U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

ENVIRONMENTAL ASSESSMENT RELATED TO CONSTRUCTION AND OPERATION OF THE PRAIRIE ISLAND INDEPENDENT SPENT FUEL STORAGE INSTALLATION

DOCKET NO. 72-10
NORTHERN STATES POWER COMPANY

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 DESCRIPTION OF THE PROPOSED ACTION 1
1.2 BACKGROUND INFORMATION 2
1.3 PREVIOUS ENVIRONMENTAL ASSESSMENTS AND SUPPORTING DOCUMENTS . . . 6

2.0 NEED FOR PROPOSED ACTION 6
3.0 ALTERNATIVES 7
4.0 EXISTING ENVIRONMENT 11

4.1 SITE LOCATION, LAND USE AND TERRESTRIAL ECOLOGY 12
4.2 WATER USE AND AQUATIC RESOURCES 14
4.3 SOCIOECONOMIC, HISTORICAL, ARCHEOLOGICAL AND CULTURAL RESOURCES . 15
4.4 DEMOGRAPHY 16
4.5 METEOROLOGY 16
4.6 GEOLOGY, SEISMOLOGY AND SOILS 16

5.0 DESCRIPTION OF THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT ISFSI . . . 17

5.1 GENERAL DESCRIPTION 17
5.2 ISFSI DESIGN 18
5.3 ISFSI OPERATIONS 22
5.4 MONITORING PROGRAM 27

6.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION 27

6.1 CONSTRUCTION IMPACTS 27

6.1.1 LAND USE AND TERRESTRIAL RESOURCES 28
6.1.2 WATER USE AND AQUATIC RESOURCES 29
6.1.3 OTHER IMPACTS OF CONSTRUCTION 29
6.1.4 SOCIOECONOMIC 30
6.1.5 RADIOLOGICAL IMPACTS FROM CONSTRUCTION 30

6.2 OPERATIONAL IMPACTS 31

6.2.1 RADIOLOGICAL IMPACTS FROM ROUTINE OPERATIONS 31

6.2.1.1 OFFSITE DOSE 31
6.2.1.2 COLLECTIVE OCCUPATIONAL DOSE 32

6.2.2 RADIOLOGICAL IMPACTS OF OFF-NORMAL EVENTS AND ACCIDENTS . . 40
6.2.3 NONRADIOLOGICAL IMPACTS 47

6.2.3.1 LAND USE AND TERRESTRIAL RESOURCES 47
6.2.3.2 WATER USE AND AQUATIC RESOURCES 47
6.2.3.3 OTHER EFFECTS OF OPERATION 47

7.0 SAFEGUARDS FOR SPENT FUEL 48
8.0 DECOMMISSIONING 49
9.0 SUMMARY AND CONCLUSIONS 50

9.1 SUMMARY OF ENVIRONMENTAL IMPACTS 50
9.2 BASIS FOR FINDING OF NO SIGNIFICANT IMPACT 51

10. REFERENCES 52

ENVIRONMENTAL ASSESSMENT

RELATED TO THE CONSTRUCTION AND OPERATION

OF THE PRAIRIE ISLAND

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

1.0 INTRODUCTION

1.1 DESCRIPTION OF THE PROPOSED ACTION

By letter dated August 31, 1990, Northern States Power Company (NSP) (the Applicant) submitted an application for a Nuclear Regulatory Commission license to construct and operate a dry cask independent spent fuel storage installation (ISFSI) to be located on the site of the Prairie Island Nuclear Generating Plant in Goodhue County, Minnesota. The ISFSI or some other spent fuel storage system is needed to provide interim onsite spent fuel storage. This Environmental Assessment (EA) addresses the expected environmental impacts associated with the proposed construction and operation of the ISFSI on the Prairie Island site.

NSP owns approximately 560 acres of land at the Prairie Island Nuclear Generating Plant. They operate two 1650 MWt nuclear generating units at the site. There are a few areas at the plant site controlled by the U.S. Army Corps of Engineers. The protected area of the ISFSI and the access road connecting the ISFSI and Auxiliary Building will be on land owned by NSP. The site is located within the city limits of the City of Red Wing, Minnesota, on the west bank of the Mississippi River. The controlled area for the ISFSI corresponds to the exclusion area of the nuclear station. The nearest site boundary (fence) is 360 feet west of the nearest edge of the ISFSI concrete storage pad. The nearest road (Wakonade Drive East) borders the site boundary to the west of the ISFSI. The edge of the road is 400 feet west of the nearest edge of the pad. Figure 1.1 shows the location of the proposed ISFSI relative to the other features on the site including the reactor buildings and security fence. Figure 1.2 provides additional detail on the ISFSI layout.

The proposed ISFSI is a system designed by Transnuclear Incorporated of Hawthorne, New York. It is called the TN-40 Dry Cask Storage System and is similar in design to the TN-24, which has already been approved by the NRC. Each cask will hold 40 Prairie Island spent fuel assemblies. The ISFSI will be designed to accommodate a total of 48 TN-40 storage casks stored on two concrete pads, each with two parallel rows of 12 casks. The ISFSI site will be surrounded by an earthen berm to a height of 17 feet above pad grade. The casks will be loaded with the spent fuel assemblies in the spent fuel pool enclosure of the Auxiliary Building at the plant, decontaminated, lifted by a crane and moved laterally through an access door. They will then be and picked up by the transport, vehicle which will be pulled by the tow vehicle to the concrete pads at the ISFSI site. The casks are self-contained, independent, passive systems, which do not rely on any other systems or components for their operation.

The TN-40 dry storage cask is designed to provide storage of spent fuel for at least 25 years. The ISFSI will provide adequate capacity to enable Units 1 and 2 at the Prairie Island Nuclear Generating Plant to continue operation until expiration of their licenses in 2013 and 2014, respectively. Licenses issued for ISFSIs under Part 72 Title 10 of the Code of Federal Regulations (10 CFR Part 72) are for 20 years, but the licensee may seek to renew the license, if necessary, prior to its expiration.

1.2 BACKGROUND INFORMATION

The Prairie Island Nuclear Generating Plant began commercial operation in December 1973. Prior to the mid 1970's, the nuclear industry planned to store, for an interim period, spent fuel from nuclear power reactors in a spent fuel pool at the reactor site, where it was generated. After an indefinite interim storage period, utilities anticipated that spent fuel would be transported to a reprocessing plant for recovery and recycling of fuel materials.

FIGURE WITHHELD UNDER 10 CFR 2.390

FIGURE WITHHELD UNDER 10 CFR 2.390

Reactor facilities, such as the Prairie Island units, were not designed to provide spent fuel storage capacity for life-of-plant operations.

Because commercial reprocessing did not develop as anticipated, the NRC, in 1975, directed the staff to prepare a generic environmental impact statement (EIS) on spent fuel storage. The Commission directed the staff to analyze alternatives for the handling and storage of spent fuel from light water power reactors with particular emphasis on developing long range policy. The staff also considered the consequences of restriction or termination of spent fuel generation through nuclear power plant shutdown. A "Final Generic Environmental Impact Statement (FGEIS) on Handling and Storage of Spent Light Water Power Reactor Fuel," NUREG-0575, was issued by NRC in August 1979 (Reference 1).

In the FGEIS, the storage of spent fuel is considered interim storage until the issue of permanent disposal is resolved and a plan implemented. Interim storage options evaluated in detail and included in the FGEIS are: (1) onsite expansion of spent fuel pool capacity; (2) expansion of spent fuel pool storage capacity at reprocessing plants; (3) use of ISFSIs; (4) transshipment of spent fuel between reactors; and (5) reactor shutdowns or derating to terminate or reduce the amount of spent fuel generated.

The FGEIS concluded that an ISFSI represents the major means of interim storage at a reactor site once the spent fuel pool capacity has been reached. While the environmental impacts of the dry storage option were not specifically addressed in the FGEIS, the use of alternative dry passive storage techniques for aged fuel appeared to be as feasible as wet storage and environmentally acceptable. In the case of both dry passive storage and wet storage, environmental impacts need to be considered on a site-specific basis.

The onsite expansion of spent fuel pools has been used by most utilities. NRC has reviewed and approved more than 120 onsite spent fuel pool capacity expansions through reracking modifications since issuance of the FGEIS. At Prairie Island, efforts to maintain sufficient spent fuel storage reserve capacity have included a decrease in the annual spent fuel discharge rate through various core design refinements and two separate spent fuel pool rerackings. Additional expansion of onsite storage capacity will be required by 1994 to ensure uninterrupted operation of the Prairie Island units.

As required by 10 CFR Part 72 and Part 51, this assessment addresses the site-specific environmental impacts of construction and operation of the dry storage ISFSI at the Prairie Island site.

1.3 PREVIOUS ENVIRONMENTAL ASSESSMENTS AND SUPPORTING DOCUMENTS

Several environmental documents have been prepared specific to the Prairie Island site. A Final Environmental Statement (FES) related to the Prairie Island Nuclear Generating Plant was prepared by the U.S. Atomic Energy Commission in May of 1973 (Reference 2). This EA relies on information supplied by NSP in its Environmental Report (ER) (Reference 3) related to the proposed ISFSI for Prairie Island submitted with the application in August 1990 and supplementary information submitted in response to NRC questions in References 4 and 16. In addition, the FGEIS (NUREG-0575) (Reference 1), the applicant's Updated Safety Analysis Report (USAR) (Reference 5) and Technical Specifications and Safety Analysis Report (Reference 6) provided additional information. The Minnesota State EIS (Reference 7) is also referenced.

2.0 NEED FOR PROPOSED ACTION

Discharged spent fuel assemblies from Prairie Island Nuclear Generating Plant, Units 1 and 2, are currently stored onsite in a spent fuel pool. The spent fuel pool provides for long-term storage of 1386 assemblies in high density storage racks (Reference 6). The spent fuel pool will lose capacity for discharge of a full core in 1993. Storage capacity will be exhausted completely in 1994. The capacity of the ISFSI will enable NSP to store an additional 1920 spent fuel assemblies in 48 casks, and will enable Units 1 and 2 to continue operation until expiration of their respective Operating Licenses in 2013 and 2014.

3.0 ALTERNATIVES

NSP evaluated a number of alternatives for the storage of spent nuclear fuel prior to the selection of the dry storage ISFSI. The alternatives did not sufficiently meet the requirements for storage of spent nuclear fuel generated at the Prairie Island Plant. A brief discussion of these alternatives follows.

Permanent Federal Repository

If a permanent Federal repository were available, the preferred alternative would be to ship spent fuel to the repository for disposal. The Department of Energy (DOE) is currently working to develop a repository as required under the Nuclear Waste Policy Act of 1982, amended in 1987 (NWPA). DOE is looking at a site at Yucca Mountain, Nevada, to determine if it is a suitable location for a high-level radioactive waste repository. It is not likely that DOE will have a licensed repository ready to receive spent fuel before 2010. Although DOE recommended that a Monitored Retrievable Storage (MRS) facility be constructed and in operation by 1998, the NWPA prohibits siting an MRS before obtaining a construction permit for the repository. Given the uncertainties of schedules for a repository and MRS, this alternative does not meet the immediate needs of NSP.

Alternative Dry Storage Systems

Several alternative dry storage systems other than the Transnuclear TN-40 Dry Cask Storage System exist. The NUTECH Horizontal Modular Storage (NUHOMS) is in place, or planned for installation, at other locations. A vault storage system has been in use in Great Britain, and a vault designed to store United States type spent fuel has received NRC approval. A concrete cask storage system, similar to NUHOMS except providing vertical storage, is being reviewed by the NRC. In addition, metal dry storage casks have been developed by other companies. While the design may differ, the impacts associated with these alternative dry storage systems are expected to be similar. NSP determined that these alternative dry storage systems did not meet its needs.

Modified Pool Storage

Modifications to the existing fuel pit could be made to combine it with spent fuel pool and thereby increase the total pool storage capacity. The modifications are of a sufficient magnitude that the pool would be out of commission until completion. This alternative for expansion would add storage for about 500 more spent fuel assemblies. At current generation rates, this greater storage capacity would be exhausted by about 2002. This does not provide a means to store spent fuel for the balance of the plant's licensed operational lifetime. Also, the spent fuel in the pool would need to be stored elsewhere while the modification took place. For these reasons, this alternative was not selected.

Existing Pool Capacity Increase

There are several alternatives in this category which involve modifying the existing spent fuel storage pool. Unlike the above alternative, these do not require expansion and the major reconstruction of the fuel pool. Reracking, or changing to racks designed with a more compact array of cells, was last done in 1981. Current generation rack designs are even more compact, and it might be possible to increase the pool capacity by about 15 percent by reracking again. Another possible way to increase the existing pool capacity is through spent fuel rod consolidation. In consolidation, the fuel rods from two spent fuel assemblies are removed, reconfigured and then placed in a canister, returning to the rack cell formerly occupied by a single spent fuel assembly. The use of two-tiered racks is a third method of increasing pool capacity. A second tier of filled storage racks is placed on top of the existing storage racks. None of these alternatives meets NSP's needs. Reracking will not provide a means to store spent fuel for the balance of the plant's licensed operational lifetime. Spent fuel rod consolidation would not meet life-of-plant needs and would interfere with normal plant operations. The use of two-tiered racks would require considerable support of the fuel pool walls, and there are technical and licensing uncertainties associated with it. Therefore, none of these alternatives alone is adequate to meet Prairie Island's storage needs.

Construction of a New Independent Storage Pool

Additional storage capacity could be achieved by building a new spent fuel storage pool similar to that existing at the plant site. The capacity of the pool is fixed at the time of construction. The NRC has generically assessed this alternative and found that the storage of LWR spent fuel in water pools has an insignificant impact on the environment (Reference 1). This alternative would require about 5 years to design, obtain state and federal reviews and approvals, and construct. It could result in the temporary shutdown of both reactors or a sustained period of operation at reduced power levels, and was, therefore, a less attractive alternative than the proposed action.

Shipment to Existing Storage Facilities

This alternative involves shipping Prairie Island spent fuel to Monticello or to Pathfinder, near Sioux Falls, South Dakota, or to a facility at a site owned by another utility. Monticello's fuel assemblies are smaller than Prairie Island's and the handling tool is different. The racks and handling equipment would have to be replaced and modified to store Prairie Island fuel. Additionally, the current pool capacity does not provide a means to store spent fuel for the balance of the plant's operational lifetime. Shipping to Pathfinder could not be accomplished without rebuilding the fuel storage system, which was removed during conversion from a nuclear power plant to a fossil fuel plant in 1967. A third possibility entails shipping to a spent fuel storage facility at another site. This alternative requires another utility to agree to this arrangement, and it is unlikely that this will happen.

The impacts of storage at other facilities would be similar to the impacts of storage at Prairie Island, but with the additional concern of transportation impacts. Accordingly, these alternatives were not selected.

Shipment to Reprocessing Facility

When Prairie Island was constructed, NSP intended to ship the spent fuel to a commercial reprocessing facility in the United States. The reprocessing industry did not develop as expected and applications for reprocessing were frozen in 1977 during President Carter's administration because of proliferation concerns. Reprocessing services are available in France and Great Britain. To avail itself of these services, NSP would have to contract with a company to receive and reprocess the spent fuel, manage the plutonium and uranium extracted, and solidify the waste for shipment back to the United States for permanent disposal. This alternative has not been selected by any utility to date because the procedural difficulties are thought to be insurmountable. It is not, therefore, considered a viable alternative.

Future Reduction in Rate of Spent Fuel Generation

Reducing the rate of spent fuel assemblies generated will defer the date at which space in the spent fuel pool runs out. The use of fuel with a higher burnup is one way to reduce the rate of generation. The combination of fuel and core design currently being used at Prairie Island is achieving the maximum burnup allowed today. This alternative does not, therefore, provide a solution to the storage problem. Reducing operations and the rate of spent fuel generation at the Prairie Island plant until DOE begins to accept spent fuel could only be considered a realistic alternative if the forecast time was more certain. While the reduction in rate of spent fuel generation would have less impact on the environment than other storage or shipment alternatives, it does not appear feasible to achieve at Prairie Island. Since large uncertainties remain concerning this whole issue, the potential for Prairie Island to run out of storage space under reduced operation is very real. It is, therefore, not considered a potential alternative.

No Action

This alternative would result in NSP filling the existing spent fuel storage capacity at the Prairie Island plant by January 1994, and thereby forcing shutdown of the plant. NSP estimates large baseload facilities cannot be brought into service until the late 1990's. Peaking plants could be built by 1994, but these cannot generate electricity for baseload use in a cost-effective manner. This alternative was not selected for this reason. The impacts of curtailing the generation of spent fuel by ceasing operation of existing power plants when their spent fuel pools become filled was evaluated by the NRC in the Final Generic Environmental Impact Statement and found to be undesirable.

4.0 EXISTING ENVIRONMENT

The general environment around the Prairie Island Nuclear Generating Plant is well characterized as a result of studies conducted in support of the construction of the plant, and from additional field investigations at the proposed ISFSI site made in June 1991. This section briefly reviews the environment surrounding the site, with emphasis on those features most likely to be affected by the construction and operation of the ISFSI. The assessment of construction and operational impacts is presented in Chapter 6.

4.1 SITE LOCATION, LAND USE AND TERRESTRIAL ECOLOGY

Site Location

The proposed ISFSI will be located within the existing plant site for Prairie Island. It is located in the city limits of the city of Red Wing, Minnesota, on the west bank of the Mississippi River. It will be located in Section 5, T113N, R15W in Goodhue County, at approximately 92 degrees 37.9 minutes west longitude and 44 degrees 37.3 minutes north latitude. The ground surface near the Prairie Island site is fairly level to slightly rolling, ranging in elevation from 675 to 706 feet above mean sea level (1929 adjustment). The surface slopes gradually toward the Mississippi River to the northeast and the Vermillion River on the southwest. Steep bluffs run parallel to this stretch of the Mississippi River and rise to an elevation of over 1000 feet above mean sea level approximately 1.5 miles northeast and southwest of the site.

Land Use

Goodhue County, in which the site is located, and the adjacent counties of Dakota and Pierce (in Wisconsin) are predominantly rural. Dairy products and livestock account for most of the farm products with field crops and vegetables accounting for most of the remainder. The region within a 5-mile radius of the site is almost exclusively agricultural. Principal crops include soybeans, corn, oats, hay and some cannery crops at about 4 miles from the plant site. The nearest dairy farm is located more than 3 miles southwest of the plant site. Some beef cattle are raised approximately 2 miles southwest. Cattle are on pasture from early June to late September or early October. During the winter, cows are fed on locally produced hay and silage. Beyond the site boundary, within a 1-mile radius of the plant, there are approximately 30 permanent residences and summer cottages. The closest occupied offsite residence is approximately 2400 feet northwest of the proposed ISFSI site. Located near the site, is the Mdewakanton Sioux reservation. All traffic to and from the plant passes through the reservation (References 3 and 7).

There are several industrial facilities located within 5 miles of the ISFSI site. No military installations are within 5 miles, and no large natural gas pipelines pass close to the site. The Red Wing airport is located about 7 miles east southeast. High speed railroad traffic occurs on the Soo Line Railroad, the Burlington Northern and the Chicago Northwestern Railroad, all within 5 miles of the site. Truck traffic occurs on Minnesota State Highway 61, which runs within 2.5 miles of the ISFSI site to the south. In addition, several county roads are located within 5 miles. Barge traffic on the Mississippi River occurs in the main channel within one half mile of the ISFSI site.

Terrestrial Ecology

Terrestrial Ecology studies have been conducted in a 1.5-mile radius around the Prairie Island Nuclear Generating Plant on the Minnesota side of the Mississippi River. These studies identified the quantity and quality of various habitats in the near vicinity. The four major types of habitat are oak openings, lowland forests, prairie or abandoned fields, and sand terrace. The ISFSI site area is approximately 70% wooded and 30% open. Of the wooded area, about 80% of the trees are Siberian elm (*Ulmus pumila*). The remaining woody species include American elm (*Ulmus americana*), white pine (*Pinus strobus)*, box elder (*Acer negundo*), Cottonwood (*Populus deltoides*), Aspen (*Populus tremuloides*), Red cedar (*Juniperus virginiana*), Red oak (*Quercus rubra*), White spruce (*Picea glauca*), and Butternut (*Juglans cinera*). In addition, there are some shrubs and woody vines, such as Staghorn sumac (*Rhus typhina*), raspberry (*Rubus indaeus)*, prickly ash (*Xanthoxylum americanum*), grape (*Vitis riparia*) and poison ivy (*Rhus radicans*). The three most common grasses found on the site are Little Bluestem (*Andropogon scoparius*), Big Bluestem (*Andropogon geraldi*) and Kentucky Bluegrass (*Poa pratensis*). Since this is an old farm site, many of the trees were planted. Steps were taken in 1974 to restore prairie vegetation in the vicinity of the plant, through controlled burning. This was continued in 1975 with plowing and seeding of several native plant species. The results of the ecology studies and the prairie establishment operation are included in documents contained in the Prairie Island Nuclear Generating Plant Annual Reports (Reference 16).

Wildlife ecology studies were conducted together with the terrestrial ecology studies. Common species of small mammals, insects, and birds predominate in the vicinity of the proposed ISFSI site. Certain species were targeted for further studies. The Great Blue Heron and the Great Egret were studied for four years to determine the effects of power plant operation on them. Direct effects from operation at the plant were determined to be minimal. A Mourning Dove and Grackle study was initiated in 1974. The conclusion was reached that the Mourning Dove population at Prairie Island was stable. Bald Eagle studies were also conducted. The results of all of these studies are included in the Prairie Island Annual Reports.

4.2 WATER USE AND AQUATIC RESOURCES

The principal surface waters in the area of the site are the Mississippi River, the Vermillion River, the Cannon River, and Sturgeon Lake. The levels of the Mississippi River and Sturgeon Lake are controlled by Lock and Dam Number 3 which is located approximately one and one half miles downstream from the plant. The Vermillion River enters the main stream of the Mississippi below the dam. There are no withdrawals of river water for supply of city water for at least 300 miles downstream from the site. Some withdrawals of water for irrigation use do occur, with the nearest being 53 miles downstream.

Regionally, the movement of ground water is toward the Mississippi River and its main tributaries. The ground water slopes toward these surface streams, generally at low gradients. The result of boring tests performed in June 1991, show that the ground water generally is found at depths of 16.0 to 20.7 feet below the surface. Due to the permeable nature of the sandy alluvial soils forming Prairie Island, the ground water table responds quickly to changes in river stage. There is only minor usage of ground water near the site or immediately downstream. The nearest ground water consumption of magnitude is 6 miles downstream in the town of Red Wing. The water supply comes from four deep wells, which penetrate sandstone aquifers. These wells pump from depths of 400 to 730 feet. Several industries in the Red Wing area also utilize ground water, principally from the bedrock aquifers. The communities of Lake City and Wabasha, 25 and 37 miles downstream, also supply their water needs from wells in bedrock. The wells located in and around the Indian reservation pump from depths of 90 to 110 feet.

Dispersion of surface run off/drainage (effluents) entering the ground water system from the plant would take place principally in the upper portion of the saturated zone of the river alluvium. Due to the numerous surface waterways in the area of the site, most of the surface run off would leave the ground water and mix with surface waters at the borders of Prairie Island. These effluents are from operations in the reactor building, not from the ISFSI itself.

4.3 SOCIOECONOMIC, HISTORICAL, ARCHEOLOGICAL AND CULTURAL RESOURCES

The immediate area surrounding the Prairie Island site is predominately rural, with the exception of the city of Red Wing. The Prairie Island Indian Reservation is located within one mile of the proposed site. There is a large community center nearby, run by the Mdewakanton Sioux.

The area surrounding the Prairie Island Nuclear Generating Plant is one of past Indian and French trader activity. An archaeological survey was conducted in 1967, and nothing significant in the immediate area of the power plant or ISFSI area was found. They did find evidence of an Indian village and burial mounds at the southern boundary of the plant site. This area, called the Bartron Archaeological Site, has been designated to archaeological interests and was added to the National Register of Historic Places in February 1971. No other areas of historical, archeological and cultural significance are found within the site boundary.

4.4 DEMOGRAPHY

The population density in the vicinity of the Prairie Island Nuclear Generating Plant is generally low, with the exception of the city of Red Wing. The nearest offsite occupied residence is approximately .45 miles northwest of the proposed ISFSI site. The 1985/1986 population within 2 miles of the site was estimated to be 464 people, and within 10 miles it was estimated to be 23,054 people. An additional 320 people reside within the 10-mile radius on a seasonal basis. The city of Red Wing projected a population of 14,754 people for the year 1990, which accounts for over half of the projected Goodhue County total population for that year. The estimated 1985/1986 permanent population distribution within 50 miles is 2,193,433. This population is expected to increase from 3 to 11 percent per decade, (Reference 3).

4.5 METEOROLOGY

The climate in the region of the Prairie Island Nuclear Generating Plant is basically continental with influence from the general storms which move eastward along the northern part of the United States. The geographical location results in frequent changes in weather systems as the polar and tropical air masses alternate. Rainfall averages about 25 inches per year, with 65 percent falling in the months of May through September. Snowfall averages about 44 inches per year. Minnesota lies to the north of the principal tornado belt in the United States. Data collected in 1971-1972 indicate an average wind speed of 6.7 mph with a prevalence of stable vertical stability conditions, (Reference 5).

4.6 GEOLOGY, SEISMOLOGY AND SOILS

The Prairie Island Nuclear Generating Plant is located on a low island terrace associated with the Mississippi River flood plain. The Mississippi River flood plain in this area is confined within a valley about 3 miles wide. Rocky bluffs and heavily forested slopes rise abruptly from both sides of the valley to a height of about 300 feet. The overburden materials at the site are permeable sandy alluvial soils, which were deposited as glacial outwash and as recent river sedimentation. The uppermost bedrock unit at the site is sandstone and is believed to be part of the Franconia formation. Underneath the Franconia formation are several hundred feet of lower Cambrian and Precambrian sandstone with minor shale horizons. The dominant structural feature in the area is the Keweenawan Basin which was formed in early Precambrian times. This basin is separated from a smaller basin in the Twin Cities area by the Afton-Hudson anticline. The site is located on the west limb of the Red Wing anticline.

There are several major faults in the Minnesota-Wisconsin region. The principal movements along these faults appears to have been restricted to Precambrian times. The Douglas fault and the Lake Owen fault penetrated Precambrian rocks along the North and South sides of the Keweenawan Basin, respectively. A southern portion of the Lake Owen fault, known as the Hastings fault, trends southwest near the city of Hastings, about 13 miles northwest of the site. There is no evidence of recent activity along any of the known fault zones in the Minnesota-Wisconsin region.

The soils at the site are somewhat frost susceptible, and to avoid any potential problems, footings and slabs will be founded below the anticipated frost depth or on fill below the frost depth. The settlement upon loading the cement slab has been found to be acceptable. In addition, a liquefaction analysis was performed in June 1991, and the subsurface materials have been found to be stable and adequate for the proposed foundation loading.

5.0 DESCRIPTION OF THE PRAIRIE ISLAND NUCLEAR GENERATING PLANT ISFSI

5.1 GENERAL DESCRIPTION

The proposed ISFSI is designed to safely store spent fuel by confining the fuel and providing shielding from radiation through the incorporation of physical components and a system of complementary procedures to protect both the onsite personnel and the general public from radioactivity in the spent fuel. The physical components of the proposed ISFSI are described in Section 5.2, while the operational procedures are described in Section 5.3. The planned monitoring program for the ISFSI is described in Section 5.4.

5.2 ISFSI DESIGN

The ISFSI provides for the temporary dry storage of irradiated fuel assemblies in storage casks. The major physical components of the proposed ISFSI are the spent fuel, the storage casks, the transport vehicle and the concrete pads. Each of these components is discussed below.

Spent Fuel

Spent fuel, because of its radioactive nature, presents a potential hazard to plant personnel, the general public, and the environment. The ISFSI system is designed to safely store spent fuel by confining the fuel material and providing bulk shielding from radiation. Fuel to be stored at the ISFSI will originate only from Prairie Island and will have been allowed to cool a minimum of 10 years. In addition, only intact unconsolidated fuel must be used. If partial assemblies are to be stored, the missing fuel pins must be replaced by dummy pins.

NSP has identified the spent fuel assemblies to be stored in the ISFSI. Specifically, the spent fuel must comply with the restrictions listed in Table 5.1 before it will be transferred to the ISFSI. These restrictions are based on the need to assure that: (1) there is no potential for nuclear criticality; (2) maximum allowable fuel clad temperatures are not exceeded, and (3) dose rates around the ISFSI are within the allowable design limits.

Storage Cask

The TN-40 storage cask consists of a basket assembly for support of the fuel assemblies, a containment vessel, the gamma and neutron shields, a weather cover, a pressure monitoring system, and trunnions for lifting and rotating the cask. The casks will be stored in a vertical position on a concrete pad. The ISFSI will enable NSP to store 1920 spent fuel assemblies in 48 casks. The storage casks are designed with the objectives of ensuring that fuel criticality is prevented, cask integrity is maintained, and fuel is not damaged so as to preclude its ultimate removal from the cask. A summary of the TN-40 Cask design is included in Table 5.2.

TABLE 5.1

FUEL ASSEMBLY PARAMETERS

Maximum weight (w/o control component)	1300 lb.
Assembly dimensions (w/o control component)	7.763"x7.7 3"x 61.3"
Fuel rod array	14 x 14
Number of fuel rods	179
Active fuel length	144"
Initial enrichment (maximum)	3.85 w/o U235
Burnup (maximum)	45 GWD/MTU
Cooling time (minimum)	10 years
Initial uranium content: (max.)	400 kg
(min.)	360 kgU
Fuel Pellet O.D.	0.3444 in.
Fuel Rod O.D.	0.4000 in.
Clad Thickness	0.0203 in.
Clad Material	Zr-4
Gamma Source per Assembly	2.44E+15 photo s/sec
Neutron Source per Assembly	2.19E+8 neutro s/sec
Decay Heat per Assembly	0.675 kW

TABLE 5.2

DIMENSIONS AND WEIGHT OF TN-40 CASK

No. of assemblies/cask	40
Overall length, w/cover	202.0"
Outside diameter	72.0"
Loaded weight on storage pad	240,690 lb.
Loaded weight on crane hook	237,533 lb.
Surface temperature	less than 250 degrees
Cooling	Radiant and convective
Maximum Surface Contact Dose Rate:	
radial	57.5 mrem/hr
top	25.6 mrem/hr
bottom	1275.0 mrem/hr
Maximum Surface Dose Rate on the pad	200 mrem/hr

Transport System

The transport system moves the loaded storage casks from the Auxiliary Building rail bay to the concrete pads in the ISFSI. The transport vehicle must be designed for a minimum of 100 fully-loaded one way trips over approximately a 25-year period over several different types of ground surfaces. The transporter shall be designed to limit cask lift height to less than 18 inches.

Concrete Pad

The storage casks will be stored in two parallel rows of 12 casks on each of two 216-foot long x 36-foot wide x 3-foot thick concrete pads. The two slabs will be positioned end to end with 40 feet in between. To improve foundation performance and earthquake safety, 3 feet of soil beneath each slab will be excavated and replaced with compacted structural fill. The pad elevation will be 693 feet 6 inches above mean sea level (msl) to preclude immersion of the cask seals during the probable maximum flood. They will be surrounded by a 17-foot high earthen berm.

5.3 ISFSI OPERATIONS

Fuel handling and cask loading operations in the Auxiliary Building will be done in accordance with requirements of the Prairie Island Nuclear Generating Plant 10 CFR Part 50 Operating Licenses DPR-42 (Unit #1) and DPR-60 (Unit #2). Cask transport and storage at the ISFSI will be subject to requirements of the Prairie Island ISFSI 10 CFR Part 72 License. The major steps associated with the placing of fuel in the Prairie Island ISFSI are presented in Table 5.3.

TABLE 5.3

ISFSI OPERATIONAL STEPS

A. RECEIVING

1. Unload empty cask and separately packaged seals at plant site.

2. Inspect the following for shipping damage: exterior surfaces, sealing surfaces, trunnions, seals, accessible interior surfaces and basket assembly, bolts, bolt holes and threads, neutron shield vents.

3. Remove weather shield and install plug in neutron shield vent hole.

4. Remove lid bolts and lid.

5. Install protective plate over cask body sealing area.

6. Obtain lid and lid seal from storage.

7. Attach lid seal to lid by means of six retaining screws.

8. Move to spent fuel pool area.

B. SPENT FUEL POOL AREA

1. Lower cask into cask loading pool.

2. Load preselected spent fuel assemblies into the 40 basket compartments.

3. Verify identity of the fuel assemblies loaded into the cask.

4. Remove protective plate from cask body flange.

5. Lower lid and place on cask body flange over the two alignment pins.

6. Lift cask to surface of pool and install lid bolts.

7. Connect drain line to quick-disconnect coupling in the drain port.

8. Bolt special adapter, with quick disconnect coupling, to vent port bolt holes.

9. Connect plant compressed air line to special adapter quick-disconnect coupling.

10. Pressurize cavity to force water from cavity through drain port to the spent fuel pool.

11. Disconnect plant compressed air line and drain line from their quick-disconnect couplings.

12. Move cask to the decontamination area.

C. DECONTAMINATION AREA (RAIL BAY)

1. Decontaminate cask until acceptable surface contamination levels are obtained.

2. Torque lid bolts using the prescribed procedure.

3. Remove plug from neutron shield vent and install pressure relief valve.

4. Connect Vacuum Drying System (VDS) to vent port.

5. Evacuate cavity to remove remaining moisture using prescribed procedure.

6. Break vacuum by closing vacuum valve and opening air valve to admit dry air into the cavity.

7. Disconnect VDS at vent port and install vent port cover with seal and bolts.

8. Connect Vacuum-Backfill System (VBS) to quick-disconnect coupling in the drain port.

9. Evacuate cavity to 10 millibar and backfill with dry helium gas.

10. Pressurize cavity to about 2 ATM with helium.

11. Disconnect VBS at the drain port quick-connect coupling and install drain port cover with seal and bolts.

12. Perform helium leak test of lid seals.

13. Remove over pressure port cover.

14. Install top neutron shield drum.

15. Torque the bolts using prescribed procedure.

16. Pressurize over pressure system with Helium to a pressure of about 5.5 ATM.

17. Perform leak test on over pressure system.

18. Check external surface temperatures using an optical pyrometer.

19. Check surface radiation levels.

20. Install protective cover with seal and bolts.

21. Load cask on transport vehicle.

22. Move cask to Storage Area.

D. STORAGE AREA

1. Unload cask from transport vehicle.

2. Position cask in preselected location on storage pad.

3. Check for surface defects.

4. Connect pressure instrumentation to cask and to monitoring panel.

5. Check that pressure instrumentation is functioning.

6. Check surface radiation levels.

The administrative procedures for the ISFSI will be the same as those used for the Prairie Island Nuclear Generating Plant. Any changes to these procedures will be reviewed and approved by the Station Operations Committee and Safety Audit Committee. Before startup and during the lifetime of the ISFSI, the cask monitoring instrumentation, the electrical system, the communications system, and the storage casks will be tested to ensure their proper functioning. The existing training program at the plant will be used to provide and maintain a well qualified work force for safe and efficient operation of the ISFSI. All personnel working in the fuel storage area will receive radiation and safety training and those actually performing cask and fuel handling functions will be given additional training in specific areas as required by the Radiation Protection program in effect at the Prairie Island Nuclear Generating Plant.

5.4 MONITORING PROGRAM

An effluent monitoring program is not applicable to the ISFSI, because its operation will not result in any water or other liquid discharges. It also will not generate any chemical, sanitary, or solid wastes; or release any radioactive materials in solid, gaseous, or liquid form during normal operations. Similarly, because there are no liquid or gaseous effluents from the ISFSI, special environmental monitoring for these exposure pathways is not necessary. Therefore, a separate environmental measurement program for the ISFSI is not warranted. However, to help ensure proper operation of the ISFSI system, NSP will incorporate monitoring in the Prairie Island site monitoring program. The site operational surveillance program will also be expanded to include surveillance of the ISFSI.

The current operational meteorological and radiological monitoring programs will be continued through the life of Prairie Island Nuclear Generating Plant, Units 1 and 2. The program is designed to confirm that NSP operations are within regulatory requirements and consistent with the documented As Low As Is Reasonably Achievable (ALARA) program. The main purpose of this program is to minimize exposure to radiation so that the total exposure to personnel in all phases of design, construction, operation, and maintenance are as low as can be reasonably achieved. As an additional measure of conservatism, 16 thermoluminescent dosimeters will be placed at equal intervals along the perimeter fence in the vicinity of the ISFSI. The population dose from the plant will be reported periodically in the Station Operating Reports, and these will include the contribution from the ISFSI.

6.0 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

6.1 CONSTRUCTION IMPACTS

The ISFSI site will be developed and managed so as to minimize construction impacts. All construction activities will comply with Federal, State and local regulations for environmental protection, as well as occupational safety and health. Most of the construction area is covered with prairie grass and weeds or is wooded and will be cleared. Timber resulting from the clearing operation will be collected for appropriate disposal. Portions of the ISFSI site and adjacent areas have been used for the disposal of dredged material taken periodically from the station intake channel.

6.1.1 LAND USE AND TERRESTRIAL RESOURCES

Construction of the ISFSI, including the site area, berm and access road, will affect approximately 10 acres of the 560 acre Prairie Island Nuclear Generating Plant site area. Portions of the ISFSI site and adjacent areas have been used for the disposal of dredged material taken periodically from the station intake channel. The principal terrain alterations to the site area will come from clearing, excavation, grading, and berm construction. Cleared areas and exposed earth will be seeded, graveled or paved to stabilize and control runoff, and to minimize soil erosion. After construction of the concrete slabs is complete, the area immediately surrounding the slabs will be covered with well-compacted crushed rock. The construction will not impact offsite land use.

Loss of biological production from approximately 10 acres is anticipated. The habitat displaced by the ISFSI consists primarily of trees, shrubs, prairie grasses, and weeds. It is also used by common small mammals, insects and birds. Displacement of resident fauna within the proposed ISFSI is likely to occur due to construction activities which produce noise. Since wildlife egress from the area immediately surrounding the construction site is unrestricted, the construction noise impact is expected to be minimal. The habitat is not unique or critical to wildlife. The site area is not used for nesting or feeding by bald eagles or migratory birds. Disruption of wildlife activities due to construction noise is expected to be minimal (Reference 8). The only resources committed irretrievably are the steel, concrete, and other construction materials in the ISFSI pads and storage casks.

6.1.2 WATER USE AND AQUATIC RESOURCES

Construction of the ISFSI will not impact local water supplies. Concrete for the slab will arrive on the site ready-mixed. Drinking water and water for cleaning operations and fugitive dust control will be transported to the site by truck. The portable rest rooms provided during construction require no onsite source of water. During clearing, and excavation operations, a temporary drainage system may be constructed to collect the runoff into temporary settling ponds. More permanent drainage will be installed as soon as area excavations and backfill allow. The drainage system will not alter the natural drainage patterns. As the construction of the ISFSI involves no use or degradation of the regional water, its impact on navigation, fish and wildlife resources, water quality, water supply and aesthetics should be negligible.

The ISFSI has been sited to avoid the problems associated with the occupancy and modification of flood plains. It has been designed such that the lowest point of potential leakage into the cask is above the level of the probable maximum flood.

6.1.3 OTHER IMPACTS OF CONSTRUCTION

Noise

Construction of the ISFSI will generate noise, but it will be of minimal duration. Due to the distance of the site from the nearest residence, the impact on the surrounding community is considered to be acceptable. By complying with Occupational Safety and Health Administration (OSHA) noise regulations, the impact of noise on the construction workers will be minimal.

Air Quality

Temporary increases in levels of suspended particulate matter will result from construction activities. In addition, exhaust from construction vehicles will add to levels of hydrocarbons, carbon monoxide and oxides of nitrogen. Measures, such as watering of unpaved roads, will be used to minimize the generation of fugitive dust. In addition, cleared areas and exposed earth will be seeded, graveled, or paved to stabilize and control runoff, and minimize soil erosion.

6.1.4 SOCIOECONOMIC

Construction of the Prairie Island ISFSI is scheduled to be performed by local construction forces wherever possible. Relocation of construction personnel and their families is therefore not expected. A peak construction force of about 20 workers, including all employees of contractors and their subcontractors, is anticipated. The additional work force required during construction will not be of sufficient size or their stay of sufficient duration to affect the basic socioeconomic characteristics of the local area.

6.1.5 RADIOLOGICAL IMPACTS FROM CONSTRUCTION

All construction activities related to site preparation will have been completed prior to the commencement of fuel transfer. Ambient radiation levels at the construction site do not differ significantly from average background levels in the area. Radiological impacts from construction activities are considered to be negligible.

6.2 OPERATIONAL IMPACTS

6.2.1 RADIOLOGICAL IMPACTS FROM ROUTINE OPERATIONS

External exposure to direct and scattered radiation is the primary pathway through which site workers and nearby residents may get a dose commitment from normal operation of the ISFSI. Because the proposed ISFSI involves only dry storage of spent nuclear fuel, there will be no gaseous or liquid effluent associated with normal operations. Cask loading and decontamination will be conducted within the Prairie Island Nuclear Generating Plant Auxiliary building, and are conducted under the 10 CFR Part 50 operating license. Radiological impacts from gaseous and liquid effluent resulting from these operations fall within the scope of impacts of reactor operations and have been previously addressed in the Final Environmental Statement for the Prairie Island Plant (Reference 2).

6.2.1.1 OFFSITE DOSE

ISFSI operations will result in a very small additional dose to members of the public from direct radiation exposure. Section 72.104(a) of 10 CFR Part 72 requires that dose equivalents from normal operations to any real individual located beyond the ISFSI controlled area not exceed 25 mrem/yr. to the whole body, 75 mrem/yr. to the thyroid, and 25 mrem/yr. to any other organ as a result of planned effluent releases, direct radiation from ISFSI operations, and radiation from other uranium fuel cycle operations within the region. Using conservative assumptions in the ISFSI Safety Analysis Report (Reference 6), the dose to the nearest permanent resident from ISFSI operations, in combination with the maximum permissible dose from the Prairie Island Nuclear Generating Plant, will not exceed the 25 mrem per year limit specified in 10 CFR 72.104.

In calculating the offsite collective dose, the entire population within a 2 mile radius of the plant was conservatively taken to be at the location of the residence subject to the highest exposure. The residence of highest exposure was found by determining the dose rate to the residence nearest to the spent fuel cask storage source. The nearest residence, which is shielded by the 17-foot berm, was determined to be .45 miles northwest of the ISFSI.

The dose rate was calculated assuming that at distances beyond 800 meters, the dose rate falls off inversely with the square of the distance. The dose rate resulting from cask storage to the nearest residence NW of the ISFSI was calculated to be 9.0E-06 mrem/hour. The dose to the population was obtained by taking the dose rate (in rem/hr) for the NW sector and multiplying it by the total population within a 2-mile radius of the plant to obtain (person-rem)/hour and then multiplying by 8760 hours/year to obtain (person-rem)/year. Because of the conservative assumptions in this dose calculation, the dose to the population residing within 2 miles of the plant, placed at the residence exposed to the highest dose rate, adequately estimates the population dose.

Currently, there are 464 residents within 2 miles of the Prairie Island Nuclear Generating Plant. The total annual population direct dose from cask storage was calculated to be 0.037 person-rem. Based on a dose rate of 9.0E-06 mrem/hour, the annual dose to the nearest permanent resident due to ISFSI operations has been conservatively calculated to be 8.0E-02 mrem/year. The maximum annual dose to the nearest resident from the Prairie Island Nuclear Generating Plant has been calculated to be 0.0027 mrem/year due to liquid effluents and 0.334 mrem/year due to gaseous effluents (Reference 6). The total from both the plant and the ISFSI would therefore be less than 1.0 mrem/year. The conservative calculation of dose to residents within 2 miles and the rapid attenuation of neutron and gamma dose rates with distance make the collective doses for the more distant population negligible.

6.2.1.2 COLLECTIVE OCCUPATIONAL DOSE

Spent fuel storage at the Prairie Island ISFSI will result in a small increase in the total occupational dose at the site. Occupational radiation exposure for ISFSI operations is expected to result during loading, transport and emplacement of the casks, and from surveillance and maintenance activities. One-time exposures which occur during cask loading are expected to result in a radiation exposure of 2.315 person-rem. Annual surveillance, assumed to be done four times per year, will contribute .16 person-rem. Other maintenance operations contribute .604 person-rem to the total collective occupational dose.

The onsite collective dose has been assessed by estimating the number of personnel required to perform specific tasks, the time required to do them, and the estimated radiation levels in the areas in which the tasks are performed. Table 6.1 gives the estimated maximum collective occupational doses from one-time exposures during cask loading, transport and emplacement. These operations will be performed each time one of the casks is filled. Table 6.2 shows the annual exposures due to ISFSI maintenance operations.

To evaluate the additional dose to station personnel from ISFSI operations, a conservative analysis has been performed. All workers at the Prairie Island Nuclear Generating Plant are considered to be in buildings or in the plant yard. No credit is taken for shielding of personnel by buildings. Dose rates at various site locations were conservatively calculated based on the distance from each source using the East-West directed source dose rate versus distance data.

Table 6.3 shows the dose rates at several onsite locations due to cask storage. Distant dependent dose rates at each location are calculated by summing the direct shine and skyshine components. The berms have been shown to essentially eliminate the direct radiation dose component (Reference 6). Table 6.4 shows the number of station personnel, and Table 6.5 presents the annual collective exposure estimates to onsite personnel not directly involved in ISFSI activities.

Table 6.6 shows the collective occupational dose to those workers who are directly involved in ISFSI activities. The surveillance and maintenance activities are conservatively assumed to be performed twice as often during the first year, resulting in a larger dose for these activities during that year. The cumulative dose (in person-rem) is shown over the 21 years it takes to completely fill both pads with 48 casks.

TABLE 6.1

DESIGN BASIS OCCUPATIONAL ONE TIME EXPOSURES DURING CASK LOADING, TRANSPORT AND EMPLACEMENT[1]

Task	Time Required (hr)	No. of persons	Dose Rate (mrem/hr)	Dose (Person-rem)
Placement in pool[2]	2	3	5.0	0.03
Loading process	5	5	5.0	0.125
Removal from pool	5	5	30.0	0.75
Transfer to decontamination area	1	3	30.0	0.09
Processing of cask	6.5	2	30.0	0.39
Helium leak test	2	2	30.0	0.12
Decontamination	2	3	30.0	0.18
Install neutron shield, pressurize, test	3	2	30.0	0.18
Preparation for transport	1	3	30.0	0.09
Transfer of cask to ISFSI	1	3	20.0	0.06
Final cask emplacement	2	5	30.0	0.30
TOTAL				2.315

[1]Dose rates at 1 meter were utilized for all cases except cask transfer, when individuals will typically be at least 2 meters away from the cask.

[2]Steps from Table 5.3.

TABLE 6.2

DESIGN BASIS ISFSI MAINTENANCE OPERATIONS ANNUAL EXPOSURES

Task	Time Required (hr)	No. of persons	Dose Rate (mrem/hr)	Annual Dose (Person-rem)
Visual Surveillance of Casks[1]	1	2	78.8	0.16
Instrumentation Operability Tests[2,7]	1	2	1.0	.002
Instrumentation Calibration[3,7]	2	2	1.0	.002
Instrumentation Repairs[4,8]	1	2	118	0.24
Surface defect repair[5,8]	1	2	118	0.24
Major Maintenance[6]	32.5	3	25.6	0.12
TOTAL				0.764

Notes:

1. Assumes 4 yearly surveys, 15 minutes each, no closer than 2 meters to cask.
2. Based on two tests per year, 30 minutes each.
3. Based on re-calibration of the instruments every 2 years (annualized).
4. Assumes repair of one instrument every year, 1 hour per repair.
5. Assumes repair of one cask every year, 1 hour per repair.
6. Assumes once in 20 years (total dose of 2.5 person-rems is annualized by dividing total dose by 20 years)
7. Assumed to be at monitoring panel at the perimeter fence entrance.
8. Assumed to be positioned between 2 rows of casks.

TABLE 6.3

DOSE RATES AT ONSITE LOCATIONS DUE TO CASK STORAGE*

Location	Distance (Ft.) from cask	Dose Rate (mrem/hr)
Administration Building	1517	1.60E-04
Training Building	773	2.43E-03
NPD Building	835	1.89E-03
Construction Warehouse B	733	2.86E-03
Parts Warehouse	1288	3.40E-04
Environmental Lab	1876	5.00E-05
Computer Area	1797	7.00E-05
Outage Trailers	1512	1.60E-04
Security Building	1132	6.10E-04
Power House	2161	2.00E-05
Substation	2098	2.00E-05
Construction Warehouse A	1124	6.20E-04

*Dose rates were conservatively calculated based on the distances from each source using the East-West directed source dose rate versus distance data. Air attenuation was not taken into account in developing these estimates.

TABLE 6.4

NUMBER OF STATION PERSONNEL

Location Number	Location	Full Time[1]	Outage[2]	Summer Help[3]
1	Administration Building	190	0	0
2	Training Building	55	0	0
3	NPD Building	120	0	0
4	Construction Warehouse B	15	45	0
5	Parts Warehouse	6	0	0
6	Environmental Lab	2	0	2
7	Computer Area	14	0	5
8	Outage Trailers	3	40	0
9	Security Building	117	25	0
10	Power House	92	192	0
11	Substation	2	2	0
12	Construction Warehouse A	15	45	0
	TOTAL	631	349	7

Notes:

1. For full time employees, assume 2500 hours/year.
2. For outage employees, assume 540 hours/year.
3. For summer help, assume 400 hours/year.

TABLE 6.5

ANNUAL COLLECTIVE EXPOSURE ESTIMATES TO ONSITE PERSONNEL DUE TO CASK STORAGE

Location No.	Location	Full Time (person-rem)	Outage (person-rem)	Summer Help (person-rem)	Total (person-rem)
1	Administration Building	7.60E-02	0.00E+00	0.00E+00	7.60E-02
2	Training Building	3.34E-01	0.00E+00	0.00E+00	3.34E-01
3	NPD Building	5.67E-01	0.00E+00	0.00E+00	5.67E-01
4	Construction Warehouse B	1.07E-01	6.95E-02	0.00E+00	1.77E-01
5	Parts Warehouse	5.10E-03	0.00E+00	0.00E+00	5.10E-03
6	Environmental Lab	2.50E-04	0.00E+00	4.00E-05	2.90E-04
7	Computer Area	2.45E-03	0.00E+00	1.40E-04	2.59E-03
8	Outage Trailers	1.20E-03	3.48E-03	0.00E+00	4.66E-03
9	Security Building	1.78E-01	8.23E-03	0.00E+00	1.85E-01
10	Power House	4.60E-03	2.07E-03	0.00E+00	6.67E-03
11	Substation	1.00E-04	2.16E-05	0.00E+00	1.22E-02
12	Construction Warehouse A	2.33E-02	1.51E-02	0.00E+00	3.84E-02
	TOTAL	1.30E+00	9.48E-02	1.80E-04	1.40E+00

TABLE 6.6

COLLECTIVE OCCUPATIONAL DOSE TO PRAIRIE ISLAND WORKERS DIRECTLY INVOLVED IN ISFSI ACTIVITIES (PERSON-REM)

Year	# of New Casks Loaded	Cask Loading[1]	Visual Surveil-lance[2]	General Mainte-nance[2]	Total at Year End	Cumula-tive Total
1	8	18.52	.32	1.21	20.05	20.05
2	2	4.63	.16	.604	5.39	25.44
3	2	4.63	.16	.604	5.39	30.84
4	2	4.63	.16	.604	5.39	36.23
5	2	4.63	.16	.604	5.39	41.63
6	2	4.63	.16	.604	5.39	47.02
7	2	4.63	.16	.604	5.39	52.41
8	2	4.63	.16	.604	5.39	57.81
9	2	4.63	.16	.604	5.39	63.20
10	2	4.63	.16	.604	5.39	68.60
11	2	4.63	.16	.604	5.39	73.99
12	2	4.63	.16	.604	5.39	79.38
13	2	4.63	.16	.604	5.39	84.78
14	2	4.63	.16	.604	5.39	90.17
15	2	4.63	.16	.604	5.39	95.57
16	2	4.63	.16	.604	5.39	100.96
17	2	4.63	.16	.604	5.39	106.35
18	2	4.63	.16	.604	5.39	111.75
19	2	4.63	.16	.604	5.39	117.14
20	2	4.63	.16	.604	5.39	122.54
21	2	4.63	.16	.604	5.39	127.93
TOTAL	48	111.12	3.52	13.29	127.93	

[1]Occupational exposure of 2.315 person-rem per cask.
[2]Exposure based on fully loaded pad, all activities assumed to be performed twice as often during first year.

6.2.2 RADIOLOGICAL IMPACTS OF OFF-NORMAL EVENTS AND ACCIDENTS

A variety of off-normal and accident scenarios which may affect the safe operation of the Prairie Island ISFSI have been postulated by the applicant. These include earthquakes, tornadoes, tornado missiles, lightning, fires, loss of electric power, extreme wind, floods, explosions, inadvertent loading of a newly discharged fuel assembly, cask seal leakage, cask drop and tipping, and loss of confinement barrier.

Of the off-normal operations, only loss of electric power is considered to be applicable to ISFSI operations. A loss of power to the ISFSI may occur as a result of natural phenomena, such as lightning or extreme wind, or as a result of disturbances in the non safety-related portion of the electric power system of the Prairie Island Nuclear Generating Plant. If electric power is lost, the area lighting and receptacles and the cask pressure monitoring instrumentation would be nonfunctional. If the loss of power were localized solely at the ISFSI, detection would occur during periodic surveillance of the site. This event has no safety or radiological consequences because a loss of power will not affect the integrity of the storage casks, jeopardize the safe storage of the fuel, or result in radiological releases.

The consideration of the set of infrequent events which could be expected to occur during the lifetime of the ISFSI (Design Events III and IV), provides a conservative basis for the design of certain systems with confinement features.

The design earthquake (DE) is postulated to occur as a design basis extreme natural phenomenon. The DE for use in the design of the casks and ISFSI structures is equivalent to the safe shutdown earthquake for the Nuclear Generating Plant. Analyses of seismic response characteristics of the casks show that cask leak-tight integrity is not compromised and that no damage will be sustained. The DE is not capable of damaging the cask, and therefore no radioactivity is released.

Extreme winds due to passage of the design tornado are postulated to occur as an extreme natural phenomenon. Tornado loading consists of a differential pressure buildup from normal atmospheric pressure to 3 psi in 3 seconds, a lateral force caused by a funnel of wind having a peripheral tangential velocity of 300 mph, and a forward progression of 60 mph. Extreme winds are not capable of overturning these casks nor of damaging their seals. Since no radioactivity is released, no resultant doses will occur. Local damage to the neutron shield may be caused by tornado missiles; however, the dose rate at the site boundary, without any shield is less than the allowable dose rate. Corrective actions would be utilized to keep the dose rate low.

The probable maximum flood has been calculated to reach a level of 703.6 feet above msl with wave action to a maximum level of 706.7 feet. The casks are designed to withstand the forces developed by the probable maximum flood without damage to cask integrity or tipping of the casks. The height of the cask seals will be above the level of the probable maximum flood and associated wave action. No fuel damage or criticality is postulated to occur as a result of flooding, and no resultant doses are projected.

A munitions barge explosion has been postulated to occur at a location approximately 2600 feet from the ISFSI. This occurrence represents the worst-case impact on safe operation of the ISFSI due to a transportation accident. An overestimate of the blast effect is given by assuming that the impacts calculated at the reactor control room would also occur at the ISFSI, which is farther away from mid-channel. A pressure wave of 2.25 psi is estimated to occur at the ISFSI. The cask is designed to withstand a pressure wave of 3 psi. It will not tip as a result of the postulated pressure wave, and no cask damage or release of radioactivity is postulated.

The only combustible materials in the ISFSI are in the form of insulation on instrumentation wiring, and paint on the outside surface of the storage casks. In addition, the tow vehicle will contain a small amount of gasoline or diesel fuel. No other combustible or explosive materials are allowed to be stored on the ISFSI slabs. The ISFSI area will be cleared of trees. The area surrounding the Equipment Storage Building and concrete pad within the perimeter road will be covered with crushed rock. No fires, other than small electrical fires, are considered credible at the ISFSI. The casks are designed to withstand this kind of fire. No radioactivity is released, and therefore no resultant doses would occur.

The possibility of a spent fuel assembly with a heat generation rate greater than 0.675 kW being inadvertently loaded into the cask has been considered. In order to preclude this accident from going undetected, a final verification of the assemblies loaded into the casks and a comparison with fuel management records will be performed to ensure that the loaded assemblies do not exceed any of the specified limits. Due to the multiple administrative controls in selecting fuel assemblies, this accidental loading is not considered credible.

In order to prevent cask seal leakage from occurring, the storage casks feature redundant seals together with an extremely rugged body design. Additional barriers to prevent release of radioactivity include the sintered fuel pellet matrix and the zircaloy cladding which surrounds the fuel pellets. The interseal gaps are pressurized in excess of the cask cavity pressure. Although no credible mechanism that could result in leakage of radioactive products has been found, a complete loss of the cask seal capability has been analyzed and the results found to be negligible.

In an accident where the confinement function is non-mechanistically removed, heat removal and radiation shielding functions operate in the normal passive manner. In the event of broken cask seal barriers or removal of the closure lids, no release occurs. If the cladding in the loaded fuel assemblies fails, there is gap activity release. If the fuel pellets themselves fail, the remaining Kr-85 is released from the fuel matrix. Table 6.7 lists the fission gas and volatile nuclides in a cask. Of the nuclides present in a cask containing 40 design basis fuel assemblies, Kr-85 is the only one naturally occurring in a gaseous state and which could escape from the cask in a breach of confinement barrier. No additional credit is taken for decay of Kr-85 during dispersion offsite nor for personnel protection due to shielding provided by any structure or system.

In the postulated accident, all of the Kr-85 gas is assumed to be instantaneously released. The maximally exposed individual is assumed to be located at the site boundary where the least amount of atmospheric dispersion takes place (largest x/Q value). The dose results for this location are conservative for any individual and may be reported as dose to an individual at the nearest boundary. Table 6.8 lists the downwind dispersion factors. These were calculated using the Briggs formula for lateral and vertical plume spread. The equations for atmospheric diffusion found in the SAR are based on Regulatory Guide 1.145 which result in more conservative x/Q values.

Tables 6.9 and 6.10 summarize the expected doses at the site boundary in a containment failure where 30 percent of the K-85 and 10 percent of the H-3 inventory is released. The release fraction estimates for particulate radioactivity (i.e., Cs-134 and Cs-137) used in this analysis were based on a worst-case scenario for air-cooled transfer casks (Reference 18). This reference is expected to provide a reasonable assumption of the result of a non-mechanistic failure of the cask seal. Particulate releases clearly contribute a very small amount to the radiation dose.

After the radioactive material escapes the cask, two factors determine whether the particles reach the population: the fraction that becomes suspended in air; and the fraction less than 10 microns in diameter, which is respirable. An atmospheric dispersion value was used to calculate a dose at the nearest controlled area boundary and residence.

The calculated whole body dose at the boundary is 435 mrem and 11 mrem at the nearest residence. This is a small fraction of the 5000 mrem (5 rem) criteria specified in 10 CFR 72.106(b). These doses are also much less than the Protective Action Guides established by the Environmental Protection Agency (EPA) for individuals exposed to radiation as a result of accidents: 1000 mrem to the whole body and 5000 mrem to the most severely affected organ.

The release of effluents from the ISFSI due to accidents, even a postulated worst-case accident, will have a negligible impact on the population surrounding the Prairie Island Nuclear Generating Plant.

TABLE 6.7
FISSION GAS AND VOLATILE NUCLIDES INVENTORY
(CURIES/40 ASSEMBLIES)

Nuclide	10 year Decay	20 year Decay
H-3	6.46E+03	3.68E+03
KR-85	9.67E+04	5.06E+04
Cs-134	1.35E+05	4.68E+03
Cs-137	1.7E+06	1.35E+06

Westinghouse OFA 14x14, 3.85 w/o U-235, 45,000 MWD/MTU, 10 year cooling

TABLE 6.8
DOWNWIND DISPERSION FACTORS

Downwind Section	Downwind Distance (m)	x/Q (sec/m^3
N	1015	1.95E-04
NNE	905	2.20E-04
NE	650	3.11E-04
ENE	550	4.92E-04
E	550	4.92E-04
ESE	775	2.59E-04
SE	795	2.52E-04
SSE	445	7.27E-04
S	345	1.17E-03
SSW	255	2.08E-03
SW	255	2.08E-03
WSW	195	3.49E-03
W	180	4.08E-03
W*	110	1.07E-02
WNW	195	3.49E-03
NW	245	2.25E-03
NNW	1055	1.87E-04

* All distances and x/Q values are calculated from the center of the site except the 110 meter distance west which is from the edge of the pad nearest to the site boundary.

TABLE 6.9
EXPECTED DOSE OF THE CONTROLLED AREA BOUNDARY RESULTING FROM A DRY CASK LEAKAGE ACCIDENT AT THE PRAIRIE ISLAND ISFSI

WHOLE DOSE AT BOUNDARY

Nuclide	Cask Inventory (uCi)[1]	Release Fraction	x/Q (sec/m^3)	Breathing Rate (m^3/sec)	Whole Body DCF[2] (Rem/uCi)	Dose at Boundary (Rem)
H-3	6.46E+09	1.00E-01	1.07E-02	2.54E-04	1.58E-04	.277
Kr-85	9.67E+10	3.00E-01	1.07E-02	1.00E+00	5.10E-10[3]	.158
Cs-134	1.35E+11	5.00E-10	1.07E-02	2.54E-04	9.10E-02	1.67E-05
Cs-137	1.70E+12	5.00E-10	1.07E-02	2.54E-04	5.35E-02	1.24E-04
					TOTAL	.435 Rem

[1] 10 Year cooled fuel
[2] Reference 20
[3] Whole Body submersion dose conversion factor in rem-m^3/uCi-sec (Ref. 20)

TABLE 6.10
EXPECTED DOSE AT THE NEAREST RESIDENCE RESULTING FROM A DRY CASK LEAKAGE ACCIDENT AT THE PRAIRIE ISLAND ISFSI

WHOLE BODY DOSE AT RESIDENCE

Nuclide	Cask Inventory (uCi)[1]	Release Fraction	x/Q (sec/m^3)	Breathing Rate (m^3/sec)	Whole Body DCF[2] (Rem/uCi)	Dose at Boundary (Rem)
H-3	6.46E+09	1.00E-01	2.78E-04	2.54E-04	1.58E-04	.0072
Kr-85	9.67E+10	3.00E-01	2.78E-04	1.00E+00	5.10E-10[3]	4.11E-03
Cs-134	1.35E+11	5.00E-10	2.78E-04	2.54E-04	9.10E-02	4.34E-07
Cs-137	1.70E+12	5.00E-10	2.78E-04	2.54E-04	5.35E-02	3.21E-06
					TOTAL	.011 Rem

[1] 10 Year cooled fuel
[2] Reference 20
[3] Whole Body submersion dose conversion factor in rem-m^3/uCi-sec (Ref. 20)

6.2.3 NONRADIOLOGICAL IMPACTS

6.2.3.1 LAND USE AND TERRESTRIAL RESOURCES

Operation of the ISFSI will not require the use of any land beyond that which was cleared and graded during construction, and is not expected to adversely impact the terrestrial environment. Operation of the ISFSI will have a minimal impact on the local wildlife. Birds are not expected to roost directly on the casks due to their high surface temperature. A fence surrounding the concrete storage pads will prevent access by other wildlife.

6.2.3.2 WATER USE AND AQUATIC RESOURCES

The operation of the ISFSI requires no active water cooling system; therefore, there will be no impact on surface or ground water quality or aquatic biology.

6.2.3.3 OTHER EFFECTS OF OPERATION

Noise

The only operational noise associated with the proposed action will result from the transfer of spent fuel from the spent fuel pool facility to the dry cask storage facility. Since the noise associated with this operation is not expected to be louder than normal truck traffic, no adverse impacts are expected.

Climatology

The surface of the storage casks may approach 240°F. This will cause the air temperature in the immediate vicinity of the casks to be higher than ambient temperature. The affected area is very small and localized. During rainy days, precipitation may vaporize at the cask surface because of these high cask surface temperatures. Any cask-induced fogging episodes will have the greatest impact at the locations where visibility is important. The county road to the west of the ISFSI site and the nearest residence, .45 miles NW, were chosen to represent the impacts along the road. Using the EPA Industrial Source Complex Dispersion Model, the two pads were modeled as an area source with a water vapor plume release height of 16 feet. Many conservative assumptions were included in the analysis. The results indicate that the fogging impacts due to the ISFSI casks at the county road and nearest residence would occur .04 percent of all hours during the May-October period and 0.2 percent of all hours during the November-April period.

7.0 SAFEGUARDS FOR SPENT FUEL

The NRC requirements for the protection of an ISFSI are set forth in 10 CFR Part 72, Subparts H and K, which include provisions for security plans, a security organization, response guards, detection aids, response force action, communication capability, and law enforcement agency liaison.

On March 10, 1992, the applicant submitted to the NRC a Physical Security Plan which incorporates measures presently in effect for the protection of the Prairie Island Nuclear Generating Plant, and additional safeguards specifically for the spent fuel. These include the following:

- Barriers to limit unauthorized access to the ISFSI,
- Access controls for personnel, vehicles, and packages,
- Search requirements to detect contraband materials,
- Detection and assessment capability for all alarms,
- Site-specific training for security force members,

- Pre-planned contingency events and security actions,
- Commitments for responding to unresolved alarms,
- Provisions for obtaining support from the local law enforcement agency,
- Secure transportation of the spent fuel from the reactor site to the ISFSI.

The implementation of these physical security plans will be inspected for effectiveness and operational compliance.

An independent safety review of the cask design is being conducted by NRC. Conservative data are used for safety analysis of the design, including design basis criteria, margins of safety, siting factors, quality assurance and physical protection. The potential for radiological sabotage, theft or diversion of spent fuel from the ISFSI with the intent of utilizing the contained special nuclear material for nuclear explosives is not considered credible due to the massive size and construction of the cask, the unattractive form of the enclosed radioactive material, and the hazard posed by the high radiation levels of the fuel to persons not provided radiation protection. Accordingly, the storage of spent fuel at this ISFSI will not constitute an unreasonable risk to the public health and safety from acts of radiological sabotage, theft, or diversion of special nuclear material.

8.0 DECOMMISSIONING

The ease of decommissioning of the storage casks to be utilized at the Prairie Island ISFSI is one feature of the design concept. A decommissioning plan must be submitted in accordance with 10 CFR 72.30. At the end of its service lifetime, cask decommissioning could be accomplished by one of the following options:

1. The loaded storage cask could be shipped to a suitable fuel repository for permanent storage. If licensing requirements at the time allow, the entire cask could be placed inside a shipping container or overpack for shipment.

2. The spent fuel could be removed from the cask and shipped in a certified shipping container to a fuel repository. The cask could then be decontaminated and scrapped.

3. The surface of the ISFSI cask can be decontaminated by chemical etching with hydrochloric or nitric acids, or electropolished to achieve the same results.

The cask materials will be only slightly activated from the spent fuel, and it is expected that after surface decontamination, the activation products will be negligible and the cask could be scrapped. A detailed evaluation will be performed at the time of decommissioning to determine the appropriate mode of disposal.

Due to the leak tight design of the casks, no residual contamination is expected to be left behind on the concrete base pad. The spent fuel pool will remain functional until the ISFSI is decommissioned. This will allow the pool to be utilized to transfer fuel from the storage casks to licensed shipping containers for shipment offsite if this decommissioning option is chosen.

9.0 SUMMARY AND CONCLUSIONS

9.1 SUMMARY OF ENVIRONMENTAL IMPACTS

As discussed in Section 6.1, no significant construction impacts are anticipated. The activities will affect only a very small fraction of the land area at the Prairie Island Nuclear Generating Plant. With good construction practices, the potentials for fugitive dust, erosion and noise impacts, typical of the planned construction activities, can be controlled to insignificant levels.

The primary exposure pathway associated with the ISFSI operation is direct radiation of site workers and nearby residents. As discussed in Section 6.2.1, the radiological impacts from liquid and gaseous effluent during normal operation of the ISFSI fall within the scope of impacts from licensed reactor operations.

The dose to the nearest resident from ISFSI operation is about 8.0E-02 mrem/year, and when added to that of the operations of both reactor units, is much less than 25 mrem/year, as required by 10 CFR 72.104. The collective dose to residents within 1 to 2 miles of the ISFSI is .037 person-rem. Occupational dose to site workers, both directly and indirectly involved in ISFSI activities, is a small fraction of the total occupational dose commitment.

The gamma dose to an individual at the controlled area boundary from a loss of confinement accident has been calculated to be .435 rem, which is well within the 5 rem criteria set forth in 10 CRF 72.106(b) and less than the EPA Protective Action Guide of 1 rem.

No significant nonradiological impacts are expected during operation of the ISFSI. The heat given off by the casks has been determined to cause an insignificant amount of cask induced fogging. No other effects are anticipated in the immediate vicinity of the ISFSI.

9.2 BASIS FOR FINDING OF NO SIGNIFICANT IMPACT

The proposed action has been reviewed relative to the requirements set forth in 10 CFR Part 51, and based on this assessment, the NRC has determined that issuance of a materials license under 10 CFR Part 72 authorizing storage of spent fuel at the Prairie Island ISFSI will not significantly affect the quality of the environment. Therefore, an environmental impact statement is not warranted and, pursuant to 10 CFR Part 51.31, a Finding of No Significant Impact is appropriate.

10. REFERENCES

1. U.S. Nuclear Regulatory Commission, "Final Generic Environmental Impact Statement on Handling and Storage of Spent Light Water Power Reactor Fuel," NUREG-0575, August 1979.

2. U.S. Atomic Energy Commission, "Final Environmental Statement related to the Prairie Island Nuclear Generating Plant," May 1973.

3. Northern States Power, "Prairie Island Independent Spent Fuel Storage Installation Environmental Report," Docket Number 72-10, Revision 1, September 1991.

4. Northern States Power, letter from Thomas Parker, "Responses to NRC Questions Regarding the Prairie Island Independent Spent Fuel Storage Installation Technical Specifications and Safety Analysis Report," June 5, 1991.

5. Northern States Power, "Prairie Island Nuclear Generating Plant Updated Safety Analysis Report," Revision 8, December 1989.

6. Northern States Power, "Prairie Island Independent Spent Fuel Storage Installation Technical Specifications and Safety Analysis Report," Docket Number 72-10, Revision 2, September 1991.

7. Minnesota Environmental Quality Board, "Final Environmental Impact Statement on the Prairie Island Independent Spent Fuel Storage Installation," April 12, 1991.

8. Northern States Power, "Prairie Island, Docket No. 72-10, Application for a License to Construct and Operate a Dry Cask Independent Spent Fuel Storage Installation," August 31, 1990.

9. U.S. Nuclear Regulatory Commission, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-level Radioactive Waste," 10 CFR Part 72.

10. U.S. Nuclear Regulatory Commission, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," 10 CFR Part 51.

11. U.S. Nuclear Regulatory Commission, "Standards for Protection against Radiation," 10 CFR Part 20.

12. U.S. Nuclear Regulatory Commission, "Applicability of Existing Regulatory Guides to the Design and Operation of an Independent Spent Fuel Storage Installation," Regulatory Guide 3.53, July 1982.

13. U.S. Nuclear Regulatory Commission, "Preparation of Environmental Reports for Nuclear Power Stations," Regulatory Guide 4.2, Revision 2, July 1976.

14. American National Standards Institute/American Nuclear Society, "Design Criteria for an Independent Spent Fuel Storage Installation (Dry Storage Type), "ANSI/ANS-57.9, 1984.

15. U.S. Nuclear Regulatory Commission, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors," Regulatory Guide 1.3, June 1974.

16. Prairie Island Nuclear Generating Plant Annual Reports.

17. Northern States Power, letter from Thomas Parker, "Responses to NRC Questions Regarding the Prairie Island Independent Spent Fuel Storage Installation, Quality Assurance and Cask Thermal Analysis," February 6, 1992.

18. Wilmot, Edwin C., "Transportation Accident Scenarios for Commercial Spent Fuel," SAND80-2124, Sandia National Laboratory, Albuquerque, NM, February 1981.

19. Environmental Protection Agency, Federal Guidance Report #11, EPA 520, 1-88-020.

20. U.S. NRC "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Reg Guide 1.109, October 1977.