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ABSTRACT

Xcel Energy has applied to the United States Nuclear Regulatory Commission (NRC) for license renewal of the Monticello Nuclear Generating Plant (MNGP). This application is for a permit to continue operating the Plant for an additional 20 years past the end of the current license in 2010. This application includes the request to construct a dry cask storage system for spent nuclear fuel canister assemblies at the plant site.

Xcel Energy has applied to the Minnesota Public Utilities Commission (PUC) for a Certificate of Need (CON) to establish the dry cask storage system, an Independent Spent Fuel Storage Installation (ISFSI), at the Monticello Generating Plant. The CON application was submitted on January 18, 2005 and a Supplement was submitted on June 15, 2005. This environmental impact statement (EIS) is required as part of the PUC CON process.

Additional information on this project is available in the project applications listed in the Reference section of this EIS; much of the material also is online at the PUC website: http://energyfacilities.puc.state.mn.us/Docket.html?Id=9901.

DRAFT EIS COMMENTS ARE DUE BY MARCH 3, 2006
Formal comments on the accuracy and completeness of the draft EIS will be accepted until **March 3, 2006**. Please refer to Docket No. E002/CN 05-123 in all correspondence. Comments should be sent by e-mail or U.S. mail to:

> Ms. Sharon Ferguson
> Department of Commerce
> 85 7th Place, Suite 500
> St. Paul, MN 55101-2198
> e-mail: Sharon.ferguson@state.mn.us

PUBLIC HEARING AND INFORMATION MEETINGS SCHEDULED
Before the PUC makes a final decision, it must hold a public information meeting and hearing to accept comments on the draft EIS, answer questions and provide further information on the proposed project. The hearing will be conducted by an independent administrative law judge

(ALJ). The ALJ will ensure that the record created at the hearing is preserved and transmitted to the PUC. The ALJ will prepare a report that will include proposed findings of fact and conclusions and a recommendation. Hearing sessions will take place at the following two locations:

- Monticello area on February 2, 2006
- Twin Cities area on February 16, 2006

Additional sessions will be provided if necessary to hear all interested parties wishing to testify. Further information on these hearing will be provided to interested parties and will be posted online at the PUC website: http://energyfacilities.puc.state.mn.us/Docket.html?Id=9901.

It is not necessary to attend more than one session to have your input heard and included in the record. All members of the public are welcome to attend any public hearing sessions.

FINAL EIS

After the comment period, the Department of Commerce Energy Facility Permitting staff will prepare a final EIS. The final EIS will include revisions to the draft as well as staff responses to substantive comments on the draft.

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Acronym Table for Monticello EIS

AAQS.............Ambient Air Quality Standards

ALARA..........as low as reasonably achievable

ALJ.................Administrative Law Judge

CFR................Code of Federal Regulations

CON...............Certificate of Need

CWA..............Clean Water Act

DG..................Distributed Generation

DNR...............Minnesota Department of Natural Resources

DOC...............Minnesota Department of Commerce

DOE...............U.S. Department of Energy

DSM...............Demand Side Management

EAS................Emergency Alert System

EAW..............Environmental Assessment Worksheet

ECL................Emergency Classification Levels

EFP.................Energy Facility Permitting (section of DOC with siting and routing duties)

EIA.................Energy Information Agency

EIR.................Environmental Impact Report (California's equivalent to an EIS)

EIS..................Environmental Impact Statement (Federal or State Environ. Review doc)

EPA................United States Environmental Protection Agency

EPZ................Emergency Planning Zone

EQB................Minnesota Environmental Quality Board

ER..................Environmental Report

FAA................Federal Aviation Administration

FRMAC..........Federal Radiological Monitoring and Assessment Center

FSAR..............Final Safety Analysis Report

GEIS...............Generic Environmental Impact Statement (Federal)

IRP.................Integrated Resource Plan (Xcel Energy 2004 Plan)

ISFSI..............Independent Spent Fuel Storage Installation

LET................Linear-energy Transfer

LFA................Lead Federal Agency

LLC................Limited Liability Corporation

LMIC..............Land Management Information Center (at Minnesota Dept. of Admin.)

MAPP.............Mid-Continent Area Power Pool

MDH ....Minnesota Department of Health

MEIS..............Minnesota Environmental Impact Statement (State level)

MEOP ....Minnesota Emergency Operations Plan

MEPA ....Minnesota Environmental Policy Act

MIMS.............Minnesota Incident Management System

MNGP............Monticello Nuclear Generating Plant (also "the Plant")

MPC...............Multi-purpose Canisters

MPCA -.........Minnesota Pollution Control Agency

MW................megawatt

MWh ....megawatt-hours

NCRP ....National Council on Radiation Protection and Measurements

NEPA.............National Environmental Policy Act

NESHAP........National Emission Standards for Hazardous Air Pollutants

NIRL ....Negligible Individual Risk Level

NMC ....Nuclear Management Company, LLC (Firm operating MNGP for Xcel)

NRC ....United States Nuclear Regulatory Commission

NSP ....Northern States Power (Minnesota Company, now a part of Xcel Energy)

NWI................National Wetlands Inventory

OCA ....Owner-controlled Area

PFS.................Private Fuel Storage, LLC   in Skull Valley, Utah

PIC ....Pressurized-ionization Chambers

PRA................Probabilistic Risk Assessment

psi...................pounds per square inch

PUC................Minnesota Public Utilities Commission

rem ....Roentgen equivalent man (unit of ionizing radiation)

RGU ....Responsible Government Unit

RM ....River Mile

SEOC ....State Emergency Operations Center

T&D ....Transmission and/or Distribution

TLD................Thermoluminescent Dosimeters

USFWS ....United States Fish and Wildlife Service

USGS ....United States Geological Survey

WMA ....Wildlife Management Area

WPA...............Waterfowl Production Area

Xcel ....Northern States Power d/b/a Xcel Energy

SECTION 1

SUMMARY

Xcel Energy has applied to the United States Nuclear Regulatory Commission (NRC) for license renewal of the Monticello Nuclear Generating Plant (MNGP). This application is for a permit to continue operating the Plant for an additional 20 years past the end of the current license in 2010 and includes the request to construct a dry cask storage system for spent nuclear fuel canister assemblies at the plant site.

Xcel Energy applied to the Minnesota Public Utilities Commission (PUC) for a Certificate of Need (CON) to establish the dry cask storage system in January 2005. This environmental impact statement (EIS) is required as part of the PUC CON process.

The specific topics and the extent of analysis provided in this EIS were outlined in the Monticello EIS Scoping Decision, adopted by the Minnesota Environmental Quality Board in June 2005.

Regulatory Framework

In general, the U.S. Nuclear Regulatory Commission (NRC) decides whether ongoing and continued plant operations, and the proposed dry cask containers for the spent nuclear fuel, are safe. Federal regulations preempt state regulations of radiological, engineering, health and safety standards. The state, however, decides as an economic and policy matter whether it is in the public interest to allow more storage of spent nuclear fuel at the site in order to allow the plant to keep operating past 2010. Section 2 of the EIS outlines the regulatory framework governing the Monticello Plant.

Project Description

The Xcel Energy proposal calls for providing additional spent fuel storage in an Independent Spent Fuel Storage Installation or ISFSI. Spent fuel canisters will be stored in modular concrete vaults, placed on a reinforced concrete support pad. The proposed design capacity of the ISFSI is 30 storage units, the amount needed for plant operates through 2030. The storage facility is laid out so that it can accommodate another 35 vaults that could be used for casks to decommission the plant. Section 3 contains further details on the proposal.

Analysis of Proposed Project

Section 4 focuses on the additional environmental impact that the construction of an Independent Spent Fuel Storage Installation would have on the environment. It is assumed that there are no new impacts from the continued operation of the Monticello Plant, other than those from the Storage Installation itself. Analysis covered fish, wildlife and ecologically sensitive resources, water resources, traffic, noise, nearby resources and visual impacts. No significant impacts were found.

The section includes a cumulative impacts matrix, noting possible impacts of continued plant operation until 2030 and of potential on-site storage of spent fuel at Monticello for up to 200 years. Anticipated impacts in all time periods were rated as "low" or "very low."

Radiation Environmental Impacts
Radiation is a major public health concern associated with nuclear plant operations and spent fuel storage. It is subject to extensive monitoring, regulation and incident management planning. Section 5 discusses the results of current monitoring efforts and the impacts expected due to routine operations and incidents at both the Monticello Plant and Storage Installation. Analysis of existing data revealed no adverse effects from current plant operations. Additionally, no adverse effects were found to be expected from the spent fuel storage facility. Recommendations are made, however, for monitoring at the ISFSI.

Analysis of Alternatives to the Independent Spent Fuel Storage Facility
Section 6 contains an analysis the feasibility of alternatives for storing the spent nuclear fuel rods generated by the Monticello Plant. It covers four away-from-reactor storage possibilities, together with several onsite options included in the Certificate of Need application. Options covered are:

- Reprocessing spent nuclear fuel
- Contracting for additional spent fuel storage capacity at an existing spent fuel storage facility
- Developing an interim spent fuel storage facility in Utah
- Relying on the federally sponsored repository for spent fuel at Yucca Mountain, Nevada
- Using the existing or a new storage pool
- Using an alternate technology for dry storage
- Using an alternate site for dry storage

It also covers the "no action" alterative. None of the four off-site disposal options appeared to be viable.

Analysis of Alternatives to the Monticello plant
The "no action" alternative, described in Section 6, would lead to the shutdown and decommissioning of the Monticello Nuclear Generating Plant and subsequent loss of 600 megawatts of generating capacity. This section identifies alternative methods of supplying this amount of power and examines the environmental impacts of those alternatives, including an all-renewable distributed generation alternative. Five 600 megawatt capacity alternatives were addressed:

1. A base load pulverized coal power plant
2. A coal fueled integrated gasification combined cycle power plant (IGCC)
3. A natural gas fueled combined cycle plant
4. A wind and natural gas plant combination
5. System-wide distributed, renewable generation

All alternatives were found to have greater impacts than continuation of the Monticello Plant.

SECTION 2

REGULATORY FRAMEWORK

In general, the U.S. Nuclear Regulatory Commission (NRC) decides whether ongoing and continued plant operations, and the proposed dry cask containers for the spent nuclear fuel, are safe. The state, however, decides as an economic and policy matter whether it is in the public interest to allow more storage of spent nuclear fuel at the site in order to allow the plant to keep operating past 2010.

In 2003, the Minnesota Legislature made the Public Utilities Commission (PUC) responsible for the decision of whether to issue a certificate of need for expanded spent nuclear-fuel storage facilities. The legislature did, however, retain the option of reviewing that PUC decision. In addition, an environmental impact statement (EIS) is required prior to the PUC decision.

2.1 Federal Regulatory Processes

Federal regulations preempt state regulation of radiological, engineering standards, health and safety standards applicable to nuclear generating plants and spent nuclear fuel storage. The U.S. Nuclear Regulatory Commission (NRC) has responsibility for regulating the use of source material (uranium and thorium), special nuclear material (enriched uranium and plutonium) and byproduct material (material made radioactive in a reactor and residues from the milling of uranium and thorium). Nuclear electricity generating plants like the Monticello Nuclear Generating Plant are considered parts of the nuclear fuel cycle operation and are regulated by the NRC.

The NRC regulates the use of radioactive materials through the Code of Federal Regulations 10 CFR Part 20 "Standards for Protection Against Radiation." Part 20 includes requirements for dose limits for radiation workers and members of the public, monitoring and labeling radioactive materials, posting radiation areas and reporting the theft or loss of radioactive material. It also includes penalties for not complying with NRC regulations.

Radiation limits are imposed in the 10 CFR 20 and 72. NRC also enforces the U.S. Environmental Protection Agency (EPA) rules on nuclear power operations (40 CFR 190 and 191) through a Memorandum of Understanding. The federal government has formal and deliberate processes for creating and changing its rules. The Minnesota Department of Health has identical requirements to the NRC for radioactive materials use in Minnesota Rules Chapter 4731 and very similar requirements for x-ray machine use in Minnesota Rules Chapter 4730.

Table 2-1 Federal Nuclear Plant Regulations Applicable to the Monticello Plant

Title	Agency	Reference No.
Requirements for Renewal of Operating Licenses for Nuclear Power Plants	U.S. NRC	10 CFR 54
Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions	U.S. NRC	10 CFR 51
Electronic Maintenance and Submission of Information Federal Register Notice – Final NRC Rule	U.S. NRC	68 FR 58792
Industry Guideline for Implementing the Requirements of 10 CFR part 54 – The License Renewal Rule, Rev 4	Nuclear Energy Institute	NEI 95-10
Standard review Plan for Review of License Renewal Applications for Nuclear Power Plants	U.S. NRC	NUREG-1800
Generic Aging Lessons Learned (GALL) Report	U.S. NRC	NUREG-1801
NRC regulations for source material, special nuclear material and by-product material licenses	U.S. NRC	10 CFR 30, 40, 70
NRC regulations for orders, license conditions, exemptions, waste and spent fuel storage, transportation and technical specifications including plant-specific design-basis information for the MNGP facility as documented in the updated Safety Analysis Report	U.S. NRC	10 CFR 2, 19, 20, 21, 26, 30, 40, 50, 51, 54, 55, 70, 71, 72, 73, 100
NRC also enforces the U.S. Environmental Protection Agency (EPA) rules on nuclear power operations	U.S. NRC, U.S. EPA	40 CFR 190 and 191
NRC regulates the release of liquid effluents that may have radionuclides from nuclear generating plants	U.S. NRC	10 CFR 20 and 50
Nuclear generating plants are required to have a formal emergency response plan and to exercise that plan periodically to ensure workability	U.S. NRC MDH	10 CFR 50

***NRC License Renewal Application*[1]**

The U.S. Nuclear Regulatory Commission (NRC) licenses the operation of domestic nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and NRC implementing regulations through:

- Title 10, Energy, *Code of Federal Regulations* (CFR), Part 54, Requirements for Renewal of Operating Licenses for Nuclear Power Plants, Section 54.23, Contents of Application-Environmental Information (10 CFR 54.23)

- Title 10, Energy, CFR, Part 51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, Section 51.53, Post-Construction Environmental Reports, Subsection 51.53(c), Operating License Renewal Stage [10 CFR 51.53(c)]

These regulations provide for an operating license renewal period for up to 20 years beyond the initial 40-year license term which was granted to the Monticello Plant in 1970.

[1] Application for Renewed Operating License, Monticello Nuclear Generating Plant, Docket No. 50-263 License DPR-22, March 15, 2005

The NRC license renewal process focuses on technical and engineering aspects of plant operations but also includes a federal environmental review component (both a generic EIS and a facility-specific supplemental EIS or ER). This federal process and these documents will cover, among other issues, the expected radiation safety and health impacts of continued operation of the plant and ISFSI, as well as a separate analysis of the impacts of generation alternatives to the continued operation of the Monticello plant itself. The NRC environmental review process also includes a scoping process, public meetings, and opportunity for public comment.

Generic Environmental Impact Statement

The Generic Environmental Impact Statement (GEIS), which applies to all facilities, examines the possible environmental impacts that could occur because of renewing any commercial nuclear power plant license, and, to the extent possible, establishes the significance of these potential impacts. For each type of environmental impact, the GEIS attempts to establish generic findings covering as many plants as possible.

While plant and site-specific information is used in developing an envelope of generic findings, the NRC does not intend for the GEIS to be a compilation of individual plant environmental impact statements. Instead, this report may be incorporated by reference by an applicant into a license renewal application. The GEIS makes maximum use of environmental and safety documentation from original licensing proceedings and information available from state and federal regulatory agencies, the nuclear utility industry, scientific literature and plant operating experience. It allows the applicant to concentrate on those impacts that must be evaluated on a plan-specific basis.

Supplemental Facility Environmental Report

Every individual facility applying for relicensing is required to complete a plant and site-specific supplemental environmental report to deal with unique facility and location issues. NRC regulation 10 CFR 51.53(c) requires that an applicant for license renewal submit with its application a separate document entitled, *Applicant's Environmental Report - Operating License Renewal Stage*. The report is to include an assessment of the environmental consequences and potential associated mitigating actions and is to supplement the GEIS. Appendix E[2] to the Monticello Plant License Renewal Application contains the report for the Monticello Nuclear Generating Plant operating license renewal.

Final Safety Analysis Report

One of the detailed technical and engineering studies required as part of the license application was a "Final Safety Analysis Report" (FSAR), which looks at engineering aspects of the nuclear power system.

The NUHOMS dry fuel system was initially certified for use in January 1995 by the NRC. A subsequent license amendment was approved in September in 2001 for the NUHOMS 61BT storage and transport system proposed for use at Monticello. This NRC approval of the NUHOMS system is known as a "General License" under the rules of 10CFR Part 72.

[2] Applicant's Environmental Report , Appendix E – Operating License Renewal Stage
Monticello Nuclear Generating Plant, Nuclear Management Company
Docket No. 50-263 License No. DPR-22, March 2005

In order to receive a general license, Transnuclear, the system manufacturer, submitted a number of nuclear, mechanical, thermo-hydraulic, and structural analyses for the storage system. Submittals also included a generic set of site environmental conditions intended to define the permissible conditions under which the storage system could be used.

The analyses supporting the system were reviewed and approved the NRC and Transnuclear prepared a Final Safety Analysis Report (FSAR). The NRC then established a set of Technical Specifications that govern the design, construction, and operation of the storage system. Technical Specifications consist of activities, conditions of use and system parameters that must be maintained to ensure the safe use of the storage system.

Monticello must ensure that it complies with these Technical Specifications. It must prepare and maintain documentation at the plant demonstrating compliance with all of the applicable requirements for use of the NUHOMS 61 BT system as licensed by the NRC. The NRC typically will review and confirm that Monticello is in compliance prior to implementation.

Section 2.2 Minnesota Regulatory Processes – CON, IRP and EIS

In addition to the federal requirements, a nuclear power generating plant in Minnesota is covered by a series of state regulatory steps. These include filing the Certificate of Need (CON) for the facility, the Integrated Resource Plan (IRP) for the utility and the Environmental Impact Statement (EIS) for the facility.

Certificate of Need (CON) Application

The Certificate of Need (CON) Application describes the proposed project in detail and provides information and analysis required by Minnesota Rules Chapter 7849 that specify criteria for the assessment of need for large electric generating facilities and large high voltage transmission lines. The Monticello CON Application provides information on the economics and reliability of siting the proposed ISFSI system, thus allowing the nuclear plant to remain operating, as compared to the economics, environmental impacts and reliability of alternative baseload plants. The application also contains an overview of the environmental, economic, employment impacts of the proposed ISFSI and predicted on-site and off-site radiation exposure in the surrounding area.

Integrated Resource Planning

Xcel is required to submit an Integrated Resource Plan (IRP) that examines the long-range planning for the future mix of energy generation alternatives and goals. Pursuant to Minnesota Statute §216B.2422, utilities in Minnesota are required to submit IRPs to the PUC. In its resource plan filing, the utility examines the need for electricity over a 15-year planning period, evaluates a broad spectrum of alternatives to meet the anticipated demand for power and presents its plan. In the case of regulated utilities like Xcel, the PUC accepts, modifies, or rejects the utility's IRP. The process includes opportunities for comments including alternative resource plan proposals and, if necessary, provides for public meetings and hearings. The proceeding typically takes over a year to complete.

Environmental Impact Statement
An environmental impact statement (EIS) must be prepared prior to the PUC decision on the Certificate of Need (Minnesota Statute §116C.83). This EIS must present the potential environmental impacts of the proposal, allow opportunity for public comment and input into the document and examine the environmental impacts of alternatives and potential mitigation measures. Its purpose is to inform the PUC of the environmental consequences and potential impact mitigation measures to consider in its need determination.

The Environmental Quality Board began preparation of the EIS and approved its scope in June 2005. In July 2005, the Minnesota Legislature transferred the authority for preparing the EIS to the Minnesota Department of Commerce.

EIS Scoping Decision. The first step in the EIS was the “scoping process,” intended to reduce the scope and bulk of the EIS and to identify only those potentially significant issues relevant to the proposed project. The Scoping decision, included as an appendix to the draft EIS, describes the major issues to be studied in the EIS, new studies to be completed, and the issues that will not be studied in the EIS. It also describes the level of detail to which each topic will be studied further in the EIS.

Draft EIS and Final EIS Procedures. The Department of Commerce prepared the draft EIS consistent with environmental review rules and in accord with the scoping determination. The entire draft EIS also is available on the PUC website. Following public review and comment and informational meetings, the department will prepare a final EIS.

The Department of Commerce will determine the adequacy of the final EIS. A final EIS is deemed adequate if it addresses the potentially significant issues and alternatives raised in scoping so that all significant issues for which information can be reasonably obtained have been analyzed, provides responses to the substantive comments received during the draft EIS review concerning issues raised in scoping and that all required procedures have been followed.

Section 2.3 Permits and Approvals

Xcel Energy must comply with two principal sets of requirements in order to construct and operate a spent nuclear fuel storage facility at the Monticello Power Plant.

- A Certificate of Need authorizing the storage facility and containers must be obtained from the Minnesota Public Utilities Commission (Minnesota Statutes §§116C.83, 216B.243, Minnesota Rules Chapter 7855), and

- Requirements established by the United States Nuclear Regulatory Commission for the design, construction and operation of an Independent Spent Fuel Storage Installation (ISFSI) and the use of storage containers must be complied with (Title 10, Code of Federal Regulations, Part 72).

The only state permit required is a National Pollution Discharge Elimination System Stormwater Permit from the Minnesota Pollution Control Agency.

SECTION 3

PROJECT DESCRIPTION

Xcel Energy is proposing to expand the Monticello Nuclear Power Generating Plant's spent fuel storage capacity by building an Independent Spent Fuel Storage Installation or ISFSI. The installation would be within plant boundaries, but outside the generating plant itself. The installation is needed in order for the plant to continue operating past the end of its current license which expires in 2010. The spent-fuel pool at the plant also runs out of capacity in 2010.

To operate the plant past 2010, Xcel Energy must gain a license extension from the Nuclear Regulatory Commission (NRC), as well as the state approval for additional nuclear spent fuel storage capacity at the plant. Xcel Energy applied to the NRC for a 20-year license renewal in March, 2005.[3]

Section 3.1 Plant Description

The Monticello facility is a 600-megawatt, nuclear powered, boiling water reactor, electric generating plant. The Plant provides base load electrical service. It operates at full capacity around the clock for extended periods of time. The Plant is used to meet the ongoing, steady or base demand for electrical power. The Monticello plant produced 4.6 million megawatt-hours (MWh) of electricity in 2003, which was about 10 percent of Xcel customers' electric energy needs. It was first licensed in 1970 by the NRC for a period of 40 years; this operating license expires in September 2010.

The plant is owned by Xcel Energy and operated by Nuclear Management Company, LLC (NMC) under contract with Xcel. NMC, a nuclear power plant operating company, is a joint venture, owned by Xcel, Alliant Energy, CMS Energy, Wisconsin Public Service and We Energies. In addition to the Monticello Plant, NMC operates five other plants, including the Prairie Island Nuclear Power Generating Plant.

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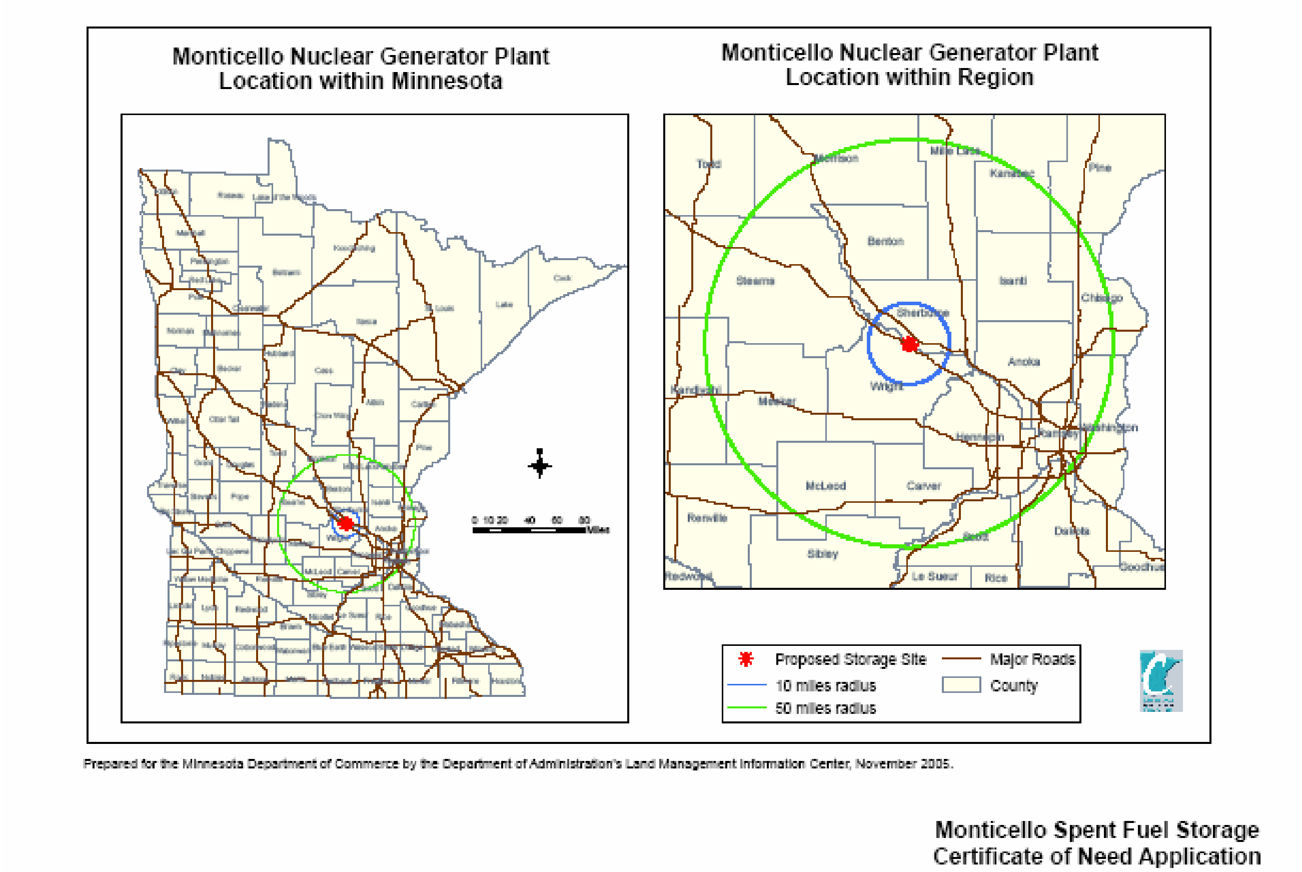
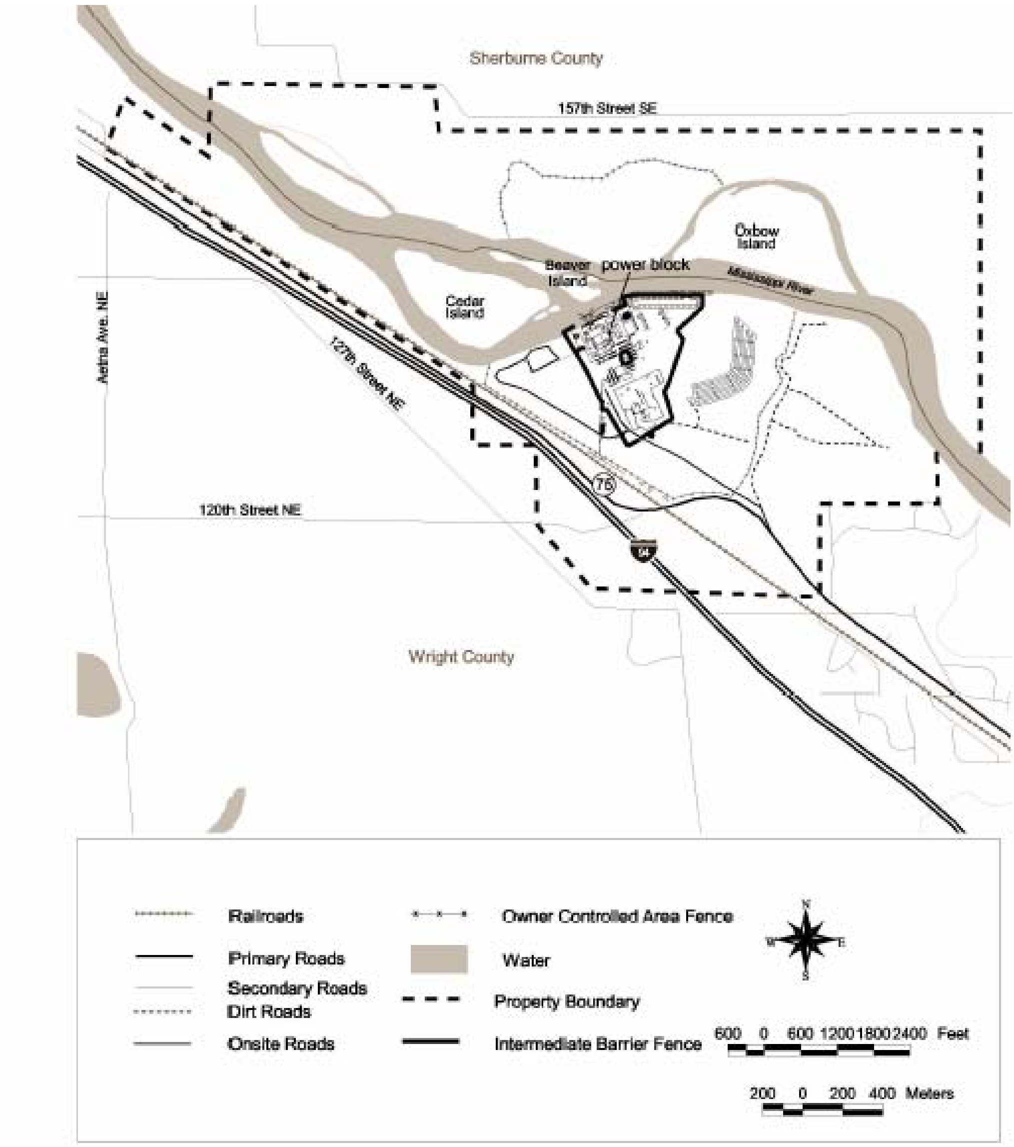
[3] Application for Renewed Operating License, Monticello Nuclear Generating Plant, Docket No. 50-263 License DPR-22, March 15, 2005

Figure 3.1 Location Map



The Plant is located within the city limits of Monticello, Minnesota, in Wright County, on the western bank of the Mississippi River, in Section 32, T–122N, R–25W, at 45° 20' N latitude and 93° 50' W longitude, approximately 50 miles northwest of Minneapolis/ St. Paul. The Plant site consists of approximately 2,150 acres of land owned by Xcel. Part of this property is on the eastern bank of the river in Sherburne County and part is on the western bank in Wright County. A perimeter fence and other barriers restrict access to the plant. The proposed new spent fuel storage facility would be located in the Northeast one-quarter of the Southeast one-quarter section of Section 32, Township 22N, and Range 25W of Wright County.

Figure 3-2 Facility Site Boundary – The total Monticello facility property occupies a 2,100 acre site, outlined with a dashed line

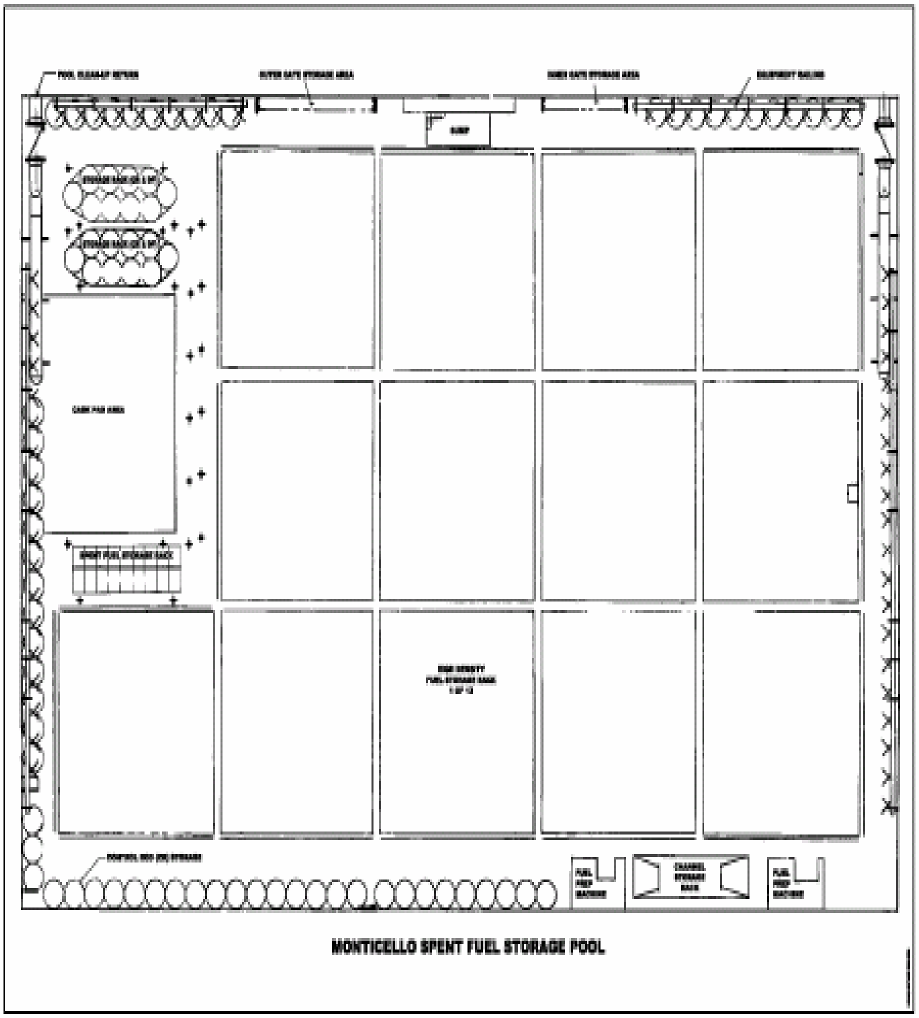


The detailed description of the proposed project is in Chapter 3 of the Certificate of Need Application.

Spent Fuel Pool

Xcel stores spent nuclear fuel in a pool within the Monticello Plant. The spent fuel pool provides storage for spent fuel assemblies. The pool is located on the refueling floor in the reactor building. It is filled with racks that hold the spent fuel assemblies and other irradiated reactor components. This storage pool will run out of space in 2010.

Figure 3- 3 MNGP Spent Fuel Storage Pool



The spent fuel storage pool is contained inside the reactor building.

Section 3.2 Spent Fuel Inventory

The NRC operating license allows for storage of up to 2,237 spent fuel assemblies in the current spent fuel storage rack configuration. Eight of the licensed storage spaces are not available because during manufacture they did not meet quality control specifications. This left 2,229 storage spaces available for use in the pool at the Plant. Twenty of those spaces hold used reactor control rod blades generated during handling fuel assembly handling. Thus, 2,209 spaces are available for spent nuclear fuel storage.

As of December 15, 2004, 1,478 spent fuel assemblies were in the pool. The spent fuel pool has sufficient storage capacity to handle all spent fuel rods until 2007. In the mid 1980's, 1,058 spent fuel assemblies were shipped to a General Electric storage pool in Morris, Ill.

Xcel estimates that 1,520 spent fuel assemblies would be discharged from the plant's reactor during operation between 2010 and 2030.

The plant's reactor core is comprised of 484 fuel assemblies, arranged in 121 cells. Each cell contains 4 fuel bundles or assemblies and a control blade. Approximately every two years, the Plant is shut down to refuel the reactor. Between refueling outages, the Plant typically operates at full output around the clock. During each refueling operation, approximately a third of the fuel assemblies (currently 152), in the reactor are replaced with new ones.[4]

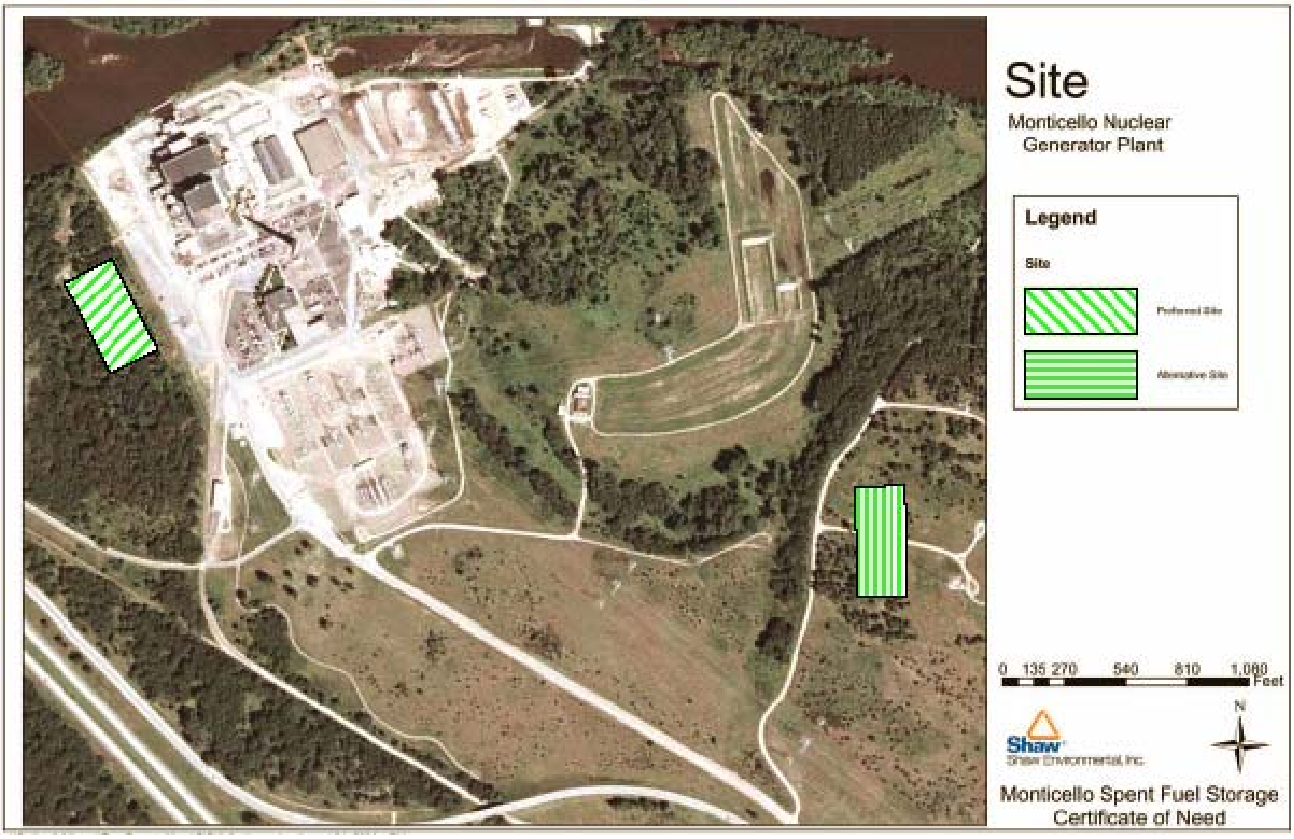
Section 3.3 Independent Spent Fuel Storage Installation

Xcel Energy proposes to provide additional spent fuel storage in an Independent Spent Fuel Storage Installation or ISFSI. This above-ground dry-cask storage facility would consists of a lighted area, approximately 460 feet long and 200 feet wide, roughly 3.5 acres in size, located adjacent to the reactor and turbine building. The tallest structures are the light poles that are approximately 40 feet tall. Two fences would surround the facility with a monitored, clear zone between.

Within the storage area, spent fuel canisters are stored in modular concrete vaults, placed on a reinforced concrete support pad, 18 to 24 inches thick. Concrete approach pads surround the support pad to accommodate vault placement and spent fuel canister transfer traffic. A small concrete building will be located within the ISFSI to house electrical equipment. The site and storage vaults are monitored with cameras, other security devices, and temperature sensors. An access road connects the ISFSI to the rest of plant.

[4] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005 (Text and Figure 3-8)

Figure 3-4 Monticello Site Map – ISFSI Preferred and Alternate Sites



The preferred site is closer to the main plant area and associated infrastructure.

Installation Capacity

The proposed design capacity of the ISFSI is 30 storage units, the amount needed for plant operations through 2030. This is equivalent to a design capacity of 144 cubic meters. The storage facility is laid out so that it can accommodate another 35 vaults on a second support pad without having to change the security perimeter. The extra space could be used for casks to decommission the plant.

The proposed ISFSI is intended for temporary storage. Xcel Energy anticipates that the spent fuel will be transported to a federal repository like Yucca Mountain when such a facility is available, although the date for such a facility is uncertain.

An ISFSI may be necessary regardless of how long the plant operates. If the plant shuts down at the end of 2010, some sort of dry-cask storage system will be needed to empty the pool and reactor for decommissioning.

Other Installations
There are 28 ISFSI's in operation in the United States. Three boiling water reactors currently use the technology selected for implementation at Monticello:

- Pennsylvania Power & Light's Susquehanna Nuclear Power Plant
- AmeriGen's Oyster Creek Nuclear Power Plant
- Alliant Energy's Duane Arnold Energy Center

The Canisters
Xcel Energy proposes to use a dry storage canister system, called the NUHOMS 61BT, for the storage and transport of spent fuel at the Monticello Plant. Each canister is licensed to store and transport 61 spent fuel assemblies. Each canister weighs approximately 45,400 pounds empty and 88,400 pounds loaded with spent fuel. The NUHOMS 61BT Dry Fuel Storage System is designed, licensed, and manufactured by Transnuclear Inc. The NUHOMS 61BT system is licensed in accordance with federal regulations – 10 C.F.R. Part 72 for storage and 10 C.F.R. Part 71 for transportation.

A Transfer Cask is used to lift and handle the canister during spent fuel loading, closure, and transfer operations. The Transfer Cask is a NUHOMS OS197 cask. The transfer cask is made primarily of stainless steel. The exterior shell has a highly polished surface to facilitate decontamination. The transfer cask is constructed from two concentric cylindrical steel shells with a bolted top cover plate and a welded bottom end assembly. The space between these two shells is filled with cast lead to provide gamma shielding. The transfer cask also includes an outer stainless steel jacket, which is filled with water for neutron shielding. The top and bottom end assemblies incorporate a solid neutron shield material.

Figure 3-5 Artists rendering of the Proposed ISFSI Facility

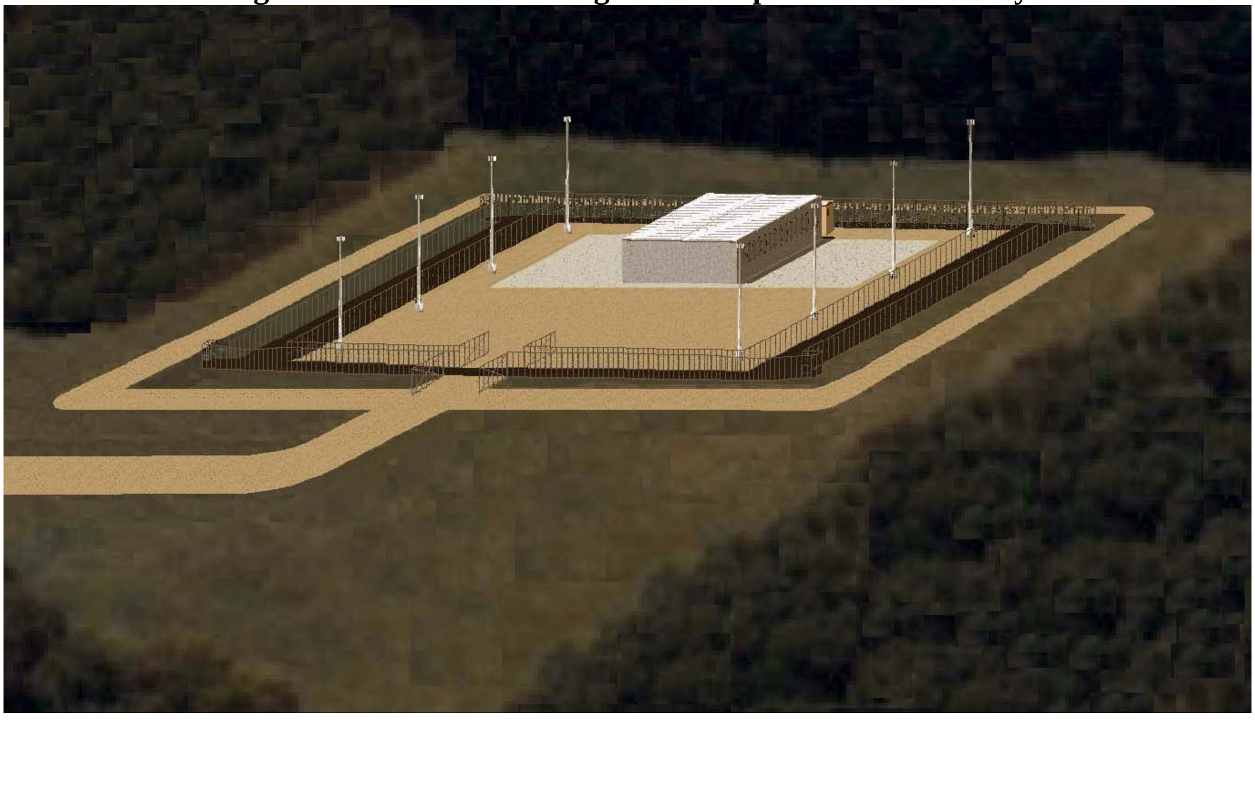
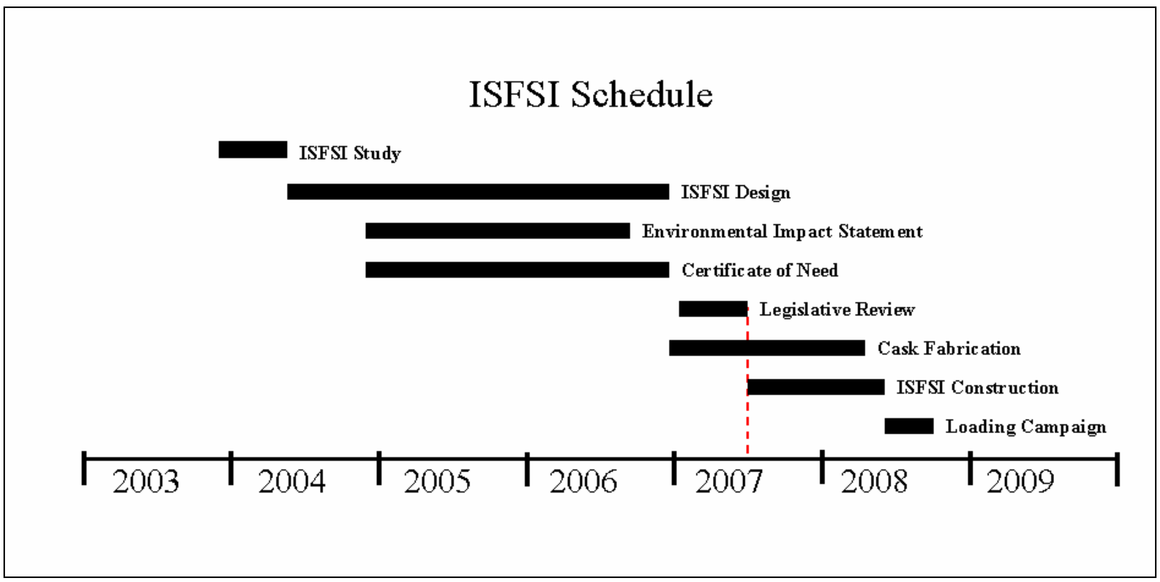


Figure 3-6 Photo of a Completed set of Concrete ISFSI buildings

Each concrete cask storage cell is a about the size of a single car garage.

Figure 3.7 ISFSI Schedule



For the facility to be completed by 2008, storage canisters order must be placed and fabrication begun in 2006

Facility Operation

Spent fuel assemblies must be stored in the spent fuel pool inside the Plant for at least five years before they can be loaded into dry cask storage canisters.

When it is time to load spent fuel assemblies, the NUHOMS 61BT canister is placed inside the NUHOMS OS197 Transfer Cask. The canister and cask are placed in the spent fuel pool and the fuel assemblies are loaded into the canister. The shielded lid to the canister is installed underwater, the canister is dried, and then welded and bolted shut. The canister and cask are then placed on a transport trailer and taken to the ISFSI, where the canister is inserted into the storage module. This system of loading the canister into vaults does not require lifting of the canister during transfer. The transfer trailer can be backed up to the storage module and the canister transferred to or from storage modules.

The first storage campaign would begin in April 2008 and take approximately four months to complete. Additional spent fuel canisters would periodically be placed in more concrete storage modules at the ISFSI throughout the remaining operating life of the plant.

Cost of the ISFSI (in Millions)	
Regulatory Processes	$ 2.0 M
Engineering and Design	$12.0 M
Plant Upgrades	$ 4.0 M
ISFSI construction	$ 3.5 M
30 canisters and storage modules	$26.0 M
Canister Loading Campaigns	$ 7.5 M
Total	$55.0 M

Fuel Assembly Fuel Rod

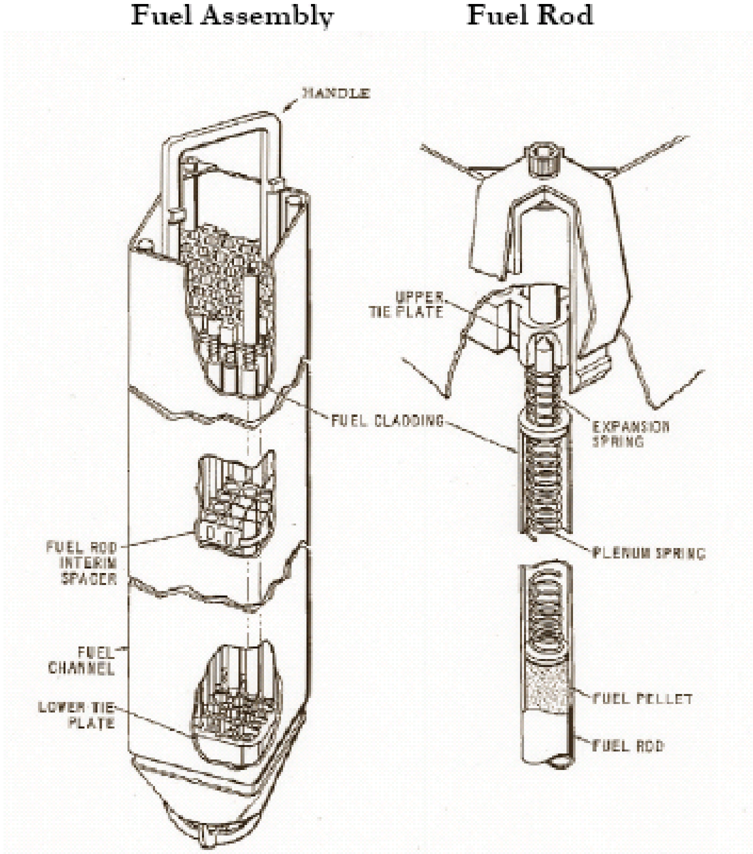


Figure 3-8

This is a diagram of a fuel rod and the fuel rod assembly in the reactor core.

Section 3.4 Plant Closure and Final Decommissioning

When the operating license for the plant expires, the spent nuclear waste in the plant and in the Storage Installation must be transferred and ultimately disposed of. All other non-radioactive deconstruction would be handled in a conventional fashion, with extra precautions for workers handling low-level radioactive waste and contaminated debris. The Storage Installation can be decommissioned once all spent fuel stored in it has been transported to an off-site facility. Because this system is licensed for both storage and transportation, the canisters and the spent fuel stored in them can be shipped for final disposal. This will leave the concrete storage modules and supporting infrastructure to be disposed of by Xcel Energy and NMC. Because the canisters are sealed by welding no radioactive materials should be present once the canisters and spent fuel have been removed. See the "The “No Action” Alternative" in Section 6 for more information on decommissioning.

SECTION 4

ANALYSIS OF PROPOSED PROJECT

This section is focused on the additional environmental impact that the construction of an Independent Spent Fuel Storage Installation would have on the environment. It is assumed that there are no new impacts from the continued operation of the Monticello Plant, other than those from the spent fuel Storage Installation itself. Non-radiation environmental impacts are covered in this section; radiation-related environmental impacts are addressed in Section 5. The analysis assumes that the Storage Installation could be in place for up to 200-years.

Scope of the analysis. The Monticello EIS Scoping Decision[5] designated the specific topics and the extent of analysis that would be provided in this EIS. In keeping with Minnesota environmental review rules, the scoping decision acknowledged the separate environmental review being conducted by the federal government as part of the facility's relicensing request and directed that the state EIS incorporate by reference material available in federal environmental review documents to the fullest extent possible.

Section 4.1 Facility Site Characteristics

The Monticello Plant and the surrounding area are situated on an outwash terrace that forms a low bluff on the southwest bank of the Mississippi River. The plant site is at an elevation of 935 feet above sea level, about 30 to 35 feet above the river. Topography of the Preferred Storage Installation Site ranges from 939 to 945 feet and is flat with 0 to 3 percent slope over most of the site. The northeast corner of this site drops off slightly in that direction into a gentle swale that slopes to the north, wrapping around the site and eventually emptying into the Mississippi. The Alternate Site is at an approximate elevation of 945 feet and is also flat to gently sloping.

[5] Environmental Impact Statement Scoping Decision and Scoping Environmental Assessment Worksheet for the Monticello Nuclear Generating Plant EQB Docket No. 04-87-CON-Monticello, June 16, 2005

Figure 4- 1 Monticello Plant (MNGP)

Monticello Nuclear Generating Plant

The Plant is located on the south bank of the Mississippi River

Geologic Setting

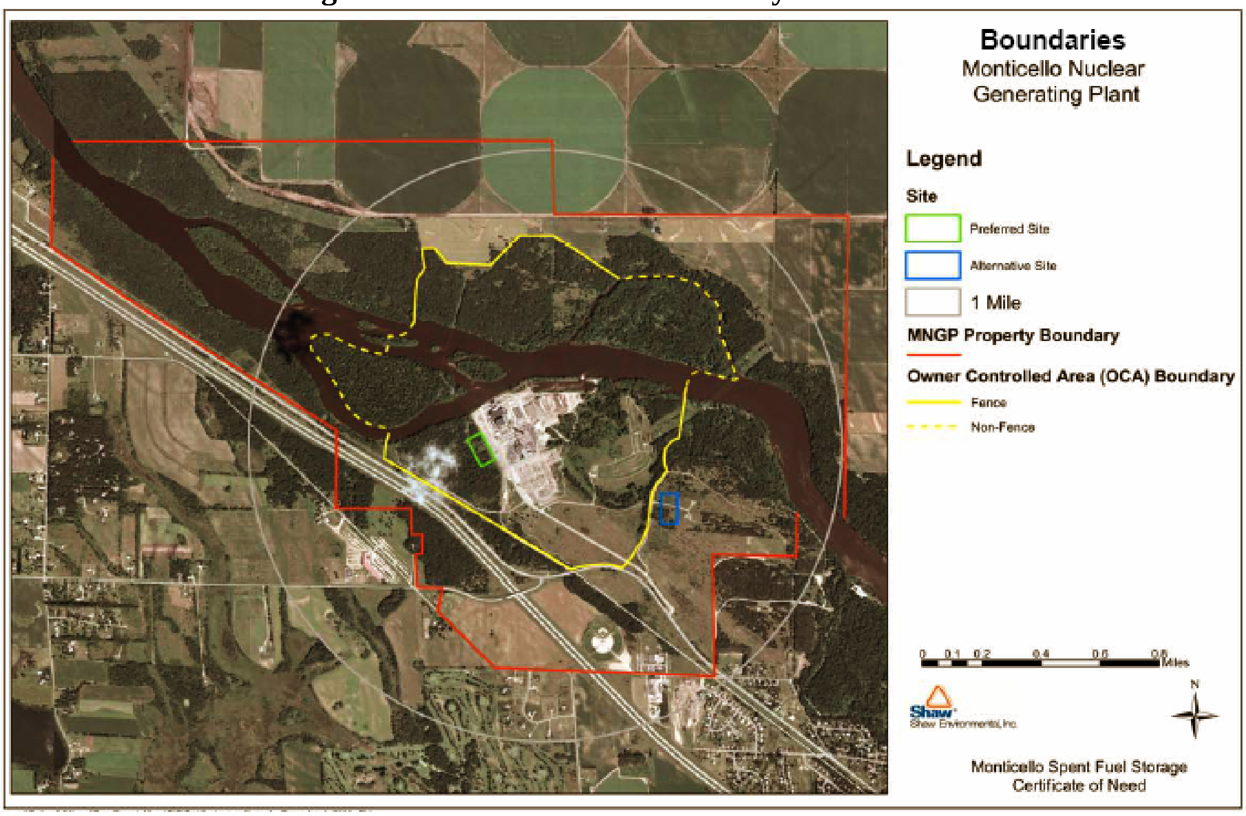
Decomposed granite and basic rocks of Precambrian age comprise the oldest formation at the site. This material lies at a depth of about 75 to 122 feet below the ground surface. Resting directly upon the weathered Precambrian crystalline rocks is approximately 10 to 15 feet of medium-grained quartz sandstone, which in general is moderately well cemented. Above the sandstone is a series of alluvial strata about 50-feet thick which consists predominantly of clean sands with gravel, as well as a few layers of clay and glacial till. This alluvial sequence represents successive depositions of glacial outwash, moraine, and more recently, sediments laid down by the Mississippi River. Groundwater occurs some 35 feet below the surface.

Land Use

The proposed Storage Installation would be located entirely within the property of the existing plant and would be approximately three and a half acres in size. The Preferred site is located adjacent to the reactor and generation building. The eastern portion of this site was used during plant construction activities for staging and lay-down and includes some structural remnants from original construction activities. Much of the site is covered with second growth vegetation such as quaking aspen and variable perennial grass species. The western and southern portion of the site borders on mature forest with numerous large pin oaks still remaining along the edge of the site.

The Alternate Site, located on an outwash plain, is an open field bisected by a dirt road internal to the plant and also may have been used as a construction lay-down area. These outwash plains along the Mississippi were historically used for agriculture and the entire vicinity in and around the Alternate Site has been cleared of its original forest cover**.**

Figure 4- 2 Monticello Plant Facility Boundaries

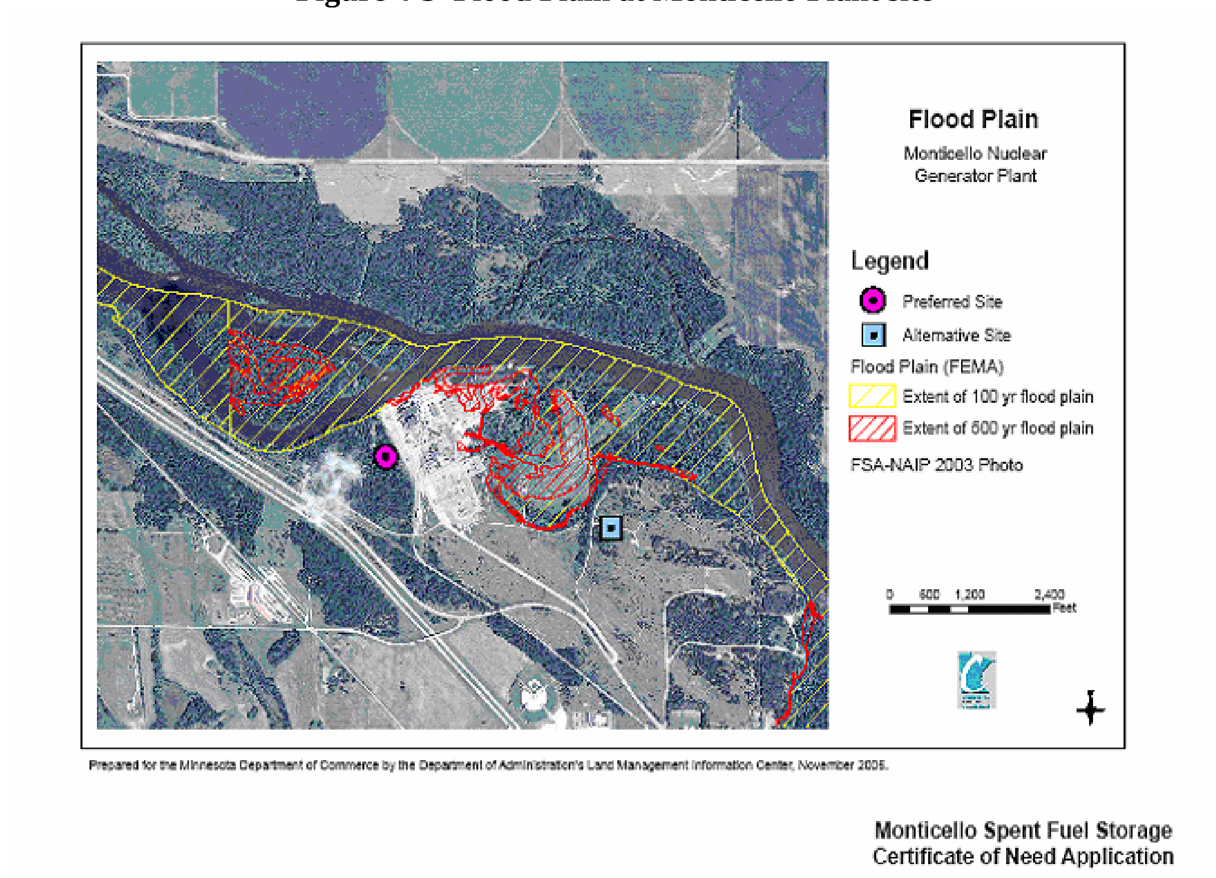


The Monticello Plant facility boundary and area perimeter fence buffer it from surrounding areas.

Relationship to Floodplain

Both the preferred and alternative Storage Installation sites are above the level of the 500-year flood extent. In addition, both would be above the elevation of a maximum probable flood. This is a term for the hypothetical flood that would result if all the factors that contribute to the generation of a flood were to reach their most critical values concurrently. The elevation of the top of the concrete support pad is currently designed to be at 943 feet at the preferred site; the maximum probable flood elevation is 939.2 feet.

Figure 4-3 Flood Plain at Monticello Plant site



Both the alternate and preferred ISFSI sites are above the 500-year floodplain.

Section 4.2 Fish, Wildlife and Ecologically Sensitive Resources

Impacts on fish, wildlife or ecologically sensitive resources from the proposed Storage Installation are not likely to be significant. The proposed sites have been previously disturbed by construction activities and are not high quality habitat for flora or fauna.

Fish

The Mississippi River and fishery are not expected to be impacted by the Storage Installation. The river in the vicinity of the Monticello Plant is a warm water fishery, including several species of sport fish such as northern pike and walleye. The impacts of thermal discharges due to the plant will be evaluated in the federal EIS and discharge limits are under the NRC permitting jurisdiction. A water thermal discharge permit is presently in force and no change in water discharge temperature is anticipated due to the construction and operation of the Storage Installation; the ISFSI would not use river water in its storage function.

Wildlife
About three acres of lower quality wooded land and scrub brush will be cleared for the project. Some birds and animals will lose this amount of marginal habitat from a much larger area of higher quality habitat adjacent to the proposed sites.

Rare plant or animal species
The Minnesota Natural Heritage and Non-game Research Program identified two rare species within approximately a mile of the proposed site: dry oak savannah and the peregrine falcon. However, vegetation at the preferred sites was previously disturbed and there does not appear to be any reason the storage facility would impact nesting falcons or the hunting patterns and success of mature peregrine falcons.

Dry Oak Savanna. Just west of the preferred site is an area identified in the Minnesota County Biological Survey as a "Site of High Biodiversity." The Minnesota Natural Heritage Program has classified this wooded habitat as a Sand-Gravel Subtype of the Dry Oak Savanna. The Minnesota Department of Natural Resources describes this forest type is dry to dry-mesic community. It is most common in the deciduous forest-woodland zone, but also occurs sporadically throughout the prairie zone. The principal trees are bur oaks and northern pin oaks, but black oaks (Q. velutina) are also common in the southeast. The stature and spacing of trees is somewhat variable, reflecting differences in soils, topography and climate. Small, gnarly, open-grown trees are most common, although in moister spots, or in heavier soils, larger trees are sometimes more common. Tree spacing ranges from sparsely and evenly distributed to strongly clumped in moderately dense patches. Shrub cover is variable as well.

Dry Oak Savanna occurs on the same kinds of landforms as Dry Prairie, except for bedrock bluffs. Correspondingly, substrates range from excessively-drained to well-drained, sand to loam soils. The presence of savanna rather than prairie indicates a lower fire frequency or intensity (or both) than in prairie. Dry Oak Savanna requires less frequent fire than Mesic Savanna for maintenance. However, in the complete absence of fire, woodland will eventually replace Dry Oak Savanna, which is what appears to have happened at the Storage Installation preferred site. Therefore, the ISFSI preferred site would not detrimentally impact a dry oak savanna.

Peregrine Falcon. The second occurrence found by the Natural Heritage and Nongame Research Program was a Peregrine Falcon (*Falco peregrinus)* nesting area. Peregrine Falcons were recently removed from the U.S. Endangered Species List; however, they are still a state-listed threatened species in Minnesota and are further protected by the Migratory Bird Treaty Act. Historically, Peregrine Falcons nested on cliff ledges or in shallow caves in cliffs. However, this species has the ability to adapt to a wide range of environments, demonstrated by the diversity of habitats it now occupies throughout the world. Urban environments are becoming an important habitat for Peregrine Falcons, where buildings and bridges provide nesting structures and birds such as pigeons provide a food base. These urban Peregrine Falcons have contributed to the recovery of the species as a whole.

In 1995, a nesting box was established on the stack at the Monticello Plant and peregrines introduced. Peregrines have successfully fledged at Monticello and presently reside on the stack located south of the power plant facility. The proposed storage facility will be constructed well to the north of the nesting site; thus, the installation of the ISFSI should pose little or no impact to the survival patter of the falcon.

Section 4.3 Water Resources

The Storage Installation is not expected to impact water resources. It will affect surface water or impact the Minnesota Department of Health's ongoing efforts to coordinate a non-regulatory Source Water Protection Plan with the cities of St. Cloud, Minneapolis and St. Paul. It will meet the requirements of the Wild and Scenic Rivers Program and implement measures to control erosion and sedimentation during construction.

Water Use

Water use at the Monticello Plant will not change with the addition of the Storage Installation. The Monticello Nuclear Generating Plant Application for Renewed Operating License[6] notes that under low flow conditions, the plant's consumptive use of the Mississippi River is 1.7 percent of flow, equating to a negligible change in river surface water elevation. Water use also is addressed in the federal EIS for plant re-licensing.

Wild and Scenic Rivers Program

The portion of the Mississippi that passes by the Monticello power plant is designated "recreational" under the state's Wild and Scenic Rivers Program. The Mississippi River from St. Cloud to Anoka was added to the program in 1976. The Mississippi Wild and Scenic River Management Plan was developed when the segment was designated; the plan is currently being updated and revised.

The purpose of the State Wild and Scenic Rivers Act (Minnesota Statutes 103F.301) is to preserve and protect the outstanding scenic, recreational, natural, historical, and scientific values of certain Minnesota rivers and their adjacent lands. The act's intent is not to restore pre-settlement conditions, but rather to prevent intensive development and recreational overuse from damaging these rivers. The legal extent of lands covered by the program is a maximum of 320 acres per each river mile on both sides of the river. All state, local, and special governmental units (councils, commissions, boards, districts, agencies, etc.), and all other authorities must exercise their powers to further the purpose of the act and adopted management plans.

Recreational rivers are those rivers that may have undergone some impoundment or diversion in the past and that may have adjacent lands which are considerably developed, but that are still capable of being managed to further the purposes and intent of the designation. These bordering lands may be in agricultural or other land uses, and may be readily accessible by pre-existing roads or railroads. Xcel Energy owns the largest undeveloped tract of land along this segment of the river which includes the buffer zones of the Monticello and Sherco power plants.

[6] Applicant's Environmental Report , Appendix E – Operating License Renewal Stage
Monticello Nuclear Generating Plant, Nuclear Management Company
Docket No. No. 50-263 License No. DPR-22, March 2005

Under the rules for the program (Minnesota Rule 6105.0870), the Monticello Plant is a permitted use. The rules also require that the structure meet the following criteria:

- Structure setbacks are 100' from the ordinary high water mark, 20' from a bluff line
- Structures must not be located on slopes greater than 13 percent (unless screened)
- Compliance with state floodplain standards
- The structure should not exceed 35' in height
- Also required is consistency with all other provisions of the Minnesota Rules parts 6105.0080 to 6105.0200

It is expected that the new ISFSI facility will meet these criteria.

Erosion, Sedimentation and Runoff

The construction and operation of the Storage Installation will not have a significant impact in the areas of erosion, sedimentation and storm water runoff. Approximately 4000 cubic yards of soil materials will be moved or excavated and replaced with structural fill for the concrete storage and approach pads at the 3-acres site. However, there are no steep slopes or highly erodable soils associated with the proposed site and no site dewatering is anticipated during construction.

Construction measures will ensure that there are no point discharges from the site into any drainage ditches that could pass sediment runoff into natural flow routes that discharge into the Mississippi River. Best Management Practices to minimize run-off and erosion will be employed during construction; strategic placement of hay bales, silt fencing or other erosion controls will be located around the site as necessary to mitigate erosion potential. Sediment controls such as geo-textiles and in-situ vegetation also will be used to minimize erosion. These measures will be formally developed as part of the site construction specifications later in the project. The Minnesota Pollution Control Agency's National Pollution Discharge Elimination Permit storm water discharge permit will require an erosion and sediment control plan to ensure that construction activities do not pollute nearby waterways.

Since the site will not add any wastes to storm water, it is expected that the quality of the runoff will be similar to the existing runoff quality. The site will add impervious surfaces that will not absorb runoff. Therefore, the quantity of runoff will slightly increase. During construction, it is estimated that most storm water will drain into the soil since there will be little impervious surfaces and the sandy soils of the site are highly permeable. The finished storage facility will be designed with a slight slope to direct runoff to the sides of the facility. Ditches along the perimeter road will collect runoff and disperse the water to existing natural flow routes. Flow dispersion methods such as riprap will be used to attenuate runoff before entering natural flow routes.

Groundwater Quality

The proposed ISFSI is designed to provide a reasonable expectation that the operation of the facility will not result in groundwater contamination. The proposed storage system has been evaluated and approved for use by the NRC. It includes canisters that are sealed stainless steel canisters, sealed by welding and stored in concrete vaults. The storage system is completely passive. There are no other sources of contamination at the facility that could contaminate the soil or ground water. NRC regulations require ongoing inspection and maintenance to insure canister integrity and safety.

The soils at the proposed site are primarily Hubbards, which are sandy mixed, frigid Entic Hapludolls. These soils are excessively permeable and have limited available water capacity. They readily transmit rainwater or any surface water to groundwater and are susceptible to wind erosion. Xcel Energy has drilled a total of 12 borings at the site. The borings provided no indication of any irregular soil conditions. No sinkholes, shallow limestone formations or Karst have been identified on the proposed site.

Section 4.4 Traffic

No traffic improvements or mitigation measures are warranted due to the construction activities associated with the project. The major roads and highways that will be used by ISFSI construction traffic would be primarily Interstate 94, Minnesota Highways 10, 25, 39 and 55. These are major roads in good condition and the increased traffic is unlikely to have any significant negative impact. The minimal number of addition vehicles on local roadways during construction activities for such a short duration will add only a negligible amount of air emissions to the environment.

Construction of the storage facility will include clearing and removal of topsoil, grading, excavation and structural fill of the storage pad, pouring the concrete storage pad, duct bank, and miscellaneous foundations, erecting the electrical building and fences, placing gravel, and implementing various associated activities. The vehicles employed include bull dozers, scrapers, front end loaders, graders, dump trucks, cement trucks, delivery trucks, and various small support vehicles. Additional traffic will be generated from truck deliveries and commuting workers. It is estimated that construction activities and deliveries will add an average of seven trips each day and commuting will add up to 16 trips (two per round trip) each day. No full time staff is required at the storage facility during operation beyond existing plant personnel.

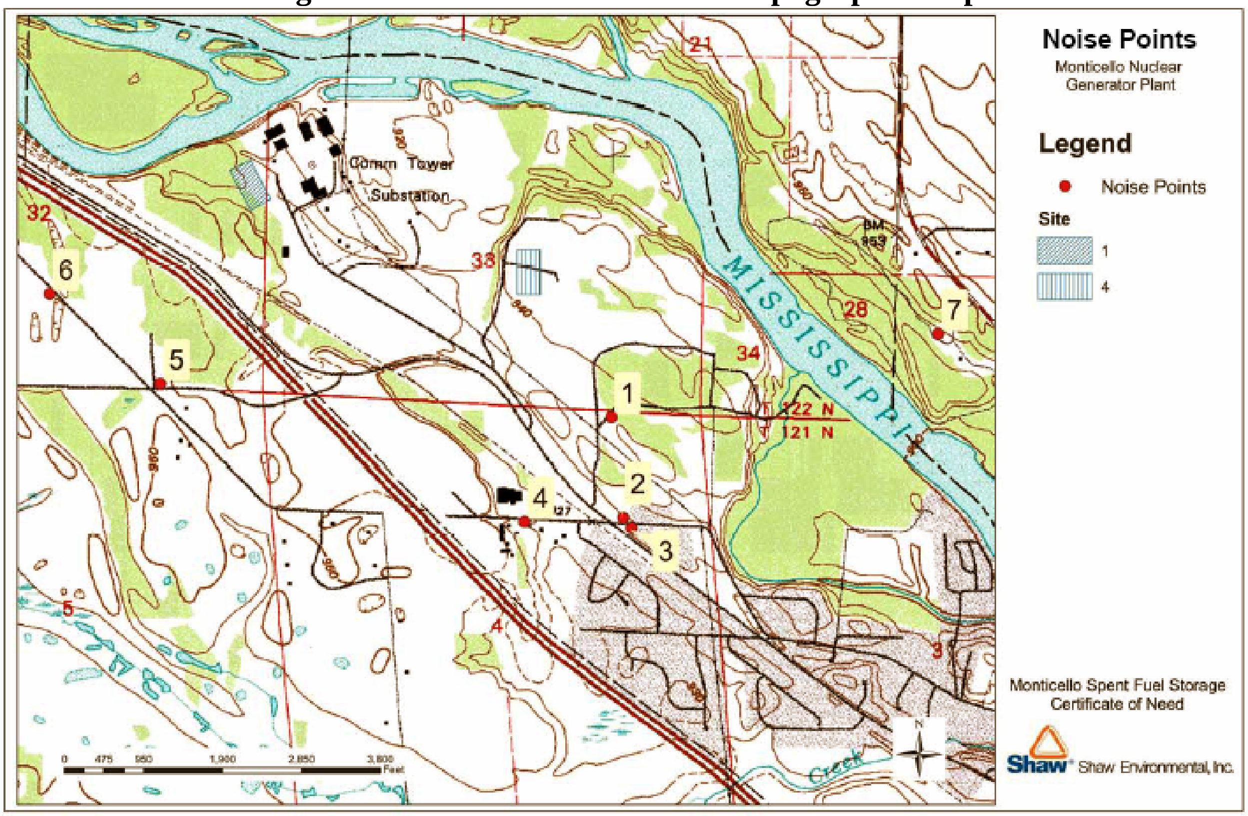
Section 4.5 Noise

Noise impacts are not expected from the construction or operation of the Storage Installation. Ambient sound level data collected in the vicinity of Monticello Plant was highly dependent on traffic density and proximity to I-94. The daytime L90s varied from 44 to 59 dBA and the nighttime L90s varied from 38 to 52 dBA.

Construction of the project will generate noise. For example, earth moving equipment such as bull dozers, scrapers, and graders will clear and level the area. Concrete trucks will deliver concrete to the site and pumping trucks will place it. Similar industrial vehicles will be used for erecting the electrical building and fences. However, the predicted sound levels from the site during construction are expected to be much lower than the ambient sound levels.

During the operation of the storage facility, the spent fuel will be moved from the plant to the storage facility with either a front-end loader or truck. To be conservative, both vehicles were assumed to be used concurrently. The resulting sound levels in the residential areas near the ISFSI were estimated to be 6-17 dBA below the ambient sound levels at nearest residences.

Figure 4-4 Noise Points on USGS Topographic Map

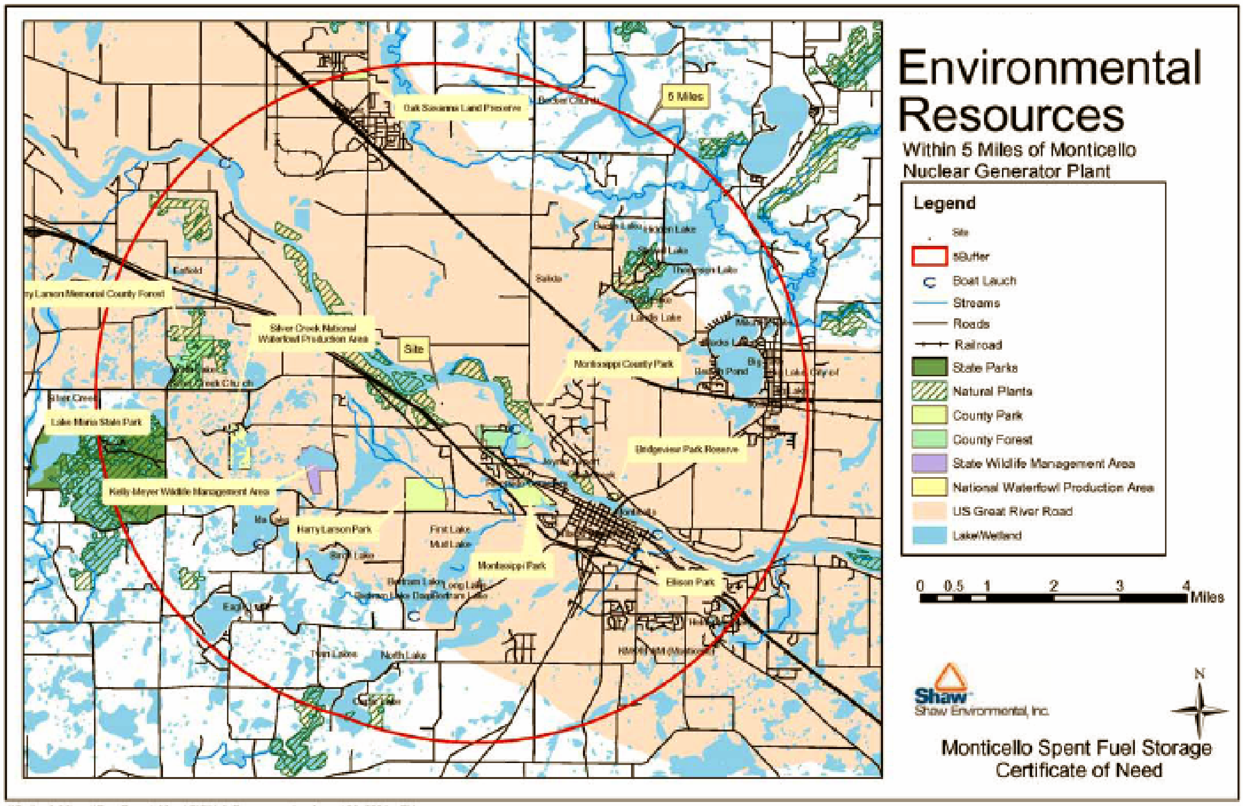


No noise impacts are expected due to construction and operation of the ISFSI.

Section 4.6 Nearby resources

The closest historical site is located approximately three miles from the facility site and no impacts are anticipated. The facility site is not located on designated Prime or Unique farmland. The closest park/recreation area to the project is the Montissippi County Park located approximately 1 mile to the southeast; the proposed project will not impact this area. To the west of the site is an area of Biological Sensitivity classified as a Sand-Gravel Subtype of a Dry Oak Savanna. Impacts to this resource are not expected.

Figure 4-5 Environmental Resources



No off-site impacts or changes to land use will occur with the project.

Section 4.7 Visual impacts.

The facility will not be visible from the Mississippi River or adjacent properties. The preferred site is obscured by wooded areas within the plant property; it will not be visible during construction or operation. During operation lighting will illuminate the facility site for security reasons. However, the light fixtures are only 40 feet high, which is less than many of the trees surrounding the site. It should not conflict with the designated "Mississippi River Scenic Byway Corridor."

A visualization of the proposed ISFSI is included in Section 3, Project Description.

Section 4.8 Cumulative impacts.

While the storage facility will be constructed to house 30 storage vaults, the secured area will be sized to support up to 65 storage vaults. At decommissioning of the plant in 2030, an additional 35 storage vaults would be needed to allow full offloading of the spent fuel. In addition, the purpose of the storage installation is to provide sufficient spent fuel storage to continue operations past 2010, so continued operation of the plant is a "connected action" to the ISFSI.

Given this “connected action” and the uncertainty as to when an off-site spent fuel storage facility will be available, it is appropriate to consider impacts of continued operation of the Monticello Plant through 2030 and on-site storage of spent fuel past plant decommissioning.

Cumulative Impacts Matrix. The cumulative impacts of continued plant operation until 2030 and potential on-site storage of spent fuel at Monticello for up to 200 years were assessed through a summary matrix. The matrix pairs actions that could cause impacts with elements of the impacted environment by 50 year increments up to 200 years past 2010. Factors influencing the level or degree of impact were identified to guide the analysis, as were assumptions concerning the broader geopolitical landscape.

The analysis considered six possible causes of impacts: terrorism, accidents, degradation, controlled releases, earthquakes and floods, including those due to dam failure.

These causes were looked at relative to their possible impact on four elements of the environment: air quality, water quality, human health and ecological resources. The analysis in the EIS concerning the current and past impacts of the Monticello Plant and anticipated impacts of the Storage Installation were used to guide the evaluation.

Four factors were used to gauge the level or degree of impact the specific cause might have. They were:

- **Frequency or likelihood of occurrence –** How likely is it that this event or incident will occur and how often is it likely to occur? For example, earthquakes are much more likely to occur in some parts of the world than others.

- **Warning time –** How long will responders and individuals have to prepare for or respond to an occurrence? For example, flood warnings can be hours or days ahead of an event.

- **Potential severity or extent –** Would damage from or impacts of the incident be confined to a small area or would it be broad in scope? Hurricanes, for example, tend to affect board areas, while tornadoes affect small ones.

- **Population and resources at risk –** How many people might be affected? How extensively are important resources affected? An incident in a population center will affect more people than one in an isolated area.

In addition, several assumptions were made for the analysis:

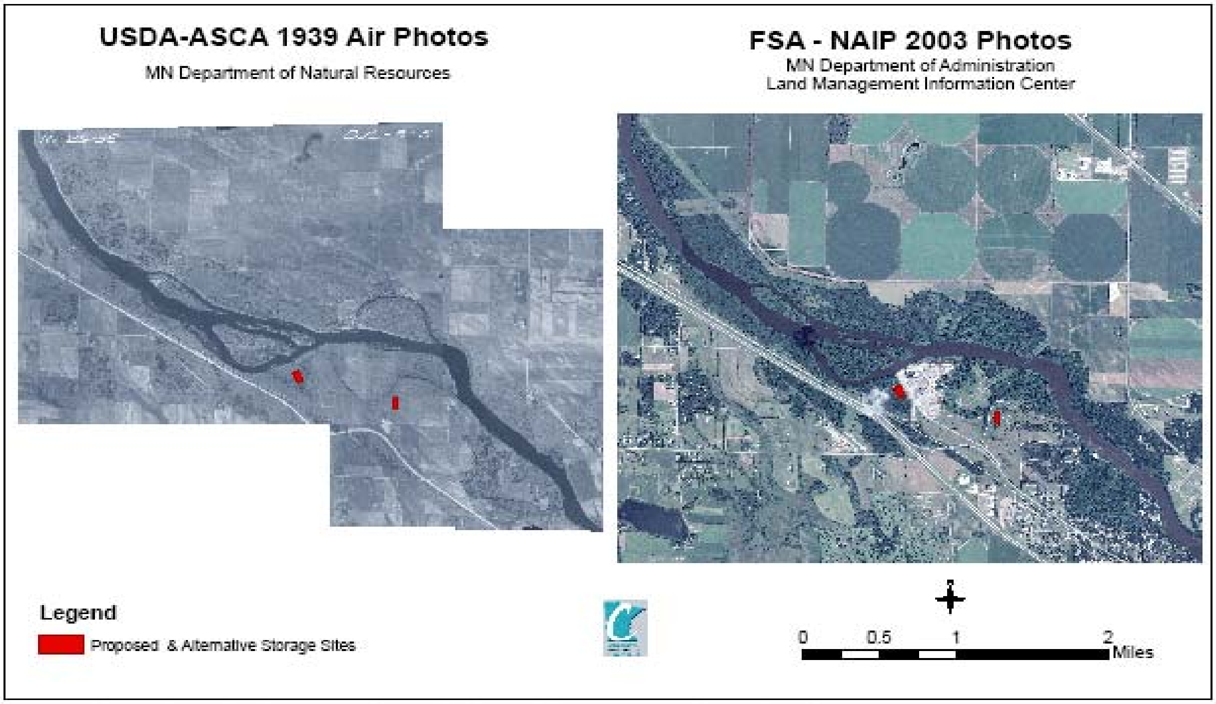
- Improvements in preparedness and response capabilities will continue
- NCR or other federal authority will continue its oversight and regulatory functions
- Local, state and federal governing structures remain intact and stable

Based on the above considerations, impacts were rated as “very low,” “low,” “moderate,” or “high.” Anticipated impacts in all time periods were rated as “low” or “very low” for all potential causes of impacts.

Cumulative Impact Matrix

Causes of Impacts/Year	2010-2060	2060-2110	2110-2160	2160-2210
Terrorism	**Low** ▪ Response and preparedness efforts improve ▪ Population that could be affected increases ▪ Buffer and land use controls remain in place	**Low** ▪ Decommissioning complete reducing target potential ▪ Response and preparedness efforts improve ▪ Population that could be affected increases ▪ Buffer and land use controls remain in place	**Low** ▪ Response and preparedness efforts improve ▪ Population that could be affected increases ▪ Buffer and land use controls remain in place	**Low** ▪ Response and preparedness efforts improve ▪ Population that could be affected increases ▪ Buffer and land use controls remain in place
Accidents	**Low** ▪ Plant's past safety record accurately predicts future accidents ▪ Response plans and preparedness efforts improve	**Very Low** ▪ Decommissioning complete, possibility of plant accidents removed ▪ Site is static	**Very Low** ▪ Site is static	**Very Low** ▪ Site is static
Degradation	**Low** ▪ Inspection, maintenance continue ▪ Repairs, replacements made as needed	**Low** ▪ Inspection, maintenance continue ▪ Repairs, replacements made as needed	**Low** ▪ Inspection, maintenance continue ▪ Repairs, replacements make as needed	**Low** ▪ Inspection, maintenance continue ▪ Repairs, replacements make as needed
Controlled releases	**Very Low** ▪ Plant ceases operation in 2030 ▪ Plant's past record accurately predicts future	**Very Low** ▪ Decommissioning complete ▪ Spent fuel site is static; no releases	**Very Low** ▪ Spent fuel site is static; no releases	**Very Low** ▪ Spent fuel site is static; no releases
Earthquake	**Very Low** ▪ Earthquake probability and magnitude very low, based on state hazard mitigation plan	**Very Low** ▪ Earthquake probability and magnitude remain very low ▪ Population increases, but response, preparedness efforts improve	**Very Low** Earthquake probability and magnitude remain very low	**Very Low** Earthquake probability and magnitude remain very low
Flood/dam failure	**Very Low** ▪ ISFSI is above maximum probable flood ▪ Plant is downstream of dam flood way ▪ River appears stable based on analysis of historic photos and geology	**Very Low** ▪ Assuming federal and state dam safety programs and flood-warning systems remain in place ▪ River changes are tracked and necessary responses taken	**Very Low** ▪ Assuming federal and state dam safety programs and flood-warning systems remain in place ▪ River changes are tracked and necessary responses taken	**Very Low** ▪ Assuming federal and state dam safety programs and flood-warning systems remain in place ▪ River changes are tracked and necessary responses taken

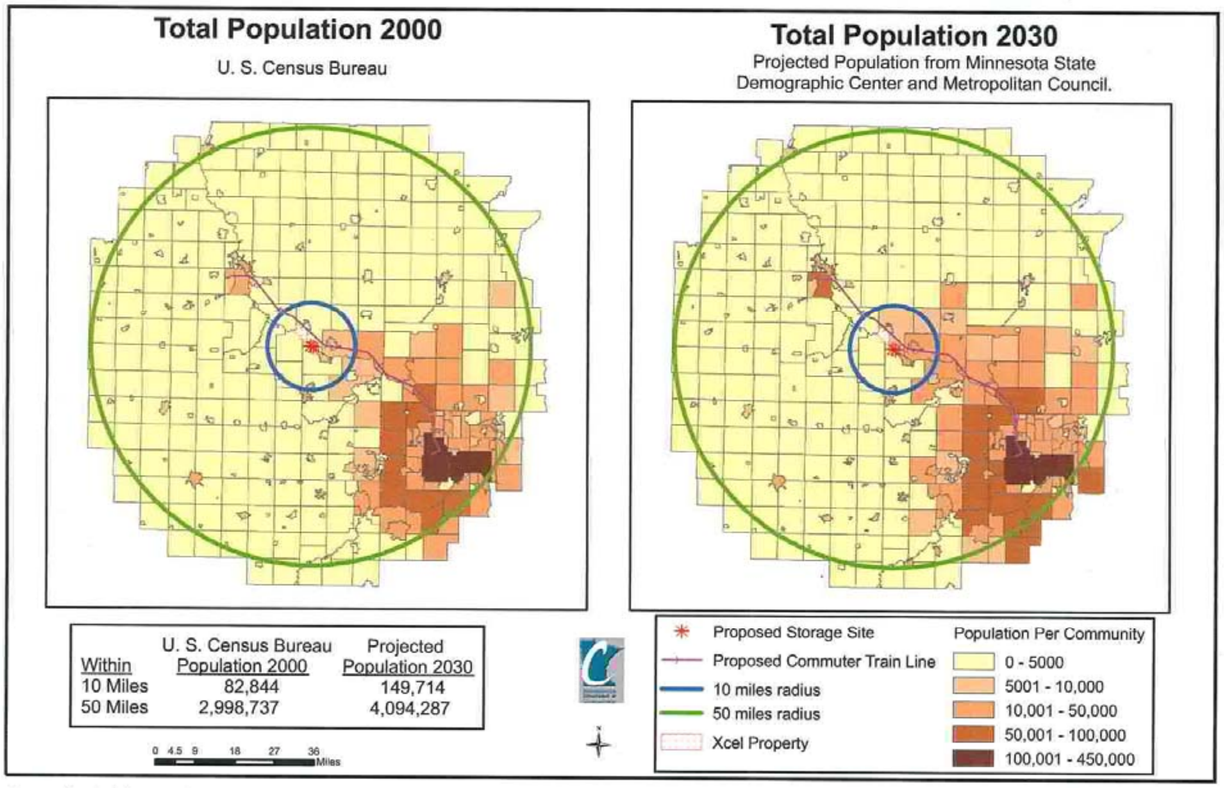
Figure 4-6. Mississippi River Appears Stable Over Last 65 Years.



Prepared for the Minnesota Department of Commerce by the Department of Administration's Land Management Information Center, November 2005.

Monticello Spent Fuel Storage
Certificate of Need Application

Figure 4-7. Population Growth is Expected to Continue in Corridor From Twin Cities to St. Cloud.



Prepared for the Minnesota Department of Commerce by the Department of Administration's Land Management Information Center, November 2005.

Monticello Spent Fuel Storage
Certificate of Need Application

SECTION 5

RADIATION ENVIRONMENTAL IMPACTS

Radiation is a major public health concern associated with nuclear plant operations and spent fuel storage. It is subject to extensive monitoring, regulation and incident management planning. This section discusses the results of current monitoring efforts and the impacts expected due to routine operations and incidents at both the Monticello Plant and Storage Installation. It was developed with the input and expert assistance of the Minnesota Department of Health (MDH) staff Radiation Control Unit.

Section 5.1 Natural Background Radiation Near the MNGP

Like all places on the surface of the earth, a sea of radiation surrounds the Monticello Plant. The amount of this radiation depends on elevation, surrounding geology, and atmospheric conditions. There is also an anthropogenic component due to atmospheric testing of nuclear weapons and nuclear accidents. Human, animal and plant tissues are constantly awash with radioactivity from the sun, the earth and products of human technology. All cells have limited natural mechanisms to repair mutations that may occur from radioactive exposure.

One way to distinguish the source of radioactivity is to identify the radionuclides specific to that source. Certain radioactive isotopes are known to be created only through human nuclear power activity. These radionuclides allow us to trace any leakage from the containment area very effectively and distinguish Monticello Plant radioactivity effects, if any, from the effects of all the other natural and human-engineered sources of radioactivity in our environment.

No radionuclides associated with nuclear power activity have been found near the plant. For example, iodine-131 is a product of nuclear fission, and if found near Monticello, would indicate a plant effect. Iodine-131 concentrates in cow's milk, so sampling of milk from nearby dairy farms would be a good indicator of plant emissions. No iodine-131 has been detected from the plant since the plant installed a larger off-gas hold-up tank in 1975. Another specific radionuclide associated with plant operations is cesium-134; this is checked in downstream sediment, and would indicate a plant effect if found. No cesium-134 or other radionuclide associated with plant operations has ever been detected.

In addition, air samples and thermo luminescent dosimeter (TLD) results have been consistent with natural background radiation for the life of the plant. By holding off-gases from the steam turbine, significant amounts of radioactivity have time to undergo decay. Releasing gases through a 100-meter tall stack, having a diluting effect, further reduces radioactivity. Using historical meteorological data, it is possible to estimate the area downwind of this stack where the highest dose should exist due to fallout from the plant. According to the Monticello Off-site Dose Calculation Manual, the maximum off-site dose occurs 0.6 miles from the reactor building vents in the predominant downwind direction (SSW). The MDH has an air sampler and a thermo luminescent dosimeter TLD near this area. For reference, the Xcel/Monticello Technical Training Center is located near there.

In 2004, the MNGP staff estimate the dose at this point to be 0.022 mrem per year (NMC, 2004 Radioactive Effluent Release Report, 2005), significantly less than the Negligible Risk Level of 1 mrem per year defined by the National Council on Radiation Protection and Measurements.

Section 5.2 Expected Radiation Risks from the Independent Spent Fuel Storage Installation

Risks to public health from the Monticello Independent Spent Fuel Storage Installation as a result of exposure to radiation appear to be negligible under normal (non-accident) conditions. Plant operating rules are designed to ensure a high level of public protection from radiation hazards. The radiation exposure limits and levels are set to have an ample margin of safety to minimize risk for the most sensitive segments of the population.

Health Risks

Radiation regulations cover occupational and public exposures, and in some cases, patient exposures. Standards have been developing continuously over the last 100 years to ensure the safe use of nuclear materials while protecting those most at risk. Public health risk from regulated uses of radioactive materials is widely regarded by medical experts as very small.

The Nuclear Regulatory Commission limits doses to Monticello Plant workers to less than 5,000 mrem per year and requires that doses be as low as reasonably achievable (ALARA). The NRC limits doses to the public from the independent storage of spent nuclear fuel to 25 mrem per year (10 CFR 72.104). At non-fuel cycle facilities, the NRC limits public exposure to 2 mrem in any one hour and 100 mrem per year and also requires that doses be as low as reasonably achievable. The Minnesota Department of Health has identical requirements to the NRC for radioactive materials use in Minnesota Rules Chapter 4731 and very similar requirements for x-ray machine use in Minnesota Rules Chapter 4730.

Review of the health risks in Appendix B to the Certificate of Need Application[8] (Xcel Energy, 2004) found that a standard assessment of radiation risks for the non-radiation worker population was made using risk estimates from Report No. 115 of the National Council on Radiation Protection and Measurements[9] (NCRP, 1993) of 5×10^{-7} fatal cancers per mrem received.

Dose rates were taken from a report by Transnuclear[10] (Final Safety Analysis Report--FSAR, 2004) and were estimated assuming a 70-year exposure. This means that the risks are calculated assuming that the nearest resident is exposed to radiation continuously for 70 years. This is a conservative assumption.

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[8] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005

[9] National Council on Radiation Protection and Measurements (NCRP, 1993), Report No. 115

[10] Transnuclear (Final Safety Analysis Report--FSAR, 2004)

The dose rate (0.16 mrem per year) estimated for the nearest resident (0.33 miles away) is less than the Negligible Individual Risk Level (NIRL) of 1 mrem per year, as defined by the NCRP (NCRP, Report No. 116, 1993)[11]. Dose limits are generally set above the Negligible Individual Risk Level (based on benefits of the use of radiation) and ALARA analyses are usually not performed for uses where the dose is estimated to be below the NIRL.

The cancer mortality risks in Table 4 of Appendix B to the Certificate of Need Application [12] were checked and found to be estimated correctly. Excess cancer deaths per 100,000 (hypothetical resident population nearest the Independent Spent Fuel Storage Installation (ISFSI)) were less than 1 (0.6). Current U.S. overall cancer deaths rates are about 20,000 per 100,000.

The actual population within a two-mile radius of the Monticello Plant reactor is only about 2,300. The population within a one-mile radius is only about 130 (Application for Renewed Operating License, Appendix E – Environmental Report, 2005[13]). So, assuming the population within one mile and the Spent Fuel Storage Installation do not change for 70 years, implies a theoretical 0.0008 cancer fatalities due to the installation.

The Spent Fuel Storage Installation dose of 0.16 mrem per year can be compared to radon exposure from cooking with natural gas. The National Council on Radiation Protection and Measurements estimates that this exposure pathway results in a dose of about 0.4 mrem per year (NCRP Report No. 95, 1987[14]).

The doses from the Monticello Storage Installation to the public appear to be calculated conservatively (with an extra margin of error on the safe side); these are low, and according to the National Council on Radiation Protection and Measurements, result in negligible risks under normal (non-accident) conditions during the licensing period.

Releases to Water

The NRC regulates the release of liquid effluents from nuclear generating plants under 10 CFR 20 and 50. Regulations cover both the amount and concentration of radioactivity and the maximum off-site dose. The "as low as reasonably achievable" (ALARA) limit from this release path is 3 mrem per year.

It should be noted that the Monticello Nuclear Generating Plant is not allowed to release radionuclides or radioactivity into ground water or surface water. The Storage Installation and the storage casks for spent nuclear fuel are designed so these will not release radioactivity or radionuclides into surface water or ground water. The NRC certifies that the use of the

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[11] National Council on Radiation Protection and Measurements (NCRP, 1993), Report No. 116

[12] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005

[13] Applicant's Environmental Report , Appendix E – Operating License Renewal Stage
Monticello Nuclear Generating Plant, Nuclear Management Company
Docket No. No. 50-263 License No. DPR-22, March 2005

[14] National Council on Radiation Protection and Measurements (NCRP, 1987), Report No. 95

NUHOMS cask and ISFSI storage technology will prevent any releases of radioactive liquids into the environment. The federal operating license specifies the use of containers that have been certified as acceptable to NRC.

As a safety check to ensure radioactivity is not being released from the plant, the Monticello Plant Technical Specifications require that surface water (Mississippi River) be sampled weekly upstream and downstream and analyzed as two composite samples monthly. Every quarter (three months) three samples are collected from wells within five miles of the plant and one sample is collected from a well greater than 10 miles from the plant. One sample from the city of Minneapolis water supply is collected weekly and composited monthly for analysis. These water samples have never shown any evidence of a radioactive release to the environment.

To check on cumulative effects, river sediments are sampled and checked for radioactive isotopes that would indicate a plant effect on the environment. A good indicator is cesium-134, which is produced by the Monticello Plant, but has never been found in downstream sediment. Monticello Plant personnel calculate that doses from releases to surface water are millions of times less than the "as low as reasonably achievable" limit.

Effects of Gamma and Neutron Radiation

The applicant provided a primer on radiation as Appendix A[15] to the Certificate of Need. This primer is a good reference for the characteristics of ionizing radiation, quantities and units used to measure radiation, sources of radiation, public health effects, and principles of radiation safety.

Only gamma and neutron radiation escape the steel casks and concrete containment system. The alpha and beta particulate radiations are completely stopped by the shielding. Gamma radiation is considered low linear-energy transfer (LET) radiation because it ionizes over a long track (relative to the length of organic molecules). Low LET radiation has been observed to have a dose rate effectiveness factor at low doses. In this case, cellular repair mechanisms work. This means that halving a dose does not half the health effect, such as cancer, but rather decreases it to about one quarter. However, gamma radiation is regulated as if it were a linear, no-threshold carcinogen.

On the other hand, neutron radiation is considered high linear-energy transfer radiation. High LET radiation has not been observed to have a dose rate effectiveness factor at low doses. Repair mechanisms appear not to work. This means that halving a dose halves the health effect, such as cancer. Neutron radiation is regulated as if it were a linear, no-threshold carcinogen (Department of Health and Human Services, Report on Carcinogens[16], 2005).

[15] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005, Appendix A

[16] Department of Health and Human Services, "Report on Carcinogens", 2005

Gamma radiation is attenuated, or diminished, by objects between the ISFSI and the nearest residents. It is also reflected towards the population by air and tall trees. Doses have been estimated by Transnuclear using the Monte Carlo Neutron and Photon Transport Code (MCNP 4, Oak Ridge National Laboratory, 1991[17]), and further refined by the nuclear industry.

Combined gamma and neutron radiation dose rates are given in the Monticello Initial Risk Assessment (Appendix B to the CON application[18]). Dose rates are estimated at the boundary of the owner-controlled area (OCA) and the nearest resident to the ISFSI (about 0.33 miles). These dose rates are estimated to be 0.86 mrem per year gamma plus neutron radiation at the boundary of the owner-controlled area, and 0.16 mrem per year gamma plus neutron radiation to the nearest resident. The neutron dose is about 10 percent of the total dose.

These dose rates can be compared to natural background radiation. Long-term monitoring of external radiation like that from the ISFSI has been done near the Monticello Plant by MDH staff for more than 20 years. No increases in radiation due to a plant effect have ever been observed. Levels near the plant typically range from 13 to 15 mrem per quarter, or 52 to 60 mrem per year. The estimated dose rate from the ISFSI to the nearest resident is a small fraction of natural background in the area (about 0.3 percent). The observed variation in background is about 2 mrem per year (about 15 percent).

Section 5.3 Analysis of Potential Impacts of Storage Installation Incidents

With regular inspection and minor maintenance to keep the heat removal vents clear, the system should not degrade due to environmental conditions for the design lifetime of the cask storage system, which is 60 years. The casks that hold the spent fuel are basically simple in design and require very little maintenance. The steel casks are stored in concrete vaults that use a passive heat transfer mechanism. If spent fuel needs to be stored longer than that, new casks can replace the old ones. The NRC has certified the cask materials and handling techniques to be used at Monticello Plant as providing an acceptable level of environmental and public health protection for radiation exposure to facility workers and the surrounding residents.

Accidents

The NRC has estimated doses from a "worst-case" cask accident in NUREG-1140 (NRC, 1988). The scenario assumes the lid of a cask is completely removed and gaseous krypton-85 and vaporous iodine-129 escape. This radioactivity mostly stays trapped in the fuel cladding, but 10 percent of the krypton-85 and 1 percent of the iodine-129 escapes. It seems reasonable that less iodine-129 escapes because it is a heavier vapor than krypton-85 gas and less likely to diffuse through the cladding. Under these conditions, the NRC estimates the dose to be 3 mrem per accidental lid removal at 100 meters. This is still well below the NRC limit of 25 mrem per year.

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[17] Monte Carlo Neutron and Photon Transport Code (MCNP 4, Oak Ridge National Laboratory, 1991

[18] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005, Appendix B

Accidents were also assessed in the Final Safety Analysis Report (FSAR). The worst case is an accidental reduction in the air inlet and outlet shielding. Transnuclear, the NUHOMS cask manufacturers, estimate the dose from this accident to be 44 mrem at 100 meters. This is below the NRC design-basis accident requirement of 5 rem (NRC NUREG-1567, 2000).

Emergency Response Plans
Nuclear generating plants are required to have a formal emergency response plan and to exercise that plan to ensure workability (10 CFR 50). Since September 11, 2001, the threat of a terrorist attack is a real concern. Nuclear generating plants have responded by increasing security and exercising security plans against this threat. If there is a radiological incident at the Monticello plant there will be many organizations responding. These will come from federal, state, and local governments as well as the utility.

The Monticello plant considers any security threat as an emergency. Should protective actions for the public be recommended, plant personnel would inform appropriate law enforcement agencies in addition to the standard emergency off-site notifications. Plant personnel and law enforcement agencies are trained in responding to nuclear generating plant emergencies.

In January 2004, the California County of San Luis Obispo prepared an Environmental Impact Report (EIR) on the Diablo Canyon ISFSI[19] (Marine Research Specialists, 2004). As indicated in that report, there have been conflicting opinions concerning the impact of a terrorist attack involving the multi-purpose canisters (MPC, or casks). Below is a quoted portion of the Diablo Canyon EIR Executive Summary dealing with terrorism issues:

> "Depending on the level of success of a potential terrorist attack and the severity of damage to the cask, potential consequences could range from no release of radiation above the normal operating levels, to a complete loss of containment."
>
> "These potential threats to the ISFSI were found to be a significant impact given the potential consequences associated with a complete loss of containment from a single cask. Mitigation measures have been proposed that would reduce the impact level to less than significant. These mitigation measures include designing the casks and/or the ISFSI to withstand such an event such that the MPC is not breached, designing the ISFSI to ensure that any spilled jet fuel does not accumulate under the casks, and installing a fire suppression system."

Federal, State, and local governments have plans in place for stopping and mitigating acts of terrorism, which are applicable to the Monticello plant. These plans are briefly discussed later in this section.

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[19] Environmental Impact Report (EIR) on the Diablo Canyon ISFSI prepared by (Marine Research Specialists, 2004). California County of San Luis Obispo

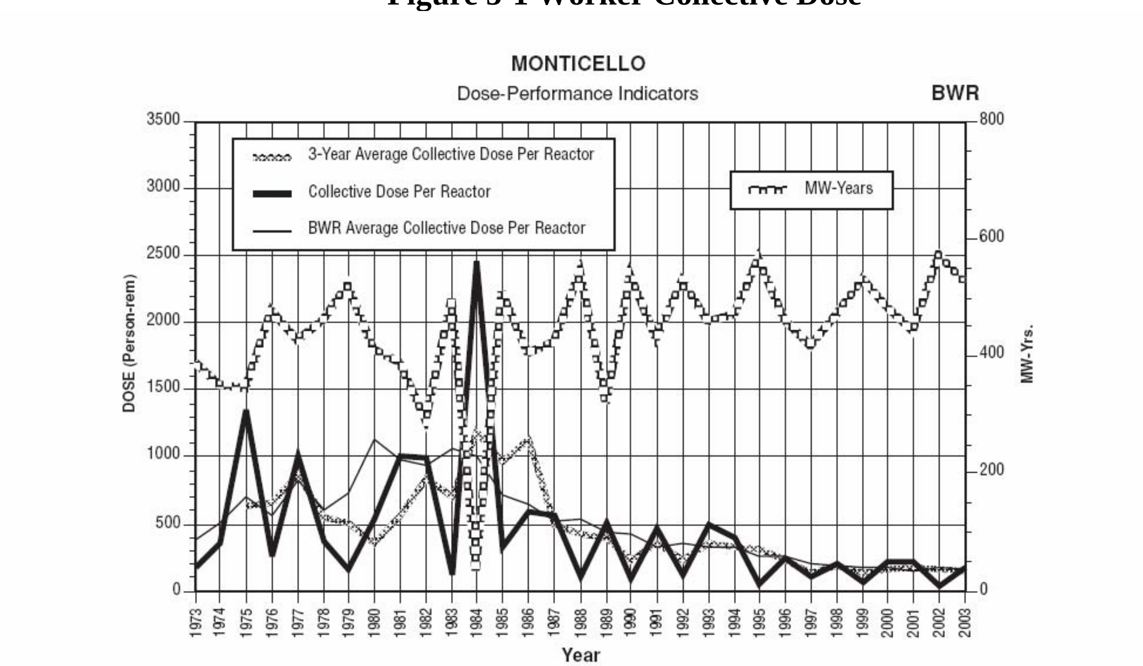
In addition, NRC is in the process of toughening its "design basis threat" rules to insure better defense against suicide attacks, theft of sensitive nuclear materials and other terrorist threats.

Section 5.4 Analysis of Potential Impacts of Incident at the Plant

While the generating plant itself is also subject to degradation, accidents or terrorism, no large-scale releases have ever occurred from the Monticello plant. When planning for a 20-year life extension, items that would degrade within that time will be replaced or a preventive maintenance program established.

The plant has a 35-year history that identifies the kinds and frequency of corrective maintenance. Evaluation of facility component integrity and periodic maintenance of all plant systems is carried out continuously by NMC staff. For example, in 1984 the recirculating piping was replaced. This resulted in an increase in worker dose for that year, but initiated a decreasing trend to doses since then (NRC, NUREG-0713, 2003), as indicated by a 30-years plotted in Figure 5-1.

Figure 5-1 Worker Collective Dose



A 1984 incident and corrective maintenance punctuate an overall downward trend in worker dosage.

Reactor accidents have been assessed via the NRC-required Probabilistic Risk Assessment (PRA) for the MNGP. Results are presented in Appendix E to the Application for Renewed Operating License[20](Xcel Energy, 2005).

[20] Applicant's Environmental Report , Appendix E – Operating License Renewal Stage
Monticello Nuclear Generating Plant, Nuclear Management Company
Docket No. No. 50-263 License No. DPR-22, March 2005

The Probabilistic Risk Assessment provides the best estimates of the risks of these releases. The Monticello Plant reactor uses the GE Mark I containment, which is among the earliest types of containment. The reactor is surrounded by a torus, or ring, half-filled with water, which can absorb heat and radioactive gases and vapors during an accident. This early Mark I containment has been retrofitted with a hardened-vent to allow radioactivity and pressure to be released in a controlled fashion after an accident.

The most likely containment failure for the Monticello Plant would result in a small, late release of radioactivity. This frequency is once every 25,000 reactor-years. Here, a small release means that less than 1 percent of the radioactive cesium in the reactor core is released, and late means it occurs more than six hours after a general emergency is declared (people have time to evacuate). This accident would be similar to the one at Three Mile Island in 1978.

By extending the life of the plant an additional 20 years, this lifetime probability of a small, late release changes from about 1 in 630 to 1 in 420. The most likely consequence of such an accident is zero off-site fatalities (assuming the affected population is evacuated).

The frequency of an extreme release is once every 400 million reactor-years (more than one-half of the radioactive cesium is released from the reactor core). This accident would be similar to the one at Chernobyl in 1986.

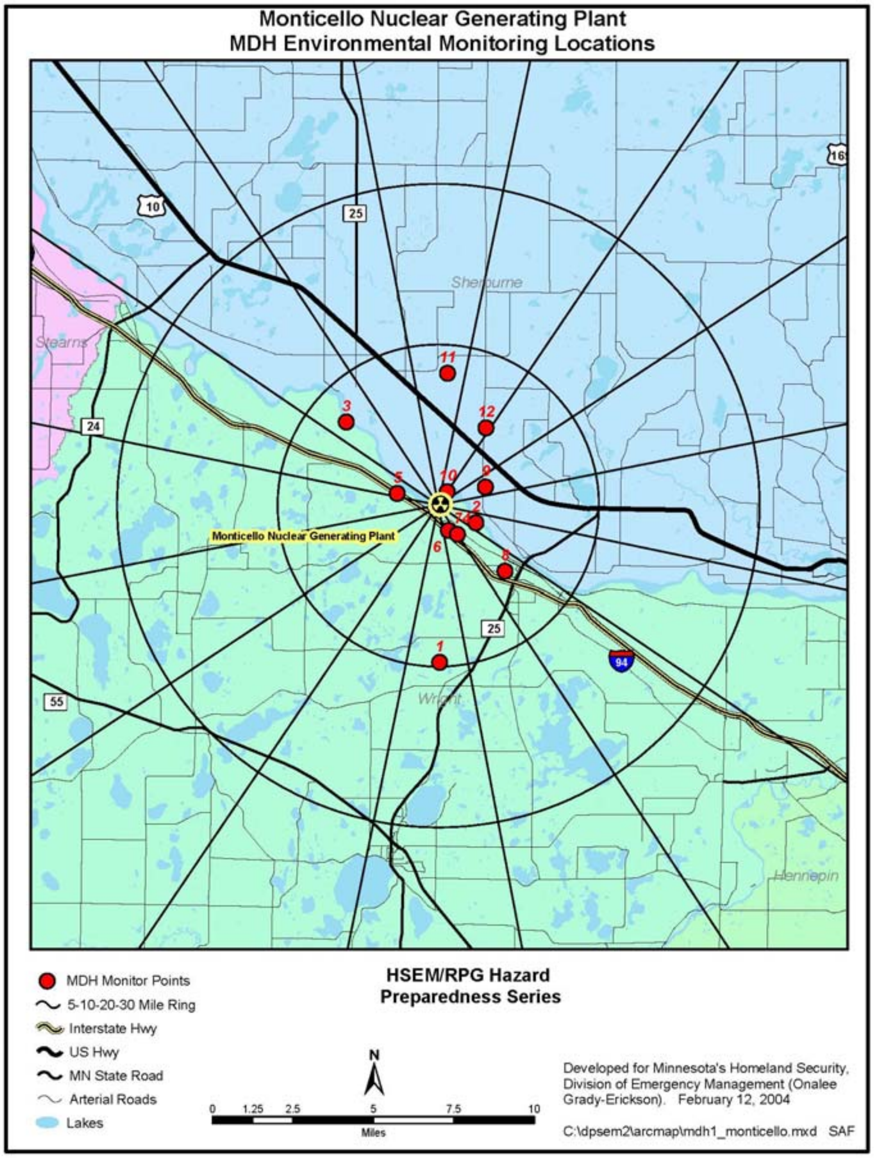
Section 5.5 Existing Radiation and Radioactivity Monitoring Near the Monticello Plant

Monitoring results indicate no increases in radioactivity due to plant operations. The Minnesota Department of Health (MDH) monitors the environment near the plant for radiation and radioactive effluents. Monticello plant staff also operates a similar program to MDH, but larger in scope. These programs are designed based on knowledge of radioactivity release rates, weather conditions, topography, expected pathways of transport of radioactivity through the environment, and natural levels of radioactivity from which plant effects are attempted to be differentiated. Monitoring sites are selected based on the need to maximize the early detection of any radioactive releases to the environment that might occur.

There is a long history of environmental monitoring at the plant, going back to a few years before the plant became operational in 1971. This baseline can also be used to detect releases. However, a key method of differentiating plant releases from natural or other anthropogenic releases is the use of control and indicator samples. A control sample is one taken upwind or upstream somewhat distant from the plant. An indicator sample is one taken downwind or downstream and close to the plant. If there is a difference between the control and indicator samples, a plant release may have been detected. Evaluation of the long-term monitoring data has never shown a large-scale release of radiation from the MNGP during its operating history.

The eight MDH and the four NMC control monitoring locations are shown in Figure 5-2. The two circles indicate a five and ten mile radius from the plant. The monitoring points may be air, water, or biological tissue such as milk or crops.

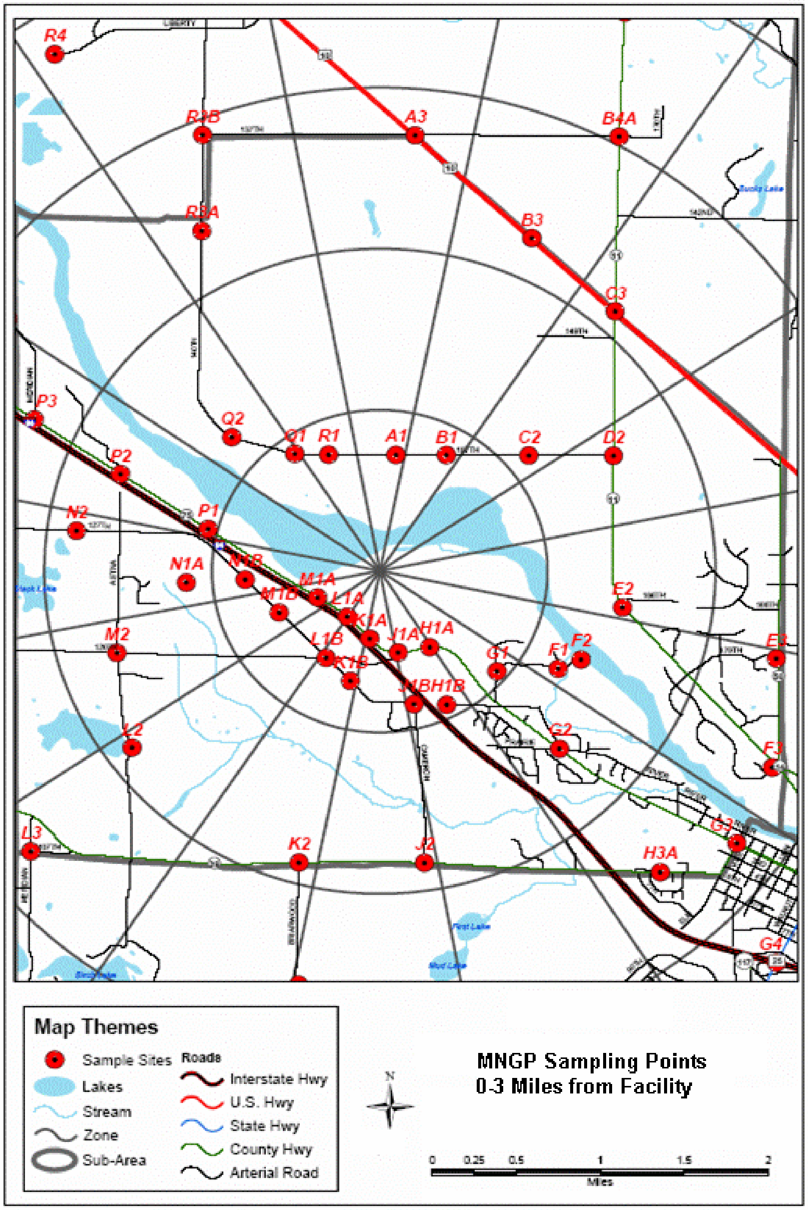
Figure 5- 2 Monticello plant area-monitoring locations (5 – 10Mi)



8 MDH and 4 NMC control monitoring station are within ten miles of the plant.

Additional monitoring locations are shown in Figure 5-3, the Two-Mile Sub-area for emergency response purposes. Both Monticello and MDH have an air sampler and thermo luminescent dosimeter (TLD) located near point H1B. MDH has TLD at points P1 and B1. The other points on the map are references to be used for sampling during an emergency. Figure 5-3 shows the 45 monitoring points within one to three miles from the plant; these include MDH and NMC routine and emergency air and water sampling points and thermoluminescent detectors (TLD). Due to security concerns, sampling location points shown are proximate to the actual location.

Figure 5- 3 Monticello plant area-monitoring locations (0 – 3Mi)



45 routine and emergency sampling sites surround the plant.

Laboratory measurements can easily identify specific radionuclides in a sample; releases from a plant have characteristic radionuclides that would indicate a plant release (iodine-131, for example, which is not naturally present in the environment).

Radiation is measured near the plant using thermo luminescent dosimeters (TLDs). TLDs are changed quarterly. They are integrating devices that measure the cumulative amount of radiation during the monitoring period. They cannot provide hourly radiation readings, for example. Monticello Plant staff place four controls and 37 indicator TLDs around the plant. They use the control and indicator method by placing TLDs in five-mile (control) and two-mile (indicator) rings around the plant. MDH staff place one control at Orrock, Minnesota, and seven indicators TLD around the plant. Radiation levels typically range from 13 to 15 mrem per quarter.

Radioactivity is measured near the plant by sampling environmental media in the vicinity. The plant and MDH measure air, surface water, milk, crops and sediment. Plant staff also sample groundwater, fish, and invertebrates (for example, crayfish) for radioactivity.

Gross beta concentrations of radioactivity in air samples collected by MDH and the Monticello Plant's operating company Nuclear Management Corporation (NMC) are shown in Table 5-1 for the last five years (MDH, Environmental Data Report, 2005[21]). Based on similarities to concentrations in Minneapolis air, the results indicate no increases in radioactivity due to plant operations.

TABLE 5-1
Median Gross Beta Concentration in Monticello Air Samples
2000-2004

pCi/m^3

	2000	2001	2002	2003	2004
Monticello (MDH)	0.027	0.023	0.022	0.026	0.019
Monticello (NMC)	0.027	0.024	0.027	0.027	0.024
Minneapolis (MDH)	0.022	0.026	0.029	0.028	0.024

Concentrations near the plant are similar to those in Minneapolis.

Gross beta concentrations in surface water samples collected by MDH are shown in Table 5-2 for the last five years (MDH, Environmental Data Report, 2005). Based on similarities to concentrations upstream, the results indicate no increases in radioactivity due to plant operations. These data are plotted in Figures 5-4 and 5-5.

TABLE 5-2
Median Gross Beta Concentration in Mississippi River Water Near Monticello
2000-2004

pCi/L

	2000	2001	2002	2003	2004
Upstream	2.6	2.9	3.3	4.2	3.0
Downstream	2.7	2.8	3.0	3.9	2.9

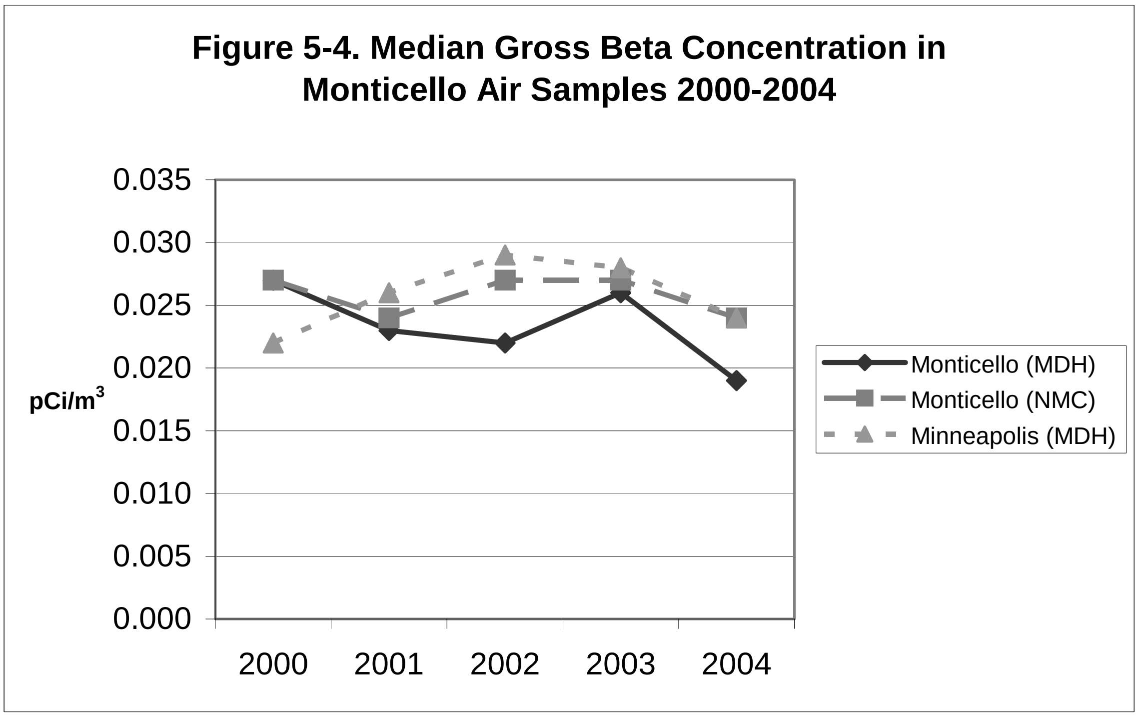
Concentrations in Mississippi River water are the same above and below the plant.

[21] Radiation Control Unit (2005). *2004 Environmental Radiation Data Report*, (Minnesota Department of Health, Saint Paul, Minnesota).

The paired tables and charts show the same data numerically and graphically. The results indicate that radioactivity in the air around Monticello Plant is low and very similar to the concentration in Minneapolis air. The second set shows that Mississippi River water is actually lower in radioactivity downstream of the plant than upstream. This is evidence that the plant is not releasing any measurable radioactivity to the Mississippi River.

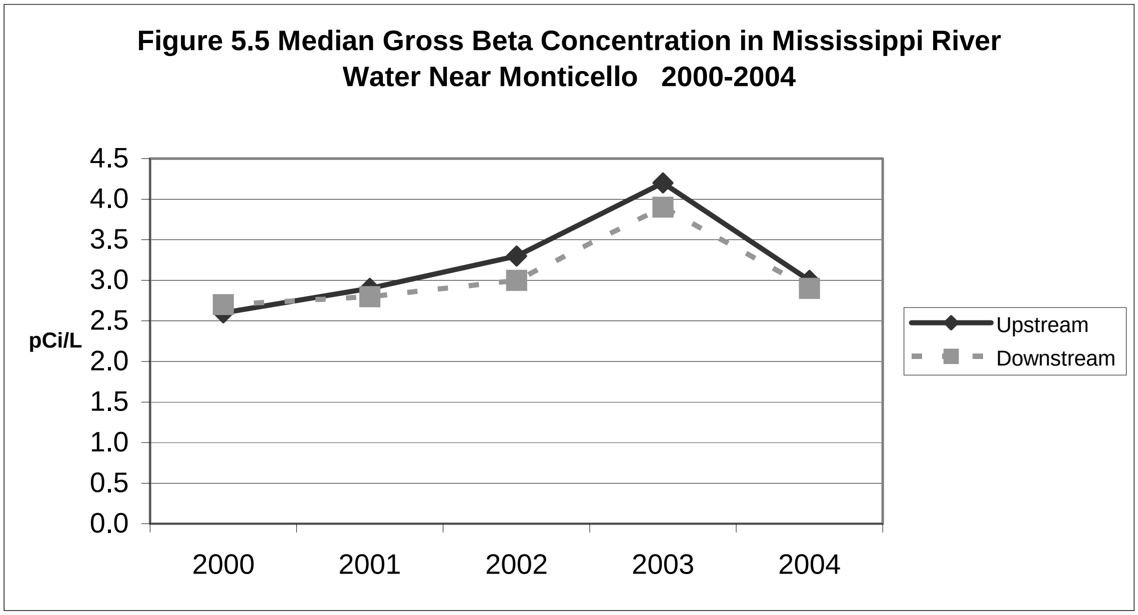
NMC staff collects and analyzes groundwater samples and reports the results annually to the MDH. Monticello plant results for 2004 indicate that no radionuclides associated with plant operations were detected in ground water (NMC, 2004 Annual Radiological Operating Report, 2005[22]).

Figure 5-4 Graphic Display of Air data in table 5-1



[22] Nuclear Management Company (2005). *Monticello 2004 Annual Environmental Operating Report*, (Nuclear Management Company, Hudson, Wisconsin).

Figure 5-5 Graphic Display of Data in Table 5-2



Section 5.6 Additional Monitoring Recommendations for Storage Installation

Monitoring experience with the Independent Spent Fuel Storage Installation at the Prairie Island plant is useful when considering additional monitoring at Monticello.

Prairie Island has added thermo luminescent dosimeters (TLD) both inside and outside the earth berm, on plant property, and close to the nearest resident. This Storage Installation also has two, pressurized-ionization chambers (PIC) that provide real-time radiation readings and remote alarming features. The TLD were especially useful in verifying the gamma and neutron dose models. Prairie Island staff also survey and wipe the casks quarterly for changes in radiation levels and radioactivity.

Based on the successful Prairie Island monitoring experience, MDH feels that additional TLD monitoring at Monticello is an appropriate method to detect radioactivity releases, if any. At least four TLD should be added to its program (one in each direction). TLD are reliable and inexpensive.

MDH also feels that PIC monitoring is appropriate. It is another form of continuous monitoring that indicates the condition of the Storage Installation, like temperature monitoring of the casks. This extra TLD monitoring would back up the temperature monitoring, and be consistent with monitoring at the Prairie Island installation.

Section 5.7 Incident Response Plans

The Minnesota Department of Public Safety describes on its website its role and NMC’s role during an emergency as follows:

> “The State of Minnesota provides direction, coordination, and control in accordance with the Minnesota Emergency Operations Plan (MEOP). The State Emergency Operations Center (SEOC) is structured on the Minnesota Incident Management System (MIMS) with facilities for planning, operations, finance, logistics, and public information. The governor or governor’s delegate participates in the SEOC in the command function.
>
> “For actual or projected severe core damage or loss of control to the facility, recommend evacuation for a 2-mile radius around the station and 5 miles downwind, depending on local conditions. Continually assess data from the station and field teams to extend distances or add other areas. Advise the remainder of the population in the plume Emergency Planning Zone (EPZ) to go indoors and listen to the Emergency Alert System (EAS) messages.
>
> “The utility maintains an emergency operations plan that is used if a radiological incident at a nuclear generating station would occur. The station’s main responsibility is to find the cause of the radioactive release and stopping it as soon as possible while keeping the station safe from further damage. The utility monitors conditions of the station and determines Emergency Classification Levels (ECL) that are communicated to the state and counties based on those conditions. The utility makes projections of radiation dose to the public based on plant conditions and makes protective action recommendations. The radiation dose projections and protective action recommendations are sent to the state and counties for review and implementation. The station dispatches monitoring teams to verify the amount of radioactivity that was released. Since the NRC is the Lead Federal Agency, the utility stays in close communication with this agency.
>
> “There are annual drills and exercises to make sure that the plans work. This is to ensure the safety of the public.”

http://www.hsem.state.mn.us/HSem_view_Article.asp?docid=252&catid=3

No large-scale releases of radiation have ever occurred at the Monticello plant. In the event that there is a radiological or security incident at one of the nuclear generating stations there will be many different organizations responding. Communication and coordination of all levels of responders is emphasized to ensure timely and appropriate response actions are taken. These actions will come from federal, state, and local governments as well as the utility. The response for a security incident would be similar, but have unique characteristics depending on the nature of the incursion. Due to increasing concern about facility security, details of these plans are not available to the public, but only to those with a demonstrated need to know.

The Lead Federal Agency (LFA) for most radiological incidents at nuclear generating stations is the Nuclear Regulatory Commission (NRC). The NRC reports to the President of the United States and Congress in this situation. The NRC will coordinate any federal assets that the NRC or the State of Minnesota requests. A major department that may provide assistance is the Department of Energy (DOE). The DOE may provide resources in the form of the Federal Radiological Monitoring and Assessment Center (FRMAC). FRMAC provides technical assistance such as field sampling, sample analysis, and plotting of radiological data to assist county, state, and federal agencies in decision-making.

The State of Minnesota provides direction, coordination, and control in accordance with the Minnesota Emergency Operations Plan. The State Emergency Operations Center (SEOC) is structured on the Minnesota Incident Management System with facilities for planning, operations, finance, logistics, and public information. The governor or governor's delegate participates in the SEOC in the command function.

For actual or projected severe core damage or loss of control to the facility, the plan recommends evacuation for a 2-mile radius around the station and 5 miles downwind, depending on local conditions. Data from the station and field teams is continually assessed to determine the need to extend distances or add other areas. People in the remainder of the in the plume emergency zone are advised to go indoors and listen to the Emergency Alert System messages. General status is maintained until close out or reduction of the level of the emergency.

If radiological incident were to occur, the counties surrounding the nuclear generating station would also respond with their emergency operations plans. Their focus is to maximize the protection of lives and property, ensure that government can survive and continue to provide essential services, and support local units of government. By activating their Emergency Operations Centers they will assure that this is accomplished by exchange of information between county departments and where appropriate, to coordinate operations with other counties, state and federal agencies, as well as Indian communities. All county Emergency Operations Center will be in direct contact with the state center and participate in the decision process for all protective actions.

The utility maintains an emergency operations plan that is used if a radiological incident at a nuclear generating station would occur. The station's main responsibility is to find the cause of the radioactive release and stopping it as soon as possible while keeping the station safe from further damage. The utility monitors conditions of the station and determines emergency levels that are communicated to the state and counties based on those conditions. The utility makes projections of radiation dose to the public based on plant conditions and makes protective action recommendations. The radiation dose projections and protective action recommendations are sent to the state and counties for review and implementation. The station dispatches monitoring teams to verify the amount of radioactivity that was released. Since the NRC is the Lead Federal Agency, the utility stays in close communication with this agency.

All of the parts discussed in this section are included in the emergency plans of the nuclear power plants and federal, state, and local governments. There are annual and other drills and exercises to make sure that the plans work. This activity is undertaken to ensure the continued safety of the public.

SECTION 6

ANALYSIS OF INDEPENDENT SPENT FUEL STORAGE INSTALLATION ALTERNATIVES

This section analyzes the feasibility of alternatives for storing the spent nuclear fuel rods generated by the Monticello Plant. It covers four away-from-reactor storage possibilities, together with several onsite options included in the Certificate of Need application[23]

- Reprocessing spent nuclear fuel
- Contracting for additional spent fuel storage capacity at an existing spent fuel storage facility
- Developing an interim spent fuel storage facility in Utah
- Relying on the federally sponsored repository for spent fuel at Yucca Mountain, Nevada
- Using the existing or a new storage pool
- Using an alternate technology for dry storage
- Using an alternate site for dry storage

It also covers the “no action” alterative. None of the four off-site disposal options offers a viable alternative to building additional spent fuel storage space at the Monticello Plant.

6.1 Reprocessing Spent Nuclear Fuel

Reprocessing is a method of recovering unused uranium and plutonium from used nuclear fuel and recycling it for use in new reactor fuel. Reprocessing does not result in elimination of all nuclear wastes and radioactivity. However, the volume of high-level waste to be stored is reduced. When electric power companies first considered using nuclear energy to generate electricity, it was assumed that when the nuclear fuel was used up or "spent," it would be recycled so that useful fuel could be extracted and used again. Approximately 96 percent of the spent fuel is uranium that could be reprocessed into usable fuel to generate electricity. It is this assumption that led to sizing spent fuel pools to provide the limited space necessary to cool spent fuel for a few years before transporting for reprocessing.

Reprocessing is not a viable alternative to establishing on site dry storage at the Monticello Plant due to lack of available facilities, costs and security issues. No private companies have invested in constructing and operating reprocessing facilities in the United States due to the costs of reprocessing compare to fabrication of new fuel rods and the uncertainty surrounding public acceptance of this technology. There are no nuclear fuel reprocessing facilities available in this country, except limited plants for military and research uses. Security concerns make shipment of spent fuel rods to European nuclear reprocessing facilities extremely unlikely.

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[23] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005

6.2 Existing Off-Site Storage Facilities

The only facility storing spent fuel on a contract basis from commercial nuclear power reactors is the General Electric Morris facility in Morris, Illinois; however, it is no longer accepting spent fuel from commercial nuclear power plants. Currently 1,058 spent fuel assemblies from the Monticello Plant are being stored under contract at the Morris facility. Xcel is responsible for the ultimate final disposal of these spent fuel rod assemblies when the Monticello Plant is decommissioned.

6.3 Private Fuel Storage Initiative

Xcel is pursuing temporary, away-from-reactor storage in Utah as a member of Private Fuel Storage[24], LLC (PFS). PFS is a consortium of eight utilities including Xcel Energy; it is working to build a spent fuel storage facility on the reservation of the Skull Valley Band of Goshute Indians. PFS and the Band entered into an agreement in December 1996 that allows for temporary storage of spent fuel from commercial nuclear power plants. The proposed facility is subject to licensing approval by the Nuclear Regulatory Commission (NRC). Any spent nuclear fuel sent to the PFS facility for temporary storage will still require final disposal at a permanent nuclear repository site.

However, construction of the PFS facility faces obstacles. Throughout the development of the proposal, the state of Utah has been a staunch opponent and the project has been the subject of lawsuits and debate in the state legislature and the U.S. Congress. While efforts to defeat the proposal have not been successful, they are expected to continue. The U.S. Court of Appeals ruled that the federal government has final authority over the disposition of high level waste in the United States; but, Utah has appealed this decision to the U.S. Supreme Court and any NRC license decision is subject to appeal. The U.S. Supreme Court has not yet decided whether to consider this case. If they chose not to hear the matter, the facility might be available to accept nuclear waste as early as 2008.

6.4 Yucca Mountain

The U. S. Department of Energy (DOE) began studying Yucca Mountain[25], Nevada, in 1978 to determine whether it would be suitable for the nation's first long-term geologic repository for spent nuclear fuel and high-level radioactive waste currently stored at 131 sites in 33 states. On July 9, 2002, after some $7 billion dollars in investigations at the site, numerous technical reports, and an Environmental Impact Statement (EIS), the U.S. Senate passed and the president signed into law legislation overriding Nevada’s objections to the site and approving the submittal of license applications to the NRC for a repository at Yucca Mountain. However, development of

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[24] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005, pages 4-4 – 4-6

[25] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005, pages 4-6 – 4-10

a national geological repository has significant opposition and the project continues to face challenges.

While the DOE's current schedule calls for construction to begin in 2008 and the site to begin receiving waste in 2010, it has yet to file a license application with NRC; it was scheduled to be filed in 2004. The federal government is responsible for providing a nuclear waste repository for utilities. But, given past delays and continuing controversy, it seems unlikely that Yucca Mountain site will be available by 2010.

Stable funding of the Yucca Mountain site also is an issue. Development is paid for by funds paid by customers of utilities who own and generate electricity from nuclear power plants. A fee of 1 mil (0.1 cents) for each kilowatt-hour generated by a nuclear power plant is collected and paid to the federal government. Currently this money is placed into the federal government's general fund and Congress must act each year to appropriate the collected funds to the Yucca Mountain project. Since 1983, Xcel Energy's Minnesota consumers have paid more than $538 million into the federal Nuclear Waste Fund to finance nuclear waste management. Nationally, consumers have committed $22 billion into the federal Nuclear Waste Fund. Through fiscal year 2003, the DOE has only received $6 billion in disbursements from the Nuclear Waste Fund.

In addition, it is unclear if Yucca Mountain will have space for Monticello Plant wastes beyond those associated with its initial licensing period. Yucca Mountain is intended to hold a total of 70,000 metric tons of spent nuclear fuel, which translates into space for 1,750 spent fuel rod canisters to cover the high-level radioactive fuel disposal needs of the entire United States. This includes the wastes at Monticello through 2010, the date its current license expires. By 2030, Xcel will need 35 more canisters worth of permanent storage space to enable decommissioning if it is not relicensed at that time.

6.5 Alternatives to Increase Storage Pool Capacity

There are three primary ways to increase the present capacity at the Monticello Plant to store additional fuel rods without building a dry storage system[26]. None of the three is a viable alternative to dry storage.

Consolidation

Fuel rod consolidation – a process that reduces the volume of the fuel assemblies by disassembling and repackaging the fuel rods and assembly hardware – requires complex and site-specific solutions, to date, no utility has pursued as a means of expanding onsite storage capacity for spent nuclear fuel.

Fuel rod consolidation and hardware processing can be performed in the existing spent fuel pool. During this process, fuel rods are removed from the fuel assembly. Next, the rods are grouped in a closer-packed array and placed in a container with similar dimensions as a fuel assembly. The assembly hardware is compacted and then packed into separate containers in the pool or in a dry

[26] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005, pages 4-10 – 4-14

storage configuration. Fuel rod consolidation has not been widely used and the domestic nuclear industry experience with consolidation is not extensive beyond demonstration projects. Consequently, the technology is not optimized or as commercially mature as other alternatives.

Extend Operation by Re-Racking to Increase Pool Storage
Re-racking to increase pool storage of spent fuel would not increase storage enough to support plant operations through 2030. The Monticello Plant spent fuel storage pool is licensed to hold up to 2,237 fuel assemblies using a combination of one original low density fuel storage rack and multiple high density fuel storage racks licensed and installed in the late 1970's. Twenty of the licensed available spaces hold used reactor control blades and eight of the licensed available spaces were plugged because those spaces did not meet the required dimensional specifications, leaving 2,209 usable spaces to store spent fuel.

Re-racking would consist of replacing all of the current storage racks (one low-density fuel storage rack and all existing high-density spent fuel storage racks). Any proposal to increase the fuel storage pool capacity would be subject to review and approval by the NRC to insure structural, thermal and nuclear limits can be safely met with the increased number of spent fuel assemblies stored in the pool. An evaluation of these safety limits was undertaken and it was concluded that 2,651 spent fuel assemblies could potentially be licensed and safely stored in the Monticello Plant fuel storage pool if it was re-racked. This represents an increase of 442 usable spent fuel storage spaces and would support plant operations with full core discharge capability maintained only until 2014.

Construct a New Pool On-Site
This alternative entails constructing a new building containing a new spent fuel storage pool. The new building and pool structure would be designed and constructed to the same or higher standards as the existing spent fuel storage pool in the reactor building and would be licensed and regulated by the NRC. A new pool would be designed for older, cooler fuel. It would likely be located directly adjacent to the reactor and turbine-generator buildings.

A transfer cask would be required to transfer spent fuel assemblies from the existing pool to the new pool. The number of times the spent fuel assemblies are handled would triple because in addition to handling it to place it in a qualified transportation canister, the spent fuel assemblies would have to be handled two additional times – once to place it in the transfer cask to move it to the new pool and once to remove it from the transfer cask to place it in the new storage pool.

A new storage pool would require the same components as the existing pool and would rely on active cooling rather than passive cooling systems. These components would include storage racks, pool cooling and filtration systems, pool bridge crane and fuel assembly handling tools, building ventilation systems, radiation monitoring equipment and a cask decontamination area.

It would take an estimated three years to design a new pool building and to complete state and federal reviews and approvals. Construction would last approximately 2 years for a total project duration of at least 5 years. Based on the estimates for a new storage pool prepared for the Prairie Island Certificate of Need in 1991 the estimated project costs would be on the order of $50 million. This estimate does not include costs of maintaining a second active pool system nor does it include the costs associated with purchasing hardware or plant personnel to load and transport the spent fuel to Yucca Mountain when it becomes available.

6.6 Alternative Dry Cask System Technologies

NRC approves spent fuel dry storage systems by evaluating each design for resistance to accident conditions such as floods, earthquakes, tornado missiles, and temperature extremes and authorizes a nuclear power plant licensee to store spent fuel in NRC-approved casks at a site that is licensed to operate a power reactor.

Four types of NRC-approved storage system technologies are available for dry storage of spent nuclear fuel and were evaluated in the Certificate of Need application[27]. All four systems rely on passive cooling to remove decay heat from the spent fuel. They vary in the manner in which they store the spent fuel, how they accommodate the transfer of spent fuel from the power plant, and how they are transported. The four types are:

- Horizontal Canisterized Storage System
- Vertical Canisterized Storage Systems
- Non-Canisterized Storage Systems
- Modular Vault Dry Storage System

Due primarily to cost factors and past experience with this system, Xcel and NMC determined that the horizontal containerized system was the most appropriate alternative for the Monticello Plant.

6.7 Site Screening for Alternative ISFSI Locations

Minnesota Statute requires that spent nuclear fuel storage be limited to the plant site at which the fuel is used (Minn. Stat. 116C.83 Subd. 4b). Therefore, any additional spent nuclear fuel storage must be established on the Monticello Nuclear Generating Plant site.

Xcel identified five different locations on the site suitable for dry spent nuclear fuel storage; two areas, a preferred and an alternate site, were identified as most suitable, given the following site evaluation considerations:

Security

Federal regulations require that the storage facility be set back 100 meters from the perimeter of the owner-controlled area so that security can be maintained. Several active systems must be part of the security provided, including electronic surveillance. Power must be part of a self-contained site with its own backup power supply or the site must be close enough to other secured areas with backup power. A facility close to the plant's power block can be incorporated into existing security and backup power facilities rather than duplicating them in a separate area. The preferred site is closer to the plant.

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[27] Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant Docket No. E002/CN-05-123 Northern States Power Company d/b/a Xcel Energy, January 18, 2005, pages 4-14 – 4-24

Floodplain Concerns
Spent fuel storage containers and the vaults they are stored in are very heavy, at 400,000 pounds each. The containers and vaults do not displace their weight in water. They will not float and are not likely to be breached or moved by debris should they be hit by large objects in floodwaters. The concern associated with flood and submersion of storage containers is the ability of the cask system to continue to dissipate heat generated by the spent fuel in a water environment. While preliminary calculations suggest that heat can adequately be dissipated, no storage system has gone through the in-depth analysis required for such a determination before the NRC. All other factors being equal, storage facilities should be kept out of floodplains. Both the preferred and alternative sites are above the floodplain.

Physical Hazards
Federal rules require the spent fuel storage facility be located so that a storm or some other event that would cause existing structures on the plant site to fall will not threaten the storage containers or vaults in which spent fuel is stored.

Radiation Dose
Federal rules require the facility to be located so that the contribution of radiation from the stored spent nuclear fuel to employees or the public does not exceed federal standards.

Fire and Explosion Hazards
Federal rules require the spent nuclear fuel storage facility to be far enough away from fire and explosion hazards so that spent fuel integrity is not threatened. This includes transportation routes where dangerous materials might be transported and on-site areas where flammable or explosive materials might be used or stored.

Existing Plant Infrastructure
All other things being equal, locations requiring relocation of existing infrastructure (existing parking lots, buildings, substations, transmission lines, roads, etc.) should be avoided. It also is preferable to locate the facility so that existing roads can be used to the fullest extent possible.

Avoidance of Sensitive Areas
All other things being equal, areas with sensitive plant communities, critical habitat for animals, and known historic or archaeologically significant resources should be avoided.

6.8 The "No Action" Alternative – Monticello Plant Shutdown and Decommissioning

The Application for Renewed Operating License and Certificate of Need for an Independent Spent Fuel Storage Installation are intended to extend operation at the Monticello Plant to 2030. If the Certificate of Need and Renewed Operating License were not granted, the Monticello plant would shut down by the end of 2010, the date its current license expires, and then be decommissioned in accordance with NRC requirements.

The need for dry on-site storage is not eliminated if the plant ceases operation in 2010. In order to decommission the plant, spent fuel would have to be removed from the reactor and spent fuel pool. A dry storage facility accommodating 40 storage containers would be needed in order to completely decommission the plant in 2010. As part of the process of developing a decommissioning plan, Xcel would apply to the Public Utilities Commission for a Certificate of Need for that on site storage.

Decommissioning, as defined by NRC, denotes the safe removal from service of a nuclear generating facility and the reduction of residual radioactivity to a level that permits release of the property for unrestricted or restricted use, and termination of the license. The two decommissioning options typically selected for U.S. reactors are:

- Immediate decontamination and dismantlement
- Safe storage of the stabilized and defueled facility for a period of time followed by decontamination and dismantlement

Regardless of the option chosen, decommissioning methods would be described in the post-shutdown decommissioning activities report, which must be submitted to NRC within two years following cessation of operations. Decommissioning activities must be completed within 60 years after operations cease and are subject to environmental review under the National Environmental Policy Act. NRC *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*[28], provides a summary of decommissioning activities, generic environmental impacts of the decommissioning process, and an evaluation of potential changes in impact that could result from deferring decommissioning.

[28] NRC (U.S. Nuclear Regulatory Commission). 1988. *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*. NUREG-0586. Office of Nuclear Regulatory Research. Washington, D.C. August.

SECTION 7

ANALYSIS OF ALTERNATIVES TO THE MONTICELLO NUCLEAR GENERATING PLANT

The "no action" alternative, described in Section 6, would lead to the shutdown and decommissioning of the Monticello Nuclear Generating Plant and subsequent loss of 600 megawatts of generating capacity. This section identifies alternative methods of supplying this amount of power and examines the environmental impacts of those alternatives.

The information for this section is derived primarily from the Nuclear Management Company (NMC) Environmental Report Section[29] of the Facility License Application, data provided by the Energy Information Administration, Strategist model runs completed by Xcel Energy and the distributed generation analysis provided by PA consultants to Xcel.

Section 7.1 Monticello Plant Capacity and Minnesota Energy Supply

The current Monticello Plant has a net generating capability of approximately 597 megawatts electrical (MWe). In 2002-2003, the plant generated an annual average of approximately 4,800,000 megawatt-hours (MWh) of electricity, approximately 13 percent of NSP's total[30] annual electricity generation in that 2-year period. This power is equivalent to the annual electric power usage of approximately 585,000 of NSP's Minnesota residential customers.

Fuel Sources

The generating capacity of Minnesota's electric utility industry consists mostly of coal, natural gas and nuclear units. Xcel's generating capability in Minnesota consists primarily of coal-fired and nuclear units. Facilities firing primarily natural gas and petroleum represent smaller capacity shares of Xcel's generating portfolio, while renewables account for less than 3 percent of capacity.

Use is made of coal-fired and nuclear plants to generate electricity in Minnesota, because of the lower operating cost and suitability of these technologies for continuous (base-loaded) operation. The use of fossil-fueled generating capability other than coal (i.e., gas and oil) is lower, due to higher fuel costs for oil and natural gas. These fuels are used primarily to meet intermediate or peak loads.

Minnesota has the potential to develop significant wind energy resources, particularly in the Buffalo Ridge area in the southwestern part of the state. However, this power source is intermittent in supply and reliability. Minnesota also has a large potential biomass resource present in the forms of woody biomass, food crops for energy extraction and manure and other

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[29] Applicant's Environmental Report , Appendix E – Operating License Renewal Stage
Monticello Nuclear Generating Plant, Nuclear Management Company
Docket No. No. 50-263 License No. DPR-22, March 2005

[30] EIA (Energy Information Administration. 2004a. "Monthly Nuclear Generation by State, 2002 and 2003." Accessed at http://www.eia.doe.gov/cneaf/nuclear/page/nuc_generation/gensum.html.

organic wastes. This renewable biomass resource has great energy potential, but low energy density. Biomass is included as a factor in the distributed generation option.

Demand-Side Management

The amount of energy needed is influenced by demand and efforts to temper that demand. Alternatives to the Monticello Plant take advantage of these Demand-Side Management savings.

Demand-Side Management, or DSM, generally is a set of programs under the direction of a utility to encourage customers to: a) use less energy overall, b) use less energy at specific times, such as when demand for energy is highest, or c) achieve both goals in (a) and (b).

Encouraging customers to use less energy overall is also known as “energy conservation;” encouraging customers to use less energy at certain times is known as “load management.” Effective energy conservation means that less energy is produced and used annually than would be the case without energy conservation. An example of such energy conservation is the installation of more efficient appliances such as refrigerators, air conditioners and light bulbs. Effective load management means that less energy is demanded at critical periods than would be the case without load management; however, there may be no reduction in energy use throughout the year due to the load management program, if the energy use simply shifts to a different time period. An example of such load management would be for a company to work with the utility to change its production schedule and avoid using as much energy during a critical peak period and shift that production to an off-peak period.

An example of a project that is intended to accomplish both a reduction in energy use overall and a reduction of energy use at peak periods is Xcel’s “Savers Switch ®” program that cycles on and off the central air conditioners of participating customers.

The following describes the primary benefits and costs of DSM[31]:

> There are three primary benefits. First, DSM helps utilities and their customers avoid the operating costs of providing more electricity and natural gas. These costs include buying fuel and operating and maintaining power plants. In the conservation field, these benefits are referred to as “avoided energy costs.” Second, DSM helps the utilities and their customers avoid or delay the capital costs of adding new system capacity. Without DSM, utilities would have a greater need to construct new power plants, transmission lines, natural gas pipeline, and distribution systems. These benefits are referred to as “avoided capacity (or demand) costs.” Third, DSM reduces the environmental damage caused by burning fossil fuels and the resulting smog, acid rain, and global warming. These benefits are referred to as “avoided environmental damage costs.”

[31] Legislative Auditor's Report, Energy Conservation Improvement Program, January 2005. In this excerpt, the term DSM is substituted for the word “conservation” used in the report.

> There are two primary costs of DSM. First, there is the higher price that is paid for energy-efficient products. The customers pay for part of these costs, and DSM rebates pay for the rest. Second, the utilities pass these costs onto their customers by increasing the energy rates that they charge.

Section 7.2 Alternatives to Continued Operation of the Monticello Plant

Replacement options considered included building new generating facilities, replacing existing power with a mix of distributed generation sources and reducing power requirements through demand reduction and energy conservation. Land use and environmental characteristics of the generic alternative generating technologies were estimated for a plant approximately 600 MW in size for each alternative. Fuel consumption and air and water emissions associated with each type of plant and solid waste volumes and environmental characteristics associated with each plant type were estimated.

The Monticello power plant is an electric power generator that is relied on to meet the baseload customer demand for electricity. If the plant is shut down, it must be replaced with equivalent amounts of baseload generating capacity reliable more than 90 percent of the time.

Five 600 megawatt capacity alternatives were addressed:

1. A base load pulverized coal power plant
2. A coal fueled integrated gasification combined cycle power plant (IGCC)
3. A natural gas fueled combined cycle plant
4. A wind and natural gas plant combination
5. System-wide distributed, renewable generation

Results from the Strategist model, a proprietary computer model developed by New Energy Associates, Inc., were used to compare emissions from the alternatives. The economic analyses of these alternatives conducted by the Minnesota Department of Commerce and other parties to the Certificate of Need proceedings are incorporated by reference.

Typical design life of 30 years for the combined-cycle natural gas-fired plant and 40 years for the coal-fired plant were assumed where necessary for analysis. Additional facilities such as new natural gas supply pipeline, new rail for delivery of coal and limestone and new 345-kV transmission line to connect to the grid would be required for some alternatives. A coal-fired plant would take approximately 5 years to construct, not including permitting time, while a gas-fired one would take approximately two. The choice of specific alternatives and locations for any alternative would require detailed studies, analysis and approvals.

NMC also evaluated environmental impacts for feasible replacement power alternatives in its *Environmental Report Appendix E – Operating License Renewal Stage Monticello Nuclear Generating Plant*, including in Table 7.2-3 "Other Generation technology Options Considered."

Pulverized Coal-Fired Generation

The representative coal-fired plant to effectively replace the Monticello Plant was assumed to be a modern pulverized coal-fired steam unit with advanced, clean-coal technology and air emission controls. Future viable coal-generating technologies are less certain for coal than for a natural gas-fired plant, due to the potentially higher air emissions of coal. However, this as a proven technology that is economically competitive and commercially available in large-capacity unit sizes that could effectively replace the Monticello Plant, according to Xcel.

The representative pulverized coal plant consists of a commercially available standard-sized unit having a nominal net output of approximately 600 MW, comparable to the Monticello Plant's net capacity. Table 7-1 lists basic specifications for the plant. Based on this information, annual coal consumption for the facility would be approximately 2.7 million tons. The coal plant would be designed to meet applicable Minnesota Pollution Control Agency (MPCA) air and wastewater emissions standards. Exhaust would be dispersed through a stack approximately 500 feet high. NMC estimates that approximately 31,000 tons of limestone could be needed annually to operate the scrubber assumed for control of sulfur oxides ($SO_{\mathbf{x}}$) emissions.

Table 7-1 Pulverized Coal Fired - Alternative
based on NMC table 7.2.2 pg. 7-35 Appendix E

Characteristic		**Basis / Detail**
1 pulverized coal unit		Standard size to match MNGP total net capacity
660 MW (gross), 600 MW (net)		Industry Data - Standard Package
Capacity Factor - 85%		Within range for baseload plant comparable to MNGP
Firing Mode - sub critical dry-bottom pulverized coal		Widely demonstrated, economic, reliable
Fuel Type - sub-bituminous coal		Assumed
Fuel ash content by weight 5.7%		Average for coal used at NSP King Plant
SOx emission rate 13.0 lb/ ton coal - Uncontrolled		EPA estimate for sub-bituminous coal
SOx removal rate - 90%		Best available technology for minimizing SOx - EPA
NOx emission rate 7.2 lb/ ton coal - Uncontrolled		EPA estimate for sub-bituminous coal
NOx emission rate catalytic reduction 95%		Best available technology for minimizing NOx - EPA
CO emission rate 0.5 lb/ ton coal - Uncontrolled		EPA estimate for sub-bituminous coal
PM emission rate 13.1 lb/ ton coal - Uncontrolled		EPA estimate for sub-bituminous coal
PM emission rate fabric filter reduction 99.9%		Best available technology for minimizing PM - EPA

This table shows the primary technical and air emission factors of importance to consider when evaluating the environmental impact of a pulverized coal plant compared to the MNGP. These characteristics would be similar for an IGCC Coal plant although the air emissions would be presumably less than at the pulverized coal facility.

Integrated Gasification Coal-Fired Generation Alternative
Air emissions impacts of IGCC may be lower than modern pulverized coal, but would be comparable to or higher than the gas-fired combined-cycle alternative. Integrated gasification combined-cycle (IGCC) coal technology could be viable in the future. The Mesaba Energy Project is an IGCC facility with a capacity of approximately 600 MW proposed for development in northern Minnesota. However, the Mesaba facility would be the largest capacity IGCC facility constructed to date in the United States and represents technology that is not yet fully demonstrated commercially at that size. IGCC demonstration plants to date have been much smaller. The long-term reliability of IGCC may not be known at the point when a decision would need to be made regarding replacement of Monticello Plant capacity. The IGCC coal plant is expected to have lesser air emissions than the pulverized coal plant.

Siting Considerations for Coal Plant Options
The minimum total land area required for either a pulverized coal or an IGCC coal plant of 600 MW is approximately 380 acres. This includes:

- 260 acres for the generating plant and related onsite ancillary and support facilities and infrastructure

- 120 acres for disposal of ash from the plant's air emissions control systems over a 40-year plant life. (Assuming that 30 percent of the ash goes to such beneficial uses as concrete products and roadbed material, as in Xcel's existing plants, and that the remainder is land-filled onsite to an average fill depth of 30 feet.)

- Plus additional land for a peripheral buffer around the coal plant

Offsite infrastructure needed for the plant could include a new rail spur for delivery of coal and limestone and new transmission facilities to connect the plant to the grid.

Natural Gas Fueled Combined Cycle Plant Alternative

The Mankato Energy Center[32] baseload natural gas-fired combined-cycle plant was used as the representative plant to replace power currently generated by the Monticello Plant. NMC used selected plant characteristics as described in the environmental assessment for that facility as a main source of information for the representative plant characteristics. Basic design and operating assumptions for the representative gas plant are listed in Table 7-2. The assumed

[32] MEQB (Minnesota Environmental Quality Board). 2004. *Environmental Assessment* –
Calpine Mankato Energy Center Power Generating Plant, EQB Docket No. Number 04-76-PPS-Calpine Mankato Energy Center. July 2004. Accessed at http://www.eqb.state.mn.us/pdf/FileRegister/Calpine-Mankato/1111CalpineJune30.pdf.

representative plant consists of two steam combustion turbines (CTs), each with an associated heat recovery steam generator (HRSG) that together supply steam to a single steam turbine generator. Net generating capacity of the representative plant with this "two-on-one" configuration is approximately 550 MW, somewhat less than but comparable to the Monticello Plant.

Table 7-2 Natural Gas – Generation Alternative
based on NMC table 7.2.2 pg. 7-35 Appendix E

Characteristic		**Basis / Detail**
1 combined cycle unit , 550 MW		Standard size to match MNGP total net capacity
2 combustion turbines plus 1 steam turbine		Industry Data - Standard Package
Capacity Factor – 85%		Within range for baseload plant comparable to MNGP
Fuel Type - Natural Gas		Assumed
SOx emission rate 0.00064 lbs/MMBtu		EPA estimate for natural gas-fired turbines
NOx emission rate 0.099 lbs/MMBtu		EPA estimate for natural gas-fired turbines, primary
NOx emission rate catalytic reduction 90%		EPA estimate for natural gas-fired turbines, final
CO emission rate 0.015 lbs/MMBtu		EPA estimate for natural gas-fired turbines
PM emission rate 0.0019 lb/MMBtu		EPA estimate for natural gas-fired turbines
CO2 emission rate 110 lbs/MMBtu		EPA estimate for natural gas-fired turbines

This table shows the primary technical and air emission factors of importance to consider when evaluating the environmental impact of a natural gas plant compared to the MNGP.

The gas plant would be designed to meet applicable MPCA air and wastewater emissions standards. NMC estimates that the representative plant with associated support facilities would occupy approximately 25 acres at a greenfield site. Additional land could be needed as a buffer from adjacent land uses. Offsite infrastructure needed for the representative plant could reasonably include a natural gas supply pipeline and new transmission facilities to connect the plant to the grid. Assuming use of an existing power plant site (e.g., MNGP site) as a replacement unit and use of the existing switchyard and perhaps other support facilities and no need for additional land as buffer, NMC estimates that new facilities would occupy approximately 15 acres.

Wind-Gas Alternative
In the Wind-Gas alternative, the Monticello plant is replaced by two 270.5 MW combined-cycle gas units and 240 MW of wind power. Wind power is an intermittent source of electric generation, where power output varies depending on the speed of the wind and ability of the transmission system to carry the power when it is generated. Wind power's discontinuous availability means it cannot be counted on by itself to replace a baseload unit. In order to provide

the same amount of power production capability for the electrical system, wind power was combined with natural gas generation to form a complete alternative.

Combined-cycle technology was used for the gas generation portion of the alternative. The combined-cycle unit costs and operating characteristics were based on the generic combined-cycle unit in the Strategist model. The combined-cycle unit in this alternative was created by scaling the size and costs of the generic combined-cycle unit up to a summer capacity of 270.5 MW, so two of these units equal 541 MW of capacity. This total comes close to matching the total summer nuclear capacity of the Monticello plant. The fixed and capital costs for the gas part of the alternative were calculated using the same per kilowatt costs as were used for the generic combined-cycle unit.

Xcel Energy approximated the ramping capability of a combined-cycle unit, the ability to follow the varying output of wind turbines, to be about 40 percent of the capacity of the unit, assuming the minimum load of the combined-cycle to be about 60 percent. Xcel Energy then matched the level of wind generation in the scenario to the ramping capability of the combined-cycle units. The result is roughly 240 MW of wind necessary to complete a system with firm production capacity capable of replacing the nuclear unit. The replacement wind units were calculated using the same costs and characteristics as the generic wind units used in Strategist.

The Wind-Gas alternative is added as follows: Monticello is shutdown at the end of 2010 and is replaced in 2011 with 541 MW of combined-cycle gas and 240 MW of wind. The results of the economic analysis of this option are reported in Chapter 5 of the CON Supplement[33].

The environmental impacts and economic reasonableness of such a dual system would be heavily dependent on a number of site-specific factors such as the availability of a large gas pipeline, adequate wind resources, sufficient transmission capacity and proximity to power demand.

[33] *Supplement to Application to the Minnesota Public Utilities Commission for a Certificate of Need to Establish an Independent Spent Fuel Storage Installation at the Monticello Generating Plant,* Docket No. E002/CN-05-123, June 15, 2005, Chapter 5

Defining the Renewable Distributed Generation Alternative
The EIS was tasked to define and study one or more renewable energy based "distributed generation" (DG) alternatives. The DG alternatives had to be capable of replacing about 600 megawatts of baseload capacity with a combination of conservation, load management, wind, biomass, or other renewable energy sources, for 2010 through 2030.

Staff invited 20 experts to participate in a collaborative process to define a renewable distributed generation alternative, including university researchers, environmental activists and people with recognized distributed generation expertise. They were asked:

- What combination of renewable, 10kw to 10MW distributed generation technologies do you think is most likely? Of what size?
- Do you think it is it necessary to define the specific electric and thermal loads served by the DG in order to reasonably assess potential technologies?
- Could the alternative simply include any combination of dispersed renewable generators—of less than10 MW capacity—that could supply 600 MW of firm capacity to the grid?

Initial responses were circulated among all participants, after which they were asked to submit a final ideas. The final results were compiled and evaluated by staff to develop the renewable distributed generation scenario evaluated in the EIS.

System-Wide Renewable Distributed Generation Alternative
Distributed generation, or DG, generally means small amounts of generation (usually 10 MW of capacity or less) that are connected to a utility's distribution system rather than its transmission system. Such generation differs from the generation that takes place at large power plants and is then transmitted, sometimes over long distances, to where the power is needed.

The primary social benefits of DG are seen to be reducing the demand for transmission lines and possibly helping reliability of the electric system, particularly when the utility can count on the DG units to produce power in the same manner as large generation units. The reliability benefits are seen to arise from having more units operate, and thus less negative effect on the electric system if one generation plant fails to operate. Moreover, depending on what fuel is used to produce electricity at the DG plants compared to the project being studied, there may be fewer environmental consequences from energy produced at DG facilities than at large power plants. However, it is important to compare the environmental effects of the fuels used at both DG and large power facilities before drawing such a conclusion.

The drawbacks of DG are seen to be possible difficulties in relying on DG facilities to be built when needed and to produce power when needed, especially if the utility does not own the facilities. One problem in this regard is finding enough sites to build such facilities. In addition there may be noise or other concerns by neighbors living close to these facilities since they are, by design, built close to electricity consumers. Finally, the costs of DG facilities may (or may not) be greater than the project being studied. It is important to look at the facts in each case.

Department of Commerce staff assembled an all-renewable DG alternative to compare against the other four plant-replacement alternatives. The scenario is composed of:

Wind power. The all-renewable DG alternative relies heavily on wind power. This technology has much potential to provide clean energy, but there are also a couple of major disadvantages. Wind does not blow constantly or near where the power is used. This uncertainty results in the need for a large excess capacity of wind generators and extra transmission lines to carry the power from where it is generated to where it is needed.

Biomass. Most of the replacement power is scheduled to come from biomass, primarily woody biomass, but crop residues, ethanol and biodiesel also could be used. This resource is widely dispersed, may be difficult and costly to develop and can present air quality concerns.

Demand-side management. Demand side management can help replace a small portion of Monticello's baseload power.

Digesters. Digesters of manure and possibly human sewage could provide a limited amount of relatively low-cost energy.

Hydro-power. Hydro-power has no air emissions, but can disrupt fisheries. The scenario relies on two existing Xcel-owned facilities identified in a U.S. Department of Energy inventory as having unused capacity.

Table 7-3 Components of Renewable DG

The Renewable distributed generation alternative relies mainly on intermittent wind and a large fraction of biomass energy.

Technology	Nameplate Capacity	Capacity Factor	Accreditation Factor	Accredited Capacity	MWh
Wind I Off Ridge	200	26.5%	13.5%	27.0	463,930
Wind II Off Ridge	300	26.5	13.5%	40.5	695,894
Tree Biomass	367	81.8%	100.0%	367.0	2,657,749
DSM	101	33.6%	100.0%	101.0	297,014
Digesters	11	85.1%	100.0%	10.6	78,899
HydroXcel	25	39.7%	100.0%	25.0	86,943
Total	1,004			571.1	4,280,429

Section 7.3 Comparison of the Alternatives

This section evaluates the potential for significant environmental impacts associated with the continuance of the Monticello Nuclear Power Generating Plant when compared to the five generic alternative means of generating the same quantity and quality of power.

Figures 7-4, 7-5 and 7-6 compare the five alternatives based on land and fuel consumption, air and water emissions and solid waste. Estimates were based on the representative facilities, as well as outputs from the proprietary utility planning model, Strategist, developed by New Energy Associates, Inc. Inputs to the model include initial capital costs, annual operating costs, monthly energy production, monthly capacity patterns and emission rates. Selected outputs were verified against representative facilities.

Strategist also was used in the analysis of the economic feasibility of the alternatives. This analysis is covered in the Department of Commerce testimony in the Certificate of Need proceeding.

Table 7-4 Impacts of renewable Distributed Generation Alternative

Alternative DG Combination units	Wind I Off Ridge	Wind II Off Ridge	Biomass	Demand Side Management	Digesters	Hydro	Renew DG Totals	Units
Additional Land Necessary	20,000	30,000	370,000	0	20,000	0	440,000	Acres
Fuel Consumption Annual	0	0	2,400,000	0	0	0	2,400,000	Tons of dry wood
Air Emissions (primarily CO_2)	0	0	451,000	0	*	0	451,000	Tons/year
Cooling Water Emissions	0	0	**	0	0	0	**	Cubic feet per second
Solid Waste	0	0	600,000	0	0	0	600,000	Tons/year
Costs from Strategist	***	***	***	***	***	***	***	Dollars

*The Strategist model outputs yielded only a sum of air emissions over all DG components. Since the biomass units provided more than 98 percent of the total energy, all air emissions were assigned to this component.

** Due to the many possible configurations of an all-renewable distributed generation alternative involving a number of disbursed biomass energy units, no reasonable estimate could be made for the quantity of cooling water that may be required for this system alternative.

***Original cost data from Xcel Strategist model runs can be found in the CON testimony of Dr. Steve Rakow in Docket No. E002/CN-05-123 in Tables 10, 12, 13 and 14. This data and narrative is also provided in exhibits SRR-14, SRR-15 and SRR-18. All questions on interpretation of this data should be referred to Dr. Rakow.

Table 7-5 Monticello Plant Alternatives comparison

All options to Monticello Plant show additional land needed or higher emission rates.

Option Number >>>	Base case	1	2	3	4	5	
Item >>>>	**Monticello**	**Generic IGCC**	**Generic Coal**	**Generic Gas CC**	**Gas CC Plus Wind**	**Renewable DG Combination**	**Units**
Additional Land Needed	0	400	400	25	5,025	440,000	Acres
Annual Fuel Consumption	76 fuel rods	3,000,000 tons	2,700,000 tons	26,900,000,000 cubic feet	13,450,000,000 cubic feet	2,400,000 tons	tons, fuel rods, cubic feet
Air Emissions (primarily CO_2)	0	4,500,000	4,500,000	2,000,000	1,100,000	451,000	tons/ year
Cooling Water Use	0.25	13	13	4	2.4	*	cubic feet/sec
Solid Waste	0	150,000	150,000	0	0	600,000	tons/year
Costs from Strategist Model	**	**	**	**	**	**	Dollars

Sources:

- Wind power land estimate was based on 100 acres per MW collected
- Biomass land estimate was based on 1,000 acres per MW of biomass energy collected
- Natural gas fuel water and land consumption were based on NMC, Appendix E, pg 7-15
- Coal fuel water and land consumption were based on NMC, Appendix E pg 7-17.
- Coal solid waste (ash) was calculated at 5 percent of weight of incoming coal
- Wood solid waste (ash) was calculated at 25 percent of dry weight

* Due to the many possible configurations of an all-renewable distributed generation alternative involving a number of disbursed biomass energy units, no reasonable estimate could be made for the quantity of cooling water that may be required for this system alternative.

**Original cost data from Xcel Strategist model runs can be found in the CON testimony of Dr. Steve Rakow in Docket No. E002/CN-05-123 in Tables 10, 12, 13 and 14. This data and narrative is also provided in exhibits SRR-14, SRR-15 and SRR-18. All questions on interpretation of this data should be referred to Dr. Rakow.

Table 7-6 Air Emission Comparisons from various alternatives to MNGP

The Monticello Plant has the lowest air emissions for all systems analyzed.

Item	Monticello	Generic Gas CC	Generic IGCC	Generic Coal	Gas CC	Wind	Gas CC Plus Wind	Renew DG Scenario	Units	Generic Source or Formula
Capacity per Unit*	578	250	550	600	250	50		**	MW	Industry Estimates
Number of Units	1.00	2.30	1.05	0.96	2.00	12.00		**		Monticello Scale
Capacity for Alternative	578	575	578	576	500	600	578	571	MW	Wind accred at 13%
Capacity Factor*	90.4%	90.8%	90.4%	90.7%	58.8%	38.0%		80.0%	Percent	Industry Estimates
Heat Rate*	10,400	7,196	8,309	8,844	7,196	-		3,413	Btu / kWh	Industry Estimates
Heat Input	6,011	4,138	4,798	5,094	3,598	-			Mln Btu / Hour	Heat Rate * (Capacity * 1,000) / 1,000,000
Annual Energy Production	4,577,205	4,573,596	4,573,246	4,576,504	2,575,440	1,997,280	4,572,720	4,280,429	MWh	Capacity * (8,760 * Capacity Factor)
Emissions										
NOx	-	0.012	0.007	0.070	0.012	-		0.115	lbs / Million btu	Xcel Responses to data requests and Wisconsin Energy Permit Analysis verified by MPCA AQ staff
CO	-	0.013	0.004	0.150	0.013	-		0.117	lbs / Million btu	
PM10	-	0.008	0.008	0.003	0.008	-		0.016	lbs / Million btu	
Pb	-	-	-	-	-	-		0.000	lbs / Million btu	
SOx	-	0.0006	0.0300	0.1500	0.0006	-		0.003	lbs / Million btu	
Hg	-	-	0.0006	0.0011	-	-		0.000	lbs / Million btu	
VOC	-	0.0000	0.0000	0.0000	-	-		0.000	lbs / Million btu	
CO2	-	119.000	205.000	205.000	119.000	-		23.500	lbs / Million btu	
Annual Emissions										
NOx	-	197	133	1,417	111	-	111	2,333	Tons / Year	(Emissions/2,000) * (Heat Rate / 1,000,000) * (Annual Energy Production * 1,000)
CO	-	207	76	3,036	117	-	117	2,367	Tons / Year	
PM10	-	132	152	51	74	-	74	267	Tons / Year	
Pb	-	-	-	-	-	-	-	-	Tons / Year	
CO2	-	1,958,240	3,894,908	4,148,647	1,102,706	-	1,102,706	445,800	Tons / Year	
SOx	-	10	570	3,025	267		267	100	Tons / Year	
Hg	-	-	11	23	5		5	0	Lbs / Year	
VOC	-	66	76	71	36		36	67	Tons / Year	

*Estimates for Capacity per Unit, Capacity Factor and Heat Rate were supplied by equipment manufacturers and provided by Xcel to DOC in the CON Application.

** Due to the large number of possible system configurations in the renewable distributed generation scenario, no reasonable estimate could be made of capacity per unit or number of units in the scenario.

SECTION 8

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* These documents are found on PUC website:
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