6.0 Environmental Impacts of the Uranium Fuel Cycle and Solid Waste Management

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required. There are no Category 2 issues for the uranium fuel cycle and solid waste management.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management during the license renewal term that are listed in Table B-1 of Title 10 of the *Code of Federal Regulations* (CFR) Part 51, Subpart A, Appendix B, and are applicable to Monticello. The generic potential impacts of the radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and in 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

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[a] The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

6.1 The Uranium Fuel Cycle

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1 that are applicable to Monticello from the uranium fuel cycle and solid waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management During the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and HLW disposal)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.3.1; 6.4.3.2; 6.4.3.3; 6.4.4; 6.4.4.1; 6.4.4.2; 6.4.4.3; 6.4.4.4; 6.4.4.5; 6.4.4.5.1; 6.4.4.5.2; 6.4.4.5.3; 6.4.4.5.4; 6.4.4.6; 6.6
Mixed waste storage and disposal	6.4.5.1; 6.4.5.2; 6.4.5.3; 6.4.5.4; 6.4.5.5; 6.4.5.6; 6.4.5.6.1; 6.4.5.6.2; 6.4.5.6.3; 6.4.5.6.4; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.4.6.1; 6.4.6.2; 6.4.6.3; 6.4.6.4; 6.4.6.5; 6.4.6.6; 6.4.6.7; 6.6
Nonradiological waste	6.1; 6.5; 6.5.1; 6.5.2; 6.5.3; 6.6
Transportation	6.1; 6.3.1; 6.3.2.3; 6.3.3; 6.3.4; 6.6, Addendum 1

Nuclear Management Company (NMC) stated in its Environmental Report (ER) (NMC 2005) that it is not aware of any new and significant information associated with the renewal of the

Monticello operating license (OL). The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the staff concluded in the GEIS that the impacts are SMALL except for the collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, as discussed below, and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the staff review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of these issues follows:

- Offsite radiological impacts (individual effects from other than the disposal of spent fuel and HLW). Based on information in the GEIS, the Commission found that

  > Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

The staff has not identified any new and significant information on this issue during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (collective effects). In the GEIS, the staff found that

  > The 100-year environmental dose commitment to the U.S. population from the fuel cycle, HLW and spent fuel disposal excepted, is calculated to be about 14,800 person rem, or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits, and even smaller fractions of natural background exposure to the same populations.

> Nevertheless, despite all the uncertainty, some judgement as to the regulatory National Environmental Policy Act (NEPA) implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (spent fuel and HLW disposal). Based on information in the GEIS, the Commission found that

  > For the HLW and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 mrem per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 mrem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 mrem per year. The lifetime individual risk from 100 mrem annual dose limit is about 3×10^{-3}.
  >
  > Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the U.S. Department of Energy in the *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste* [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of

breaching a reference repository in the year of closure, after 1000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other Federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1000 premature cancer deaths worldwide for a 100,000 metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and HLW disposal, this issue is considered Category 1.

On February 15, 2002, based on a recommendation by the Secretary of the Department of Energy, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and high-level nuclear waste. The U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 Stat. 735 (2002) approved Yucca Mountain as the site for the development of a repository for the disposal of high-level radioactive waste and spent nuclear fuel. This development does not represent new

and significant information with respect to the offsite radiological impacts from license renewal related to disposal of spent nuclear fuel and high-level nuclear waste.

The EPA developed Yucca Mountain-specific repository standards, which were subsequently adopted by the NRC in 10 CFR Part 63. In an opinion, issued July 9, 2004, the U.S. Court of Appeals for the District of Columbia Circuit (the Court) vacated EPA's radiation protection standards for the candidate repository, which required compliance with certain dose limits over a 10,000 year period. The Court's decision also vacated the compliance period in NRC's licensing criteria for the candidate repository in 10 CFR Part 63. In response to the Court's decision, the EPA issued its proposed revised standards on August 22, 2005 (*Federal Register*, Volume 40, page 49014 [70 FR 49014]). In order to be consistent with the EPA's revised standards, the NRC proposed revisions to 10 CFR Part 63 on September 8, 2005 (70 FR 53313).

Therefore, for the HLW and spent fuel disposal component of the fuel cycle, there is some uncertainty with respect to regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, prior to promulgation of the affected provisions of the Commission's regulations, the staff assumed that limits would be developed along the lines of the 1995 National Academy of Sciences report, *Technical Bases for Yucca Mountain Standards*, and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository that would comply with such limits could and likely would be developed at some site.

Despite the current uncertainty with respect to these rules, some judgment as to the regulatory NEPA implications of offsite radiological impacts of spent fuel and HLW disposal should be made. The staff concludes that these impacts are acceptable in that the impacts would not be sufficiently large to require the NEPA conclusion that the option of extended operation under 10 CFR Part 54 should be eliminated.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no offsite radiological impacts related to spent fuel and HLW disposal during the renewal term beyond those discussed in the GEIS.

- Nonradiological impacts of the uranium fuel cycle. Based on information in the GEIS, the Commission found that

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there

are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found that

> The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of low-level waste (LLW) storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found that

> The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Onsite spent fuel. Based on information in the GEIS, the Commission found that

> The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found that

> No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information contained in the GEIS, the Commission found that

> The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting HLW to a single repository, such as Yucca Mountain, Nevada, are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4 — Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in § 51.52.

Monticello meets the fuel enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

6.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment,* Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

Energy Policy Act of 1992, Public Law No. 102-486, § 801, 1069 Stat. 2921. (codified at 42 USC 10101 note).

National Academy of Sciences (NAS). 1995. *Technical Bases for Yucca Mountain Standards.* Washington, D.C.

National Environmental Policy Act (NEPA) of 1969, as amended. 42 USC 4321, et seq.

Nuclear Management Company (NMC). 2005. *Applicant's Environmental Report—Operating License Renewal Stage, Monticello Nuclear Generating Plant.* Docket No. 50-263, License No. DPR-22. Monticello, Minnesota.

Nuclear Energy Institute, Inc. v. EPA, 373 F.3d 1251, 1273, 1299 (D.C. Cir. 2004).

U.S. Department of Energy (DOE). 1980. *Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste.* DOE/EIS-0046F. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2. Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report.* Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2001. "Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain, Nevada." *Federal Register,* Vol. 66, No. 213, p. 55792. Washington, D.C. November 2, 2001.

7.0 Environmental Impacts of Decommissioning

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in the *Generic Environmental Impact Statement for Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors*, NUREG-0586 (NRC 2002). The staff's evaluation of the environmental impacts of decommissioning presented in NUREG-0586, Supplement 1 identifies a range of impacts for each environmental issue.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term are discussed in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999).[a] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one of more of the criteria for Category 1, and therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

[a] The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

7.1 Decommissioning

Category 1 issues in Table B-1 of Title 10 of the *Code of Federal Regulations* (CFR) Part 51, Subpart A, Appendix B that are applicable to Monticello decommissioning following the renewal term are listed in Table 7-1. Nuclear Management Company (NMC) stated in its Environmental Report (ER) (NMC 2005) that it is aware of no new and significant information regarding the environmental impacts of Monticello license renewal. The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft Supplemental Environmental Impact Statement (SEIS). Therefore, the staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For all of these issues, the staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of Monticello Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
DECOMMISSIONING	
Radiation doses	7.3.1; 7.4
Waste management	7.3.2; 7.4
Air quality	7.3.3; 7.4
Water quality	7.3.4; 7.4
Ecological resources	7.3.5; 7.4
Socioeconomic impacts	7.3.7; 7.4

A brief description of the staff's review and the GEIS conclusions, as codified in Table B-1, for each of the issues follows:

- Radiation doses. Based on information in the GEIS, the Commission found that

> Doses to the public will be well below regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem [0.01 person-Sv] caused by buildup of long-lived radionuclides during the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found that

  > Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information found in the GEIS, the Commission found that

  > Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Water quality. Based on information found in the GEIS, the Commission found that

  > The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Ecological resources. Based on information found in the GEIS, the Commission found that

  > Decommissioning either after the initial operating period or after a 20-year license renewal period is not likely to have any direct ecological impacts.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there

are no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic impacts. Based on information found in the GEIS, the Commission found that

  > Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

The staff has not identified any new and significant information during its independent review of the NMC ER, the staff's site visit, the scoping process, its evaluation of other available information, or public comments on the draft SEIS. Therefore, the staff concludes that there are no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

Nuclear Management Company (NMC). 2005. *Applicant's Environmental Report—Operating License Renewal Stage, Monticello Nuclear Generating Plant.* Docket No. 50-263, License No. DPR-22. Monticello, Minnesota.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report,* Section 6.3 – Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2002. *Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors.* NUREG-0586, Supplement 1, Vols. 1 and 2, Washington, D.C.

8.0 Environmental Impacts of Alternatives to License Renewal

This chapter examines the potential environmental impacts associated with denying the renewal of an operating license (OL) for Monticello Nuclear Generating Plant (Monticello) (the no-action alternative); the potential environmental impacts from electric generating sources other than the Monticello site; the possibility of purchasing electric power from other sources to replace power generated by Monticello and the associated environmental impacts; the potential environmental impacts from a combination of generating and conservation measures; and other generation alternatives that were deemed unsuitable for replacement of power generated by Monticello. The environmental impacts are evaluated using the U.S. Nuclear Regulatory Commission's (NRC's) three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines and set forth in the footnotes to Table B-1 of Title 10 of the *Code of Federal Regulations* (CFR) Part 51, Subpart A, Appendix B:

SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.

LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996, 1999)[a] with the additional impact category of environmental justice.

8.1 No-Action Alternative

NRC's regulations implementing the National Environmental Policy Act (NEPA) of 1969 specify that the no-action alternative be discussed in an NRC environmental impact statement (EIS), (see 10 CFR Part 51, Subpart A, Appendix A[4]). For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the Monticello OL. The Northern States Power Company (NSP) would then cease plant operations when the current license expires and initiate the decommissioning of the plant.

[a] The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

NSP would be required to shut down Monticello and to comply with NRC decommissioning requirements in 10 CFR 50.82 whether or not the OL is renewed. If the Monticello OL is renewed, shutdown of the unit and decommissioning activities will not be avoided, but will be postponed for up to an additional 20 years.

The environmental impacts associated with decommissioning following a license renewal period of up to 20 years or following the no-action alternative would be bounded by the discussion of impacts in Chapter 7 of the license renewal GEIS (NRC 1996), Chapter 7 of this supplemental environmental impact statement (SEIS), and the *Final Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities*, NUREG-0586, Supplement 1 (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, Supplement 1.[a] Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are considered here. These impacts, which will occur when the unit permanently shuts down regardless of whether the license was to be renewed or not, are discussed below, with the results presented in Table 8-1. Plant shutdown will result in a net reduction in power production capacity. The power not generated by Monticello during the license renewal term would likely be replaced by (1) power purchased from other electricity providers, (2) generating alternatives other than Monticello, (3) demand-side management (DSM) and energy conservation, or (4) some combination of these options. The environmental impacts of these options are discussed in Section 8.2.

- **Land Use**

In Chapter 4, the staff concluded that the impacts on land use of continued plant operation during the renewal term would be SMALL. Onsite land use will not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning. The transmission lines associated with the project would be expected to remain in service after the plant stops operating. As a result, maintenance of the transmission corridors will continue as before. Therefore, the staff concludes that the impacts on land use from plant shutdown would be SMALL.

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[a] Appendix J of NUREG-0586 Supplement 1 discusses the socioeconomic impacts of plant closure, but the results of the analysis in Appendix J are not incorporated in the analysis presented in the main body of the NUREG.

Table 8-1. Summary of Environmental Impacts of the No-Action Alternative

Impact Category	Impact	Comment
Land Use	SMALL	Impacts are expected to be SMALL because plant shutdown is not expected to result in changes to onsite or offsite land use.
Ecology	SMALL	Impacts are expected to be SMALL because current aquatic impacts are SMALL. Terrestrial impacts are not expected because there will not be any land use changes.
Water Use and Quality—Surface Water	SMALL	Impacts are expected to be SMALL because surface water intake and discharges will decrease.
Water Use and Quality—Groundwater	SMALL	Impacts are expected to be SMALL because groundwater use will decrease.
Air Quality	SMALL	Impacts are expected to be SMALL because releases related to plant operation and worker transportation will decrease.
Waste	SMALL	Impacts are expected to be SMALL because generation of high-level waste will end, and generation of low-level and mixed waste will decrease.
Human Health	SMALL	Impacts are expected to be SMALL because radiological doses to workers and members of the public, which are within regulatory limits, will be reduced.
Socioeconomics	SMALL to LARGE	Impacts are expected to be SMALL to LARGE because of a decrease in employment and tax revenues.
Socioeconomics (Transportation)	SMALL	Impacts are expected to be SMALL because the decrease in employment would reduce traffic.
Aesthetics	SMALL	Impacts are expected to be SMALL because plant structures will remain in place.
Historic and Archaeological Resources	SMALL	Impacts are expected to be SMALL because shutdown of the plant will not result in changes to onsite or offsite land use.
Environmental Justice	SMALL to LARGE	Impacts are expected to be SMALL to LARGE because loss of employment opportunities is expected.

- **Ecology**

In Chapter 4 of this SEIS, the NRC staff concluded that the ecological impacts of continued plant operation would be SMALL. Cessation of operations will be accompanied by a reduction in cooling water flow and the thermal plume from the plant. The environmental impacts to aquatic species, including threatened and endangered species, associated with these changes are generally positive. The impact of plant closure on the terrestrial ecosystem will be negligible because the transmission lines to the plant will remain energized. Therefore, the staff concludes that ecological impacts from shutdown of the plant would be SMALL.

- **Water Use and Quality—Surface Water**

In Chapter 4 of this SEIS the NRC staff concluded that impacts of continued plant operation on surface water use and quality would be SMALL. When the plant stops operating there will be an immediate reduction in the consumptive use of water because of reduction in cooling water flow and in the amount of heat rejected to the Mississippi River. Therefore, the staff concludes that the impacts on surface water use and quality from plant shutdown would be SMALL.

- **Water Use and Quality—Groundwater**

In Chapter 4, the staff concluded that impacts of continued plant groundwater use on groundwater availability and quality would be SMALL. When the plant stops operating, there will be an immediate reduction in use of groundwater for makeup. In addition, there will be a gradual reduction in groundwater use for potable water as the plant staff decreases. Therefore, the staff concludes that groundwater use and quality impacts from shutdown of the plant would be SMALL.

- **Air Quality**

In Chapter 4, the staff found the impacts of continued plant operation on air quality would likely be SMALL. When the plant stops operating, there will be a reduction in emissions from activities related to plant operation, such as use of diesel generators and workers' transportation. Therefore, the staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

- **Waste**

The impacts of waste generated by continued plant operation are discussed in Chapter 6. The impacts of low-level and mixed waste from plant operation are characterized as SMALL. When the plant stops operating, the plant will stop generating high-level waste, and generation of low-level and mixed waste associated with plant operation and maintenance will be reduced. Therefore, the staff concludes that the impact of waste generated after shutdown of the plant would be SMALL.

- **Human Health**

In Chapter 4 of this SEIS the NRC staff concluded that the impacts of continued plant operation on human health would be SMALL. After the cessation of operations the amount of radioactive material released to the environment in gaseous and liquid forms will be reduced. Therefore, the staff concludes that the impact of shutdown of the plant on human health would be SMALL. In addition, the variety of potential accidents at the plant will be reduced to a limited set associated with shutdown events and fuel handling. In Chapter 5 of this SEIS the NRC staff

concluded that the impacts of accidents during operation were SMALL. Therefore, the staff concludes that the impacts of potential accidents following permanent shutdown of the plant would be SMALL.

- **Socioeconomics**

In Chapter 4, the NRC staff concluded that the socioeconomic impacts of continued plant operation would range from SMALL to MODERATE. There would be immediate socioeconomic impacts associated with the shutdown of the plant because of the reduction in the staff at the plant. There may also be an immediate reduction in property tax revenues for Wright County. The NRC staff concludes that the socioeconomic impacts of permanent plant shutdown could range from SMALL to LARGE. Some of these impacts could be offset if new power generating facilities are built at or near the current site. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of the potential impacts of plant shutdown.

- **Socioeconomics (Transportation)**

In Chapter 4, the staff concluded that the impacts of continued plant operation on transportation would be SMALL. Cessation of operations will be accompanied by a reduction of traffic in the vicinity of the plant. Most of the reduction will be associated with a reduction in the plant workforce, but there will also be a reduction in shipment of material to and from the plant. Therefore, the staff concludes that the impacts of plant shutdown on transportation would be SMALL.

- **Aesthetics**

In Chapter 4, the staff concluded that the aesthetic impacts of continued plant operation would be SMALL. Cessation of operations will be accompanied by a reduction in visible plumes from the cooling towers. Plant structures and other facilities are likely to remain in place until decommissioning. Therefore, the staff concludes that the aesthetic impacts of plant shutdown would be SMALL.

- **Historic and Archaeological Resources**

In Chapter 4, the staff concluded that the impacts of continued plant operation on historic and archaeological resources would be SMALL. Onsite land use will not be affected immediately by the cessation of operations. Plant structures and other facilities are likely to remain in place until decommissioning. The transmission lines associated with the project are expected to remain in service after the plant stops operating. As a result, maintenance of transmission line corridors will continue as before. Therefore, the staff concludes that the impacts on historic and archaeological resources from plant shutdown would be SMALL.

- **Environmental Justice**

In Chapter 4, the staff concluded that the environmental justice impact of continued operation of the plant would be SMALL because continued operation of the plant would not have a disproportionately high and adverse impact on minority and low-income populations. Permanent shutdown of the plant could have disproportionately high and adverse impacts on minority and low-income populations because of the loss of employment opportunities at the site and because of secondary socioeconomic impacts (e.g., loss of patronage at local businesses). The staff concludes that the environmental justice impacts of plant shutdown could range from SMALL to LARGE. Some of these impacts could be offset if new power generating facilities are built at or near the current site. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of these impacts.

8.2 Alternative Energy Sources

This section discusses the environmental impacts associated with alternative sources of electric power to replace the power generated by Monticello, assuming that the OL for Monticello is not renewed. The order of presentation of alternative energy sources in Section 8.2 does not imply which alternative would be most likely to occur or to have the least environmental impact.

The following generation alternatives are considered in detail:

- coal-fired generation at an alternate greenfield site[a] (Section 8.2.1)
- natural gas-fired generation at an alternate greenfield site (Section 8.2.2)
- coal gasification at an alternate greenfield site (Section 8.2.3)
- nuclear generation at the Monticello site and an alternate greenfield site (Section 8.2.4).

The alternative of purchasing power from other sources to replace power generated Monticello is discussed in Section 8.2.5. Other power generation alternatives and conservation alternatives considered by the staff and found not to be reasonable replacements for Monticello are discussed in Section 8.2.6. Section 8.2.7 discusses the environmental impacts of a combination of generation and conservation alternatives.

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[a] A greenfield site is assumed to be an undeveloped site with no previous construction.

Each year the Energy Information Administration (EIA), a component of the U.S. Department of Energy (DOE), issues an *Annual Energy Outlook.* In its *Annual Energy Outlook 2005 with Projections to 2025,* EIA projects that combined-cycle[a] or combustion turbine technology fueled by natural gas is likely to account for approximately 60 percent of new electric generating capacity between the years 2005 and 2025 (DOE/EIA 2005). Both technologies are designed primarily to supply peak and intermediate capacity, but combined-cycle technology can also be used to meet baseload[b] requirements. Coal-fired plants are projected by EIA to account for approximately 35 percent of new capacity during this period (DOE/EIA 2005). Coal-fired plants are generally used to meet baseload requirements. Renewable energy sources, primarily wind, biomass gasification, and municipal solid waste units, are projected by EIA to account for the remaining 5 percent of capacity additions. EIA's projections are based on the assumption that providers of new generating capacity will seek to minimize cost while meeting applicable environmental requirements. Combined-cycle plants are projected by EIA to have the lowest generation cost in 2005 and 2025, followed by coal-fired plants and then wind generation (DOE/EIA 2005).

EIA projects that oil-fired plants will account for very little of new generation capacity in the United States during the 2005 to 2025 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2005).

EIA also projects that new nuclear power plants will not account for any new generation capacity in the United States during the 2005 to 2025 time period because natural gas and coal-fired plants are projected to be more economical (DOE/EIA 2005). In spite of this projection, a new nuclear plant alternative for replacing power generated by Monticello is considered for reasons stated in Section 8.2.4. NRC established a new reactor licensing program organization in 2001 to prepare for and manage future reactor and site licensing applications (NRC 2001).

Monticello has a net rating of 600 megawatts electric (MW[e]); therefore, for the coal alternative, the staff assumed construction of a 600-MW(e) plant. For the natural gas alternative, the staff assumed construction of a 550-MW(e) plant consisting of two team combustion turbines (CTs). These assumptions are consistent with the NMC Environmental Report (ER) (NMC 2005). For the coal gasification alternative, the staff assumed construction of two 340-MW(e) modules. This assumption slightly overstates the environmental impacts of replacing the 600 MW(e) from Monticello. For the new nuclear alternative, the staff assumed construction of a 600-MW(e) plant. This assumption is roughly equivalent to the environmental impacts of replacing the 600 MW(e) from Monticello.

[a] In a combined-cycle unit, hot combustion gas in a combustion turbine rotates the turbine to generate electricity. The hot exhaust from the combustion turbine is routed through a heat-recovery boiler to make steam to generate additional electricity.

[b] A baseload plant normally operates to supply all or part of the minimum continuous load of a system, and consequently produces electricity at an essentially constant rate. Nuclear power plants are commonly used for baseload generation; i.e., these nuclear units generally run near full load.

8.2.1 Coal-Fired Generation

The staff believes that the Monticello site would not be a viable location for a representative coal-fired plant. The configuration of the area, the proximity to County Road 75 and Interstate 94, and the fact that the river bisects the site all present significant constraints to an optimal layout of plant facilities. Potentially significant issues include the possible need to realign County Road 75 and insufficient suitable area for onsite disposal of air emission control waste south of the river. The latter constraint would necessitate transport of this waste to an existing disposal facility at NSP's Sherburne County Generating Plant site or a new facility developed offsite or on suitable land on the Monticello site north of the river.

Construction at an alternate site would necessitate approximately ten miles of new rail for delivery of coal and limestone. In addition, approximately five miles of new 345-kV transmission would be needed to connect to the grid (NMC 2005).

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.1 are from the NMC ER (NMC 2005). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

The coal-fired plant would consume approximately 2.7 million tons per year of pulverized sub-bituminous coal with an ash content of approximately 5.7 percent. NMC assumes a heat rate[a] of 9800 BTU/kWh and a capacity factor[b] of 85 percent in its ER. After combustion, 99.9 percent of the ash would be collected. Thirty percent of this ash would go to beneficial uses such as concrete products and roadbed material. The remaining 69.9 percent would be disposed of at the plant site. In addition, approximately 51,000 tons of scrubber sludge would be disposed of at the plant site based on annual calcium hydroxide usage of approximately 31,000 tons. Calcium hydroxide is used in the scrubbing process for control of sulfur dioxide (SO_2) emissions.

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[a] Heat rate is a measure of generating station thermal efficiency. In English units, it is generally expressed in British thermal units (BTUs) per net kilowatt-hour (kWh). It is computed by dividing the total BTU content of the fuel burned for electric generation by the resulting kWh generation. The corresponding metric unit for energy is the joule (J).

[b] The capacity factor is the ratio of electricity generated, for the period of time considered, to the energy that could have been generated at continuous full-power operation during the same period.

Table 8-2. Summary of Environmental Impacts of Coal-Fired Generation at an Alternate Greenfield Site Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	MODERATE	The total site could consist of approximately 1700 ac for facilities and an appropriate buffer for adjacent land uses. Land occupied by a 120-ac landfill would be permanently restricted to noninvasive uses for the long term. Offsite, an estimated 60 ac of land would be converted to transportation use and 90 ac would be converted for utility use.
Ecology	SMALL to MODERATE	Impact depends on whether the site has been previously developed. Factors to consider include location and ecology of the site, transmission line route and rail spur route. In total, impacts could include habitat degradation, fragmentation, or loss as a result of construction activities and conversion of land to industrial use. Ecological communities might experience reduced productivity and biological diversity from disturbance of previously intact land.
Water Use and Quality—Surface Water	SMALL to MODERATE	The impact on the surface water is site-dependent and would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water.
Water Use and Quality—Groundwater	SMALL to MODERATE	Impact depends on volume of water withdrawn and the characteristics of the groundwater source.
Air Quality	MODERATE	Sulfur oxides: 1755 tons/yr. National and regional impacts would be minimal because of emissions offsets through the SO_2 trading program. Nitrogen oxides: 486 tons/yr Particulates: 18 tons/yr of PM_{10} Carbon monoxide: 675 tons/yr Small amounts of mercury and other hazardous air pollutants and naturally occurring radioactive materials—mainly uranium and thorium.
Waste	MODERATE	Total waste volume would be approximately 107,000 tons of ash and 51,000 tons of flue gas desulfurization waste annually for 40 years. Approximately 30 percent of the ash would be beneficially used and the remainder of the waste would be disposed of onsite, accounting for approximately 120 ac of land area over the 40-year plant life.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.
Socioeconomics	SMALL to LARGE	Construction impacts depend on location, but could be LARGE if the plant is located in an area that is more rural than the Monticello site. Wright County would experience loss of tax base and employment, potentially offset by projected economic growth.
Socioeconomics (Transportation)	SMALL to MODERATE	Transportation impacts associated with construction workers could be SMALL to MODERATE. For rail transportation of coal and lime, the impact is considered SMALL to MODERATE. For barge transportation, the impact is considered SMALL.

Table 8-2. (contd)

Impact Category	Impact	Comment
Aesthetics	SMALL to MODERATE	Impacts could include visual impairment and infrastructure for delivery of coal and limestone. The severity of impacts is dependent on location.
Historic and Archaeological Resources	SMALL	An alternate location would necessitate cultural resource studies.
Environmental Justice	SMALL to MODERATE	Impacts will vary depending on population distribution and makeup at the site.

For purposes of this evaluation, the staff assumed that a coal-fired plant located at an alternate site would use a closed-cycle cooling system. The overall impacts of the coal-fired generating system are discussed in the following sections and summarized in Table 8-2. The extent of impacts at an alternate greenfield site will depend on the location of the particular site selected.

Land Use

Although potential impacts on land use from a new coal-fired plant would be location-specific and therefore conjectural for a greenfield site, potentially affected areas are predominantly rural agricultural land interspersed in some areas with natural vegetation, all of which are abundant in the region. The total site could consist of approximately 1700 ac to provide flexibility in facility arrangement and appropriate buffer from adjacent land uses. Land uses would be entirely precluded on 380 ac onsite for plant facilities and waste disposal. The waste would be disposed of onsite, accounting for approximately 120 ac of land area over the 40-year plant life.[a] Offsite, an estimated 60 ac of land would be converted to transportation use (rail spur) and 90 ac would be converted to utility use (transmission line). Land occupied by the 120-ac landfill would be permanently restricted to noninvasive uses (e.g., recreation) for the long term. In view of the large amount of land affected and the permanent land use change from the landfill, the staff concludes that land use impacts would be clearly noticeable but not destabilizing. Therefore, the staff concludes that land use impacts from construction and operation of a new coal-fired plant at an alternative greenfield site would be MODERATE. The impact would be greater than the OL renewal alternative.

- **Ecology**

Potential impacts on ecological resources from construction and operation of the representative coal-fired plant are highly site-dependent. Development of the representative coal-fired plant at a greenfield site in southern Minnesota would likely result in the loss of 380 ac of terrestrial habitat for onsite plant facilities and air emission control waste landfill, loss of approximately 60 ac of offsite habitat for the rail line, and modification of 90 ac of offsite terrestrial habitat for a new transmission line to serve the plant. Development of the transmission line would limit

[a] Because the new coal-fired plant is assumed to have a 40-year life, only half of the land area needed for byproduct disposal is directly attributable to the alternative of renewing the Monticello OL for 20 years.

changes in future land uses in the transmission corridor to those that are compatible with the line, but most agricultural practices and other currently compatible uses could continue. Depending on route specifics, clearing of forest and shrubland, some of which may qualify as wetland, would also likely be required. However, hydrologic regimes of wetlands would not be appreciably affected and the conversion of transmission corridor areas currently in forest to open habitats could be advantageous to species with affinities for remnant prairie habitats.

The most significant potential impacts to aquatic communities relate to the operation of the cooling water system; however, regulatory controls would be expected to ensure appropriate protection of aquatic communities from thermal discharges and the location and operation of cooling water intakes. In addition, because the new coal-fired plant is assumed to use closed-cycle cooling, the cooling water intake and discharge flows would be much lower than that of Monticello, the impact from which is considered to be SMALL.

Given this information, the staff concludes that development of the representative coal-fired plant at a greenfield site would have a SMALL to MODERATE impact on ecological communities.

- **Water Use and Quality—Surface Water**

Impacts on water quality of greatest potential concern from construction of a new coal-fired plant at a greenfield site include (1) erosion and sedimentation associated with land clearing operations, and (2) suspension of bottom sediments during construction of cooling water intake and discharge structures (NRC 1996). These adverse effects would be localized and temporary.

Potential impacts on water quality and use associated with operation of the representative coal-fired plant would be site-dependent. The impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Cooling water, wastewater, and storm water discharges would be regulated under the Clean Water Act and corresponding state programs by a National Pollutant Discharge Elimination System (NPDES) permit. Cooling water intake and discharge flows for the representative coal-fired plant, assumed to use a closed-cycle cooling system, would be substantially lower than those for Monticello, which primarily operates in a once-through mode that results in SMALL impacts. The staff concludes that the impacts of surface water use and quality from operation of a representative coal-fired plant located at a greenfield site would be SMALL to MODERATE, depending on the site chosen.

- **Water Use and Quality—Groundwater**

Use of groundwater is possible for a coal-fired plant at an alternate site. Any groundwater withdrawal would require a permit from the local permitting authority. Overall, impacts to groundwater use and quality of a new coal-fired plant with a closed-cycle cooling system at an alternate site are considered SMALL to MODERATE, depending on the volume of groundwater withdrawn and the characteristics of the groundwater source.

- **Air Quality**

The air-quality impacts of coal-fired generation vary considerably from those of nuclear generation due to emissions of sulfur oxides (SO_x), nitrogen oxides (NO_x), particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

Monticello is located in an area designated by the National Ambient Air Quality Standards as being in attainment for all criteria pollutants. The nearest area of non-attainment is the Milwaukee metropolitan area. However, Monticello is in a non-attainment area with respect to the eight-hour ozone standard (NMC 2005).

A new coal-fired generating plant located in southern Minnesota would likely need a prevention of significant deterioration (PSD) permit and an operating permit under the Clean Air Act. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42a), SO_2 (40 CFR 60.43a), and NO_x (40 CFR 60.44a).

The U.S. Environmental Protection Agency (EPA) has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act (40 CFR 51.307).

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a new regional haze rule in 1999 (EPA 1999). The rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a coal-fired plant were located close to a mandatory Class I areas, additional air pollution control requirements could be imposed. The nearest Class I Federal area is in Northern Minnesota, several hundred miles from Monticello.

In March 2005, the EPA issued the Clean Air Interstate Rule (CAIR) (EPA 2005b). CAIR will permanently cap emissions of SO_2 and NO_x in the eastern United States. CAIR achieves large reductions of SO_2 and/or NO_x emissions across 28 eastern states and the District of Columbia. When fully implemented, CAIR will reduce SO_2 emissions in these states by over 70 percent, and NO_x emissions by over 60 percent from 2003 levels. This will result in $85 to $100 billion in health benefits and nearly $2 billion in visibility benefits per year by 2015, and will substantially reduce premature mortality in the eastern United States. The benefits will continue to grow each year with further implementation. By 2015, CAIR will help Minnesota sources reduce emissions of SO_2 by 40,000 tons, or 36 percent, and emissions of NO_x by 53,000 tons, or 59 percent (EPA 2005a).

Impacts from the various pollutants that would be expected to result from operation of a new coal-fired plant are described below.

Sulfur oxides emissions. A new coal-fired power plant would be subject to the requirements in Title IV of the Clean Air Act (42 USC 7651-7651o). Title IV was enacted to reduce emissions of SO_2 and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_2 emissions and imposes controls on SO_2 emissions through a system of marketable allowances. The EPA issues one allowance for each ton of SO_2 that a unit is allowed to emit. New units do not receive allowances, but are required to have allowances to cover their SO_2 emissions. Owners of new units must therefore acquire allowances from owners of other power plants by purchase or reduce SO_2 emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_2 emissions, although it might do so locally.

Regardless, SO_2 emissions would be greater for the coal alternative than the OL renewal alternative.

NSP estimates that by using the best technology to minimize SO_x emissions, the total annual stack emissions would be approximately 1755 tons of SO_x.

Nitrogen oxides emissions. Section 407 of the Clean Air Act (42 USC 7651f) establishes technology-based emission limitations for NO_x emissions. The market-based allowance system used for SO_2 emissions is not used for NO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants at 40 CFR 60.44a(d)(1). This regulation, issued on September 16, 1998 (EPA 1998), limits the discharge of any gases that contain nitrogen oxides (expressed as NO_2) in excess of 200 ng/J of gross energy output (1.6 lb/MWh), based on a 30-day rolling average.

NSP estimates that by using NO_x burners with overfire air and selective catalytic reduction (SCR), the total annual NO_x emissions for a new coal-fired power plant would be approximately 486 tons. Regardless of the control technology, this level of NO_x emissions would be greater than the OL renewal alternative, because a nuclear power plant releases almost no NO_x during normal operations.

Particulate emissions. NSP estimates that the total annual stack emissions for a new coal-fired plant would include 77 tons of filterable total suspended particulates and 18 tons of particulate matter having an aerodynamic diameter less than or equal to 10 μm (PM_{10}) (40 CFR 60.6). Fabric filters or electrostatic precipitators would be used for control. In addition, coal-handling equipment would introduce fugitive particulate emissions. Particulate emissions would be greater under the coal alternative than the OL renewal alternative because a nuclear plant releases few particles during normal operations.

During the construction of a coal-fired plant, fugitive dust would be generated. In addition, exhaust emissions would come from vehicles and motorized equipment used during the construction process.

Carbon monoxide emissions. NSP estimates that the total carbon monoxide emissions from a new coal-fired plant would be approximately 675 tons per year. This level of emissions is greater than the OL renewal alternative.

Hazardous air pollutants including mercury. In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). The EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of hazardous air pollutants. Coal-fired power plants were found by the EPA to emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000b). The EPA concluded that mercury is the hazardous air pollutant of greatest concern. The EPA found that (1) there is a link between coal consumption and mercury emissions; (2) electric utility steam-generating units are the largest domestic source of mercury emissions; and (3) certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures resulting from consumption of contaminated fish (EPA 2000b). Accordingly, the EPA added coal- and oil-fired electric utility steam-generating units to the list of source categories under Section 112(c) of the Clean Air Act for which emission standards for hazardous air pollutants will be issued (EPA 2000b).

Uranium and thorium. Coal contains uranium and thorium. Uranium concentrations are generally in the range of 1 to 10 parts per million. Thorium concentrations are generally about 2.5 times greater than uranium concentrations (Gabbard 1993). One estimate is that a typical coal-fired plant released roughly 5.2 tons of uranium and 12.8 tons of thorium in 1982 (Gabbard 1993). The population dose equivalent from the uranium and thorium releases and daughter products produced by the decay of these isotopes has been calculated to be significantly higher than that from nuclear power plants (Gabbard 1993).

Carbon dioxide. A coal-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming. The level of emissions from a coal-fired plant would be greater than the OL renewal alternative.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated carbon dioxide emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). Adverse human health effects such as cancer and emphysema have been associated with the products of coal combustion. The appropriate characterization of air impacts from coal-fired generation would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

- **Waste**

Coal combustion generates waste in the form of ash, and equipment for controlling air pollution generates additional ash and scrubber sludge. The representative coal-fired plant would generate approximately 107,000 tons of ash and 51,000 tons of flue gas desulfurization waste annually for 40 years. Approximately 30 percent of the ash would be beneficially used and the remainder of the waste would be disposed of in a landfill on site, accounting for approximately 120 ac of land area over the 40-year plant life. Waste impacts to groundwater and surface water could extend beyond the operating life of the plant if leachate and runoff from the landfill occurs. Disposal of the waste could noticeably affect land use and groundwater quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for noninvasive uses.

Debris would be generated during construction activities.

In May 2000, the EPA issued a "Notice of Regulatory Determination on Wastes From the Combustion of Fossil Fuels" (EPA 2000a). The EPA concluded that some form of national regulation is warranted to address coal combustion waste products because: (a) the composition of these wastes could present danger to human health and the environment under certain conditions; (b) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments; (c) present disposal practices are such that, in 1995, these wastes were being managed in 40 percent to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of groundwater monitoring; and (d) the EPA identified gaps in state oversight of coal combustion wastes. Accordingly, the EPA announced its intention to issue regulations for disposal of coal combustion waste in landfills or surface impoundments under subtitle D of the Resource Conservation and Recovery Act (RCRA).

For all of the preceding reasons, the appropriate characterization of impacts from waste generated from burning coal is MODERATE; the impacts would be clearly noticeable, but would not destabilize any important resource.

- **Human Health**

Coal-fired power generation introduces worker risks from coal and limestone mining, from coal and lime/limestone transportation, and from disposal of coal combustion waste. In addition there are public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

In the GEIS, the staff stated that the operating impacts of new coal-fired plants would result in substantial human health impacts (cancer and emphysema) from inhalation of toxins and particulates, but it did not quantify these impacts (NRC 1996). In addition, the discharges of uranium and thorium from coal-fired plants can potentially produce radiological doses in excess of those arising from nuclear power plant operations (Gabbard 1993).

Regulatory agencies, including the EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health. As discussed previously, the EPA has recently concluded that certain segments of the U.S. population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects due to mercury exposures from sources such as coal-fired power plants. However, in the absence of more quantitative data, human health impacts from radiological doses and inhaling toxins and particulates generated by burning coal are characterized as SMALL.

- **Socioeconomics**

Construction of the coal-fired alternative would take approximately 5 years. The staff assumed that construction would take place while Monticello continues operation and would be completed by the time Monticello permanently ceases operations. The work force would be expected to vary between 400 and 1000 workers during the 5-year construction period (NRC 1996). These workers would be in addition to the approximately 519 workers employed at Monticello. During construction, the surrounding communities would experience demands on housing and public services that could have SMALL impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Wright County or from other counties. After construction, the communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth currently being projected for Wright and Sherburne counties (USCB 2004).

Construction of a replacement coal-fired power plant at an alternate greenfield site would relocate some socioeconomic impacts, but would not eliminate them. The communities around Monticello would still experience the impact of Monticello operational job loss, although this impact would be potentially tempered by projected economic growth, and the communities around the new site would have to absorb the impacts of a temporary work force (up to 1000 workers at the peak of construction) and a permanent work force of approximately 80 workers. Communities in Wright County in particular would experience losses in both employment and tax revenues due to the Monticello site closure, assuming the plant is constructed outside the area. This impact could be MODERATE to LARGE. In the GEIS, the staff noted that socioeconomic impacts at a rural site would be larger than at an urban site, because more of the peak construction work force would need to move to the area to work. Alternate greenfield sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be LARGE.

The appropriate characterization of socioeconomic impacts from coal-fired generation would be SMALL to LARGE.

- **Socioeconomics (Transportation)**

Transportation-related impacts associated with the commuting of construction workers at an alternate greenfield site are site-dependent, but could be SMALL to MODERATE.

Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE.

Coal and limestone would likely be delivered to an alternate site by rail or barge. Socioeconomic impacts associated with rail transportation would likely be SMALL to MODERATE. For example, there would be delays to highway traffic as trains pass and there could be negative impacts on the value of property close to the train tracks. The socioeconomic impacts of barge delivery of coal and limestone would likely be SMALL.

- **Aesthetics**

Potential aesthetic impacts of construction and operation of a coal-fired plant include visual impairment resulting from the presence of an industrial facility, particularly a 500-ft high exhaust stack and condensate plume from the cooling tower. However, the topography throughout most of southern Minnesota is rolling, and forested tracts are common in some areas. Both of these factors act to reduce the viewshed and limit potential for impairment of visual aesthetics from onsite and offsite infrastructure.

Coal-fired generation using cooling towers would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime delivery, use of outside loudspeakers, and the commuting of plant employees.

Noise impacts associated with rail delivery of coal and lime to a plant would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the many residents likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line is considered MODERATE.

The staff assumes that adequate buffer and vegetation screens would be provided at the plant site as needed to reduce visual and noise impacts. Overall the aesthetic impacts associated with locating at an alternate site can be categorized as SMALL to MODERATE.

- **Historic and Archaeological Resources**

At an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and documentation of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Prior to construction at an alternate greenfield site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

Closure of the Monticello site would result in a decrease in employment of approximately 519 operating employees, possibly offset by projected growth in Wright and Sherburne counties. Following construction of a new coal-fired plant, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, impacts would be SMALL to MODERATE, and would depend on the extent to which projected economic growth is realized and the ability of minority or low-income populations to commute to other jobs outside the Wright County area. Impacts at other sites would depend upon the site chosen and the nearby population distribution, but are likely to also be SMALL to MODERATE.

8.2.2 Natural Gas-Fired Generation

The staff believes that the Monticello site would not be a viable location for a representative natural gas-fired plant. Optimal arrangement of the natural gas-fired plant would likely require locating it within 0.5 mi of Monticello spent fuel storage, which would require specific NRC approval. Assuming this constraint were overcome, approximately 35 mi of 16-in. natural gas pipeline occupying a 30-ft wide corridor would be required to supply the plant. The Viking Gas Transmission interstate pipeline, which traverses Benton and Mille Lacs counties north of Monticello, is the closest pipeline with the potential for sufficient capacity. This additional infrastructure needed to support a natural gas-fired plant represents an economic and environmental constraint.

The environmental impacts of the natural gas-fired alternative are examined in this section for an alternate greenfield site. The staff assumed that the plant would use a closed-cycle cooling system. Construction at an alternate site would necessitate approximately 5 mi of new natural gas supply pipeline to supply the natural gas-fired plant. In addition, an estimated 5 mi of new 345-kV transmission lines would be needed to connect to the grid (NMC 2005).

The staff assumed that a replacement natural gas-fired plant would use combined-cycle technology. In a combined-cycle unit, hot combustion gases in a CT rotate the turbine to generate electricity. Waste combustion heat from the CT is routed through a heat-recovery boiler to make steam to generate additional electricity.

The staff assumed the construction of the natural gas-fired units would be timed to coincide with the expiration of the Monticello operating license period. Consistent with the NMC ER

(NMC 2005), the representative plant would consist of two team 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 is approximately 550 MW(e). This assumption understates the environmental impacts of replacing the 600 MW(e) from Monticello. However, the staff has determined that the differences in impacts between 550 MW(e) and 600 MW(e) of natural gas-fired generation would be less than 10 percent and would not change the magnitude (SMALL, MODERATE, or LARGE) of any impacts.

The staff assumed that the plant would use closed-cycle cooling using a mechanical-draft cooling tower, which is assumed to be approximately 45 ft tall. Exhaust from the two HRSGs would be dispersed through individual 200-ft high stacks.

Unless otherwise indicated, the assumptions and numerical values used in Section 8.2.2 are from the NMC ER (NMC 2005). The staff reviewed this information and compared it to environmental impact information in the GEIS. Although the OL renewal period is only 20 years, the impact of operating the coal-fired alternative for 40 years is considered (as a reasonable projection of the operating life of a coal-fired plant).

The overall impacts of the natural gas-generating system are discussed in the following sections and summarized in Table 8-3. The extent of impacts at an alternate greenfield site will depend on the location of the particular site selected.

- **Land Use**

Although potential impacts on land use would be location-specific and therefore conjectural for a greenfield site, potentially affected areas are predominantly rural agricultural land interspersed in some areas with natural vegetation. Approximately 110 ac of rural agricultural land and/or natural plant communities abundant in the region would be converted to industrial use, of which 25 ac would be occupied by plant facilities. The staff assumes that non-conflicting land uses (i.e., agriculture) on the balance of the plant site would remain unaffected and would provide appropriate buffer with respect to any highly incompatible land use such as residential development. Development of offsite infrastructure (i.e., transmission line, gas pipeline), involving a corridor of approximately 110 ac, would similarly limit development of future land uses; however, compatible land uses, including most agricultural practices, could continue.

Regardless of where the gas-fired plant is built, additional land would be required for natural gas wells and collection stations. Partially offsetting these offsite land requirements would be the elimination of the need for uranium mining to supply fuel for Monticello. In the GEIS (NRC 1996), the staff estimated that approximately 1000 ac would be affected for mining the uranium and processing it during the operating life of a nuclear power plant. Overall, land-use impacts would be SMALL to MODERATE depending on site-specific factors.

Table 8-3. Summary of Environmental Impacts of Natural Gas-Fired Generation at an Alternate Greenfield Site Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	SMALL to MODERATE	Approximately 110 ac of rural agricultural land and/or natural plant communities converted to industrial use, of which 25 ac would be occupied by plant facilities. An additional 110 ac would be developed as a transmission and pipeline corridor.
Ecology	SMALL to MODERATE	Impact depends on whether the site has been previously developed. Factors to consider include location and ecology of the site, transmission line route and rail spur route. In total, impacts could include habitat degradation, fragmentation, or loss as a result of construction activities and conversion of land to industrial use. Ecological communities might experience reduced productivity and biological diversity from disturbing previously intact land.
Water Use and Quality—Surface Water	SMALL to MODERATE	Intake and discharge would involve relatively small quantities of water compared to the coal alternative. The impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water.
Water Use and Quality—Groundwater	SMALL to MODERATE	Impact depends on volume of water withdrawn and the characteristics of the groundwater source.
Air Quality	MODERATE	Sulfur oxides: 9 tons/yr Nitrogen oxides: 134 tons/yr Carbon monoxide: 203 tons/yr Particulates: 26 tons/yr of PM_{10} Other: (1) hazardous air pollutants, including arsenic, formaldehyde, and nickel and (2) CO_2 emissions, which contribute to global warming.
Waste	SMALL	Natural gas-fired alternative would generate only small quantities of municipal and industrial waste, including spent catalyst used for NO_x control.
Human Health	SMALL	Impacts are considered to be minor.
Socioeconomics	SMALL to MODERATE	During construction, impacts would be MODERATE. Up to 450 additional workers would be required during the peak of the 2-year construction period. Wright County would experience loss of tax base and employment, potentially offset by projected economic growth in Wright and Sherburne counties.
Socioeconomics (Transportation)	SMALL to MODERATE	Transportation impacts associated with construction workers would be SMALL to MODERATE depending on the site selected. Transportation impacts associated with operational workers would be SMALL.
Aesthetics	SMALL to MODERATE	The significance of impacts would depend on the characteristics of the alternate site.

Table 8-3. (contd)

Impact Category	Impact	Comment
Historic and Archaeological Resources	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts vary depending on population distribution and makeup at the alternate site.

- **Ecology**

Potential impacts on ecological resources from construction and operation of the representative natural gas-fired plant are highly site specific. Development of the representative natural gas-fired plant at a greenfield site in southern Minnesota would likely result in the loss of approximately 25 ac of terrestrial habitat for onsite plant facilities and modification of approximately 110 ac of existing offsite terrestrial habitat for a new natural gas supply pipeline and transmission line corridor. Development of the transmission line would limit changes in future land uses in the transmission corridor to those that are compatible with the line, but most agricultural practices and other currently compatible uses could continue. Depending on route specifics, clearing of forest and shrubland, some of which may qualify as wetlands, would also likely be required. However, hydrologic regimes of wetlands would not be appreciably affected and the conversion of transmission corridor areas currently in forest and woodland habitats could be advantageous to species with affinities for remnant prairie habitats.

The most significant potential impacts to aquatic communities relate to the operation of the cooling water system, but regulatory controls would be expected to ensure appropriate protection of aquatic communities from thermal discharges and the location and operation of cooling water intakes. In addition, because the plant is assumed to use closed-cycle cooling, the cooling water intake and discharge flows would be much lower than that of Monticello, the impact from which is considered to be SMALL.

Given this information, the staff concludes that development of the representative natural gas-fired plant at a greenfield site would have a SMALL to MODERATE impact on ecological communities.

- **Water Use and Quality—Surface Water**

Each of the natural gas-fired units would include a heat-recovery boiler, using a portion of the waste heat from the combustion turbines to make steam. The steam would then turn an electric generator. The net result would be an overall reduction in the amount of waste heat rejected from the plant, with an associated reduction in the amount of cooling water required by the plant. Thus, the cooling water requirements for the natural gas-fired combined-cycle units would be much less than for conventional steam-electric generators, including the existing nuclear unit. Plant discharge would consist mostly of cooling tower blowdown, with the

discharge having a higher temperature and increased concentration of dissolved solids relative to the receiving body of water and intermittent low concentrations of biocides. In addition to the cooling tower blowdown, process waste streams and sanitary wastewater might also be discharged. All discharges would be regulated through a NPDES permit. Finally, some erosion and sedimentation would probably occur during construction (NRC 1996). These adverse effects would be localized and temporary.

A natural gas-fired plant at an alternate greenfield site is assumed to use a closed-cycle cooling system with cooling towers. The staff assumed that surface water would be used for cooling makeup water and discharge. Intake and discharge would involve relatively small quantities of water compared to the coal alternative. The impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. The staff expects that these impacts would range from SMALL to MODERATE.

- **Water Use and Quality—Groundwater**

Use of groundwater is possible for a natural gas-fired plant at an alternate site. Any groundwater withdrawal would require a permit from the local permitting authority. Overall, impacts to groundwater use and quality of a new natural gas-fired plant with a closed-cycle cooling system at an alternate site are considered SMALL to MODERATE, depending on the volume of groundwater withdrawn and the characteristics of the groundwater source.

- **Air Quality**

Natural gas is a relatively clean-burning fuel. The gas-fired alternative would release similar types of emissions, but in lesser quantities than the coal-fired alternative.

A new gas-fired generating plant located in Minnesota would likely need a PSD permit and an operating permit under the Clean Air Act. A new combined-cycle natural gas power plant would also be subject to the new source performance standards for such units at 40 CFR Part 60, Subparts Da and GG. These regulations establish emission limits for particulates, opacity, SO_2, and NO_x.

In March 2005, the EPA issued CAIR, which will permanently cap emissions of SO_2 and NO_x in the eastern United States (70 CFR 25162). CAIR achieves large reductions of SO_2 and/or NO_x emissions across 28 eastern states and the District of Columbia. When fully implemented, CAIR will reduce SO_2 emissions in these states by over 70 percent and NO_x emissions by over 60 percent from 2003 levels. This will result in $85 to $100 billion in health benefits and nearly $2 billion in visibility benefits per year by 2015, and will substantially reduce premature mortality in the eastern United States. The benefits will continue to grow each year with further implementation. By 2015, CAIR will help Minnesota sources reduce emissions of SO_2 by 40,000 tons, or 36 percent, and emissions of NO_x by 53,000 tons, or 59 percent (EPA 2005a).

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the Clean Air Act (40 CFR 51.307). Wright County is an area designated by the National Ambient Air Quality Standards as being in attainment for all criteria pollutants. However, the area is in non-attainment with respect to the eight hour ozone standard.

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from man-made air pollution. The EPA issued a new regional haze rule in 1999 (EPA 1999). The rule specifies that for each mandatory Class I Federal area located within a state, the State must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period [40 CFR 51.308(d)(1)]. If a natural gas-fired plant were located close to a mandatory Class I area, additional air pollution control requirements could be imposed. The nearest Class I Federal area is in Northern Minnesota, several hundred miles from Monticello.

NMC projects the following emissions for the natural gas-fired alternative (NMC 2005):

Sulfur oxides—9 tons/yr

Nitrogen oxides—134 tons/yr

Carbon monoxide—203 tons/yr

PM_{10} particulates—26 tons/yr

A natural gas-fired plant would also have unregulated carbon dioxide emissions that could contribute to global warming.

In December 2000, the EPA issued regulatory findings on emissions of hazardous air pollutants from electric utility steam-generating units (EPA 2000b). Natural gas-fired power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000b). Unlike coal- and oil-fired plants, the EPA did not determine that emissions of hazardous air pollutants from natural gas-fired power plants should be regulated under Section 112 of the Clean Air Act.

Construction activities would result in temporary fugitive dust. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process.

Impacts from the above emissions would be clearly noticeable, but would not be sufficient to destabilize air resources as a whole. The overall air-quality impact for a new natural gas-fired plant at an alternate greenfield site is considered MODERATE.

- **Waste**

There would be spent SCR catalyst from NO_x emissions control and small amounts of solid-waste products (i.e., ash) from burning natural gas fuel. In the GEIS, the staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Gas firing results in very few combustion byproducts because of the clean nature of the fuel. Waste-generation impacts would be so minor that they would not noticeably alter any important resource attribute. Construction-related debris would be generated during construction activities.

Overall, the waste impacts would be SMALL for a natural gas-fired plant sited at an alternate greenfield site.

- **Human Health**

In Table 8-2 of the GEIS, the staff identifies cancer and emphysema as potential health risks from gas-fired plants (NRC 1996). The risk may be attributable to NO_x emissions that contribute to ozone formation, which in turn contribute to health risks. NO_x emissions from any gas-fired plant would be regulated. For a plant sited in Minnesota, NO_x emissions would be regulated by the Minnesota Pollution Control Agency (MPCA). Human health effects would not be detectable or would be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource. Overall, the impacts on human health of the natural gas-fired alternative sited at an alternate greenfield site are considered SMALL.

- **Socioeconomics**

Construction of a natural gas-fired plant would take approximately 2 years. Peak employment would be approximately 450 workers (NMC 2005). The staff assumed that construction would take place while Monticello continues operation and would be completed by the time it permanently ceases operations. During construction, the communities surrounding the Monticello site would experience demands on housing and public services that could have MODERATE impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Wright County or from other counties. After construction, the communities would be impacted by the loss of jobs. The current Monticello work force (519 workers) would decline through a decommissioning period to a minimal maintenance size. The gas-fired plant would introduce a replacement tax base at an alternate greenfield site and approximately 24 new permanent jobs. For siting at an alternate greenfield site, impacts in Wright County resulting from decommissioning of Monticello may be offset by economic growth projected to occur in Wright and Sherburne counties.

In the GEIS (NRC 1996), the staff concluded that socioeconomic impacts from constructing a natural gas-fired plant would not be very noticeable and that the small operational work force would have the lowest socioeconomic impacts of any nonrenewable technology. Also, the shorter construction time frame and the smaller size of the operations work force for a natural

gas-fired plant would result in smaller socioeconomic impacts than the coal-fired or nuclear alternatives.

For these reasons, gas-fired generation socioeconomic impacts associated with construction and operation of a natural gas-fired power plant would be SMALL to MODERATE for siting at an alternate greenfield site. Depending on other growth in the area, socioeconomic effects could be noticed, but they would not destabilize any important socioeconomic attribute.

- **Socioeconomics (Transportation)**

Transportation-related impacts associated with commuting construction workers at an alternate greenfield site are site-dependent, but could be SMALL to MODERATE. Transportation impacts related to commuting of plant operating personnel can be characterized as SMALL.

- **Aesthetics**

Potential aesthetic impacts of construction and operation of a natural gas-fired plant include visual impairment resulting from the presence of an industrial facility and associated transmission line corridors, particularly 200-ft high exhaust stacks and the condensate plume from the cooling tower. However, the topography throughout most of southern Minnesota is rolling, and forested tracts are common in some areas. Both of these factors act to reduce the viewshed and limit potential for impairment of visual aesthetics from onsite and offsite infrastructure.

Natural gas generation would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the use of outside loudspeakers and the commuting of plant employees.

The staff assumes that adequate buffer and vegetation screens would be provided at the plant site as needed to reduce visual and noise impacts. Overall the aesthetic impacts associated with locating at an alternate site can be categorized as SMALL to MODERATE, depending on the location.

- **Historic and Archaeological Resources**

At an alternate greenfield site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at an alternate greenfield site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission and pipeline corridors, or other rights-of-way). Impacts to cultural resources can be effectively managed under current laws and regulations and kept SMALL.

- **Environmental Justice**

Closure of Monticello would result in a decrease in employment of approximately 519 operating employees, possibly offset by growth in Wright and Sherburne counties. Following construction, it is possible that the ability of local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for minority or low-income populations. Overall, impacts would be SMALL to MODERATE, and would depend on the extent to which projected economic growth is realized and the ability of minority or low-income populations to commute to other jobs outside the Wright County area. Impacts at other sites would depend upon the site chosen and the nearby population distribution, but are likely to also be SMALL to MODERATE.

8.2.3 Coal Gasification

Coal gasification is a method of producing relatively clean, burnable gas from almost any type of coal or from petroleum coke. The basic process involves crushing the coal and partially oxidizing the carbon in the coal. Partial oxidation converts the coal into a gaseous fuel composed primarily of combustible hydrogen and carbon monoxide. The gas can be piped directly into a gas turbine to generate electricity. The exhaust from the gas turbine is ducted into a heat recovery steam generator to produce steam for a conventional steam turbine generator. To make the overall process both environmentally safe and thermally efficient, a coal gasification plant must integrate a number of different technologies. Major systems include fuel preparation, an air separation unit, a gasifier, acid gas removal, sulfur recovery, a combustion turbine generator, a heat recovery steam generator, and a steam turbine generator (TVA 2003).

Consideration of a coal gasification generating plant to replace Monticello was not included as an alternative in the NMC ER. Due to size constraints, the staff believes that the Monticello site would not be a viable location for a representative coal gasification plant. The environmental impacts of the coal gasification alternative are examined in this section for an alternate greenfield site. The staff assumed that the plant would use a closed-cycle cooling system. To replace the 600-MW(e) generating capacity of Monticello the coal gasification plant would have two 340-MW(e) modules, each consisting of one coal gasification plant, one combustion turbine, and one heat recovery steam generator. The steam recovered from each module would be collected and routed to a low-pressure steam turbine generator. An air separation plant would be constructed for each gasifier to supply the pressurized 95 percent (by volume) oxygen required for the oxygen-blown gasifiers (TVA 2003). This assumption overstates the environmental impacts of replacing the 600 MW(e) from Monticello since the coal gasification

plant would have slightly larger capacity in MW(e) than the existing Monticello plant. However, the staff has determined that the differences in impacts between 680 MW(e) and 600 MW(e) of coal gasification would not be significant and would not change the standard of significance (SMALL, MODERATE, or LARGE) of any impacts.

Delivery of coal and/or petroleum coke to an alternate greenfield site would be needed. Approximately 3698 tons would be shipped in daily, probably via barge (TVA 2003). Approximately 38 tons of limestone per day would likely be required for air pollution control. Trucking would be used for limestone delivery. Fuel oil would be required for startup activities, but would not be used as a backup fuel (TVA 2003).

The overall impacts of constructing a coal gasification plant using closed-cycle cooling at an alternate greenfield site are discussed in the following sections and summarized in Table 8-4. The impact categorizations in Table 8-4 are based on 680 MW(e) of coal gasification generating capacity.

- **Land Use**

NRC staff assumes siting of the coal gasification plant at an alternate greenfield site. Approximately 1700 ac would be impacted for the power block; fuel handling, storage and transportation facilities; infrastructure facilities; and waste disposal. There would be additional land impacts for coal and limestone mining, electric power transmission lines, and cooling water intake and discharge pipelines.

In the GEIS, the staff estimated that approximately 21,745 ac would be affected for mining the coal and disposing of the waste to support a 1000-MW(e) coal plant during its operational life (NRC 1996). A replacement coal gasification plant to replace the 600-MW(e) capacity of Monticello would affect proportionately less land.

Overall, land use impacts can be characterized as MODERATE to LARGE.

- **Ecology**

At an alternate site, the coal gasification alternative would introduce construction impacts and operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat

Table 8-4. Summary of Environmental Impacts of a Coal Gasification Generation Plant at an Alternate Greenfield Site Using Closed-Cycle Cooling

Impact Category	Impact	Comment
Land Use	MODERATE to LARGE	Several hundred acres would be impacted for the power block; fuel handling, storage and transportation facilities; infrastructure facilities; waste disposal; and an appropriate buffer for adjacent land uses. There would be additional land impacts for coal and limestone mining, electric power transmission lines, and cooling water intake and discharge pipelines.
Ecology	SMALL to LARGE	Impact depends on whether the site has been previously developed. Factors to consider include location and ecology of the site, transmission line route, and rail spur route. In total, impacts could include habitat degradation, fragmentation, or loss as a result of construction activities and conversion of land to industrial use. Ecological communities might experience reduced productivity and biological diversity from disturbing previously intact land.
Water Use and Quality—Surface Water	SMALL to MODERATE	Total impacts depend on the volume of water withdrawn, the constituents of the discharge water, the characteristics of the surface water body, and the new intake structures required.
Water Use and Quality—Groundwater	SMALL to MODERATE	Impact depends on volume of water withdrawn and the characteristics of the groundwater source.
Air Quality	MODERATE	Sulfur oxides: 1815 tons/yr. National and regional impacts would be minimal because of emissions offsets through the SO_2 trading program. Nitrogen oxides: 828 tons/yr. Particulates: 259 tons/yr of PM_{10}. Carbon monoxide: 960 tons/yr. Small amounts of mercury and other hazardous air pollutants would be discharged along with approximately 4.7 million tons/yr of unregulated carbon dioxide.
Waste	MODERATE	Waste streams from the 680-MW(e) plant would be approximately 126,000 tons/yr of slag, 10,000 tons/yr of fly ash, 50,000 tons/yr of sulfur, 320 tons/yr of raw water treatment sludge, 201 tons/yr of general waste water treatment sludge, and 10 tons/yr of sludges from the biotreatment of gasification process waste water.
Human Health	SMALL	Impacts are uncertain, but considered SMALL in the absence of more quantitative data.
Socioeconomics	SMALL to LARGE	Peak construction employment would be approximately 1000 workers. The operating workforce would be between 100 to 150 employees. Construction impacts depend on location, but could be LARGE if plant is located in an area that is more rural than the Monticello site. Wright County would experience loss of tax base and employment, potentially offset by projected economic growth.

Table 8-4. (contd)

Impact Category	Impact	Comment
Socioeconomics	SMALL to LARGE	Peak construction employment would be approximately 1000 workers. The operating workforce would be between 100 to 150 employees. Construction impacts depend on location, but could be LARGE if plant is located in an area that is more rural than the Monticello site. Wright County would experience loss of tax base and employment, potentially offset by projected economic growth.
Socioeconomics (Transportation)	SMALL to MODERATE	Transportation impacts associated with construction workers could be SMALL to MODERATE. For rail transportation of coal and lime, the impact is considered SMALL to MODERATE. For barge transportation, the impact is considered SMALL.
Aesthetics	SMALL to LARGE	Impacts could include visual impairment, infrastructure for delivery of coal and limestone, and noise. The severity of impacts range from SMALL to LARGE and are dependent on location.
Historic and Archaeological Resources	SMALL	A new plant at a greenfield location would necessitate cultural resource studies. Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL to MODERATE	Impacts will vary depending on population distribution and makeup at the site.

fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts. Construction and maintenance of a transmission line and a rail spur or barge facility, if needed, would also have ecological impacts.

Overall, with the large degree of uncertainty in the magnitude of impacts resulting from not analyzing a specific site or design, the ecological impacts from a new coal gasification generating plant at an alternate greenfield site could range from SMALL to LARGE.

- **Water Use and Quality—Surface Water**

At an alternate site, water use and quality impacts would depend on the volume of water withdrawn and discharged, the constituents in the discharge water, and the characteristics of the surface water body. For purposes of this analysis, the staff adjusted the water volume for a single-unit site. The highest sustained water needs during operation would be approximately 9175 gpm. Of the 9175 gpm almost half would be for cooling system makeup water (TVA 2003). Discharges would be regulated by the State or by the EPA. Construction-related impacts would be mitigable and temporary.

Overall, surface water use and quality impacts at an alternate greenfield site can be characterized as SMALL to MODERATE depending on the location chosen.

- **Water Use and Quality—Groundwater**

Any impacts to groundwater during operation would most likely be associated with storage and handling of feedstocks and the storage, handling, and disposal of wastes generated. Runoff from the coal and petroleum coke storage areas would be collected in a drainage basin and treated as needed (TVA 2003). Impacts would depend on the volume of groundwater withdrawn and the characteristics of the groundwater source.

Overall, groundwater use and quality impacts at an alternate greenfield site can be characterized as SMALL to MODERATE depending on the location chosen.

- **Air Quality**

The air quality impacts of coal-fired generation vary considerably from those of nuclear generation emissions of SO_2, NO_x, particulates, carbon monoxide, hazardous air pollutants such as mercury, and naturally occurring radioactive materials.

Estimated air emissions for a coal gasification plant meeting all applicable regulatory requirements and sized to fully replace the 600-MW(e) capacity of Monticello are shown in Table 8-4 (TVA 2003). The estimated emissions are based on using petroleum coke as fuel. Emissions of SO_x are higher for petroleum coke than if coal is used as the fuel.

A new coal gasification generating plant would need to meet the new source review requirements in Title I of the Clean Air Act (42 USC 7401-7515). The plant would need an operating permit issued under Title V of the Clean Air Act (42 USC 7661-7661f). The plant would also need to comply with the new source performance standards for new generating plants in 40 CFR Part 60, Subpart D. The standards establish limits for particulate matter and opacity, SO_2, and NO_x.

The EPA has various regulatory requirements for visibility protection in 40 CFR Part 51, Subpart P, including a specific requirement for review of any new major stationary source in an area designated as attainment or unclassified under the Clean Air Act (40 CFR 51.307).

Section 169A of the Clean Air Act establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment is from air pollution resulting from human activities. In addition, the EPA issued a new regional haze rule in 1999 (EPA 1999). The rule specifies that for each mandatory Class I Federal area located within a state, state agencies must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51). If a new coal gasification power plan were located close to a mandatory Class I Federal area, additional air pollution control requirements could be imposed.

In March 2005, the EPA issued CAIR, which will permanently cap emissions of SO_2 and NO_x in the eastern United States (EPA 2005b). CAIR achieves large reductions of SO_2 and/or NO_x emissions across 28 eastern states and the District of Columbia. When fully implemented, CAIR will reduce SO_2 emissions in these states by over 70 percent, and NO_x emissions by over 60 percent from 2003 levels. This will result in $85 to $100 billion in health benefits, and nearly $2 billion in visibility benefits per year by 2015, and will substantially reduce premature mortality in the eastern United States. The benefits will continue to grow each year with further implementation. By 2015, CAIR will help Minnesota sources reduce emissions of SO_2 by 40,000 tons, or 36 percent, and emissions of NO_x by 53,000 tons, or 59 percent (EPA 2005a). Any new fossil-fired power plant sited in Minnesota would be subject to the CAIR limitations.

A coal gasification plant would also have unregulated carbon dioxide emissions that could contribute to global warming. The staff estimates that coal gasification plants sufficient to replace the power generated at Monticello would emit approximately 4.7 million tons per year of carbon dioxide (TVA 2003).

Overall, the air quality impacts associated with new coal gasification plants to replace the power generated at Monticello would be MODERATE. The impacts would be clearly noticeable, but would not destabilize air quality.

- **Waste**

The major solid waste and by-product streams would be generated by the gasifiers. Slag, fly ash, and sulfur account for more than 99 percent of the solids produced by coal gasification plants, with the remaining 1 percent consisting of spent catalysts and water treatment sludges. The generation rates in tons per year for a 680-MW(e) plant are shown in Table 8-4 (TVA 2003). The slag produced is an inert, glass-like material that has been found in coal gasification demonstrations to be non-leachable (TVA 2003). Based on testing at gasification demonstration plants, the slag and fly ash from gasification of eastern bituminous coal is expected to be below the RCRA threshold limits for hazardous designation (TVA 2003). Most of the sulfur in the coal is converted to hydrogen sulfide in the synthetic gas. The hydrogen sulfide is removed by acid gas removal and then converted to elemental sulfur by-product in the sulfur recovery system.

There would be three process solid waste streams composed of sludges from raw water or waste water treatment: raw water treatment sludge, general waste water treatment sludge, and sludge from the biotreatment of gasification process waste water. Generation amounts are shown in Table 8-4. These sludges are typically not hazardous and would be disposed of at nearby State-approved municipal disposal sites (TVA 2003).

Construction-related debris would be generated during construction activities for the coal gasification units and disposed at a landfill.

For all the preceding reasons, the appropriate characterization of waste impacts from coal gasification is MODERATE; the impacts would be clearly noticeable but would not destabilize any important resource.

- **Human Health**

Power generation from coal introduces worker risks from coal and limestone mining, worker and public risks from coal and lime/limestone transportation, worker and public risks from disposal of coal combustion wastes, and public risks from inhalation of stack emissions. Emission impacts can be widespread and health risks difficult to quantify. The coal gasification alternative also introduces the risk of coal-pile fires and attendant inhalation risks.

The staff stated in the GEIS that there could be human health impacts (cancer and emphysema) from inhalation of toxins and particulates from a coal-fired plant, but did not identify the significance of these impacts (NRC 1996).

Regulatory agencies, including the EPA and State agencies, set air emission standards and requirements based on human health impacts. These agencies also impose site-specific emission limits as needed to protect human health.

Overall, human health impacts from inhaling toxins and particulates generated by burning coal at a newly constructed coal gasification plant are characterized as SMALL.

- **Socioeconomics**

Peak employment during construction would be approximately 1000 workers (Bily 2005). During construction of the coal gasification plant, the surrounding communities would experience demands on housing and public services that could have SMALL impacts. These impacts would be tempered by construction workers commuting to the site from other parts of Wright County or from other counties. After construction, the communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth currently being projected for Wright and Sherburne counties (USCB 2004). The permanent operating staff would be between 100 to 150 workers (Bily 2005).

Construction of a replacement coal gasification plant at an alternate greenfield site would relocate some socioeconomic impacts, but would not eliminate them. The communities around Monticello would still experience the impact of the loss of permanent employees, contractors, and temporary workers associated with Monticello operations. This would be partially offset by projected economic growth; the communities around the new site would have to absorb the impacts of a temporary work force and a permanent work force of approximately 100 to 150 workers (Bily 2005). Communities in Wright County in particular would experience losses in both employment and tax revenues due to the Monticello site closure, assuming the plant is constructed outside the area. This impact could be MODERATE to LARGE. In the GEIS, the staff stated that socioeconomic impacts at a rural site would be larger than at an urban site,

because more of the peak construction work force would need to move to the area to work. Alternate greenfield sites would need to be analyzed on a case-by-case basis. Socioeconomic impacts at a rural site could be LARGE.

Overall, socioeconomic impacts of a new coal gasification plant would be SMALL to LARGE depending on the site.

- **Socioeconomics (Transportation)**

Transportation-related impacts associated with commuting construction workers at an alternate greenfield site are site-dependent, but could be SMALL to MODERATE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE.

Coal and limestone would likely be delivered to an alternate site by rail or barge. Socioeconomic impacts associated with rail transportation would likely be SMALL to MODERATE. For example, there would be delays to highway traffic as trains pass and there could be negative impacts on the value of property close to the train tracks. The socioeconomic impacts of barge delivery of coal and limestone would likely be SMALL.

- **Aesthetics**

Potential aesthetic impacts of construction and operation of a coal gasification plant include visual impairment resulting from the presence of an industrial facility, particularly exhaust stacks and flaring stacks to burn waste gas. Flaring operations would generally be visible within a 3-mi radius, particularly at night. Vapor fog from the cooling towers and stack emissions could be visible up to 10 mi or more. However, the topography throughout most of southern Minnesota is rolling, with forested tracts common in some areas. Both of these factors act to reduce the viewshed and limit potential for impairment of visual aesthetics from onsite and offsite infrastructure. If needed, new electric power transmission lines and/or a rail spur could have significant aesthetic impacts.

Overall, the aesthetic impacts at an alternate site would be SMALL to LARGE depending on the location chosen.

A coal gasification plant would introduce mechanical sources of noise that would be audible offsite. Sources contributing to total noise produced by plant operation are classified as continuous or intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the equipment related to coal handling, solid-waste disposal, transportation related to coal and lime delivery, use of outside loudspeakers, and the commuting of plant employees.

Noise impacts associated with rail delivery of coal and lime to a plant would be most significant for residents living in the vicinity of the facility and along the rail route. Although noise from

passing trains significantly raises noise levels near the rail corridor, the short duration of the noise reduces the impact. Nevertheless, given the frequency of train transport and the many residents likely to be within hearing distance of the rail route, the impacts of noise on residents in the vicinity of the facility and the rail line is considered MODERATE. Overall, the noise impacts at an alternate site would be MODERATE to LARGE depending on the location chosen.

- **Historic and Archaeological Resources**

At an alternate site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at an alternate greenfield site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and as such are considered SMALL.

- **Environmental Justice**

Environmental justice impacts would depend upon the population distribution around the chosen location. Construction activities would offer new employment possibilities, but could have negative impacts on the availability and cost of housing, which could disproportionately affect minority and low-income populations. Overall, environmental justice impacts are likely to be SMALL to MODERATE.

8.2.4 Nuclear Power Generation

Since 1997, the NRC has certified three new standard designs for nuclear power plants under 10 CFR Part 52, Subpart B. These designs are the 1300-MW(e) U.S. Advanced Boiling Water Reactor (10 CFR Part 52, Appendix A), the 1300-MW(e) System 80+ Design (10 CFR Part 52, Appendix B), and the 600-MW(e) AP600 Design (10 CFR Part 52, Appendix C). All of these plant designs are light-water reactors. Although no applications for a construction permit or a combined license based on these certified designs have been submitted to NRC, the submission of the design certification applications indicates continuing interest in the possibility of licensing new nuclear power plants. In addition, recent escalation in prices of natural gas and electricity have made new nuclear power plant construction more attractive from a cost standpoint. Consequently, construction of a new nuclear power plant at either the Monticello site or an alternate greenfield is considered in this section. The staff assumed that the new

nuclear plant would have a 40-year period of plant operation. Consideration of a new nuclear generating plant to replace Monticello was not included in the NMC ER.

NRC has summarized environmental data associated with the uranium fuel cycle in Table S-3 of 10 CFR 51.51. The impacts shown in Table S-3 are representative of the impacts that would be associated with a replacement nuclear power plant built to one of the certified designs, sited at Monticello or an alternate greenfield site. The impacts shown in Table S-3 are for a 1000-MW(e) reactor and would need to be adjusted to reflect impacts of 600 MW(e) of new nuclear power. The environmental impacts associated with transporting fuel and waste to and from a light-water cooled nuclear power reactor are summarized in Table S-4 of 10 CFR 51.52. The summary of NRC's findings on NEPA issues for license renewal of nuclear power plants in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B, is also relevant, although not directly applicable, for consideration of environmental impacts associated with the operation of a replacement nuclear power plant. Additional environmental impact information for a replacement nuclear power plant using closed-cycle cooling is presented in Section 8.2.4.1 and using open-cycle cooling in Section 8.2.4.2.

8.2.4.1 Closed-Cycle Cooling System

The overall impacts of the nuclear generating system are discussed in the following sections. The impacts are summarized in Table 8-5. The extent of impacts at an alternate greenfield site will depend on the location of the particular site selected.

- **Land Use**

The existing facilities and infrastructure at the Monticello site would be used to the extent practicable, limiting the amount of new construction that would be required. Specifically, the staff assumed that a replacement nuclear power plant would use the existing circulating water system, switchyard, offices, and transmission line rights-of-way. Much of the land that would be used has been previously disturbed.

A replacement nuclear power plant at the Monticello site would alter approximately 500 to 1000 ac of land to industrial use. There would be no net change in land needed for uranium mining because land needed for the new nuclear plant would offset land needed to supply uranium for fuel for Monticello.

The impact of a replacement nuclear generating plant on land use at the existing Monticello site is best characterized as MODERATE. The impact would be greater than the OL renewal alternative.

Land-use impacts at an alternate greenfield site would be similar to siting at Monticello except for the land needed for a transmission line to connect to existing lines to transmit power to NSP's customers in the Southern Minnesota area. Assuming a 60-mi transmission line, an additional 2500 ac would be needed. In addition, it may be necessary to construct a rail spur to

an alternate site to bring in equipment during construction. Depending particularly on transmission line routing, siting a new nuclear plant at an alternate greenfield site would result in MODERATE to LARGE land-use impacts.

- **Ecology**

Locating a replacement nuclear power plant at the Monticello site would alter ecological resources because of the need to convert roughly 500 to 1000 ac of land to industrial use. Some of this land, however, would have been previously disturbed.

Table 8-5. Summary of Environmental Impacts of New Nuclear Power Generation at the Monticello Site and an Alternate Site Using Closed-Cycle Cooling

Impact	Monticello Site		Alternate Greenfield Site	
Category	Impact	Comment	Impact	Comment
Land Use	MODERATE	Requires approximately 500 to 1000 ac for the plant and 1000 ac for uranium mining.	MODERATE to LARGE	Same as Monticello site plus land for transmission line (2500 ac assuming a 60-mi line).
Ecology	MODERATE	Uses undeveloped areas at current Monticello site.	MODERATE to LARGE	Impact depends on location and ecology of the site, surface water body used for intake and discharge, and transmission line route; potential habitat loss and fragmentation; reduced productivity and biological diversity.
Water Use and Quality—Surface Water	SMALL	Uses existing cooling canal system.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the surface water body.
Water Use and Quality—Groundwater	SMALL	Uses existing cooling canal system.	SMALL to MODERATE	Impact will depend on the volume of water withdrawn and discharged and the characteristics of the groundwater source.
Air Quality	SMALL	Fugitive emissions and emissions from vehicles and equipment during construction. Small amount of emissions from diesel generators and possibly other sources during operation.	SMALL	Same impacts as Monticello site.

Table 8-5. *(contd)*

Impact Category	Monticello Site		Alternate Greenfield Site	
	Impact	Category	Impact	Category
Waste	SMALL	Waste impacts for an operating nuclear power plant are set out in 10 CFR 51, Appendix B, Table B-1. Debris would be generated and removed during construction.	SMALL	Same impacts as Monticello site.
Human Health	SMALL	Human health impacts for an operating nuclear power plant are set out in 10 CFR 51, Appendix B, Table B-1.	SMALL	Same impacts as Monticello site.
Socio-economics	SMALL to MODERATE	During construction, impacts would be MODERATE. Up to 2500 workers during peak period of the 6-year construction period. Operating work force assumed to be similar to current Monticello plant; tax base preserved. Impacts during operation would be SMALL.	SMALL to LARGE	Construction impacts depend on location. Impacts at a rural location could be LARGE. Wright County would experience loss of tax base and employment, possibly offset by economic growth.
Socio-economics (Transportation)	SMALL to LARGE	Transportation impacts associated with construction workers could be MODERATE to LARGE. Transportation impacts of commuting plant personnel would be SMALL.	SMALL to LARGE	Transportation impacts of construction workers could be MODERATE to LARGE. Transportation impacts of commuting plant personnel could be SMALL to MODERATE.
Aesthetics	SMALL	No exhaust stacks or cooling towers would be needed. Daytime visual impact could be mitigated by landscaping and appropriate color selection for buildings. Visual impact at night could be mitigated by reduced use of lighting and appropriate shielding. Noise impacts would be relatively small and could be mitigated.	SMALL to LARGE	Greatest impact is from the new transmission line that would be needed.

Table 8-5. (contd)

Impact	Monticello Site		Alternate Greenfield Site	
Category	Impact	Category	Impact	Category
Historic and Archaeological Resources Historic and	SMALL	Any potential impacts can likely be effectively managed.	SMALL	Any potential impacts can likely be effectively managed.
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction.	SMALL to MODERATE	Impacts will vary depending on population distribution and makeup at the site. Impacts to minority and low-income residents of Wright County associated with closure of Monticello could be significant, but could also be mitigated by projected economic growth for the area.

Siting a replacement nuclear plant at Monticello would have a MODERATE ecological impact that would be greater than renewal of the Monticello OL.

At an alternate site, there would be construction impacts and new incremental operational impacts. Even assuming siting at a previously disturbed area, the impacts would alter the ecology. Impacts could include wildlife habitat loss, reduced productivity, habitat fragmentation, and a local reduction in biological diversity. Use of cooling makeup water from a nearby surface water body could have adverse aquatic resource impacts. Construction and maintenance of the transmission line, if needed, would also have ecological impacts. Overall, the ecological impacts of a replacement nuclear plant at an alternate site could range from MODERATE to LARGE.

- **Water Use and Quality—Surface Water**

The replacement nuclear plant alternative at the Monticello site is assumed to use the existing circulating water system, which would minimize incremental water-use and quality impacts. Surface-water impacts are expected to remain SMALL; the impacts would be sufficiently minor that they would not noticeably alter any important attribute of the resource.

Cooling towers would likely be used at an alternate site. For an alternate site, the impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. Intake from and discharge to any surface body of water would be regulated the Minnesota Department of Natural Resources (MNDNR). The impacts would be SMALL to MODERATE.

- **Water Use and Quality—Groundwater**

The staff assumed that a new nuclear power plant located at Monticello would obtain potable, process, and fire-protection water from onsite wells similar to the current practice for Monticello (see Section 2.2.2). NMC operates five groundwater wells to meet the domestic water needs of the Monticello site. It is unlikely that groundwater use for an alternative nuclear power plant at Monticello would be significantly different than existing use at Monticello. Any groundwater withdrawal would require a permit from the local permitting authority.

Overall, the impacts of the nuclear alternative at the Monticello site would be SMALL. The impacts of the nuclear alternative at an alternate site would be SMALL to MODERATE.

- **Air Quality**

Construction of a new nuclear plant at Monticello or an alternate site would result in fugitive emissions during the construction process. Exhaust emissions would also come from vehicles and motorized equipment used during the construction process. These emissions are not regulated. An operating nuclear plant would have minor air emissions associated with diesel generators and other minor intermittent sources. These minor operating emissions for a plant sited in Minnesota would be regulated by the MPCA. Overall, emissions and associated impacts at either the Monticello site or an alternate site are considered SMALL.

- **Waste**

The waste impacts associated with operation of a nuclear power plant are set out in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B. Construction-related debris would be generated during construction activities and removed to an appropriate disposal site. Overall, waste impacts of a new nuclear plant at either the Monticello site or an alternate site are considered SMALL.

- **Human Health**

Human health impacts for an operating nuclear power plant are set out in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Overall, human health impacts of a new nuclear plant at either the Monticello site or an alternate site are considered SMALL.

- **Socioeconomics**

The construction period and the peak work force associated with construction of a new nuclear power plant are currently unquantified (NRC 1996). In the absence of quantitative data, staff assumed a construction period of 6 years and a peak work force of 2500. The staff assumed that construction would take place while the existing nuclear unit continues operation and would be completed by the time Monticello permanently ceases operations. During construction, the communities surrounding the Monticello site would experience demands on housing and public

services that could have MODERATE impacts. These impacts could be tempered by construction workers commuting to the site from other parts of Wright County or from other counties. After construction, the communities would be impacted by the loss of the construction jobs, although this loss would be possibly offset by other growth currently being projected for Wright and Sherburne counties.

The replacement nuclear unit is assumed to have an operating work force comparable to the 519 workers currently working at Monticello. The replacement nuclear unit would provide a new tax base to offset the loss of tax base associated with decommissioning of Monticello.

For all of these reasons, the appropriate characterization of non-transportation socioeconomic impacts for replacement nuclear units constructed at Monticello would be SMALL to MODERATE; the socioeconomic impacts would be noticeable, but would be unlikely to destabilize the area.

Construction of a replacement nuclear power plant at an alternate greenfield site would relocate some socioeconomic impacts, but would not eliminate them. The communities around the Monticello site would still experience the impact of Monticello operational job loss (although potentially tempered by projected economic growth). The communities around the new site would have to absorb the impacts of a large, temporary work force (up to 2500 workers at the peak of construction) and a permanent work force of approximately 519 workers. In the GEIS (NRC 1996), the staff indicated that socioeconomic impacts at a rural site would be larger than at an urban site because more of the peak construction work force would need to move to the area to work. The Monticello site is within commuting distance of the Minneapolis/St. Paul metropolitan area and is therefore not considered a rural site. Impacts at an alternate greenfield site would need to be analyzed on a case-by-case basis and could range from SMALL to LARGE.

- **Socioeconomics (Transportation)**

During the 6-year construction period, up to 2500 construction workers would be working at the Monticello site in addition to the 519 workers at Monticello. The addition of the construction workers could place significant traffic loads on existing highways, particularly those leading to the Monticello site. Such impacts would be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would be similar to current impacts associated with operation of Monticello and are considered SMALL.

Transportation-related impacts associated with commuting construction workers at an alternate greenfield site are site-dependent, but could be MODERATE to LARGE. Transportation impacts related to commuting of plant operating personnel would also be site-dependent, but can be characterized as SMALL to MODERATE.

- **Aesthetics**

The containment buildings for a replacement nuclear power plant sited at Monticello and other associated buildings would likely be visible in daylight hours over many miles. The replacement nuclear plant would also likely be visible at night because of outside lighting. Visual impacts could be mitigated by landscaping and selecting a color for buildings that is consistent with the environment. Visual impact at night could be mitigated by reduced use of lighting and appropriate use of shielding. No exhaust stacks would be needed.

Noise impacts from a new nuclear plant would be similar to those from the existing Monticello site. Mitigation measures, such as reduced or no use of outside loudspeakers, can be employed to reduce noise levels and maintain the impact of noise SMALL.

At an alternate greenfield site, there would be an aesthetic impact from the buildings, cooling towers, and the plume associated with the cooling towers. There would also be a significant aesthetic impact associated with construction of a new 60-mi transmission line to connect to other lines to enable delivery of electricity to the southern Minnesota area. Noise impacts from a new nuclear plant would be similar to those from the existing Monticello site. Mitigation measures, such as reduced or no use of outside loudspeakers, can be employed to reduce noise levels and maintain the impact of noise SMALL. Aesthetic impacts at a greenfield site would be mitigated if the plant is located in an industrial area adjacent to other power plants. Overall the aesthetic impacts associated with locating at an alternative site can be categorized as SMALL to LARGE. The greatest contributor to this categorization is the aesthetic impact of the new transmission line, if needed.

- **Historic and Archaeological Resources**

At both Monticello and an alternate greenfield site, a cultural resource inventory would likely be needed for any onsite property that has not been previously surveyed. Other lands, if any, that are acquired to support the plant would also likely need an inventory of field cultural resources, identification and recording of existing historic and archaeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site.

Before construction at Monticello or another site, studies would likely be needed to identify, evaluate, and address mitigation of the potential impacts of new plant construction on cultural resources. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other rights-of-way). Historic and archaeological resource impacts can generally be effectively managed and would be SMALL at either Monticello or a greenfield site.

- **Environmental Justice**

No environmental pathways or locations have been identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if a replacement nuclear plant were built at the Monticello site. Some impacts on housing availability and prices during construction might occur, and this could disproportionately affect the minority and low-income populations. After completion of construction, it is possible that the ability of the local government to maintain social services could be reduced at the same time as diminished economic conditions reduce employment prospects for the minority and low-income populations. Overall, impacts are expected to be SMALL. Projected economic growth in Wright and Sherburne counties and the ability of minority and low-income populations to commute to other jobs outside the Wright County area could mitigate any adverse effects.

Impacts at other sites would depend upon the site chosen and the nearby population distribution, but are likely to be SMALL to MODERATE. Impacts to minority and low income residents of Wright County associated with closure of Monticello could be significant, but could also be mitigated by projected economic growth for the area.

8.2.4.2 Once-Through Cooling System

This section discusses the environmental impacts of constructing a nuclear power plant at the Monticello site using once-through cooling. The impacts (SMALL, MODERATE, or LARGE) of this option are the same as the impacts for a nuclear power plant using a closed-cycle system. However, there are minor environmental differences between the closed-cycle and once-through cooling systems. Table 8-6 summarizes the incremental differences.

Table 8-6. Summary of a Comparison of Environmental Impacts of a New Nuclear Power Plant Sited at the Monticello Site with Once-Through Cooling

Impact Category	Change in Impacts from Closed-Cycle Cooling
Land Use	Impacts may be less (e.g., through elimination of cooling towers) or greater (e.g., if a reservoir is required).
Ecology	Impacts would depend on ecology at the site. Possible impacts associated with entrainment of fish and shellfish in early life stages, impingement of fish and shellfish, and heat shock.
Water Use and Quality—Surface Water	Increased water withdrawal leading to possible water-use conflicts, thermal load higher than with closed-cycle cooling.
Water Use and Quality—Groundwater	No change.
Air Quality	No change.

Table 8-6. (contd)

Impact Category	Change in Impacts from Closed-Cycle Cooling
Waste	No change.
Human Heath	No change.
Socioeconomics	No change.
Socioeconomics (Transportation)	No change.
Aesthetics	Elimination of cooling towers.
Historic and Archaeological Resources	No change.
Environmental Justice	No change.

8.2.5 Purchased Electrical Power

If available, purchased power from other sources could potentially obviate the need to renew the Monticello OL. Purchased power accounted for approximately 14 percent of NSP power sales in 2004 (NSP 2004).

In Canada, 62 percent of the country's electrical generation capacity is derived from renewable energy sources, principally hydropower (DOE/EIA 2001). Canada has plans to continue developing hydroelectric power, but the plans generally do not include large-scale projects (DOE/EIA 2001). Canada's nuclear generation is projected to increase by 1.7 percent by 2020, but its share of power generation in Canada is projected to decrease from 14 percent currently to 13 percent by 2020 (DOE/EIA 2001). Consequently, it is unlikely that electricity imported from Canada would be able to replace the Monticello generating capacity.

The staff assumes that 100 mi of new 345-kV transmission lines on a 150-ft wide corridor in southern Minnesota, potentially affecting approximately 1800 ac, would be required to import purchased power. Considering the nature of transmission line development and potential mitigation measures available, impacts of greatest concern are those related to change in land use, terrestrial ecological communities, and aesthetics. Land use and terrestrial ecological habitats in the region where it is assumed the line would be built consists predominantly of rural agricultural land interspersed in some areas with natural vegetation. Development of the transmission line would limit changes in future land uses on the corridor to those that are compatible with the line, but most agricultural practices and other currently compatible uses could continue.

Establishment of a corridor for the transmission line would have little effect on either the amount or value of habitat represented by agricultural land, the predominant habitat expected on lands traversed by these facilities, because compatible agricultural practices could continue. Similarly, open wetlands would be spanned and therefore little effected. Some visual

impairment of rural landscape could result from development of the transmission line. However, the topography throughout most of southern Minnesota is rolling, and forested tracts occur in some parts of the area. Both of these attributes would act to reduce the viewshed and limit potential for impairment of visual aesthetics. In addition, the presence of transmission lines is not out of character for the existing rural southern Minnesota landscape. The staff expects that routing of the line could be accomplished such that highly incompatible land uses, important habitats and associated important species, and areas of potentially high impact on visual aesthetics would be recognized and avoided or appropriately mitigated such that important attributes of these resources would not be destabilized.

If power to replace Monticello capacity were to be purchased from sources within the United States or a foreign country, the generating technology would likely be one of those described in this SEIS and in the GEIS (probably coal, natural gas, coal gasification, or nuclear). The description of the environmental impacts of other technologies in Chapter 8 of the GEIS is representative of the purchased electrical power alternative to renewal of the Monticello OL. Thus, the environmental impacts of imported power would still occur but would be located elsewhere within the region, nation, or another country.

8.2.6 Other Alternatives

Other generation technologies considered by the staff in its analyses are discussed in the following subsections.

8.2.6.1 Oil-Fired Generation

EIA projects that oil-fired plants will account for very little of the new generation capacity in the United States during the 2000 to 2020 time period because of higher fuel costs and lower efficiencies (DOE/EIA 2000).

NSP has several oil-fired units; however, they produce less than one percent of NSP's power generation (NSP 2004). Oil-fired operation is more expensive than nuclear or coal-fired operation. In addition, future increases in oil prices are expected to make oil-fired generation increasingly more expensive than coal-fired generation. The high cost of oil has prompted a steady decline in its use for electricity generation. In 2001, only 0.82 billion kWh of electricity was generated from petroleum in the Mid-Continent Area Power Pool (MAPP), 0.5 percent of the total generation in the region. The percentage of total generation from oil in MAPP is projected to decrease to 0.1 percent by 2010 (DOE/EIA 2004).

Also, construction and operation of an oil-fired plant would have environmental impacts. For example, in Section 8.3.11 of the GEIS, the staff estimated that construction of a 1000-MW(e) oil-fired plant would require about 120 ac. Additionally, operation of oil-fired plants would have environmental impacts (including impacts on the aquatic environment and air) that would be similar to those from a coal-fired plant.

For these reasons, the staff does not consider oil-fired generation, by itself, a feasible alternative to replace the baseload generating capacity at Monticello.

8.2.6.2 Wind Power

Wind power, by itself, is not suitable for large baseload capacity. As discussed in Section 8.3.1 of the GEIS, wind has a high degree of intermittency, and average annual capacity factors for wind plants are relatively low (on the order of 30 percent). Wind power, in conjunction with energy storage mechanisms, might serve as a means of providing baseload power. However, current energy storage technologies are too expensive for wind power to serve as a large baseload generator.

Wind turbines are economical in wind power Classes 4 through 7 (average wind speeds of 12.5 to 21.1 mph) (DOE 2001). In Minnesota, Class 4 wind potential exists in exposed uplands in the southern part of the state and in the Red River Valley between North Dakota and northern Minnesota. These resources, particularly in the Buffalo Ridge area in the southwestern part of the state, could support development approaching 3000 MW(e) by 2010, but significant transmission constraints exist (MDC 2004). EIA projects that wind-power generating capacity in MAPP totaled 1120 MW(e) in 2004 and will increase by 590 MW(e) by 2010 (DOE/EIA 2004). From a practical perspective, the scale of this technology is too small to directly replace a power generating plant equivalent to the output capacity of Monticello.

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of wind power facilities. As stated in the GEIS, land requirements are high—150,000 ac of land to generate 1000 MW(e) of power. Approximately 90,000 ac would be required for 600 MW(e) of wind power generating capacity to replace the Monticello plant. The installation of large-scale wind farms requires construction of access roads for turbine installation and maintenance and installation of transmission lines.

The impacts associated with large-scale construction, particularly in remote or sensitive areas, could be LARGE. After the turbines and transmission lines are installed, the continuing impacts from operation would include the aesthetic impact of the turbines and transmission lines, and impacts to terrestrial biota, primarily birds, as a result of physical impacts with the turbine blades.

For these reasons, the staff concludes that wind power alone is not a feasible substitute at this time for the base load generation from Monticello. However, the staff recognizes that wind power projects are being developed in areas with significant wind potential. Therefore, it is reasonable to include wind power in a combination of alternatives that could replace the generation from Monticello. Combined alternatives are discussed in Section 8.2.7.

8.2.6.3 Solar Power

Solar technologies use the sun's energy and light to provide heat and cooling, light, hot water, and electricity for homes, businesses, and industry. The two leading solar technologies are photovoltaic and solar thermal. Photovoltaic devices use semiconducting materials that absorb sunlight and convert it directly into electricity. Solar thermal devices use direct heat from the sun, concentrating it in some manner (such as by reflection) to heat a transfer fluid to useful temperatures. In the GEIS, the staff noted that by its nature, solar power is intermittent. Therefore, solar power by itself is not suitable for baseload capacity and is not a feasible alternative to license renewal at Monticello. The average capacity factor of photovoltaic cells is about 25 percent, and the capacity factor for solar thermal systems is about 25 percent to 40 percent. Solar power, in conjunction with energy storage mechanisms, might serve as a means of providing baseload power. However, current energy storage technologies are too expensive to permit solar power to serve as a large baseload generator. In addition, solar technologies require high operation and maintenance cost, due to the need to clean reflectors or collectors to ensure efficient operation.

Therefore, solar power technologies (photovoltaic and thermal) cannot currently compete with conventional fossil-fueled technologies in grid-connected applications, due to high costs per kilowatt of capacity (NRC 1996).

There are substantial impacts to natural resources (wildlife habitat, land-use, and aesthetic impacts) from construction of solar-generating facilities. As stated in the GEIS, land requirements are high—approximately 14,000 ac per 1000 MW(e) for solar thermal and 35,000 ac per 1000 MW(e) for photovoltaic systems. Approximately 8000 and 21,000 ac would be required for 600 MW(e) of solar thermal or solar photovoltaic generating capability, respectively, to replace the Monticello site. Neither type of solar electric system could be accommodated at the Monticello site, and both would have large environmental impacts at a greenfield site.

The Monticello site receives approximately 3.3 to 4.4 kWh of solar radiation per square meter per day, compared to 6 to 8 kWh of solar radiation per square meter per day in areas of the western United States, such as California, which are most promising for solar technologies (NMC 2005). Some solar power may substitute for electric power in rooftop and building applications. Implementation of non-rooftop solar generation on a scale large enough to replace Monticello would likely result in LARGE environmental impacts.

Because of the natural resource impacts (land and ecological), the area's relatively low rate of solar radiation, and high cost, solar power is not deemed a feasible baseload alternative to renewal of the Monticello OL. However, the staff recognizes that distributed solar power can provide generation and that during the license renewal period generation from solar power could continue to grow.

8.2.6.4 Hydropower

Minnesota has an estimated 137 MW(e) of undeveloped hydroelectric resources (NMC 2005). This amount is far less than needed to replace the 600 MW(e) capacity of Monticello. In Section 8.3.4 of the GEIS, the staff points out hydropower's percentage of U.S. generating capacity is expected to decline because hydroelectric facilities have become difficult to site as a result of public concern about flooding, destruction of natural habitat, and alteration of natural river courses.

The staff estimated in the GEIS that land requirements for hydroelectric power are approximately 1 million ac per 1000 MW(e). Replacement of Monticello's generating capacity would require flooding approximately 600,000 ac. Due to the large land-use and related environmental and ecological resource impacts associated with siting hydroelectric facilities large enough to replace Monticello, the staff concludes that local hydropower is not a feasible alternative to Monticello OL renewal on its own. Any attempts to site hydroelectric facilities large enough to replace Monticello would result in LARGE environmental impacts.

8.2.6.5 Geothermal Energy

Geothermal energy has an average capacity factor of 90 percent and can be used for baseload power where available. However, geothermal technology is not widely used as baseload generation due to the limited geographical availability of the resource and immature status of the technology (NRC 1996). As illustrated by Figure 8.4 in the GEIS, geothermal plants are most likely to be sited in the western continental United States, Alaska, and Hawaii where hydrothermal reservoirs are prevalent. There is no feasible location in the MAPP for geothermal capacity to serve as an alternative to Monticello. The staff concludes that geothermal energy is not a feasible alternative for replacement of the baseload generating capacity by renewal of the Monticello OL.

8.2.6.6 Wood Waste

The use of wood waste to generate electricity is largely limited to those states with significant wood resources, such as California, Maine, Georgia, Minnesota, Oregon, Washington, and Michigan. Electric power is generated in these states by the pulp, paper, and paperboard industries, which consume wood and wood waste for energy, benefitting from the use of waste materials that could otherwise represent a disposal problem.

A wood-burning facility can provide baseload power and operate with an average annual capacity factor of around 70 to 80 percent and with 20 to 25 percent efficiency (NRC 1996). The fuels required are variable and site-specific. A significant barrier to the use of wood waste to generate electricity is the high delivered-fuel cost and high construction cost per MW of generating capacity. The larger wood-waste power plants are only 40 to 50 MW(e) in size. Estimates in the GEIS suggest that the overall level of construction impact per MW of installed capacity should be approximately the same as that for a coal-fired plant, although facilities

using wood waste for fuel would be built at smaller scales. Like coal-fired plants, wood-waste plants require large areas for fuel storage and processing and involve the same type of combustion equipment.

The biomass power generating capacity in MAPP was 160 MW(e) in 2004 and is not expected to increase through 2025 (DOE/EIA 2004). Due to uncertainties associated with obtaining sufficient wood and wood waste to fuel a baseload generating facility, ecological impacts of large-scale timber cutting (e.g., soil erosion and loss of wildlife habitat), and high inefficiency, the staff has determined that wood waste is not a feasible alternative to renewing the Monticello OL.

8.2.6.7 Municipal Solid Waste

Municipal waste combustors incinerate the waste and use the resultant heat to generate steam, hot water, or electricity. The combustion process can reduce the volume of waste by up to 90 percent and the weight of the waste by up to 75 percent (EPA 2001). Municipal waste combustors use three basic types of technologies: mass burn, modular, and refuse-derived fuel (DOE/EIA 2001). Mass burning technologies are most commonly used in the United States. This group of technologies process raw municipal solid waste "as is," with little or no sizing, shredding, or separation before combustion.

Growth in the municipal waste combustion industry slowed dramatically during the 1990s after rapid growth during the 1980s. The slower growth was due to three primary factors: (1) the Tax Reform Act of 1986, which made capital-intensive projects such as municipal waste combustion facilities more expensive relative to less capital-intensive waste disposal alternative such as landfills; (2) the 1994 Supreme Court decision *(C&A Carbone, Inc. v. Town of Clarkstown)*, which struck down local flow control ordinances that required waste to be delivered to specific municipal waste combustion facilities rather than landfills that may have had lower fees; and (3) increasingly stringent environmental regulations that increased the capital cost necessary to construct and maintain municipal waste combustion facilities (DOE/EIA 2001).

The decision to burn municipal waste to generate energy is usually driven by the need for an alternative to landfills rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; however, it is unlikely that many landfills will begin converting waste to energy because of unfavorable economics, particularly with electricity prices declining in real terms. In 2002, only 110 MW(e) of municipal solid waste generating capacity was available in MAPP, and only 10 MW(e) of additional capacity is anticipated to be developed in the region through 2025 (DOE/EIA 2004).

Municipal solid waste combustors generate an ash residue that is buried in landfills. The ash residue is composed of bottom ash and fly ash. Bottom ash refers to that portion of the unburned waste that falls to the bottom of the grate or furnace. Fly ash represents the small

particles that rise from the furnace during the combustion process. Fly ash is generally removed from flue-gases using fabric filters and/or scrubbers (DOE/EIA 2001).

Currently there are approximately 102 waste-to-energy plants operating in the United States. These plants generate approximately 2800 MW(e), or an average of approximately 28 MW(e) per plant (IWSA 2004), much smaller than needed to replace the Monticello site.

The initial capital costs for municipal solid-waste plants are greater than for comparable steam-turbine technology at wood-waste facilities. This is due to the need for specialized waste-separation and -handling equipment for municipal solid waste (NRC 1996). Furthermore, estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant should be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts (including impacts on the aquatic environment, air, and waste disposal). Some of these impacts would be moderate, but still larger than the environmental effects of license renewal of Monticello. Therefore, municipal solid waste would not be a feasible alternative to renewal of the Monticello OL, particularly at the scale required.

8.2.6.8 Other Biomass-Derived Fuels

In addition to wood and municipal solid-waste fuels, there are several other concepts for fueling electric generators, including burning crops, converting crops to a liquid fuel such as ethanol, and gasifying crops (including wood waste). In the GEIS, the staff points out that none of these technologies has progressed to the point of being competitive on a large scale or of being reliable enough to replace a baseload plant such as Monticello. For these reasons, such fuels do not offer a feasible alternative to renewal of the Monticello OL.

8.2.6.9 Fuel Cells

Fuel cells work without combustion and its environmental side effects. Power is produced electrochemically by passing a hydrogen-rich fuel over an anode and air over a cathode and separating the two by an electrolyte. The only by-products are heat, water, and carbon dioxide. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

Phosphoric acid fuel cells are generally considered first-generation technology. These fuel cells are commercially available at cost of approximately $4500 per kilowatt of installed capacity. By contrast, a diesel generator costs $800 to $1500 per kilowatt, and a natural gas turbine can be even less (DOE 2004). Higher-temperature second-generation fuel cells achieve higher fuel-to-electricity and thermal efficiencies. The higher temperatures contribute to improved efficiencies and give the second-generation fuel cells the capability to generate steam for cogeneration and combined-cycle operations. DOE has a performance target to reduce the cost of fuel cells to $400 per kilowatt by 2010 (DOE 2004).

Two second-generation fuel cell technologies using molten carbonate and solid oxide technology are currently being developed for commercial use. As market acceptance and manufacturing capacity increase, natural gas-fueled fuel cell plants are projected to become available (DOE 2004). At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. Fuel cells are, consequently, not a feasible alternative to renewal of the Monticello OL.

8.2.6.10 Delayed Retirement

Extending the lives of existing non-nuclear generating plants beyond the time they were originally scheduled for retirement represents another potential alternative to license renewal. However, delaying retirement in order to compensate for Monticello generally would be unreasonable without major construction to upgrade or replace plant components. NSP undertakes upgrades of its older baseload plants in cases where it is reasonable to do so. Such actions are currently accounted for in NSP's plans to meet anticipated demands irrespective of the loss of generating capacity if the Monticello OL is not renewed and, therefore, does not represent a realistic option.

For this reason, delayed retirement of other NSP generating units would not be a feasible alternative to renewal of the Monticello OL.

8.2.6.11 Utility-Sponsored Conservation

The utility-sponsored conservation alternative refers to a situation in which Monticello ceases to operate, no new generation is brought online to meet the lost generation, and the lost generation is instead replaced by more efficient use of electricity. More efficient use would arise from utility-sponsored conservation programs, potentially including energy audits, incentives to install energy-efficient equipment, and informational programs to inform electricity consumers of the benefits of, and possibilities for, electricity conservation.

Under provisions of Minnesota Statute 216B.241, Minnesota public utilities, rural electric cooperatives, and municipal utilities are required to invest 1.5 percent of in-state revenues in projects designed to reduce their customers' consumption of electricity and improve efficient use of energy resources. Utilities that operate nuclear generating facilities like Monticello are required to invest 2.0 percent of revenues in this manner. NSP has in place a wide variety of electrical energy conservation programs and activities including conservation programs, energy efficiency programs, and load management programs. Conservation programs such as NSP's Energy Solutions newsletter and internet-based information resources are designed to educate and inform customers about energy efficiency and NSP offerings. Energy efficiency programs like ConservationWise from Xcel Energy help customers increase energy efficiency by providing rebates, pricing, or other incentives to purchase energy-efficient systems or components; renovate facilities that meet specific energy efficiency standards; undertake energy conservation assessments; and obtain expert energy conservation design assistance. Load management programs such as OperationWise from Xcel Energy encourage customers

to switch load to customer-owned standby generators during periods of peak demand, and include features like Saver's Switch that encourages customers to allow a portion of their load to be interrupted during periods of peak demand.

In its order approving Xcel Energy's 2000 Integrated Resource Plan, the Minnesota Public Utilities Commission (MPUC) adopted the DSM goal referred to as the 175 percent incentive scenario for the 2000-2014 planning period. This scenario established aggressive targets of 3253 gigawatt-hours (GWh) of cumulative energy savings and 1174 MW of cumulative peak demand savings in NSP's service area over this period. NSP surpassed its annual goals in the early years of the program, but anticipates that it will become increasingly difficult to cost-effectively maintain annual targets (50 to 80 MW) in the future.

Additionally, even if these aggressive annual DSM savings targets are achieved, the cumulative savings through 2010 would be insufficient to replace generation lost as a result of Monticello operations termination at the end of its current operating license. Moreover, NSP credits these DSM goals in its demand forecasts; therefore, they cannot be used as credits to offset the power generated by Monticello.

Therefore, the staff does not consider energy efficiency, by itself, as a feasible alternative to license renewal. However, the staff recognizes that energy conservation is promoted and increases in energy efficiency occur as a normal result of replacing older equipment with modern equipment. It is reasonable to include conservation in a combination of generation sources that could replace Monticello. Combined alternatives are discussed in Section 8.2.7.

8.2.7 Combination of Alternatives

Even though individual alternatives to renewal of the Monticello OL might not be sufficient on their own to replace Monticello's generating capacity due to the small potential generating capacity of the resource or lack of cost-effective opportunities, it is conceivable that a combination of alternatives might be cost-effective.

There are many possible combinations of alternatives. As discussed previously, these combinations could include baseload gas-fired or coal-fired plants, purchased power, alternative and renewable technologies, and conservation. For the purpose of this discussion, one combination of alternatives has been assumed: 300 MW(e) of combined-cycle natural gas-fired generation using closed-cycle cooling, 150 MW(e) purchased from other generators, 50 MW(e) produced by new wind power facilities in southern Minnesota state, and 100 MW(e) of energy conservation. The impacts of other combinations, such as those from combinations that include solar power, would be different and possibly less than from the assumed combination. In some areas, such as the aesthetic impact of solar panels, the impacts would be at least as large as the impact of the assumed combination of alternatives. In other areas, such as waste, impacts would be smaller for these alternative technologies.

Table 8-7 contains a summary of the environmental impacts of the assumed combination of alternatives. The impacts are based on the gas-fired generation impact assumptions discussed

in Section 8.2.2, adjusted for the reduced generating capacity. While the DSM measures would have few environmental impacts, operation of the new gas-fired plant would result in increased emissions and environmental impacts. The environmental impacts associated with power purchased from other generators would still occur but would be located elsewhere within the region or nation, as discussed in Section 8.2.5. The impacts of purchased power are not shown in Table 8-7. The staff concludes that it is very unlikely that the environmental impacts of any reasonable combination of generating and conservation options could be reduced to the level of impacts associated with renewal of the Monticello OL.

Table 8-7. Summary of Environmental Impacts for an Assumed Combination of Generating (Combined-Cycle Natural Gas-Fired Generation, Wind Power, and DSM) and Acquisition Alternatives at Monticello and a Greenfield Site

Impact	Monticello Site		Alternate Greenfield Site	
Category	Impact	Comment	Impact	Comment
Land Use	SMALL to MODERATE	23 ac for gas-fired plant power block, offices, roads, and parking areas. Additional impact at wind power sites (at least 50 ac). Additional impact for construction of underground natural gas pipeline, electric power transmission line, and cooling-water intake/discharge piping.	SMALL to MODERATE	Same as Monticello site.
Ecology	SMALL to MODERATE	Uses undeveloped areas at current Monticello site, plus gas pipeline. Habitat loss due to development of wind power sites could have a MODERATE impact. Some increase in bird mortality at wind turbines.	SMALL to MODERATE	Impact depends on location and ecology of the sites, surface water body used for intake and discharge, and transmission and pipeline routes; potential habitat loss and fragmentation; reduced productivity and biological diversity. Some increase in bird mortality at wind turbines.
Water Use and Quality—Surface Water	SMALL	Uses existing circulating water system.	SMALL to MODERATE	Impact depends on volume of water withdrawn, the constituents in the discharge water, and the characteristics of surface water body.
Water Use and Quality—Groundwater	SMALL	Uses existing groundwater wells.	SMALL to MODERATE	Impact depends on volume of water withdrawn.

Table 8-7. (contd)

Impact	Monticello Site		Alternate Greenfield Site	
Category	Impact	Comment	Impact	Comment
Air Quality	MODERATE	Sulfur oxides: 4.5 tons/yr Nitrogen oxides: 67 tons/yr Carbon monoxide: 102 tons/yr PM_{10} particulates: 13 tons/yr Some hazardous air pollutants. Additional emissions from producers of purchased power.	MODERATE	Same as Monticello site.
Waste	SMALL	Minimal waste generated.	SMALL	Same as Monticello site.
Human Health	SMALL	Impacts considered to be minor.	SMALL	Same as Monticello site.
Socio-economics	SMALL to MODERATE	During construction, impacts would be SMALL to MODERATE. Up to 250 additional workers during the peak of the 2-year construction period, followed by reduction from current Monticello work force of 519 to 24. Impacts during operation would be SMALL.	SMALL to MODERATE	Construction impacts depend on location, but could be significant if location is in a more rural area than Monticello. Wright County would experience loss of tax base and employment with potentially SMALL to MODERATE impacts.
Socio-economics (Transportation)	MODERATE	Transportation impacts associated with construction workers would be MODERATE.	MODERATE	Same as Monticello site.
Aesthetics	SMALL	SMALL aesthetic impacts due to impacts of plant units and stacks for gas plant (similar to current Monticello plant). Additional impact from wind turbines.	MODERATE to LARGE	MODERATE to LARGE impact from wind turbine towers as well as the gas-fired plant, stacks, and cooling towers and associated plumes. Additional impact that could be LARGE if a lengthy new electrical power transmission line is needed.
Historic and Archaeological Resources	SMALL to MODERATE	Impacts can generally be managed or mitigated. Wind turbines often placed along ridgelines that may have higher likelihood of historic or archaeological significance.	SMALL to MODERATE	Same as Monticello site.

Table 8-7. (contd)

Impact Category	Monticello Site		Alternate Greenfield Site	
	Impact	Comment	Impact	Comment
Environmental Justice	SMALL	Impacts on minority and low-income communities should be similar to those experienced by the population as a whole. Some impacts on housing may occur during construction; loss of 519 operating jobs at Monticello likely SMALL due to the proximity of the plant to a diverse urban job market.	SMALL	Impacts vary depending on population distribution and makeup at site. Wright County would lose tax revenue and jobs; however, the impacts on minority and low-income populations would be SMALL.

8.3 Summary of Alternatives Considered

The environmental impacts of the proposed action, renewal of the Monticello OL, are SMALL for all impact categories, except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal. Collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal were not assigned a single significance level but were determined by the Commission to be Category 1 issues nonetheless. The alternative actions, i.e., no-action alternative (discussed in Section 8.1), new generation alternatives (from coal, natural gas, coal gasification, and nuclear power, discussed in Sections 8.2.1 through 8.2.4, respectively), purchased electrical power (discussed in Section 8.2.5), alternative technologies (discussed in Section 8.2.6), and a combination of alternatives (discussed in Section 8.2.7) were considered.

The no-action alternative would require the replacement of electrical generating capacity by (1) demand-side management and energy conservation, (2) power purchased from other electricity providers, (3) generating alternatives other than Monticello, or (4) some combination of these options. For each of the new generation alternatives (coal, natural gas, coal gasification, and nuclear power), the environmental impacts would not be less than the impacts of license renewal. For example, the land-disturbance impacts resulting from construction of any new facility would be greater than the impacts of continued operation of Monticello. The impacts of purchased electrical power (imported power) would still occur, but would occur elsewhere. Alternative technologies are not considered feasible at this time and it is very unlikely that the environmental impacts of any reasonable combination of generation and conservation options could be reduced to the level of impacts associated with renewal of the Monticello OL.

The staff concludes that the alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

8.4 References

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10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy*, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Functions."

10 CFR Part 52. Code of Federal Regulations, Title 10, *Energy*, Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

40 CFR Part 51. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans."

40 CFR Part 60. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 60, "Standards of Performance for New Stationary Sources."

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9.0 Summary and Conclusions

By letter dated March 16, 2005, Nuclear Management Company, LLC (NMC), submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license (OL) for Monticello Nuclear Generating Plant (Monticello) for an additional 20-year period (NMC 2005a). If the OL is renewed, State regulatory agencies and NMC will ultimately decide whether the plant will continue to operate based on factors such as the need for power or other matters within the State's jurisdiction or the purview of the owners. If the OL is not renewed, then the plant must be shut down at or before the expiration of the current OL, which expires on September 8, 2010.

Section 102 of the National Environmental Policy Act (NEPA) (42 USC 4332) requires an environmental impact statement (EIS) for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in Title 10 of the *Code of Federal Regulations* (CFR) Part 51. Part 51 identifies licensing and regulatory actions that require an EIS. In 10 CFR 51.20(b)(2), the Commission requires preparation of an EIS or a supplement to an EIS for renewal of a reactor OL; 10 CFR 51.95(c) states that the EIS prepared at the OL renewal stage will be a supplement to the Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS), NUREG-1437, Volumes 1 and 2 (NRC 1996; 1999).[a]

Upon acceptance of the NMC application, the NRC began the environmental review process described in 10 CFR Part 51 by publishing a notice of intent in the *Federal Register* to prepare an EIS and conduct scoping (NRC 2005a) on June 2, 2005. The staff visited the Monticello site in June 2005 and held public scoping meetings on June 30, 2005, in Monticello, Minnesota (NRC 2005b). The staff reviewed the NMC Environmental Report (ER) (NMC 2005b) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, the *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal* (NRC 2000). The staff also considered the public comments received during the scoping process for preparation of the draft Supplemental Environmental Impact Statement (SEIS) for Monticello. The public comments received during the scoping process that were considered to be within the scope of the environmental review are provided in Appendix A, Part 1, of this SEIS.

The staff held two public meetings in Monticello, Minnesota on March 22, 2006, to describe the results of the NRC environmental review and to answer questions in order to provide members of the public with information to assist them in formulating their comments on this SEIS. All the comments received on the draft SEIS were considered by the staff in developing this final SEIS. These comments are presented and addressed in Appendix A, Part 2, of this SEIS.

[a] The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

This SEIS includes the NRC staff's analysis that considered and weighed the environmental effects of the proposed action, the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse impacts. This SEIS also includes the staff's recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decisionmakers.

The evaluation criterion of the staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine:

> ... whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current OL.

NRC regulations [10 CFR 51.95(c)(2)] contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within the scope of the generic determination in § 51.23(a) and in accordance with §51.23(b).[a]

(a) The title of 10 CFR 51.23 is "Temporary Storage of Spent Fuel After Cessation of Reactor Operations—Generic Determination of No Significant Environmental Impact."

The GEIS contains the results of a systematic evaluation of the consequences of renewing an OL and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of 10 CFR Part 51, Subpart A, Appendix B:

SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.

LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 issues considered in the GEIS, the staff analysis in the GEIS shows the following:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste [HLW] and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the staff relied on conclusions as amplified by supporting information in the GEIS for issues designated Category 1 in Table B-1 of 10 CFR Part 51, Subpart A, Appendix B.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific supplement to the GEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized. Environmental justice was not evaluated on a generic basis and, therefore, must be addressed in a plant-specific supplement to the GEIS. Information on the chronic effects of electromagnetic fields was not conclusive at the time the GEIS was prepared.

This SEIS documents the staff's consideration of all 92 environmental issues identified in the GEIS. The staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the OL for Monticello) and alternative methods of power generation. These alternatives were evaluated assuming that the replacement power generation plant is located at either the Monticello site (nuclear generation) or some other unspecified greenfield location.

9.1 Environmental Impacts of the Proposed Action – License Renewal

NMC and the staff have established independent processes for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. Neither NMC nor the staff has identified information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. Similarly, neither the scoping process, NMC, nor the staff has identified any new issue applicable to Monticello that has a significant environmental impact. Therefore, the staff relies upon the conclusions of the GEIS for all Category 1 issues that are applicable to Monticello.

NMC's license renewal application presents an analysis of the Category 2 issues that are applicable to Monticello, as well as environmental justice and chronic effects from electromagnetic fields. The staff has reviewed the NMC analysis for each issue and has conducted an independent review of each issue. Three Category 2 issues are not applicable because they are related to plant design features or site characteristics not found at Monticello. Four Category 2 issues are not discussed in this SEIS because they are specifically related to refurbishment. NMC has stated that its evaluation of structures and components, as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications as necessary to support the continued operation of Monticello for the license renewal period. In addition, any replacement of components or additional inspection activities are within the bounds of normal plant component replacement and, therefore, are not expected to affect the environment outside of the bounds of the plant operations evaluated in the *Final Environmental Statement Related to Operation of Monticello Nuclear Generating Plant* (AEC 1972).

Fourteen Category 2 issues related to operational impacts and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields, are discussed in detail in this draft SEIS. Five of the Category 2 issues and environmental justice apply to both refurbishment and to operation during the renewal term and are only discussed in this draft SEIS in relation to operation during the renewal term. For all 14 Category 2 issues and environmental justice, the staff concludes that the potential environmental effects are of SMALL significance in the context of the standards set forth in the GEIS. In addition, the staff determined that appropriate Federal health agencies have

not reached a consensus on the existence of chronic adverse effects from electromagnetic fields. Therefore, no further evaluation of this issue is required.

For severe accident mitigation alternatives (SAMAs), the staff concludes that a reasonable, comprehensive effort was made to identify and evaluate SAMAs. Based on its review of the SAMAs for Monticello, and the plant improvements already made, the staff concludes that one of the candidate SAMAs is potentially cost-beneficial. However, this SAMA does not relate to adequately managing the effects of aging during the period of extended operation. Therefore, it does not need to be implemented as part of license renewal pursuant to 10 CFR Part 54.

Mitigation measures were considered for each Category 2 issue. Current measures to mitigate the environmental impacts of plant operation were found to be adequate, and no additional mitigation measures were deemed sufficiently beneficial to be warranted.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction have been avoided, have been mitigated, or have already occurred. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

The adverse impacts of continued operation identified are considered to be of SMALL significance, and none warrants implementation of additional mitigation measures. The adverse impacts of likely alternatives if Monticello ceases operation at or before the expiration of the current OL will not be smaller than those associated with continued operation of this unit, and they may be greater for some impact categories in some locations.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of Monticello during the current license period was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance and operation, the nuclear fuel used by the reactors, and ultimately, permanent offsite storage space for the spent fuel assemblies.

The most significant resource commitments related to operation during the renewal term are the fuel and the permanent storage space. Monticello replaces approximately thirty percent of the fuel assemblies in the unit during every refueling outage, which occurs on a nominal 24-month cycle.

The likely power generation alternatives if Monticello ceases operation on or before the expiration of the current OL will require a commitment of resources for construction of the replacement plants as well as for fuel to run the plants.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between short-term use and long-term productivity of the environment at the Monticello site was set when the plant was approved and construction began. That balance is now well established. Renewal of the OL for Monticello and continued operation of the plant will not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the OL will lead to shutdown of the plant and will alter the balance in a manner that depends on subsequent uses of the site. For example, the environmental consequences of turning the Monticello site into a park or an industrial facility are quite different.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the OL for Monticello. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. As noted in Chapter 3, no refurbishment and no refurbishment impacts are expected at Monticello. Chapters 4 through 7 discuss environmental issues associated with renewal of the OL. Environmental issues associated with the no-action alternative and alternatives involving power generation and use reduction are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the OL), the no-action alternative (denial of the application), alternatives involving nuclear, coal, coal gasification, or natural gas-generation of power, and a combination of alternatives are compared in Table 9-1. Continued use of an open-cycle cooling system for Monticello is assumed for Table 9-1.

Table 9-1 shows that the significance of the environmental effects of the proposed action are SMALL for all impact categories (except for collective offsite radiological impacts from the fuel cycle and from HLW and spent fuel disposal, for which a single significance level was not assigned [see Chapter 6]). The alternative actions, including the no-action alternative, may have environmental effects in at least some impact categories that reach MODERATE or LARGE significance.

Table 9-1. Summary of Environmental Significance of License Renewal, the No-Action Alternative, and Alternative Methods of Generation Using Once-Through Cooling

Proposed Action	No-Action Alternative		Coal-Fired Generation	Natural Gas-Fired Generation	Coal Gasification	New Nuclear Generation		Combination of Alternatives	
Impact Category	License Renewal	Denial of Renewal	Alternate Greenfield Site	Alternate Greenfield Site	Alternate Greenfield Site	Monticello Site	Alternate Greenfield Site	Monticello Site	Alternate Greenfield Site
Land Use	SMALL	SMALL	MODERATE	SMALL to MODERATE	MODERATE to LARGE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Ecology	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	MODERATE	MODERATE to LARGE	SMALL to MODERATE	SMALL to MODERATE
Water Use and Quality—Surface Water	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Use and Quality—Groundwater	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	MODERATE	MODERATE	MODERATE	SMALL	SMALL	MODERATE	MODERATE
Waste	SMALL	SMALL	MODERATE	SMALL	MODERATE	SMALL	SMALL	SMALL	SMALL
Human Health	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL to LARGE	SMALL to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Socioeconomics (Transportation)	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL to LARGE	MODERATE	MODERATE
Aesthetics	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to LARGE	SMALL	SMALL to LARGE	SMALL	MODERATE to LARGE
Historic and Archaeological Resources	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL	SMALL

9.3 Staff Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS (NRC 1996, 1999), (2) the ER submitted by NMC (NMC 2005b), (3) consultation with Federal, State, and local agencies, (4) the staff's own independent review, and (5) the staff's consideration of public comments, the recommendation of the staff is that the Commission determine that the adverse environmental impacts of license renewal for Monticello are not so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

9.4 References

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

Nuclear Management Company (NMC). 2005a. *Application for Renewed Operating License, Monticello Nuclear Generating Plant.* Monticello, Minnesota.

Nuclear Management Company (NMC). 2005b. *Applicant's Environmental Report—Operating License Renewal Stage, Monticello Nuclear Generating Plant.* Docket No. 50-263, License No. DPR-22. Monticello, Minnesota.

National Environmental Policy Act of 1969, Section 102 (NEPA). 42 USC 4332.

U.S. Atomic Energy Commission (AEC). 1972. *Final Environmental Statement Related to Operation of Monticello Nuclear Generating Plant.* Northern States Power Company. Docket No. 50-263, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1996. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants.* NUREG-1437, Volumes 1 and 2, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 1999. *Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report,* Section 6.3, –Transportation, Table 9.1, Summary of findings on NEPA issues for license renewal of nuclear power plants, Final Report. NUREG-1437, Volume 1, Addendum 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2000. *Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1:* "Operating License Renewal." NUREG-1555, Supplement 1, Washington, D.C.

U.S. Nuclear Regulatory Commission (NRC). 2005a. "Notice of Intent to Prepare an Environmental Impact Statement and Conduct Scoping Process." *Federal Register*, Vol. 70, No. 105, pp. 32381-32382. Washington, D.C. June 2, 2005.

U.S. Nuclear Regulatory Commission (NRC). 2005b. *Environmental Impact Statement Scoping Process: Summary Report, Monticello Nuclear Generating Plant, Monticello, Minnesota.* Washington, D.C. October 7, 2005.