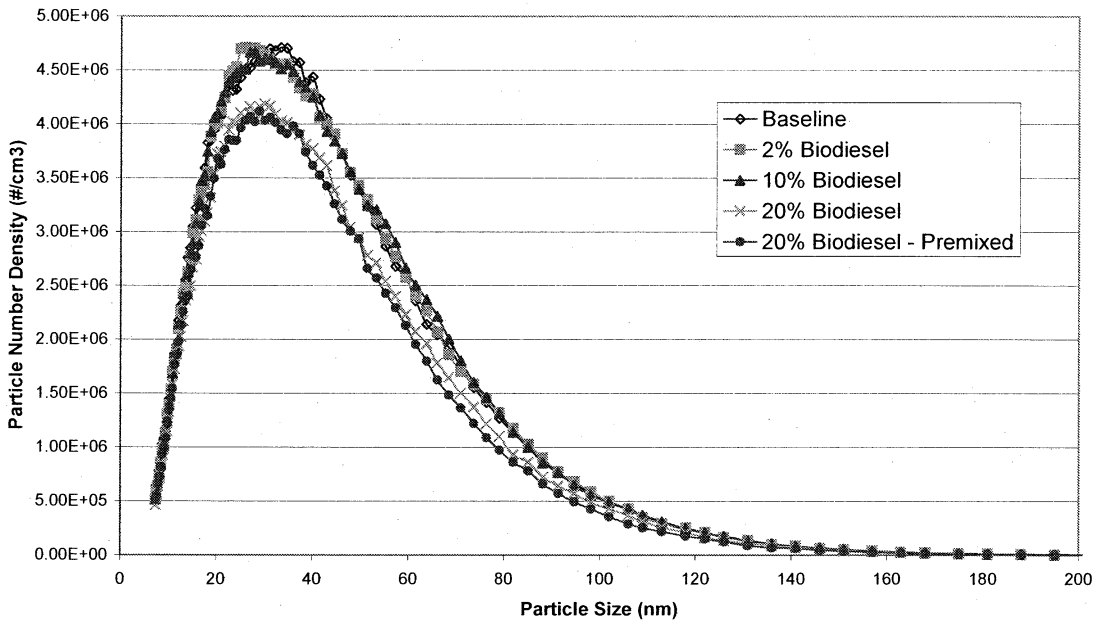


Figure 4: Particle Size Distribution from T63 Engine at Cruise for JP-8 and JP-8/Biodiesel Blends



The biodiesel had no apparent impact on the size distribution for either condition except for a slight increase in PND for particles 20-40nm in diameter for the idle condition with 20% biodiesel. The mean particle diameter at idle was 22 nm, which was unaffected by the biodiesel concentration. At cruise, reductions in PND were observed only at 20% biodiesel with no alteration of the relative particle distribution. Despite the reductions in the PND, the mean particle diameter at cruise was relatively constant at 34 nm, with and without the biodiesel. At take-off condition, the mean particle diameter was 36 nm.

Tapered Element Oscillating Microbalance (TEOM)

On-line mass measurements with the TEOM are shown in Table 2. Reproducibility for each TEOM measurement was approximately ±0.5 mg/m^3. At idle, the TEOM results did not show significant changes in the mass emissions during blending with the biodiesel. For the cruise condition, a slight increase at 10% biodiesel was observed. Data were not obtained at the 20% biodiesel level. These results show that blending the biodiesel with the JP-8 did not significantly affect the particulate mass emissions of the T63.

Table 2: TEOM Particulate Mass Measurements

FUEL	Idle (mg/m^3)	Cruise (mg/m^3)
JP-8	2.5	7.8
2% Biodiesel	3.1	7.3
10% Biodiesel	2.6	8.9
20% Biodiesel	2.9	--

Smoke Number

The smoke number (Bosch or Bacharach smoke number) is used to measure the amount of soot emissions in turbine engines and it is an industry standard for engine certification. Higher soot quantities render increased smoke numbers. Table 3 shows the smoke numbers for each biodiesel concentration at the different power settings. Similar to the TEOM results, the biodiesel did not have a significant effect on the measured smoke numbers.

Table 3: Effects of Biodiesel on soot emissions based on the Smoke Number

FUEL	Idle	Cruise	Max (take-off)
JP-8	7.1	32.3	34.7
2% Biodiesel	7.5	35.5	33.4
10% Biodiesel	7.7	34.2	30.1
20% Biodiesel	7.5	31.4	35.3
20% Biodiesel premixed	8.5	29.8	33.5

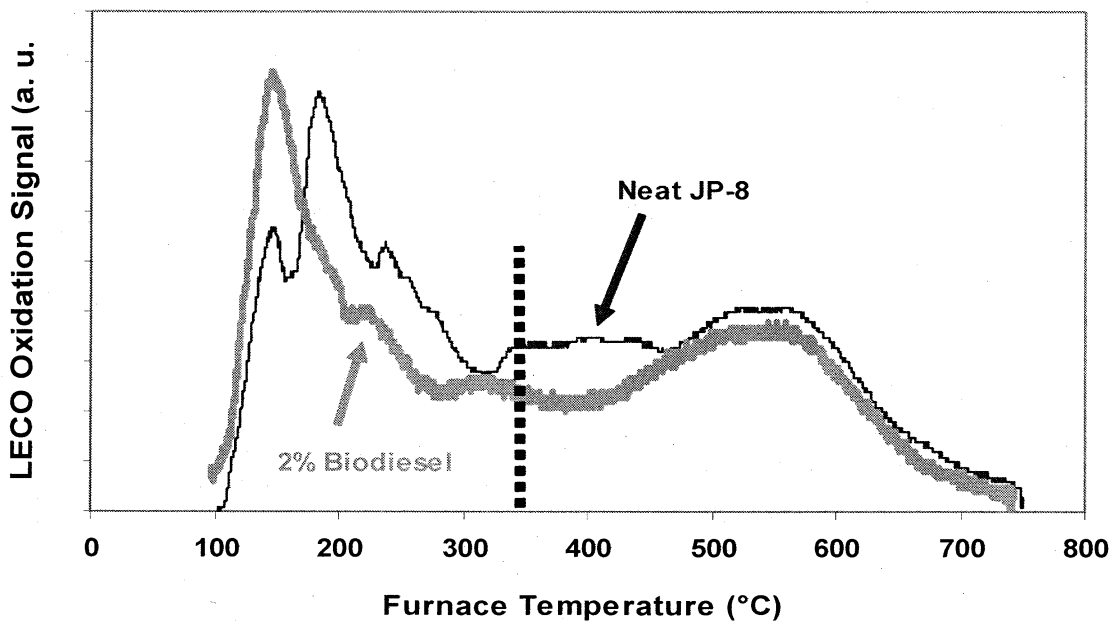
Chemical Composition of Particulate Samples

The techniques described above provide information about the quantity and size of soot produced, but do not provide insight about the chemical structure of the particulate. Information

about the chemical nature of the particulate matter would be beneficial for deconvoluting any effect of the biodiesel on the overall particulate production. Accordingly, temperature programmed oxidation (TPO) of the particulate samples can be used to provide qualitative information about the chemical composition of the soot. TPO is performed using a LECO RC-412 Multiphase Carbon Analyzer on particulate samples collected on quartz filters.[13,14] During analysis, the particulate is oxidized in the presence of excess oxygen as the furnace temperature is increased from 100°C to 750°C at a rate of 20°C/min. Species that oxidize at lower temperatures (< 325°C) are considered to be volatile organic species (e.g., PAH), while those that oxidize at higher temperatures are assumed to be primarily elemental carbon (e.g., highly graphitic).

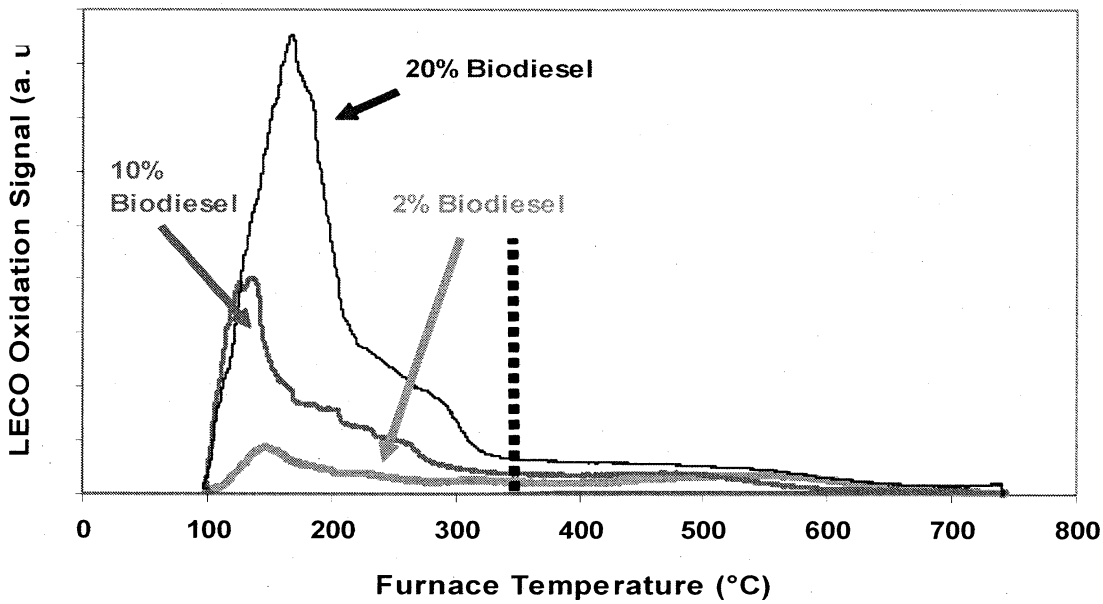
Oxidation profiles for soot samples collected during testing at the idle engine condition with varying concentrations of biodiesel are shown in Figures 5 and 6. As shown, the particulate matter produced at this condition was comprised of both volatile and elemental organic species. The addition of 2% biodiesel to the JP-8 produced a slight increase in the volatile organic fraction without significantly altering the relative composition and nature of the elemental carbon. These data imply that the addition of the biodiesel increases the rate of production of the volatile components with minimal alteration of the elemental species. However, comparison of these data with those obtained via GC/MS analysis (described below), suggests that the increased concentration of volatile organics was mostly due to the inefficient oxidation of the biodiesel. As shown in Figure 6, increasing the concentration of the biodiesel produced significant increases in the soot volatile organics with the largest increase observed for the 20% biodiesel blend. Since the area under the TPO curve is related to the overall quantity of carbon, these results imply that there was a significant increase in the production of soot with the addition of

Figure 5: Temperature Programmed Oxidation of Particulate Samples with Neat JP-8 and JP-8 Blended with 2% Biodiesel at the Idle Engine Condition



biodiesel. However, the TEOM results showed minimal changes in the particulate mass concentration with the addition of biodiesel. In the TEOM operation, particulate matter is selectively collected on the filter element while vapor phase species do not contribute to the measured mass. Therefore, differences in the TPO profiles between the various samples were primarily attributed to uncombusted biodiesel collecting on the soot sample, most likely due to the lower volatility of the biodiesel relative to JP-8.

Figure 6: Temperature Programmed Oxidation of Particulate Samples from Testing with Blends of JP-8 with Various Concentrations of Biodiesel at the Idle Engine Condition



TPO of samples collected at the cruise and maximum power conditions showed increased production of elemental organic species compared to the volatile organics. The increased elemental organics are due to the higher combustion temperatures and pressures, which increase the rate of particulate growth and dehydrogenation reactions. The addition of biodiesel had negligible effect on the TPO profile, indicating that the combustion of the biodiesel is significantly improved at the cruise and maximum power engine conditions. In addition, the results indicate that the biodiesel has minimal effect on the nature of the particulate formed during the combustion process at the higher power settings.

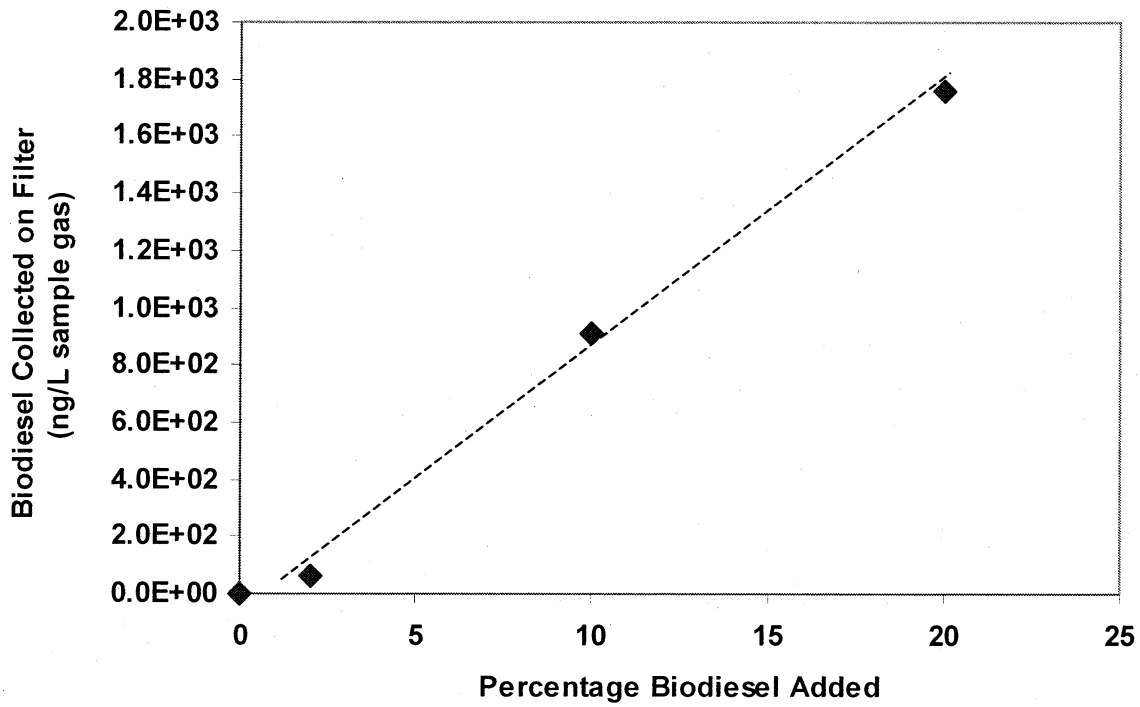
Soot Polycyclic Aromatic Hydrocarbon (PAH) Analysis

The PAH content of the collected PM samples was quantified using a technique involving the thermal desorption of adsorbed PAHs from with subsequent separation and analysis using GC/MS.[14, 15] It is possible to identify and quantify 18 separate PAHs using this technique. Since PAH formation is known to be an initial step in soot formation, this technique can provide insight into how the relative soot formation pathways and reaction rates are affected as a function

of engine condition, fuel or additive type. For this study, this technique was used to investigate whether the addition of biodiesel altered the relative selectivity of the PAHs formed. The PAH analysis indicates that pyrene and fluoranthene were formed in the highest yields under all engine conditions and for all the fuel blends studied. The effect of the biodiesel on the selectivity and relative formation rates of these species was found to be minimal. The overall measured PAH concentration was shown to increase from approximately 6.8 ng/L at the idle condition to 23 ng/L at cruise. The increase in the PAH formation is a result of increased reaction rates at the higher temperatures and pressures inherent at the cruise condition. The relative PAH concentration was similar for the cruise and take-off conditions. This was expected since the temperatures, pressures and flow conditions are similar for these two engine settings.

During the thermal desorption analysis of the PM samples collected at the idle condition, it became evident that significant quantities of uncombusted biodiesel were collected on the filters. Figure 7 shows an apparent linear relationship between the quantity of biodiesel added and the quantified biodiesel from the collected soot samples. Consistent with the trends observed in the TPO data, these results indicate that a significant quantity of biodiesel was exiting the combustor unreacted. At the higher power conditions, the biodiesel content in the soot sample did not increase, likely due to improved oxidation of the biodiesel at the higher temperature and pressure conditions. The low oxidation efficiency at idle is most likely related to the lower flash point and high molecular weight of the biodiesel components

Figure 7: Concentration of Unreacted Biodiesel Quantified with GC/MS Analysis of Collected PM Samples for the Idle Condition as a Function of Percentage of Biodiesel



Gaseous Emissions

The use of biodiesel blends in diesel engine testing, conducted by the Southwest Research Institute, showed as much as a 50% reduction in the carbon monoxide (CO) and total hydrocarbons (THC) emitted.[16] During the current study, minimal changes in CO emissions were observed with slight increases in THC (~10%) at idle with biodiesel concentrations of 20%. This increase could be attributed to uncombusted biodiesel at the low power setting. At higher power settings, there was little or no change in CO and THC.

The addition of biodiesel had negligible effects on NO_x emissions for all test cases. Only slight reductions in SO_x emissions were observed as the biodiesel concentration was increased, which was most likely a dilution effect since the biodiesel does not contain sulfur.

CONCLUSION

The engine emissions and overall performance of a T63 helicopter engine operated with blends of JP-8 and biodiesel were assessed. Biodiesel concentrations up to 20% by volume in JP-8 were shown to have no detrimental effect on overall engine performance. A slight penalty (<4%) in fuel mass flow was observed at the 20% concentration, due to slightly lower energy content of the biodiesel compared to JP-8. Test results showed that biodiesel can produce a noticeable reduction in particle number density at higher power settings; however, relatively large quantities of biodiesel are required. Negligible reductions were observed on a particulate mass basis. Apparently, the beneficial effect of diluting the aromatics with biodiesel may have been offset by an increase in soot formation due to thermal breakdown and molecular growth reactions of the long-chain biodiesel components. Improved performance may be possible with shorter chain, lower molecular weight biodiesels. At low engine power (idle), particulate and THC emissions increased with the biodiesel, likely due to the condensation of uncombusted biodiesel. This hypothesis was supported by the analysis of collected soot samples obtained at engine idle, which showed significant amounts of unreacted biodiesel. At the cruise condition, the soot characteristics between neat JP-8 and the biodiesel blends were similar. Most gaseous emissions were unaffected with the addition of biodiesel. ASTM fuel specifications tests showed that several properties (especially low temperature fuel properties) of the biodiesel/JP-8 blends did not meet the JP-8 specification standards. Improved processing of the biodiesel may alleviate these problems; however, further research is needed to make a better assessment. Although biodiesel fuels present a potential option for reducing particulate emissions from turbine engines, factors such as low temperature fuel properties, poor combustion performance at lower engine power, material compatibility and relatively high biodiesel production costs, should be addressed before biodiesel can be seriously considered as a supplemental fuel for use in turbine engines.

ACKNOWLEDGEMENTS

The authors thank the following agencies for funding this research effort: the U.S. Department of Energy Biomass Utilization Program, the North Dakota State Board of Agricultural Research & Education, and the North Dakota Soybean Council. The authors also gratefully acknowledge the efforts of Rich Streibich, Linda Shafer and Dave Brooks of the University of Dayton Research Institute (UDRI) for the chromatographic analysis of the fuels, PAH quantification and TPO

analysis of the soot samples, and Brett Ewing of AdTech Systems Research Inc. for his technical support in operating the T63 engine. The work of UDRI is supported by the Air Force Research Laboratory (AFRL) under the cooperative research agreement number F33615-03-2-2347.

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KEYWORDS:

biodiesel, jet fuel, particulate matter, emissions, turbine engine, soot, particle size distribution, particle number density